Peer-reviewed version available at Sustainability 2018, 10, 3384; doi:10.3390/su10103384

Article

Are investments in basic infrastructure the magic wand to boost the local economy of rural communities from Romania?

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Abstract: This article investigates if public investments in rural basic infrastructure represent the best strategy for boosting the local economy of rural communities from Romania. The article focuses on one specific program implemented under the Cohesion policy in the framework of the National Plan for Rural Development called Measure 322. Geographically, the research included a sample of rural communes from the North-Western Region of Romania. Moreover, the study also looks at other determinants of local economic development (LED) than infrastructure investments, with a focus on certain feature characterizing Romanian rural communities such as population size, isolation from urban centers, connection with European and national roads networks, educational stock, etc. The research included three steps, namely the construction of the LED Index, a cvasi-experimental research, and a regression model. Our main findings seem to suggest that while investments in infrastructure help the development gap between beneficiaries and non-beneficiaries remains relatively the same. In terms of determinants of LED, percentage of population with a university degree and connection to a European road are the most significant in the Romanian rural context.

Keywords: local economic development (LED) index; basic infrastructure; rural development; Romania; impact assessment

1. Introduction

A recent report by World Bank describes a troublesome reality regarding the uneven social and economic development of the regions in Romania, noting that there are 'widening disparities in economic opportunity and poverty across these regions and between urban and rural areas' [1] (p. 1). The report talks about two different worlds, one consisting of big bustling cities (capital city Bucharest and a few secondary cities such as Cluj-Napoca, Iasi, and Timisoara), the other one of small urban towns and numerous rural communes. The urban-rural divide is extremely concerning since

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Romania remains today one of the least urbanized countries in the EU, with approximately half of its population living in the rural areas and with a relatively immobile rural population (at least statistically) [2]. The rural areas suffer, among others, from poor access to public services, an infrastructure gap, and from generalized poverty.

This article investigates more in-depth the infrastructure gap in rural communities from Romania, which lack not only economic infrastructure but also social and cultural infrastructure. Road infrastructure is poor nationwide - Romania ranks 120 out of 137 countries in the quality of transport infrastructure [3] (p. 247). However, in rural communities the situation is worse - at the end of 2011, only 7% of the communal roads were modernized, the majority of the roads being either dirt roads (29%) or paved with stone (48%) [4]. The situation is very dramatic especially in the mountain regions, where communities are extremely scattered and far away from major urban centers and access to basic services depends on road accessibility and connectivity. Sewage and water infrastructure are also problematic - one in five rural people lack access to potable water, and a third live without access to a flush toilet [5]. Territorial disparities with regard to access to different types of infrastructure exist among rural communities – for example, the most affected communities by the lack of water infrastructure are the ones from South and North-Eastern parts of Romania, where less than 1% of households have access to potable water [6] (pp. 64-67). Social infrastructure is deficient as well, social spending becoming increasingly skewed towards pensions for the elderly [5]. Nationwide, in 153 rural communities the population lacks access to health services [6] (p. 45); in 2011, in rural communities, there were 524 health care units dedicated to assisting adult patients, out of which only 27 units were dedicated specifically to the elderly. Also, in rural communities there were only 295 nurseries, which explains why less than 5% of children in rural areas are enrolled in any form of childcare [4] (p. 67). While a variety of classifications of infrastructure are available in the literature [7] [8] [9], in this article we will examine only basic economic infrastructure which includes roads, water and sewage networks.

Numerous publicly funded programs (either by the Romanian Government or through Structural Funds from the EU) currently address the need to develop basic infrastructure in the rural areas of Romania as a way to boost local economic development and to improve quality of life for rural residents. These programs differ in how they select the eligible rural communities for taking part to the scheme, the type of infrastructure financed (one or multiple types of infrastructure), in whether or not they allow rural communities to partner. These programs include[1]: SAPARD program (Measure 2.1), National Program for Rural Development 2007-2013 (Measure 322), Program for Development of Infrastructure in Rural Areas (Government Ordinance no. 7/2006), National Program for Local Development (Government Emergency Ordinance no. 28/2013). This article will specifically look into the impact of infrastructure investments made under Measure 322. Measure 322 focused on three types of infrastructure investments – construction and modernization of basic infrastructure, development of basic community infrastructure for recreation, education, health care, etc., and preservation of cultural built heritage from rural areas. Measure 322, as opposed to the other programs, allowed for different types of infrastructure to be built simultaneously (integrated approach), for small local communities to partner with each other in order to make some investments more sustainable, and gave preference during the selection process to the poorest communities.

There is very little follow-up in terms of monitoring and evaluation of the results of these programs in Romania. Despite the fact that all of them intend to enhance the level of local economic development, the attractively of rural communities, as well as to reduce poverty and increase quality of life for residents, there is very little relevant data in terms of the economic and social impact these programs have created [10]. Some of the ex-post evaluation documents focus rather on immediate

[1] Because this article investigates impact of infrastructure on local economic development, we are taking into consideration programs which have already been completed by 2013. Some programs, such as the National Program for Rural Development is still available under the 2014-2020 financial cycle of the Cohesion Policy

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85 results – such as the number of kilometers of road or sewage network created. When outcomes are
86 evaluated, it is debatable if they are really relevant for local economic development or quality of life
87 [11]. This situation is not unique to Romania and it can be encounter in other former communist
88 countries experiencing significant territorial disparities [12] [13].

89 This article investigates the link between basic infrastructure investments and local economic
90 development in rural communities from Romania, with a specific focus on North-Western Region. In
91 light of the proposed public funding for programs supporting basic infrastructure in rural areas, it is
92 important to know if the objective of generating economic growth is reached in this way and what
93 factors embedded in the local context further support or hinder local economic development.
94 Numerous studies describe proper infrastructure as one of the determinants of local economic
95 development [14] [15] [16] [17] [18] and a precondition for improving quality of live and reducing
96 poverty [19] [20]. In the Romanian context, there is growing concern that the current poor state of
97 rural infrastructure brings a double limitation for the country in terms of its future development – 'a
98 drag on the international competitiveness of the more dynamic areas of Romania while limiting
99 economic opportunities in lagging and rural areas' [1] (p. 1). While the impact infrastructure
100 investments have on local economic development is more clearly established, there are other
101 determinants of local economic growth which need to be taken into consideration – existing
102 infrastructure stock, education level of the population and social capital, type of financing and
103 administration of the programs, whether different types of investments are integrated or not with
104 each other, level of corruption, legal framework, coordination among various levels of
105 government/administration and governance arrangements, etc. [21] [22] [23].

106 The main research objectives of this article are: (1) to build an index for measuring local
107 economic development in the rural communities from Romania; (2) to assess, based on the index
108 described under (1) if publicly funded programs aimed at building basic infrastructure (water,
109 sewage, transport, etc.) in rural communities contribute to their economic development and poverty

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reduction; and (3) to determine which existing factors in the analyzed local rural communities can explain the level of economic development besides infrastructure investments and how they should be taken into consideration when deciding/prioritizing publicly funded infrastructure projects by the central governments and donors.

The remaining text of the article is organized as follows: Section 2 includes a literature review focused on the role of infrastructure investments on boosting local economic development (hereafter LED) as well as on factors which act as determinants of LED. Section 3 is dedicated to methodology; the study includes a three steps research design. Section 4 includes a discussion of the main findings while Section 5 concludes the article.

1. Literature review

The effects of investments in infrastructure on economic growth represents a subject that has been debated for a long time in the literature. Poor infrastructure is likely to be associated with poverty pockets, and to hinder the economic development of communities, while investments are expected to stimulate economic growth through improving the competitiveness of local firms and stimulation of new economic activity creation (by improving trade opportunities, and reducing firms' costs), thus increasing employment opportunities, and providing better jobs for residents. [24] consider public capital as an element in the macroeconomic production function. Stocks of public capital may enter in the production function directly, as an input, or may influence the productivity of multiple factors, implicitly production, indirectly. Infrastructure development has proven to be a major determinant of economic growth, in both, advanced and developing countries.

In terms of empirical findings that link infrastructure investment and economic growth, [25] is one of the most cited authors. His study, concerning the 1949 to 1985 period considers the relationship between aggregate productivity and stock and flow government-spending variables in the United Sates. The results of the study show that public investments in infrastructure positively impacts private sector growth – the core infrastructure (streets, highways, airports, mass transit,

sewers, water systems, etc.) having the highest explanatory power for productivity (a 1% increase in public capital might increase total factor productivity by 0.4%). Distinguishing between military and non-military spending, Aschauer explained a general decline in productivity growth in the US in the 1970s as being caused by decrease in productive government services.

As a reaction to Aschauer's research, several authors criticized the findings of his study, arguing that the evidence is not clear – due to problems regarding its methodology (many econometric uncertainties), or the unclear direction of causation between public investment and output - thus making it very hard to attribute the productivity slowdown to a shortage of infrastructure investment [15] [26]. Other criticism came from studies using more sophisticated econometric techniques [27] [28] [29] [30] which challenged the significance of Aschauer's results in terms of providing a clear indication for policy that, in general, public investment in infrastructure positively affects growth.

[31] was one of the pioneers of introducing public expenditures into economic growth models, concluding that endogenous growth could be induced by public expenditure represented by infrastructure. Using an approach based on the growth model developed by Barro, [17] address the issue of an optimal threshold or growth maximizing the level of infrastructure stock. Using country data spanning from 1950 to 1992 (GDP per worker for growth, and roads, electricity generating capacity and number of telephones for infrastructure), the authors find that due to the fact that infrastructure capital comes at the cost of reduced investment in other types of capital, if infrastructure levels are set too high, positive infrastructure shocks will tend to reduce the levels of output. In another study [32] the authors go further on investigating the consequences of infrastructure provision (using the same data panel), showing that while infrastructure tends to cause long-run economic growth, there is a substantial difference across countries (under- and over-supply).

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In the same vein, [18] provide an empirical proof that growth is positively affected by the stock of infrastructure assets using a panel data of 121 countries, spanning the period 1960-2000. Moreover, the research shows that income inequality declines with higher infrastructure quantity and quality. The authors use principal component analysis in order to build infrastructure indices (the indices are given by the first principal component of the underlying variables), which are further aggregated into an index of infrastructure stocks, and infrastructure quality, using data from transportation, power and telecommunication sectors.

At the level of EU, a study conducted by [33] indicates that infrastructure endowment is a poor predictor of economic growth. Instead, regional growth is connected with innovation capacity and migrant attraction capacity. The study uses a panel of 120 regions in EU15 countries.

Closer to our research geographical area of interest, [34] conducted a research on infrastructure investments in groups of EU countries. The study (based as well on Barro's government spending model), uses 1980-2010 data (extracted from World Bank's World Development Indicators), analyzing the relationship between GDP growth and different types of infrastructure expenditures. The country panel was divided in two categories (EU 15 and EU 12), according to their accession to EU, an overview of the effects on EU 27 being presented in a model as well. In the study, GDP per capita growth rate is used as the dependent variable, while the independent variables are: telephone lines, air transport, rail lines, roads, and energy production. Although that, due to the lack of data (lack of significant total road network data was mentioned as a limit of the study), the results at EU 12 groups could not identify the connection between infrastructure investments and growth, the results of the study show that telecommunications investments have positive effects on growth in all groups, energy investments have positive effects in EU 15, and EU 27 groups, while investments on railway and road have positive effects only in the EU 27 group. What we can extract from the study, and would be significant for our research and Romania's economic development perspective is the conclusion of the authors that in EU12 member

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184 countries (most recent members of EU at the time of the study, including Romania), the impact of
185 additional infrastructure investment on growth is prominent due to the catch-up effect - investing on
186 more physical capital in these countries will substantially contribute to their production.

187 Focusing on a single specific type of infrastructure, [35] estimate the effect of broadband
188 infrastructure on the economic growth of 25 OECD countries during the 1996-2007 period, finding
189 that a 10% increase in broadband penetration increased annual per capita growth by 0.9%-1.5%.
190 Using several types of models, among which a difference-in differences specification, the authors
191 identify that GDP per capita is about 2.7%–3.9% higher on average after than before broadband
192 introduction (controlling for country and year fixed effects). [36], using difference-in differences and
193 propensity score matching evaluation techniques, found that loans made in 2002 and 2003 under the
194 Pilot Broadband Loan Program of the U.S. Department of Agriculture (USDA), have had a substantial
195 positive impact on employment, annual payroll, and the number of business establishments in
196 recipient communities. The difference-in differences fixed effects estimation was performed on the
197 panel of zip code-level data from 1998 to 2007. The difference-in differences analysis compared the
198 dependent variable between two groups of zip codes—a treatment group of zip codes that received
199 a broadband loan and a control group of zip codes that did not receive a loan—before and after the
200 treatment group received the loan.

201 Although at international level there is a significant body of research on assessing the impact
202 of infrastructure on economic growth, studies focusing on the Romanian case are missing. Except few
203 studies on the case of the Baltic States [37] or Poland [38], there is a scarcity of this type of studies also
204 regarding the countries from the CEE region. However, there is an important body of literature
205 covering developing Middle East and Asian countries, focusing not only on the national level but
206 also on regional and local level effects of different types of infrastructure provision on economic
207 development or poverty reduction.

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Using panel data throughout the 1985 to 1998 period, from a sample of 24 Chinese provinces [39] shows that geographical location and infrastructure endowment significantly accounts for observed differences in growth performance across provinces. Transport facilities are a key differentiating factor, identified by the results, in explaining the growth gap between provinces.

[40] analyze the distributive impacts of infrastructure (telephone, water and electricity) on individual income in China, providing estimates of growth and the distributive impacts of specific physical infrastructures. The results show that all infrastructures helped raise rural income, income gains differing for different population groups. In an attempt to examine the effects of several types of government expenditures on growth and rural poverty in China, using province-level data, [41] found that investment in rural roads significantly reduce poverty incidence through agricultural productivity and nonfarm employment. Estimating elasticity coefficients for agricultural and non-agricultural GDP per worker, and for wages of nonagricultural workers in relation to road infrastructure density, the authors found that rural roads projects have the largest impact (among all government infrastructure projects) on poverty reduction.

[42] explores eventual productivity gains in rural Kyrgyzstan using difference-in-differences estimate of the water infrastructure's impact. Choosing a sample of 173 villages, the author is researching whether improvements in water technologies enable changes in household time allocation and, thereby, productivity gains in households.

[43] evaluate the impacts of electrification in rural Vietnam. Their analysis is based on a panel survey from 2002 and 2005 for 1100 households, including in the econometric framework a difference-in-difference analysis, a difference-in-difference with fixed-effects regression and propensity score matching. The findings show significant positive impacts of electrification on households' income, expenditures, and also on educational outcome. Previous research in the case of Vietnam [44] investigates for positive effects of road infrastructure, and finds that in the case of poor households

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originating in rural communes with paved roads have a 67% higher probability of escaping poverty compared to the households located in communes without paved roads.

Summing up, the studies described above vary significantly in terms of the econometric models used but also with regard to how they define economic development or growth. The latter has been measured either as a function of one specific indicator or of a complex aggregated index. Studies also differ with regard to the size of the area investigated coupled with the level of government covering that area, as well as with regard to the geographical location of the investigated communities.

Our study concerns itself not only with assessing the impact of infrastructure investments on economic growth but also with identifying other determinants of local economic growth connected to the characteristics of the rural communities from Romania. We therefore looked at studies which also assessed the entire spectrum of local economic determinants.

Rural economic competitiveness is a complex issue, infrastructure being only one of the multiple factors of influence. [23] identifies 11 factors considered to be important to local economic development: locational, physical, infrastructural, human resources, capital and finance, knowledge and technology, industrial factors, quality of life, business culture, community identity and institutional capacity. Although usually there are significant discrepancies between the economic development of urban and rural areas, [45] consider that rural areas rise or fall economically based on the same principles as other regions, so we expect that the factors that explain the economic growth to be identical. The same study identifies the fact US Rural regions are in many cases tightly linked to nearby metropolitan regions, confirming location as an important developmental factor. [46] identified several factors related to U.S. rural communities' growth in the 1980s: attractiveness to retirees, right-to-work laws, excellent high school completion rates, good public education expenditures, and access to transportation networks. The findings related to the role of educational

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256 factors are in line with [47] study on data for 42 countries, which identify a positive role of human
257 capital (average year of schooling of the labor force) in explaining economic growth.

258 Examining the determinants of economic performance of 149 English rural districts, [48]
259 identified that a range of factors of economic and human capital: productivity (skills, investment, and
260 enterprise), spatial factors (peripherality and accessibility), and other key factors (economic structure,
261 government infrastructure, road infrastructure, and occupational health), are significant
262 determinants of economic performance in rural areas.

263 In a series of studies [49] [50] [51] the authors emphasize the role of SMEs in rural economic
264 development, and the importance of innovation in rural enterprises. Their research findings show
265 that innovative firms, through external income generation and employment generation, make an
266 important contribution to rural economies.

267

268 **3. Methodological framework**

269 ***3.1 Research goal, objectives and hypotheses***

270 This research aims to assess the connection between local economic development in rural
271 communities from the North-Western Region of Romania and publicly funded investments in basic
272 local infrastructure (water, sewerage, and local roads). More specifically, the analysis strives to
273 determine if local economic development of rural communities can be enhanced through investments
274 in infrastructure, or if other factors, linked to the local context in these communities (such as location
275 in relation to big urban centers and access to existing networks of roads, population size, educational
276 stock of the population in the community, etc.) need to be taken into consideration as well. The
277 specific objectives of the study are:

278 O1: To build an index for measuring local economic development; the index will serve as the
279 dependent variable in our statistical analyses.

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O2: To determine the impact of investments in various types of local basic infrastructure on local economic development.

O3: To investigate other determinants of local economic development besides investments in basic infrastructure, which are closely linked with characteristics of the rural communities from Romania.

The research hypotheses are:

H1: Rural communes which implemented infrastructure projects financed from Measure 322 have developed faster than the ones which did not access funds through this program.

H2: Rural communities implementing integrated infrastructure projects financed from Measure 322 developed at a faster pace than those which have not accessed funding through the program, or have implemented investment projects with only one or two components.

H3: During the execution/construction phase of local basic infrastructure projects the local economy of communes grows at a higher pace, compared to that of communes which have not benefited from funding.

H4: The level of local economic development in rural communities from Romania is predicted by: the size of the commune's population, direct access to national and European road networks, and percentage of university graduates in total population (educational stock).

3.2 Public investments in infrastructure – Measure 322, National Plan for Rural Development

Under the Cohesion Policy, Romania benefits from allocations aimed at the development of its rural areas. During the financial cycle 2007-2013, the National Plan for Rural Development included, among other strategies and programs, Measure 322. Measure 322 targeted investments in basic infrastructure – water systems, sewage, and local roads, in social infrastructure (i.e. kindergartens) and in cultural infrastructure (i.e. restoration of existing monuments or buildings with cultural value). The projects were awarded on the basis of competition during March 2008 - May 2014. Besides meeting certain eligibility criteria, the individual projects were assessed based on a list of relevant criteria, the higher the score obtained by a project the higher the chances of being selected.

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The applications could be done individually by each rural community or in association. The value of the projects could be no more than 6 million euros – bonuses were given to communities for applying for integrated investments (multiple types of infrastructure) and for applying in association. It is clear that these two objectives were considered as extremely important by the Romanian government – integration of multiple types of infrastructure not just one type and association of multiple rural communities for implementing these projects as a way to counteract excessive administrative fragmentation and limited capacity in small communities. The projects included in our research were signed in 2008-2009 and the execution of the works took place from 2011 to 2013. We selected only projects completed in 2013 in order to be able to have at least a period of three years for measuring potential impacts in the local economy. We only focused on basic infrastructure projects, excluding social infrastructure and cultural infrastructure from the study.

3.3 Location of research

In this study we investigate the rural communities from the North-Western region of Romania. The territory of Romania is divided into 8 development regions. They were created in 1998, in the context of Romania's accession to the EU, with the purpose of managing projects and EU funds during the pre-accession period. Despite numerous proposals for reform the structure of the regional models is still unchanged as of 2018. The regions are not self-governed bodies of local public administration, which enjoy local autonomy. They are rather created based on the voluntary cooperation of counties, having as main role the management of EU structural funds and the development and implementation of economic development strategies and policies at regional level. North-Western region was selected as the location of the research due to multiple reasons: all 8 regions are relatively similar in size and composition of rural and urban communities, therefore results obtained in one region could be extrapolated to the other regions; access to previous studies and secondary data for this region investigating similar topics, etc.

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330 ***Steps in the analysis***

331 - *Building the Local Economic Development (hereafter LED) Index*

332 For the purpose of this study, authors measured LED (dependent variable) through an index
333 that has been built and tested previously in the framework of a somewhat similar research [52],
334 assessing the impact on local economic development of a different program financing investments in
335 infrastructure. The LED Index aggregates 10 indicators measured at the level of rural community
336 (self-governed, autonomous bodies of local public administration). Most of the indicators could be
337 considered outcome/market indicators. These indicators were computed based on data obtained from
338 the National Trade Register Office, the Agency for Fiscal Policy and Local Budgeting of the Ministry
339 for Regional Development and Public Affairs, the Romanian National Institute for Statistic and 2011
340 Population Census Data. Table 1 below details how each indicator was built and what it measures.

341

342 Table 1: Variables (indicators) used in the construction of the LED Index

No.	Indicators (variables)	Explanation
1	Turnover (per capita)	Turnover at the level of the commune divided by the size of the population
2	Turnover (per employee)	Turnover at the level of the commune divided by the average number of employees
3	Average number of employees (per 1000 inhabitants)	Total number of employees at the level of the commune divided by the size of the population and multiplied by 1,000
4	The percentage of employees in the total working-age population	The average number of employees divided by the number of the working-age population (15 – 64 years)
5	Budgetary revenue from personal / company income taxes (per capita)	The total value of the budgetary revenue from personal/company income tax breakdowns at the level of the commune, divided by the size of the population
6	Budgetary revenue from local taxes (per capita)	Total budgetary revenue from local taxes at the level of the commune divided by the population size
7	Active business density	The number of enterprises divided by the size of the population and multiplied by 1,000

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8	Entrepreneurial capacity	The number of newly created enterprises for every 1,000 people; calculated based on total number of newly created enterprises divided by size of the population and multiplied by 1,000
9	Social assistance expenses (per capita)	The total social assistance expenditures at the level of the commune divided by the size of the population.
10	Number of dwellings completed during the year (per 1,000 inhabitants)	The total number of dwellings completed during the year divided by the size of the population and multiplied by 1,000

Source: Compiled by the authors

Each indicator has been computed on an annual basis for each commune. In order to be comparable, the data for each commune have been adjusted with the size of the population or the number of employees where necessary, while the indicators based on monetary units (turnover per capita, turnover per employee, budgetary revenue from income tax breakdowns per capita, budgetary revenue from local taxes per capita, social assistance expenses per capita) have been updated with the inflation rate. The indicators have been aggregated using Principal Components Analysis (PCA), one of the most common methods used by data analysts to provide a condensed description and describe patterns of variation in multivariate data sets.

- *Cvasi-experimental research*

We used a quasi-experimental research design to determine if investments in infrastructure, considered as the treatment, determine an increase in the level of LED. The communes which have implemented projects through Measure 322 represent the treatment group, while the ones which have not are the control group. In the case of the treatment group, out of the total number of 398 communes from the North-Western Region, 145 have contracted projects financed through Measure 322. However, only 64 communes have completed them until the end of 2013. From the treatment group we eliminated the communes which partially benefited from financing but did not complete the implementation of the projects (81 cases). In the end, the treatment group includes 64 communes. Out of these 64 communes, most of them implemented integrated projects, combining at least two

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types of investment: water infrastructure and sewerage infrastructure (8 cases) or water infrastructure and local roads (3 cases) or sewerage infrastructure and local roads (9 cases) or all of those three types of basic infrastructure – water, sewerage and local roads (26 cases). In 18 cases there was only one type of basic local infrastructure built, namely local roads. Also, out of the 64 communes, 11 of them implemented the projects based on association between communes. This was a feature of Measure 322, which allowed associations of communes to apply and receive higher financing.

The control group (same size as the treatment group) was built through stratified random sampling, in connection with the rank of the communes from the non-treatment group (253 cases). The rank of the commune refers to the position of a certain commune in the hierarchy of rural localities from Romania. The rank indicates the position of a commune by reference to an urban center. Communes can be located in the immediate vicinity of a big city or they can be isolated. As multiple studies have concluded, proximity to a large urban area can exert a positive influence on the surrounding rural communities, while spatial (geographical) isolation from large urban centers can often condemn deep-rural communities to underdevelopment and stagnation. The rank of the communes from the North-Western Region of Romania was determined based on a policy report prepared by the Romanian government [53]. Based on this document, we grouped the communes from the region in six categories of functional areas (along a continuum), where rank 1 includes the most isolated communes (294 communes) and rank 6 includes the communes located near a large city with a minimum of 100,000 inhabitants (50 communes).

Out of the 64 communes which completed the implementation of the projects financed from Measure 322, 51 (79.7%) of them are rank 1 communes (isolated communes), while the rest of the sample include ranks 2, 3, 4, 5 and 6 (2 communes in rank 2, 1 commune in rank 3, 5 communes in rank 4, 1 commune in rank 5, and 5 communes in rank 6). The control group has the same size and it

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was created through a random stratified sampling in order to mirror the structure of the treatment group.

In order to assess the difference between the treatment group and the control group, we used the difference-in differences technique, an intuitive technique mostly used to assess the impact of policies and programs. Before conducting the difference-in differences technique, we verified the normality of value distribution of the LED Index values for the period 2007-2016. The values of LED Index for 2007, 2013, 2016 and of the differences between them are not normally distributed (except for the differences between 2016 and 2007), which determined us to use an equivalent nonparametric Independent Sample t-test, namely Mann-Whitney U-test, in order to compare the two independent groups, treatment and control.

- *Regression model*

As a final step in our research, using linear regression models, we assessed also if other independent variables such as direct connection to a national or European road network, population size of the commune, and percentage of university graduates in the total population act as determinants of LED. LED determinants have all been investigated previously in a variety of studies. There seems to be consensus in the literature that direct connection to a national or European road network can stimulate economic activity and economic growth [54] [55] [56] [57] [58]. The connection between the population size and LED is less clear cut, with numerous studies pointing in the direction of both positive and negative influences of this variable on LED [59] [60] [61] [62]. Considering the size of population, the communes in the sample were grouped into six categories, as follows: Category 1 – up to 1,500 inhabitants; Category 2 – from 1,501 to 3,000 inhabitants; Category 3 – from 3,001 to 4,500 inhabitants; Category 4 – from 4,501 to 6,000 inhabitants; Category 5 – from 6,001 to 7,500 inhabitants, and Category 6 – more than 7,500 inhabitants. The percentage of university graduates (proxy for educational stock in the community) was included as an independent variable

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based on the findings of various studies [63] [64] [65] [66]. This indicator was calculated based on the 2011 Population Census Data, for each commune, as a share of the total population.

4. Results and discussions

O1 of our study was to construct an Index for measuring LED in rural communes from the North-Western Region of Romania, which however could be then used for all rural communes in Romania. To construct the LED Index, we used factorial analysis based on principal component analysis (PCA). For each year, we used the factorial extraction based on non-fixed number of factors. To weight each indicator, we used the values of first component extracted from the matrix of PCA.

The values of first component extracted, the Kaiser-Meyer-Olkin (KMO) values, the total variance explained by the first component extracted and the total number of extracted components are included in Table 2.

Table 2: The main results of PCA

Indicators/year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Factor loadings for the first component extracted										
Turnover per capita	.901	.900	.835	.878	.839	.887	.907	.900	.901	.894
Turnover per employee	.403	.319	.459	.450	.424	.474	.427	.374	.347	.330
Average number of employees per 1,000 inhabitants	.894	.921	.930	.925	.927	.939	.957	.941	.938	.947
Percentage of employees in the total working-age population	.887	.913	.925	.921	.922	.935	.954	.938	.937	.947
Income from income tax breakdowns per capita	.695	.607	.697	.746	.762	.845	.832	.820	.850	.843
Income from local taxes per capita	.424	.529	.681	.706	.555	.560	.524	.610	.495	.472
Active business density	.853	.874	.817	.751	.754	.737	.712	.752	.759	.752
Entrepreneurial capacity	.624	.707	.439	.121	.191	.209	.101	.588	.556	.564
Social assistance expenses per capita	-.316	-.306	-.188	-.330	-.147	-.093	-.067	-.023	.001	-.003

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Number of dwellings completed during the year per 1,000 inhabitants	.458	.499	.508	.397	.491	.470	.457	.436	.576	.537
Indicators										
KMO	.771	.789	.803	.793	.774	.783	.783	.783	.794	.783
Bartlett's Test[2] for Sphericity	3855.935	3197.062	3639.183	3816.336	3662.029	3906.862	3967.747	4344.892	4444.556	4422.721
Total variance explained by the first component extracted (%)	46.504	48.480	47.295	45.575	43.503	46.117	45.294	48.628	48.723	48.070
Number of components	2	2	2	2	2	2	3	3	3	3

The sampling adequacy (the KMO values) are well over .5 for each year, indicating the high level of adequacy of the correlation matrix and the fact that the indicators used are appropriates for aggregation using PCA, and the significance of Bartlett's test of Sphericity (which stands at .000) recommend continuing the analysis. The first factor extracted in each year explains more than 43% of the total variance and the low number of extracted factors (two for six years and three for four years) further confirm that the indicators are appropriate for aggregation.

The values for the first component extracted show that the most relevant indicators used for aggregation are the average number of employees (per 1,000 inhabitants), percentage of employees in the total working-age population, turnover (per capita), budgetary revenues from personal/company income tax breakdowns (per capita) and active business density; their weight is closer to 1 than to 0 and they are almost constant for all the analyzed period. Entrepreneurial capacity and social assistance expenses (per capita) are the indicators with the lowest weight (loadings) and the most inconstant values during the analyzed period; as we expected, social assistance expenses (per capita) are negatively weighted in the first component extracted.

[2] The significance was .000 for each year.

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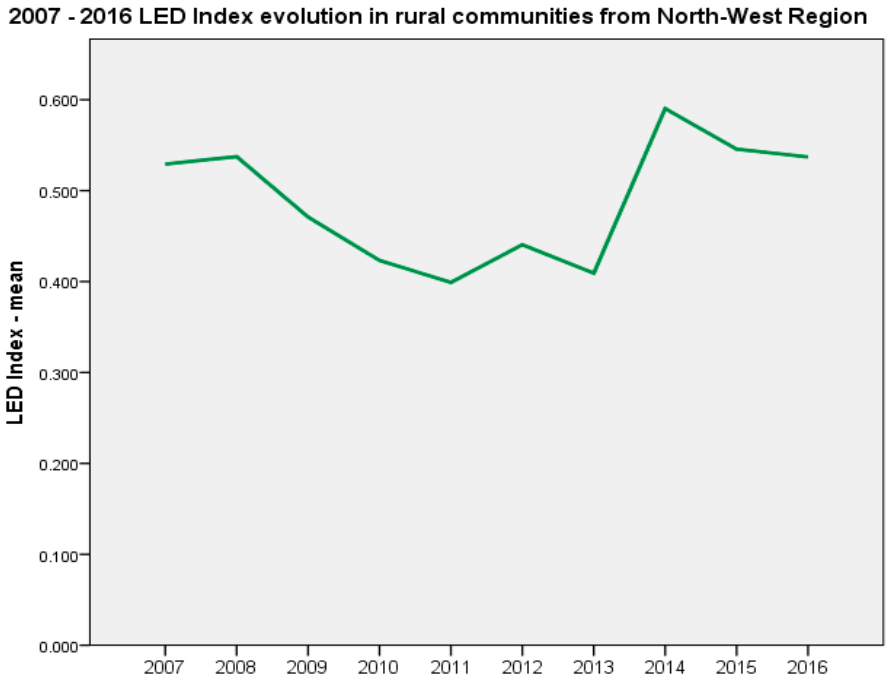
438 The values of the Index obtained based on factorial analysis vary a lot from one commune to
439 another for the same calendar year and they are not normally distributed for any of the years for
440 which they have been computed. Annual mean values graphically presented in Figure 1 confirm the
441 fluctuating evolution of the LED Index in the 398 communes of the North-Western Region of
442 Romania.

443

444



445

446 Figure 1: LED Index evolution from 2007 to 2016 in the communes from the North-Western Region
447 of Romania

448 Source: Compiled by the authors

449

450 In Figure 1 above we can observe the drop in LED Index starting with 2008, once the
451 economic crisis started. The trend continues until 2011, with a significant increase in 2014.

452

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O2 of our research was accomplished through the cvasi-experimental research. As Figure 2 below shows, the evolution of LED (mean values of the LED Index) reveals the difference which exists between communes which beneficiated from infrastructure investments (irrespective of their type) and those which did not during the period 2007-2016.

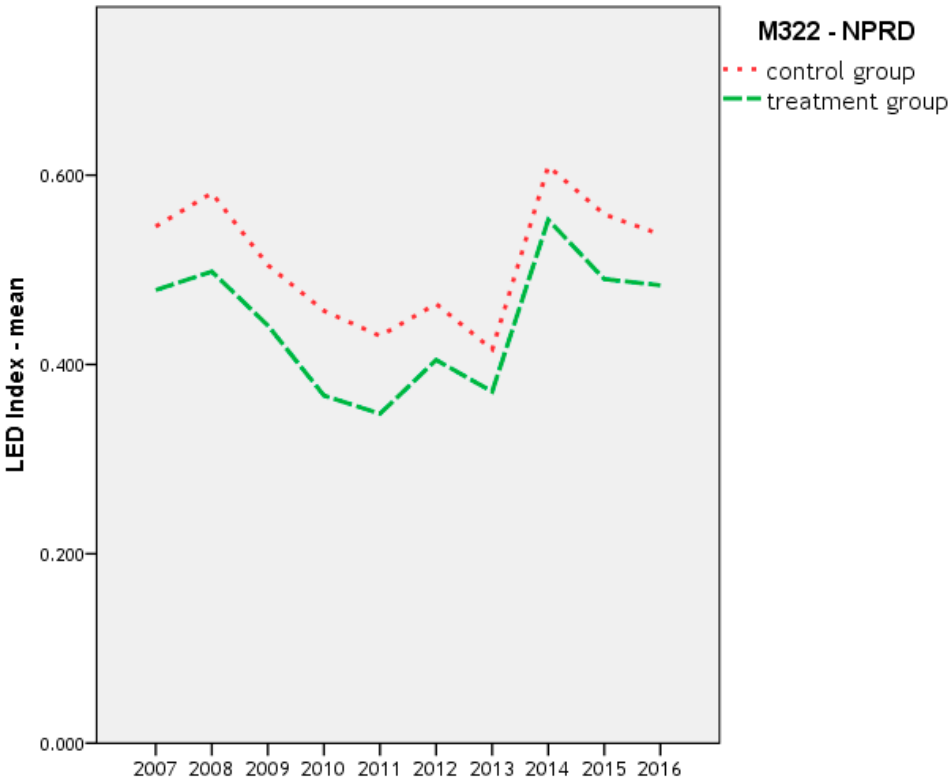

Figure 2: The evolution of the LED Index 2007-20016 for beneficiaries and non-beneficiaries of Measure 322 (irrespective of infrastructure category)

Source: Compiled by the authors

It is important to observe the initial (2007) difference existing between beneficiaries and non-beneficiaries. This difference is due to the fact that Measure 322 had as main goal to determine a reduction in poverty at local level and therefore it encouraged the poorest communities to apply. This was done by giving additional points during the application stage to communities based on their level of poverty. From this perspective, we can say that the goal of poverty reduction succeeded to facilitate the access of the poorest communes to non-refundable programs for basic infrastructure. This is a change compared with other European and national non-refundable programs for basic

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469 infrastructure in rural communities of Romania, where the beneficiaries were more developed before
470 accessing and implementing the basic infrastructure projects, proving in this case that existing higher
471 level of economic development and higher administrative capacity of the communities facilitated
472 their access to non-refundable programs [52]. Figure 2 also reveals that three years after treatment
473 the difference between beneficiaries and non-beneficiaries remains somewhat similar. Because
474 differences between 2007 and 2016 are extremely small, graphical representation is supplemented
475 with a comparison of means for the treatment group and the control group. The results are displayed
476 in Table 3 below.

477

478 Table 3: The evolution of the LED Index, treatment group versus control group

Groups	LED Index (mean) 2007	LED Index (mean) 2013	LED Index (mean) 2016	Dif. LED Index 2016-2007	LED Index 2016 divided by LED Index 2007	Dif. LED index 2013-2007	LED Index 2013 divided by LED Index 2007	Dif. LED Index 2016-2013	LED Index 2016 divided by LED Index 2013	Treatment group /control group 2007	Treatment group /control group 2013	Treatment group /control group 2016
Treatment group	0.478	0.371	0.483	0.005	1.010	-0.107	0.776	0.112	1.302	0.877	0.894	0.899
Control group	0.545	0.415	0.537	-0.008	0.985	-0.130	0.761	0.122	1.294			

479 Source: Compiled by the authors

480

481 The annual mean values of the LED Index show an initial development difference between
482 control and treatment group (as displayed by Figure 2), and the fact that the difference was slightly
483 reduced until 2016. Also, it seems that in 2013 (the year of project execution – actual building of
484 works) compared with 2007, the LED Index in the treatment group did not drop as much as in the

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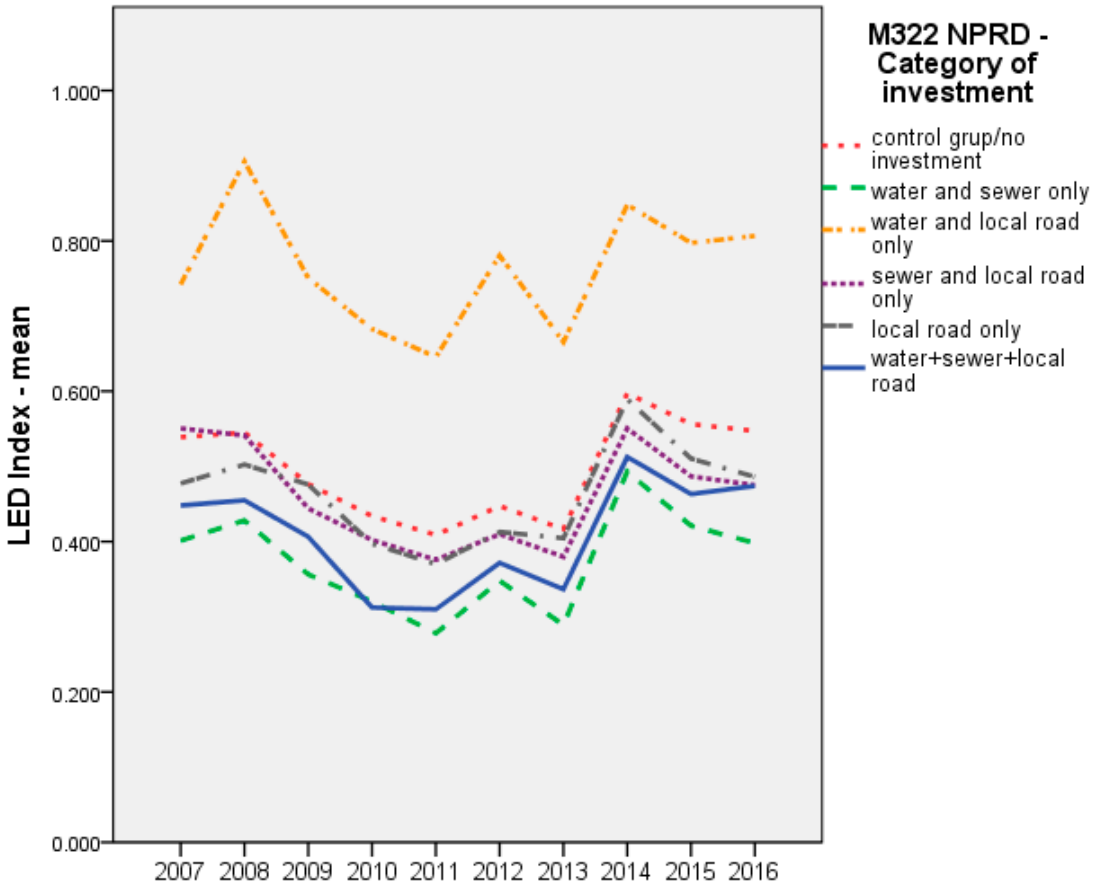
485 control group. This is most likely due to spending in the community associated with the presence of
486 workers on the construction sites.

487 If we break down investments by types of infrastructure, the evolution of the LED Index is
488 portrayed by Figure 3.



489
490 **Figure 3:** The evolution of the LED Index 2007-2016 by category of infrastructure investment
491 Source: Compiled by the authors

492

493 The communes which have implemented water and sewerage investments (8 cases) started
494 from the lowest level of LED in 2007, while the ones which implemented other combination of
495 investments - sewerage and local roads (9 cases) or water and local roads (3 cases) were at the same
496 level or over the LED Index value compared with the control group. The communes implementing
497 integrated investment projects (containing three type of infrastructure – 26 cases) started from the
498 second lowest LED Index level in 2007. Excluding the communes which implemented only water and

499 road projects due to the low number of cases (only 3), it is interesting to observe the evolution of the
500 LED Index over 2007-2016 period by considering the combination of implemented types of
501 infrastructure investments. The difference between communes in the treatment group and the control
502 group is slightly reduced over 2011-2013 time period (while the projects were executed). After that
503 period, the difference between the treatment and the control group increases until 2016, except for
504 the communes which implemented integrated projects (3 types of infrastructure). Surprisingly, the
505 situation seems to be turned around in 2016 compared to 2007 in the communes implementing water
506 and sewerage projects. In this case, although the average value of LED index was approximately
507 equal with the communes in the control group, from 2009 onward the level decreases, below the
508 value of the control group, including the period of project execution, and the difference increases in
509 the favor of control group starting from 2014.

510 According to the type of investment implemented, the situation of LED Index mean values
511 in 2007, 2013, and 2016 is presented in Table 4.

512

513 **Table 4: Mean LED Index values in 2007, 2013, 2016, according to the type of infrastructure investment**

Category of investment	LED Index (mean) 2007	LED Index (mean) 2013	LED Index (mean) 2016	Dif. LED Index 2016-2007	LED Index 2016 divided by LED Index 2007	Dif. LED index 2013-2007	LED Index 2013/LED Index 2007	Dif. LED Index 2016-2013	LED Index 2016/LED Index 2013	Treatment group/control group 2007	Treatment group/control group 2013	Treatment group/control group 2016
M322- NPRD water + sewerage (8 cases)	0.401	0.289	0.398	-0.003	0.993	-0.112	0.721	0.109	1.377	0.736	0.696	0.741
Control group	0.545	0.415	0.537	-0.008	0.985	-0.130	0.761	0.122	1.294			
M322- NPRD water + local roads only (3 cases)	0.742	0.665	0.806	0.064	1.086	-0.077	0.896	0.141	1.212	1.361	1.602	1.501
Control group	0.545	0.415	0.537	-0.008	0.985	-0.130	0.761	0.122	1.294			
M322- NPRD sewerage + local roads (9 cases)	0.550	0.379	0.475	-0.075	0.864	-0.171	0.689	0.096	1.253	1.009	0.913	0.885
Control group	0.545	0.415	0.537	-0.008	0.985	-0.130	0.761	0.122	1.294			
M322- NPRD local roads (18 cases)	0.477	0.404	0.486	0.009	1.019	-0.073	0.847	0.082	1.203	0.875	0.973	0.905
Control group	0.545	0.415	0.537	-0.008	0.985	-0.130	0.761	0.122	1.294			
M322- NPRD water + sewerage + local roads (26 cases)	0.448	0.336	0.474	0.026	1.058	-0.112	0.750	0.138	1.411	0.822	0.810	0.883
Control group	0.545	0.415	0.537	-0.008	0.985	-0.130	0.761	0.122	1.294			

514 Source: Compiled by the authors

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By comparing the mean values, some observations can be made: (a) In 3 out of the 5 sub-groups of cases in the sample by type of infrastructure investment, the initial LED index values (2007) are lower than those for the control group; (b) In 4 sub-groups the communes from the treatment group slightly recovered the development gap compared with the control group; (c) Only 3 sub-groups experienced a diminishment in the development gap in 2013, during the execution of the projects.

Next step in the analysis was to assess the difference between beneficiaries and non-beneficiaries before and after the treatment (implementation of the basic infrastructure projects). Using difference-in-differences technique, we applied Mann Whitney U-test on the value of LED Index for 2007, 2013, 2016 and the difference between treatment group and control group. The results are presented in Table 5 below:

Table 5: Mann Whitney U-test on the values of LED Index for 2007, 2013, 2016, irrespective of infrastructure category

M 322 – NPRD – not differentiated treatment								
Year/Difference	**Status**	**N**	**Mean Rank**	**Sum of Ranks**	**Mann-Whitney U**	**Wilcoxon W**	**Z**	**Asym. Sig. (2-tailed)**
2007	Control group	64	66.52	4257.50	1918.500	3998.500	-.617	.537
	Treatment group	64	62.48	3998.50				
2013	Control group	64	66.61	4263.00	1913.000	3933.000	-.643	.520
	Treatment group	64	62.39	3933.00				
2016	Control group	64	67.67	4331.00	1845.000	3925.000	-.967	0.333
	Treatment group	64	61.33	3925.00				
Index LED - Difference 2016-2007	Control group	64	62.86	4023.00	1943.000	4023.000	-.500	.617
	Treatment group	64	66.14	4233.00				

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Index LED - Difference 2013-2007	Control group	64	62.78	4018.00	1938.000	4018.000	-.524	.600
	Treatment group	64	66.22	4238.00				
Index LED - Difference 2016-2013	Control group	64	65.21	4173.50	2002.500	4082.500	-.217	.828
	Treatment group	64	63.79	4082.50				

Source: Compiled by the authors

The test shows that in 2007 (before treatment) there is a difference - Mean Rank - but not statistically significant between treatment group and control group. The difference is almost the same in 2013 and 2016 and is not statistically significant as well. Even if the treatment group recovers more than the control group (see the Mean Rank in the case of Index LED - difference 2016-2007), the 'catching up' is very small and statistically insignificant. From this perspective, it can be said that, on the short run (3 years), the investments from Measure 322 in basic infrastructure at local level did not succeed to boost local economic development. This is not to say that improvements did not occur at the local level - there could be other quality-of-life elements that have improved more significantly at the local level but in the short term the local economy does not seem to have been boosted by infrastructure investments. Quality of life improvements for rural areas of Romania are quite hard to investigate using only statistical data; qualitative techniques should be used in order to capture the true social and well-being impact generated by these projects.

We used the same technique (difference-in differences) for each indicator aggregated into the LED Index. As expected, for the most part of the indicators there is a difference in favor of the control group, the Mean Rank being higher both in 2007 and 2016. But there are some exceptions. For example, we observed that in the case of *income from local taxes per capita*, in 2007 (before treatment) there is a difference in favor of the control group, the Mean Rank being higher but not statistically significant in the case of the control group than in the case of the treatment group. In 2016, the situation is changed, the Mean Rank being higher (not statistically significant) in the case of the

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551 treatment group. A similar situation is in the case of *entrepreneurial capacity*, the Mean Rank being
552 higher (not statistically significant) in 2007 in the case of the control group (Mean Rank = 67.00 for the
553 control group and 62.00 for the treatment group) and almost the same for the treatment group and
554 the control group in 2016 (Mean Rank for the control group = 64.52, Mean Rank for the treatment
555 group = 64.48). Also surprisingly, in the case of *number of dwellings completed during the year per 1,000*
556 *inhabitants*, the Mean Rank is higher (but not statistically significant) both in 2007 and 2016 in the case
557 of the treatment group than in the case of the control group: in 2007 Mean Rank for control group =
558 62.36, Mean Rank for the treatment group = 66.64, in 2016 Mean Rank for the control group = 60.63,
559 Mean Rank for treatment group = 68.38. Based on these results, it is possible that on the short run (3
560 years) one immediate and observable impact of investments in basic local infrastructure is the
561 increasing of entrepreneurial capacity, meaning that new companies have been created at the local
562 level.

563 A surprising result was obtained in the case of the indicator *social assistance expenses (per*
564 *capita*). Even if in 2007 the situation was almost the same in the case of the treatment group and in the
565 case of the control group, in 2016 there is a statistically significant difference between the treatment
566 group and the control group, meaning that social *assistance expenses (per capita*) are statistically
567 significantly higher in the treatment group than in the control group (see Annex 1). We are
568 hypothesizing that once the problem of infrastructure is resolved, local authorities have a little bit
569 more resources to use on other categories of problems, such as social care. Same results were obtained
570 by other authors measuring the impact of other infrastructure programs on the growth of rural
571 economy in Romania [50].

572 We also investigated if there is a difference between the communes in the treatment group
573 and in the control group, by taking into consideration the category of infrastructure they invested in
574 or the combination of infrastructure categories (see Annex 2). First of all, we have to mention that the
575 differences are not statistically significant, with the exception of water + local roads category, in 2016,

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but this is a particular situation due to the low number of cases. The Mann Whitney U-Test reveals similar results with those obtained from comparing the means, with some exceptions. 3 out of 5 sub-groups in the treatment group reduced the development gap compared to the control group over the period 2007-2013; after 2013, 2 sub-groups lost again the advantage gained during the course of the previous period. These results are in line with our hypothesis that at least in some cases the actual execution of construction works offered an extra boost for the local economy. An important observation is that the communes which implemented integrated investment (water + sewerage + local roads) seem to recover continuously the difference existing between them and the control group, no matter if we talk about pre-treatment and post treatment period (2007-2016), implementation period (2007-2013), or post implementation period (2013- 2016).

O3 of our research deals with identifying possible determinants for LED, other than public investments in infrastructure. We used several linear regression models for achieving this objective. In the first regression model, we included four independent variables. For the level of LED, the dependent variable, we used the mean of LED Index during 2007-2016 period. The model only shows, in general, which independent variable influences the level of economic development as approximated by the LED we constructed. The results are presented in Table 6.

Table 6: Determinants for LED in the control + treatment groups

Independent variables		**Standardized coefficients (Beta)**
Direct connection to the European road network		.169***
Direct connection to the national roads network		.121
Population size		.148*
Percentage of university graduates		.664***
Model summary	R Square	.626
	R	.791
	F	51.415
	Sig.	.000

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595 * – statistically significant at the 0.05 level (2-tailed)

596 ** – statistically significant at the 0.01 level (2-tailed)

597 *** – statistically significant at the 0.001 level (2-tailed)

598 Source: Compiled by the authors

599

600 R^2 indicates that the explanatory power of the model is medium to strong, as the independent
601 variables together explain 62.6% of the variation of the arithmetic mean of the LED Index. The main
602 statistically significant determinants of LED are the percentage of university graduates (educational
603 stock in the community) (.664***) and direct connection to the European road network (.169***), while
604 population size and direct connection to the national road network are weakest predictors.

605 Considering the result of the first regression model regarding the level of LED, we then run
606 a second linear regression to assess if these determinants, but also public investments in local basic
607 infrastructure boosted LED in the 2007 – 2016 period. In this model, the dependent variable is LED
608 Index difference between 2016 and 2007.

609 Table 7: Determinants for boosting LED in the control + treatment groups

Independent variables		**Standardized coefficients (Beta)**
Direct connection to the European roads network		-.018
Direct connection to the national roads network		.035
Population size		-.290***
Percentage of university graduates		-.014
Measure 32		.037
Model summary	R Square	.086
	R	.293
	F	2.229
	Sig.	.049

610 * – statistically significant at the 0.05 level (2-tailed)

611 ** – statistically significant at the 0.01 level (2-tailed)

612 *** – statistically significant at the 0.001 level (2-tailed)

613 Source: Compiled by the authors

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614

615 The explanatory power of the model is low, as the independent variables explain only 8.6%
616 of the variation of the LED Index difference between 2007 and 2016. Also, it is interesting to observe
617 that population size is negatively (and statistically significant) correlated with the LED Index
618 evolution, while the other factors are not predictors for LED evolution.

619 A third regression introduced the different types of infrastructure investment from Measure
620 322 as independent variables and LED Index difference between 2016 and 2007 as the dependent
621 variable. The results of this linear regression are presented in Table 8.

622

623 Table 8: Category of non-refundable investment as predictors for boosting LED in the control +
624 treatment groups

Independent variables		**Standardized coefficients (Beta)**
Water + sewerage only		.006
Water + local roads only		.053
Sewerage + local roads only		-.083
Local roads only		.029
Water + sewerage + local roads		.067
Model summary	R Square	.016
	R	.126
	F	.393
	Sig.	.853

625 * – statistically significant at the 0.05 level (2-tailed)

626 ** – statistically significant at the 0.01 level (2-tailed)

627 *** – statistically significant at the 0.001 level (2-tailed)

628 Source: Compiled by the authors

629 The model is not statistically significant and no category of non-refundable investment from
630 Measure 322 is a determinant for the evolution of LED.

631

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5. Conclusions

Romania lags severely behind other EU countries in terms of infrastructure endowment and the belief of both lay people and decision-makers is that infrastructure investments represent the magic wand towards national prosperity. National and EU funded programs addressing the infrastructure gap, especially in rural areas, are implemented with three declared objectives in mind – grow the local economy, reduce poverty, and generate increased quality of life for the rural residents. Our study focused on the impact of infrastructure investments on the local rural economy. H1 of our study therefore tried to verify if rural communes which implemented infrastructure projects financed from Measure 322 have developed faster than the ones which did not access funds through this program. This hypothesis is only partially confirmed. The beneficiaries of Measure 322 have developed a little bit more, but not statistically significant than those who have not benefited from this program. Some specific indicators, which were used to the construction of LED Index, such as entrepreneurial activity and budgetary revenue from local taxes, increased more in the communes benefiting from infrastructure investments, but this increase is not statistically significant. More surprising is that social assistance expenses (per capita) are statistically significantly higher in the communes which received financing than in those which did not, even if in 2007 (pre-treatment) they were at the same level for both groups (beneficiaries and non-beneficiaries). The results of our research do not mean necessarily that these projects will not generate significant economic impacts later on. The research investigated projects completed in 2013, and it is possible that the interval 2013-2016 is too short for observing significant changes in the local economy. Some of the studies outlined in section 2 found these effects are more than 10 years from the completion of the works.

H2 tried to assess one specific feature of Measure 322, namely integrated infrastructure investments. With this program, government authorities argued that it is better to pursue all types of infrastructure at once, in order to see accelerated growth at the local level. H2 stated that rural communities implementing integrated infrastructure projects (water + sewerage + local roads)

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658 developed at a faster pace than those which have not accessed funding through the program, or have
659 implemented investment projects with only one or two components. H2 is also only partially
660 confirmed. The communes which implemented integrated project have developed constantly over
661 the monitored interval and a little bit more, but not statistically significant than those which did not
662 benefited from Measure 322.

663 One assumption of our research, incorporated in H3, was that during the
664 execution/construction phase of local basic infrastructure projects the local economy of communes
665 grows at a higher pace, compared to that of communes which have not benefited from funding. We
666 expected this impact to occur because construction means more people/workers on site, more
667 resources for consumption in the local community, and perhaps even more economic activity in the
668 form of local firms providing some materials or workforce. H3 is only partially confirmed. During
669 the execution phase, the local economy of beneficiaries grows at a higher pace but not statistically
670 significant compared with that of non-beneficiaries. Moreover, if we look at the category of
671 infrastructure communes invested in, we observe that in the case of sewerage and local roads
672 category of investment, the situation is the opposite.

673 In our research we were interested also in what factors act as determinants of local economic
674 development. We mainly investigated features connected with the local communities in the sample.
675 This was done keeping in mind that when decision-makers create the list of criteria based on which
676 projects are awarded, they have the possibility to encourage communities having certain features to
677 apply. Knowing what characteristics favor LED can be important for how future programs are
678 structured. With H4, we decided to observe if certain characteristics of the local communes have an
679 impact of local economic development. Thus, we hypothesized that the size of the commune's
680 population, direct access to European and national road networks, and percentage of university
681 graduates in total population (education stock) act as predictors of LED. H4 is confirmed, the main
682 statistically significant predictors for LED being the percentage of university graduates in the total

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683 population of the community and direct connection to a European road network. Another important
684 conclusion is that none of the predictors for the level of LED are not statistically significant predictors
685 for boosting LED. The situation is similar in the case of non-refundable investment projects in local
686 basic infrastructure, no matter the category of investment (integrated or both or only one component
687 of infrastructure) is not a statistically significant predictor for boosting LED.

688 The research has several major limitations which need to be acknowledged. First, the impact
689 of investments is measured after a very short period of time, 3 years, since the completion of the
690 projects. While some effects, such as the increase in entrepreneurial capacity take place rather soon,
691 others might not occur for another decade. Second, the variable infrastructure investment is
692 measured in a dichotomic manner, whether communes benefited or not from the investments. This
693 means that we are treating all investments in a certain category as similar, which is not the case in
694 reality. While the value of the projects is more or less comparable, the actual results in terms of
695 kilometers of roads or water or sewage built varies a lot. These data are not currently accessible and
696 this is the reason why for the purpose of this study investments were accounted for in communities
697 with yes or no.

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Annex 1

Table 1: Mann Whitney U-test on the values of *Social assistance expenses (per capita)* considering the financing of basic infrastructure through Measure 322, irrespective of the category of investment

M 322 – NPRD – not differentiated treatment								
Year/Difference	**Status**	**N**	**Mean Rank**	**Sum of Ranks**	**Mann-Whitney U**	**Wilcoxon W**	**Z**	**Asym. Sig. (2-tailed)**
2007	Control group	64	64.36	41119.00	2039.000	4119.000	-.043	.966
	Treatment group	64	64.64	4137.00				
2013	Control group	64	59.30	3795.00	1715.000	3795.000	-1.587	.113
	Treatment group	64	69.70	4464.00				
2016	Control group	64	57.20	3661.00	1581.000	3661.000	-2.226	**0.026**
	Treatment group	64	71.80	4595.00				
Index LED - Difference 2016-2007	Control group	64	59.95	3837.00	175.000	3837.000	-1.387	.166
	Treatment group	64	**69.05**	4419.00				
Index LED - Difference 2013-2007	Control group	64	62.91	4026.00	1946.000	4026.000	-.486	.627
	Treatment group	64	**66.09**	4230.00				
Index LED - Difference 2016-2013	Control group	64	58.09	3718.00	1638.000	3718.000	-1.954	.051
	Treatment group	64	**70.91**	4538.00				

Source: Compiled by the authors

Annex 2: Mann Whitney U-test on the values of LED Index for 2007 - 2016 considering the category of local infrastructure financed through Measure 322

M 322 – NPRD – full integrated projects – water + sewerage + local roads								
Year/Difference	**Status**	**N**	**Mean Rank**	**Sum of Ranks**	**Mann-Whitney U**	**Wilcoxon W**	**Z**	**Asym. Sig. (2-tailed)**
2007	Control group	64	39.89	2361.00	231.000	267.000	-.448	.654

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	Water and Sewerage only	8	33.38	267.00				
2013	Control group	64	37.13	2376.00	216.000	252.000	-.717	.474
	Water and Sewerage only	8	31.50	252.00				
2016	Control group	64	37.34	2390.00	202.000	238.000	-.968	.333
	Water and Sewerage only	8	29.75	238.00				
Index LED - Difference 2016-2007	Control group	64	36.46	2333.50	253.500	2333.500	-.045	.964
	Water and Sewerage only	8	36.81	294.50				
Index LED - Difference 2013-2007	Control group	64	36.37	2327.50	247.500	2327.500	-.152	.879
	Water and Sewerage only	8	**37.56**	300.50				
Index LED - Difference 2016-2013	Control group	64	36.63	2344.50	247.500	283.500	-.152	.879
	Water and Sewerage only	8	35.44	283.50				
2007	Control group	64	33.47	2142.00	62.000	2142.000	-1.031	.303
	Water and local roads only	3	45.33	136.00				
2013	Control group	64	33.11	2119.00	39.000	2119.000	-1.728	.084
	Water and local roads only	3	53.00	159.00				
2016	Control group	64	32.95	2109.00	29.000	2109.000	-2.031	.042
	Water and local roads only	3	56.33	169.00				
Index LED - Difference 2016-2007	Control group	64	33.58	2149.00	69.000	2149.000	-.819	.413
	Water and local roads only	3	**43.00**	129.00				
Index LED - Difference 2013-2007	Control group	64	33.91	2170.50	90.500	2170.500	-.167	.868
	Water and local roads only	3	**35.83**	107.50				
Index LED - Difference 2016-2013	Control group	64	34.13	2184.00	88.000	94.000	-.243	.808
	Water and local roads only	3	31.33	94.00				
2007	Control group	64	36.34	2325.50	245.500	2325.500	-.713	.476
	Sewerage and local roads only	9	41.72	375.50				
2013	Control group	64	36.68	2347.50	267.500	2347.500	-.344	.731
	Sewerage and local roads only	9	39.28	353.50				
2016	Control group	64	37.05	2371.50	284.5000	329.500	-.059	.953
	Sewerage and local roads only	9	36.61	329.50				
Index LED - Difference 2016-2007	Control group	64	37.91	2426.50	229.500	274.500	.-982	.326
	Sewerage and local roads only	9	30.50	274.50				
	Control group	64	37.89	2425.00	231.000	276.000	-.956	.339

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Index LED - Difference 2013-2007	Sewerage and local roads only	9	30.67	276.00				
Index LED - Difference 2016-2013	Control group	64	37.31	2388.00	268.000	313.000	-.336	.737
	Sewerage and local roads only	9	34.78	313.00				
2007	Control group	64	43.28	2770.00	462.000	633.000	-1.277	0.202
	Local roads only	18	35.17	633.00				
2013	Control group	64	43.01	2752.50	479.500	650.500	-1.081	.280
	Local roads only	18	36.14	650.50				
2016	Control group	64	44.03	2818.00	414.000	585.000	-1.815	.070
	Local roads only	18	32.50	585.00				
Index LED - Difference 2016-2007	Control group	64	41.02	2625.50	545.500	2625.500	-.342	.733
	Local roads only	18	43.19	777.50				
Index LED - Difference 2013-2007	Control group	64	40.17	2571.00	491.000	2571.000	-.952	.341
	Local roads only	18	46.22	832.00				
Index LED - Difference 2016-2013	Control group	64	43.26	2768.50	463.500	634.500	-1.260	.208
	Local roads only	18	35.25	634.50				
2007	Control group	64	46.55	2979.00	765.000	1116.000	-.596	.551
	Water + sewerage+ local roads	26	42.92	116.00				
2013	Control group	64	46.69	2988.00	756.000	1107.000	-.677	.499
	Water + sewerage+ local roads	26	42.58	1107.00				
2016	Control group	64	46.29	2962.50	781.500	1132.500	-.450	.653
	Water + sewerage+ local roads	26	43.55	1132.50				
Index LED - Difference 2016-2007	Control group	64	43.88	2808.50	728.500	2808.500	-.921	.357
	Water + sewerage+ local roads	26	49.48	1286.50				
Index LED - Difference 2013-2007	Control group	64	44.44	2844.00	764.000	2844.000	-.605	.545
	Water + sewerage+ local roads	26	48.12	1251.00				
Index LED - Difference 2016-2013	Control group	64	43.88	2808.50	728.500	2808.500	-.921	.357

Author Contributions: "Conceptualization, A.P. and B.M.; Methodology, A.P. and B.N..; Software, SPSS 20 and Microsoft Excel A.P.; Validation, A.P. and B.M..; Formal Analysis, A.P.; Investigation, A.P.; Resources, A.P., B.M., B.N., C.H.; Data Curation, A.P. and C.H.; Writing-Original Draft Preparation, A.P. and B.N.; Writing-Review & Editing, B.N. and C.H..; Visualization, C.H.; Supervision, B.N.".

Funding: "The study was funded by the Romanian Executive Unit for Financing Higher Education, Research, Development and Innovation (UEFISCDI) through the project Dezvoltarea cercetării de frontieră în teoriile creșterii și dezvoltării regionale prin prisma rezilienței: către o Uniune Europeană convergentă, echilibrată și sustenabilă (project code PN-III-P4-ID-PCCF-2016-0166) implemented by Alexandru Ioan-Cuza University of Iași".

Acknowledgments: A part of this research (referring to partial data collection and methodology - LED INDEX) was conducted during the PhD studies of Alexandru Pavel and was included in his unpublished doctoral thesis (Public investments in basic infrastructure and local economic development in the communes from the North-Western Region of Romania from 2002 to 2014, Babes Bolyai University, Romania).

Conflicts of Interest: "The authors declare no conflict of interest." "The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results".

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