

PAPER • OPEN ACCESS

## How to Support Better Decision Making for Sustainable Development?

To cite this article: Jakub Chruscinski *et al* 2019 *IOP Conf. Ser.: Mater. Sci. Eng.* **471** 112008

View the [article online](#) for updates and enhancements.

# How to Support Better Decision Making for Sustainable Development?

Jakub Chruscinski <sup>1</sup>, Jan K. Kazak <sup>1</sup>, Katarzyna Tokarczyk-Dorociak <sup>2</sup>, Szymon Szewranski <sup>1</sup>, Malgorzata Swiader <sup>1</sup>

<sup>1</sup> Wroclaw University of Environmental and Life Sciences, Department of Spatial Economy, Grunwaldzka 55, Wroclaw, Poland

<sup>2</sup> Wroclaw University of Environmental and Life Sciences, Institute of Landscape Architecture, Grunwaldzka 55, Wroclaw, Poland

jan.kazak@upwr.edu.pl

**Abstract.** Sustainable development paradigm refers to three basic pillars (social, environmental and economic) which strongly interact between themselves. Therefore, solving some problems needs actions in different fields, as well as solving one problem may influence different aspects of life. One of the multidimensional elements of global system is the unemployment issue and actions which are undertaken to reduce inequalities in that field. However, the open questions are: how effective those actions are?, which elements current mechanisms need an improvement? and which methods can help to overcome current problems and suggest better decision making in the future? The aim of the research is to determine whether EU funds for employment incentive actions were concentrated in those places where the unemployment rate was the highest and whether social inequalities were reduced. The case study was the evaluation of over 6000 employment incentive projects carried out in 2008-2015 in biggest EU Member State in the Central Europe – Poland. The study was carried out for NUTS-4 units. In order to assess the concentration of geospatial variables the hot spot analysis was used. The results show that the support was not concentrated in those part of the country where the unemployment rate was the highest. There is still a place to improve the implementation of national policies to obtain more satisfying effects in social inequalities mitigation. The proposed method of hot spot mapping is suggested by authors as an element of decision support system, which may have a positive impact on effectiveness of institutional actions to reach sustainable development goals.

## 1. Introduction

The paradigm of sustainable development has been evolving since 1992, when Agenda 21 was adopted at Earth Summit in Rio de Janeiro. Complex action plan addressed to 21<sup>st</sup> century was designed to be implemented as local, national as well as global level. The document set numerous challenges and goals to be achieved on the way to sustainable future of the next generations, in the fields of resource management and conservation, health promotion, social groups strengthening and inclusion, science and technology, political and financial framework [1]. In September 2000 the Millennium Development Goals (MDGs) were declared. The new anti-poverty targets for the next 15 years included: poverty and hunger eradication; primary education achievement; gender equality promotion; child mortality reduction; maternal health improvement; HIV/AIDS combat; environmental sustainability and global cooperation [2]. On 25 September 2015 more than 150 countries agreed new 17 ambitious Sustainable Development Goals, also known as the Global Goals. The 2030 Agenda for Sustainable Development



replaces Agenda 21 and MDGs and includes the set of goals to: end inequality, hunger and poverty, take action on climate change and the environment degradation, promote health and improve education, build strong institutions and partnerships up to 2030. One of the goals of sustainable development defined in New Agenda is to reduce social inequalities within and between countries (10th goal). The challenge is to achieve income growth of the bottom of 40% of the population at rate higher than the national mean value. The next target is elimination of discriminatory laws, policies and practices and from another hand promotion of the social, economic and political inclusion of all, irrespective any status and circumstances. Safe and responsible mobility of people, including well-managed migration policies is one of crucial issues within 10<sup>th</sup> goal. Among the others there are: adoption of fiscal, wage and social protection policies, regulation and monitoring of financial flows, markets and institutions [3].

First theories of social inequality appeared between 19th and 20th century [4] and until this time they were changed according to changing social conditions [5]. At the beginning, social inequalities were defined based on economic aspect [6]. Nowadays, the concept of class and process of inequality formation according to economic resources is invalid [7]. The approach of social inequality based on economic resources has been extended by other variables as: social, political and cultural resources [8]. These circumstances are connected with changing lifestyle, which determine the social position - the consumption [9]. Therefore, on one hand there are people who satisfy all their excessive needs and on the other - there are people, who cannot supply their basic needs [10]. Therefore, "social inequalities refer to differences between groups of people that are hierarchical in nature" [4]. This phenomenon is a significant aspect for rethinking of future development, policy of given area [11], which has an influence on how its society is functioning [12]. Social inequality could have an impact on spatial development [13], the same as spatial development could have influence on social inequalities [14-15] and other negative phenomena as gentrification, poverty, social marginalization [16], socio-spatial segregation [17] or exclusion [18-19]. These aspects led to socio-spatial inequalities [20], which appeared in given area and could be a result of many factors [21]. There are different fields of possible social inequalities, e.g. level of salaries [22-23], accessible public services [24], quality of infrastructure [25] or unemployment [26]. All of them may have an impact on the quality of life which varies between cities [27], urban and rural areas [28] or any other spatial pattern due to geographical conditions or historical issues, and the differences of quality of life can be measured in different ways [29].

As Berg [30] mentioned the idea that the inequality is a matter of political choice and institutional design, she concluded that in order to support the objective successfully, countries must institute a wide range of policies. The poverty reduction, as the final outcome of policies and strategies, is strongly connected with better targeted public services [31] and the role of governmental support in that sphere is especially important while struggling with economic crises [32] as it is proved that employment incentive programs contribute to job creation [33]. There are different institutional tools that can be used to overcome social inequalities. In the last decade in case of Poland such an important tool are operational programmes supported by the EU funds [34]. The EU funds support the implementation of regional and cohesion policy financially. The Regional Policy is oriented towards increasing economic and social cohesion in the European Union, which means that its primary task is to provide financial assistance to the regions. The Cohesion Policy aims to increase growth and employment in all regions and cities of the European Union. It is mainly implemented through two Structural Funds, i.e. the European Regional Development Fund (ERDF), the European Social Fund (ESF) and the Cohesion Fund (CF). The increase of employment and the increase of the share of people who are active at the labour market is one of the main objectives of the EU. The Amsterdam Treaty (1997) introduced the provisions of employment support into other EU treaties [35] and constitutes the legal basis of the European Employment Strategy [36]. Within the European Employment Strategy, the EU Member States committed themselves to establishing a number of common employment policies. Its main goal is to create better and more jobs across the EU. It is now part of the EUROPE 2020 strategy. The basic tool for minimising unemployment is the financing of employment activities by the ESF. The ESF supports the promotion of active labour market policies to counteract and prevent unemployment, tackle social exclusion, including improving the staff of the economy and developing entrepreneurship.

Projects supported under the ESF will contribute to shaping a modern model of employment policy, which is based on activation measures and human resources development, on the one hand, and on the other hand to support entrepreneurship and the development of economic initiatives. The impact of activation policies on social citizenship in Western European societies was the topic of academic analyses [37; 33]. The open question is, how the activation policies influence labour markets and the inequalities mitigation in the new Member States of European Union.

The case of social inequalities taken into account in the current research is the unemployment. The institutional support to reduce the rate of unemployment are the EU funds from EFS in last EU budget perspective 2007-2013. Due to so called “n+2” mechanism the end of the institutional support from that source was in the end of 2015. The aim of the study is to determine whether the EU funds for social activation on a labour market were concentrated in those parts of Poland where the unemployment rate was the highest and whether the social inequalities were effectively reduced after the institutional support was finished.

## 2. Method and Data

In order to evaluate the concentration of unemployment level and areas which were supported in the field of labour market activation, one of the geostatistical methods was used - hot spot analysis. It is used to search for spatial geographical relationships between individual objects. It is based on the phenomenon of spatial autocorrelation between spatial objects with specific attributes. In the spatial autocorrelation study, it is assumed that the altitudes of geographically close objects are more similar to those of the distant ones.

The procedure calculates a set of weighted features which include information on significant hot and cold spots. Statistical significance of given results was elaborated and assessed with use of Getis-Ord  $G_i^*$  statistic [38-39].

$$G_i^* = \frac{\sum_{j=1}^n w_{ij} x_j - \bar{X} \sum_{j=1}^n w_{ij}}{S \sqrt{\frac{n \sum_{j=1}^n w_{ij}^2 - (\sum_{j=1}^n w_{ij})^2}{n-1}}} \quad (1)$$

, where:

- $x_j$  – attribute value for feature  $j$
- $w_{ij}$  – spatial weight between feature  $i$  and  $j$
- $n$  – number of features and

$$\bar{X} = \frac{\sum_{j=1}^n x_j}{n} \quad (2)$$

$$S = \sqrt{\frac{\sum_{j=1}^n x_j^2}{n} - (\bar{X})^2} \quad (3)$$

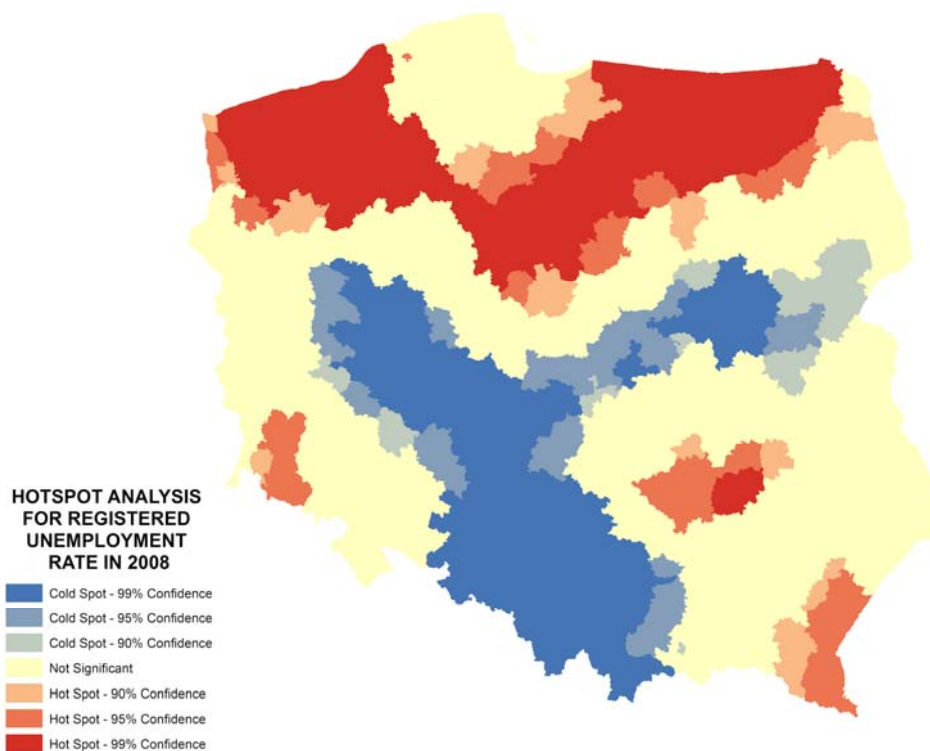
The spatial clustering is evaluated based on z-scores and p-values [40]. The p-value is a probability, that the observed spatial pattern is random - in pattern analysis we assumed null hypothesis of complete spatial randomness of observed events. Z-scores are standard deviations. Both statistic are associated with the standard normal distribution. In hot spot analysis z-score returned for each feature in the dataset is  $G_i^*$  statistic. The larger positive the z-score means more intense clustering of high values (hot spot), while the smaller and negative the z-score indicates more intense clustering of low values (cold spot).

As a result of the hot spot analysis, there are compact areas described by similar features in the form of clusters. This applies both to high concentration areas of the analysed feature (hot spot) and low value (cold spot). The results were obtained in three groups with defined confidence levels (0.99, 0.95, 0.90) for both hot spots and cold spots.

The analysis was conducted for Poland divided according to the European NUTS-4 classification, which contains 380 administrative units. The source of data on registered unemployment was the Central Statistical Office. The information on EU funds for social activation on a labour market was obtained from the Ministry of Family, Labour and Social Policy. This volume covered over 6000 projects carried out in 2008-2015. These projects were financed under the European Social Fund from the Human Capital Operational Program within the framework of the following actions: *1.3 National Integration and Activation Program* and *6.1 Improving Access to Employment and Supporting Professional Activity*. All analyses were performed in ArcGIS (version 10.3.1).

### 3. Results

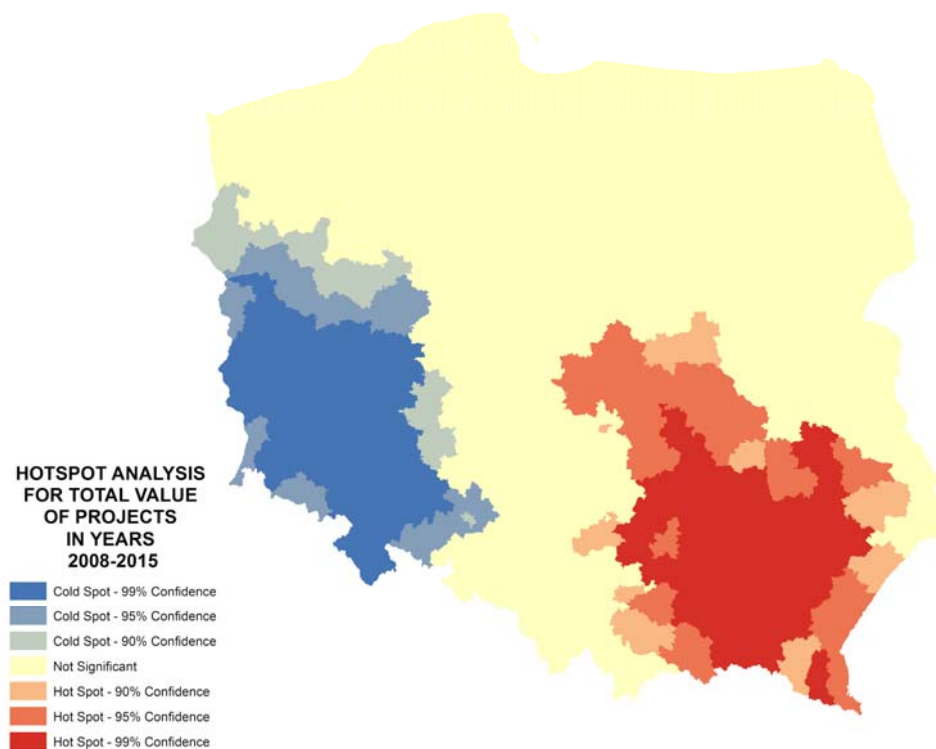
The first hot spot analysis was prepared for registered unemployment rate for NUTS-4 units for 2008, when the first contracts for EU funds implementation were signed (Figure 1).



**Figure 1.** Hot spot analysis for registered unemployment rate in NUTS-4 units in 2008

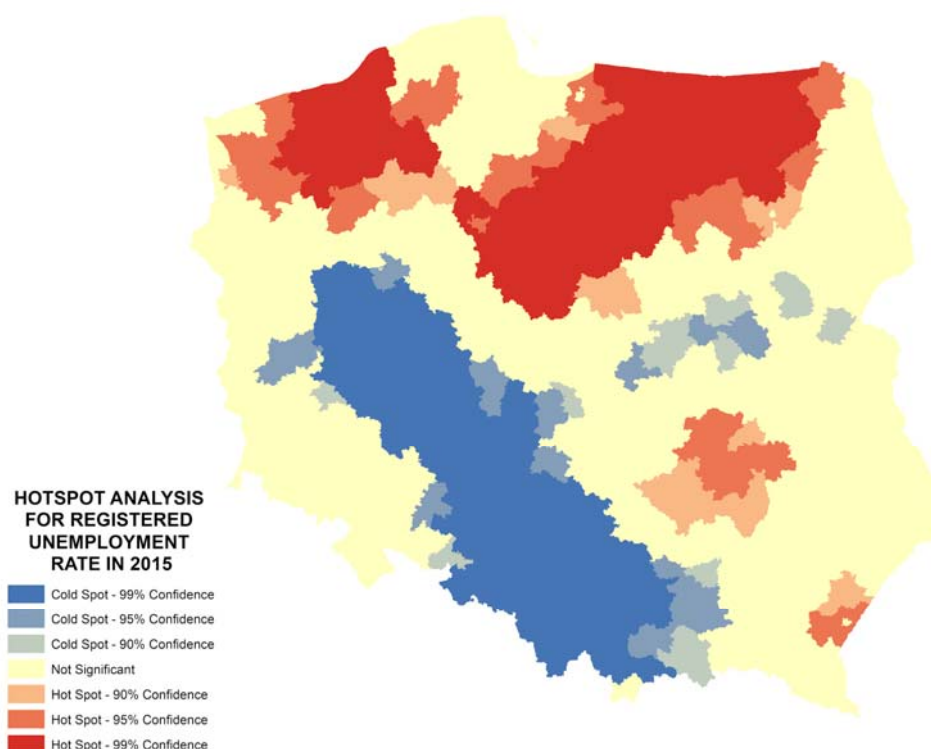
The hot spot analysis shows that the highest concentration of unemployment rate is in the North-East and North-West part of Poland. In three other parts of Poland smaller areas also represent high confidence of concentration of high unemployment rate. However in those cases the areas include up to ten units, which means that unemployment rate does not spread so widely as in the northern part of the country. There is also one cold spot in Y-shape in the middle and southern part of Poland. This presents high concentration of NUTS-4 units with relatively low level of unemployment rate.

The second hot spot analysis was prepared for total values of EU funds for social activation on a labour market in 2008-2015 (Figure 2). The analysis shows one hot spot in south-eastern part of Poland (high concentration of high total values of the EU funds for social activation) and one cold spot in south-western part of Poland (high concentration of low total values of the EU funds for social activation).



**Figure 2.** Hot spot analysis for total values of projects in NUTS-4 units in 2008-2015

The third hot spot analysis was prepared for registered unemployment rate for NUTS-4 units for 2015, when the last contracts for EU funds implementation were signed (Figure 3). The results for 2015 have some similarities comparing to hot spot analysis for registered unemployment rate in 2008. Still the highest concentration of unemployment is in the northern part of Poland, however, northern-eastern part spread to surrounding units while northern-western reduced its' size. Moreover, in 2015 there are only two additional smaller hot spots, and in most cases they reduced their size as well as the level of confidence. According to cold spots, the concentration of units with relatively low unemployment rate has no longer Y-shape. The right arm of previous Y-shape patch noticeably reduced. That area covers the capital of Poland (Warsaw) and the surrounding areas. The rest of the cold spot is similar to the first analysis.



**Figure 3.** Hot spot analysis for registered unemployment rate in NUTS-4 units in 2015

#### 4. Conclusions

The main research questions of the study were to determine (1) whether the EU funds for social activation on a labour market were concentrated in those parts of Poland where the unemployment rate was the highest and (2) whether the social inequalities were effectively reduced after the institutional support was finished. Due to hot spot analysis it is possible to say that the institutional support by EU funds on for social activation on a labour market was not concentrated in those part of the country where the unemployment rate was the highest. It looks rational to concentrate future support in the northern part of Poland. However, most of the funds were concentrated in the northern-eastern regions, which overlap with two smaller unemployment hot spots. The EU funds might be not the only factor influencing overcoming unemployment problems, but in 2015 those hot spots changed (one noticeably reduced the size and both reduced strength of the unemployment issue). One hot spot in south-western part of the country disappeared even if in that area we registered the concentration of low total values of social activation projects. The social inequalities were not reduced significantly, however, some unemployment hot spots were reduced.

The current research focuses on two actions supported by European Social Fund. Obviously, there may be also other employment incentive programs or other factors, which have an impact on the situation on the labour market. One of additional drivers could be for instance global economic crisis. It is possible that without support from European Social Fund, the social inequalities could rise in analysed period due to unstable economic situation of private enterprises and institutional support was necessary to keep the situation stable in that period. Nevertheless, it seems rational to analyse in the future the concentration of negative phenomenon that we want to reduce and to concentrate the available sources in that area.

Statistical analysis focusing on search for correlations between socioeconomic variables including financial support from EU funds is a direction of current research [41] which is helpful in decision making process. The results of the analysis might be useful for sustainable management process with the use of decision support systems which gives helpful technological tools for decision making processes [42-44]. The use of classification methods can allow to identify regions with homogeneous specification [45] and suggest decision-makers where exactly which kind of actions seems to be the most needed. Holistic assessment of institutional activity at the economy is especially important when there is a need to coordinate achieving one goal while the tasks are realized by regional or local public bodies. There is a need for integration of those actions in order to overcome social inequalities at the higher level. The first hot spot analysis was prepared for registered unemployment rate for NUTS-4 units for 2008, when the first contracts for EU funds implementation were signed (Figure 1).

## References

- [1] UN "Report of the United Nations Conference on Environment and Development", Rio de Janeiro, 3-14 June 1992, A/CONF.151/26, Vol. I, 1992.
- [2] UN "United Nation Millennium Declaration, Resolution adopted by the General Assembly" A/RES/55/2, 2000.
- [3] UN "Transforming our world: the 2030 Agenda for Sustainable Development. Resolution adopted by the General Assembly on 25 September 2015", A/RES/70/1, 2015.
- [4] D. Habibis, Daphne and M. Walter, "Social inequality in Australia : discourses, realities and futures" (Second edition). South Melbourne: Victoria Oxford University Press, pp. 2-14, 2015.
- [5] Y. D. Wei "Spatiality of regional inequality" *Applied Geography*, 61, pp.: 1-10, 2015.
- [6] G. Guidetti and B. Rehbein "Theoretical approaches to inequality in economics and sociology: A preliminary assessment" *Transcience* 5, 1 pp: 1-15, 2014.
- [7] S. J. Baek "Is rising income inequality far from inevitable during structural transformation? A proposal for an augmented inequality dynamics" *Journal of Economics and Political Economy*, 4, 3 pp: 224-237, 2017.
- [8] B. Nolan and C. T. Whelan "Using non-monetary deprivation indicators to analyze poverty and social exclusion: Lessons" *Journal of Policy Analysis and Management*, 29, pp.: 305-325, 2010.
- [9] G. Bodea and E. Herman "A World of Poverty?" *Procedia Economics and Finance*, 15 pp.: 643-653, 2014.
- [10] R. Wilkinson and K. Pickett "The spirit level" Warsaw: Czarna Owca, Iss.. I pp.: 19-26. ISBN 978-83-7554-334-6, 2011.(in Polish)
- [11] A. G. Abdulai "Rethinking spatial inequality in development: the primacy of power relations" *Journal of International Development*, 29, pp.: 386-403, 2017.
- [12] M. van Lidth de Jeude, O. Schüttea and F. Quesada "The vicious circle of social segregation and spatial fragmentation in Costa Rica's greater metropolitan area" *Habitat International* 54 pp.: 65-73, 2016.
- [13] C. Lessmann "Spatial inequality and development — Is there an inverted-U relationship?" *Journal of Development Economics*, 106, pp.: 35-51, 2014.
- [14] L. Sykora "Processes of Socio-spatial Differentiation in Post-Communist" *Housing Studies* 14, 5, pp.: 679-701, 1999.
- [15] C. Hermant-de Callatay and C. Svanfeldt "Cities of tomorrow. Challenges, visions, ways forward" Brussels: European Commission, Directorate General for Regional Policy, pp.: 4-26, 2011. ISBN: 978-92-79-21307-6, [on-line] [available 26.10.2017] [http://ec.europa.eu/regional\\_policy/sources/docgener/studies/pdf/citiesoftomorrow/citiesoftomorrow\\_final.pdf](http://ec.europa.eu/regional_policy/sources/docgener/studies/pdf/citiesoftomorrow/citiesoftomorrow_final.pdf)
- [16] M. Świąder, S. Szewrański and J. Kazak "The local development index as a tool for the evaluation of socio-spatial inequities" [in:] Pavel Jedlička (ed.) Hradec Economic Days t.3, Hradec: University of Hradec Králové, pp. 197-208. ISBN 978-80-7435-635-3, 2016.



- [17] G. F. de Cordova, A. M. Fernandez-Maldonado and J. M. del Pozo “Recent changes in the patterns of socio-spatial segregation in Metropolitan Lima” *Habitat International*, 54, pp.: 28-39, 2016.
- [18] P. Smets and T. Salman “The multi-layered-ness of urban segregation: On the simultaneous inclusion and exclusion in Latin American cities” *Habitat International* 54, 1, pp.: 80-87, 2016.
- [19] A. Frenkel E. and Israel “Spatial inequality in the context of city-suburb cleavages—Enlarging the framework of well-being and social inequality” *Landscape and Urban Planning* (in press).
- [20] K. Lymperopoulou and N. Finney “Socio-spatial factors associated with ethnic inequalities in districts of England and Wales, 2001–2011” *Urban Studies* 54(11), pp. : 2540–2560, 2017.
- [21] S. Marcińczak, S. Musterd, M. van Ham and T. Tammaru “Inequality and rising levels of socio-economic segregation. Lessons from a pan-European comparative study” [in:] Tammaru, T., Marcińczak, S., van Ham M. and Musterd S. (eds.) “Socio-Economic Segregation in European Capital Cities. East meets West. Routledge” London and New York: Taylor & Francis Group pp.: 358-382. ISBN: 9781315758879 (ebk), 2016.
- [22] I. Foryś “Gentrification on the Example of Suburban Parts of the Szczecin Urban Agglomeration” *Real Estate Management and Valuation* 21, 3 pp.: 5-14, 2013.
- [23] M. Świąder, S. Szewrański and J. Kazak “Spatial-Temporal Diversification of Poverty in Wrocław” *Procedia Engineering* 161, pp.: 1596-1600, 2016.
- [24] J. Kazak, M. Chalfen, J. Kamińska, S. Szewrański and M. Świąder “Geo-Dynamic Decision Support System for Urban Traffic Management” *Lecture Notes in Geoinformation and Cartography, Dynamics in GIScience* pp.: 195-207, 2018.
- [25] S. Chatterjee and S. J. Turnovsky “Infrastructure and inequality” *European Economic Review* 56, 8 pp.: 1730-1745, 2012.
- [26] J. Pi and X. Chen “The impacts of capital market distortion on wage inequality, urban unemployment, and welfare in developing countries” *International Review of Economics & Finance* 42, pp.: 103-115, 2016.
- [27] K. Przybyła, A. Kulczyk-Dynowska, M. Kachniarz “Quality of life in the regional capitals of Poland” *Journal of Economic Issues* 48, 1 pp.: 181-196, 2014.
- [28] P. Y. S. Sampaio, E. Ito and R.A.C. Sampaio “The association of activity and participation with quality of life between Japanese older adults living in rural and urban areas” *Journal of Clinical Gerontology and Geriatrics*, 4, 2 pp.: 51-56, 2013.
- [29] A. Kaklauskas, E.K. Zavadskas, A. Radzeviciene, I. Ubarte, A. Podvezko, V. Podvezko, A. Kuzminske, A. Banaitis, A. Binkyte and V. Bucinskas “Quality of city life multiple criteria analysis” *Cities* 72, Part A pp.: 82-93, 2018.
- [30] J. Berg “Income support for the unemployed and the poor” [in:] Berg, Janine (ed.) *Labour Markets, Institutions and Inequality*, Edward Elgar Publishing pp.: 263-289, 2015.
- [31] E. Berkhout, J. Bouma, N. Terzidis and M. Voors “Supporting local institutions for inclusive green growth: Developing an Evidence Gap Map” *NJAS - Wageningen Journal of Life Sciences* (2017): [in press]
- [32] A. Spithoven “The Role of Governments in Aligning Functional Income Distribution with Full Employment” *Journal of Economic Issues*, 51, 3 pp.: 688-697, 2017.
- [33] C. Román, A. Millán, J.M. Millán and A. van Stel “Does the Effectiveness of Employment Incentive Programs Vary by Firm Size?” *Journal of Economic Issues* 51, 1 pp.: 222-237, 2017.
- [34] M. Furmankiewicz, K. Janc and Á. Macken-Walsh “The impact of EU governance and rural development policy on the development of the third sector in rural Poland: A nation-wide analysis” *Journal of Rural Studies*, vol. 43, pp. 225-234, 2016
- [35] Treaty of Amsterdam amending the Treaty on European Union, the Treaties establishing the European Communities and certain related acts - Minutes of the signing of the Treaty of Amsterdam amending the Treaty on European Union, the Treaties establishing the European Communities and certain related acts, (97/C 340/04).

- [36] European Commission, European Employment Strategy: investing in people: investing in more and better jobs. European Commission. Directorate-General for Employment, Industrial Relations, and Social Affairs, Office for Official Publications of the European Communities pp.: 1-20, 2009.
- [37] S. Bothfeld and S. Betzelt “Activation and Labour Market Reforms in Europe: Challenges to Social Citizenship — Introduction” [in:] Betzelt, Sigrid and Bothfeld Silke (eds) “Activation and Labour Market Reforms in Europe. Work and Welfare in Europe” London:Palgrave Macmillan pp.: 3-14, 2011.
- [38] A. Getis and J.K. Ord “The Analysis of Spatial Association by Use of Distance Statistics” *Geographical Analysis* 24(3) pp.: 189-206, 1992.
- [39] J.K. Ord and A. Getis, Arthur “Local Spatial Autocorrelation Statistics: Distributional Issues and an Application” *Geographical Analysis* 27(4) pp.: 286-306, 1995.
- [40] A. Mitchell “The ESRI Guide to GIS Analysis, Volume 2” ESRI Press, 2005.
- [41] J. Hernik, A. Rutkowska and T. Noszczyk “Correlation between selected socioeconomic variables and the number of renewable energy sources in Świętokrzyskie voivodeship” 15th International Scientific Conference: Engineering For Rural Development, Book Series: Engineering for Rural Development pp.: 498-504, 2016.
- [42] M. Skiba, M. Mrówczyńska and A. Bazan-Krzywoszańska “Modeling the economic dependence between town development policy and increasing energy effectiveness with neural networks. Case study: The town of Zielona Góra” *Applied Energy* 188 pp.: 356-366, 2017.
- [43] J. Kazak, J. van Hoof and S. Szewranski “Challenges in the wind turbines location process in Central Europe – The use of spatial decision support systems” *Renewable and Sustainable Energy Reviews* 76 pp.: 425-433, 2017.
- [44] M. Płuciennik, M. Heldak, J. Szczepański and C. Patrzalek “Application of Spatial Models in Making Location Decisions of Wind Power Plant in Poland” *IOP Conf. Series: Materials Science and Engineering* 245: 072016, 2017.
- [45] I. Foryś and E. Putek-Szeląg “Methods of linear ordering in estimation of potential of Polish market of agricultural property” *Actual Problems of Economics* 151, 1 pp.: 542-550, 2014.