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Regionalization Measurement Methods' Comparative Analysis

Regionalization denotes certain sub-systems, which appear to be present in the apparently globalized world. The research aim is to compare regionalization measurement methods, used in prior research. Results reveal that the most common gravity equations method could be improved by adding weighted network measures in order to capture the complexity of the researched phenomena.

Keywords: regionalization, measurement methods, comparative analysis.

Regionalizacija apibūdina kompleksiškas subsistemas, kurios susidaro globaliame pasaulyje. Tyrimo tikslas yra palyginti regionalizacijos matavimo metodus, taikytus ankstesniuose tyrimuose. Rezultatai rodo, kad dažniausiai naudojamas gravitacinių lygčių metodas galėtų būti papildytas tinkliniais rodikliais, atskleidžiant tiriamo reiškinio kompleksiškumą.

Raktiniai žodžiai: regionalizacija, matavimo metodikos, lyginamoji analizė.

Introduction

Regionalization is not a recent phenomenon. Since the beginning of human history, geographical proximity has been a primary condition for intersocietal exchange, because distance acted as a barrier to trade (Kim & Shin, 2002), thus, leading to regionalization. The concept of regionalization has developed together with the concept of globalization and denoted certain complex subsystems, which appeared to be present in an apparently globalized world (De Lombaerde et al., 2019). The regionalization concept initially included the persistence of regional subsystems, hierarchies in the global systems. This concept reflected the main factors influencing regionalization at that time, i.e., regional trade agreements, regional custom unions and free trade areas. At the later stages together with the development of the complex concept of globalization, regionalization was described as the processes of spatial ordering (Soma et al., 2016) and the flow of information within a region and, hence, increased connectedness at a regional level (Kim & Shin,

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2002). Therefore, regionalization is currently understood as a complex, multidimensional phenomenon, which requires a complex research method.

Phenomena of regionalization in previous literature is defined differently and methods used to measure regionalization also vary (Lambert et al., 2015; Kim & Shin, 2002; Iapadre & Tajoli, 2014; Nelson & Zolnik, 2013) and include structural and correlation analysis, network analysis, regional indexes and gravity equation methods. However, it is noted that each method tends to focus on a certain aspect of regionalization but may not be able to properly address regionalization as a complex, multidimensional phenomenon. A situation when different methods on a stand-alone basis appear to be not able to address the complexity of the regionalization phenomena, urges to compare different regionalization measurement methods and discuss their similarities and differences to determine, how they could be improved in order to address regionalization as a complex, multidimensional phenomenon.

Research problem: how do regionalization measurement methods used in prior research capture the complexity of the researched phenomena?

Research object: regionalization measurement methods.

The aim: after comparison of various regionalization measurement methods, to identify their similarities, differences, and limitations in capturing the complexity of the research phenomena.

The objectives of the article are formulated as follows:

1. To analyse and synthesize a theoretical approach to the regionalization phenomenon and its measurement.
2. To develop a methodology for comparative analysis of regionalization measurement methods applied in previous research.
3. To assess regionalization measurement methods and disclose their similarities, differences and limitations in capturing the complexity of the research phenomena.
4. To discuss the comparison results and to provide insights how to capture more complexity of regionalization phenomena.

The research methods applied in this paper are: synthesis, evaluation and comparative analysis. Synthesis, evaluation and comparative analysis were applied to review, analyse and compare various regionalization measurement methods, their similarities, differences and limitations.

Regionalization and its measurement methods' review

Regionalization is not a recent phenomenon. Since the beginning of human history, geographical proximity has been a primary condition for intersocietal exchange, because distance acted as a barrier to trade (Kim & Shin, 2002), thus, leading to the regionalization. The **concept of regionalization** has developed together with the concept of globalization and denoted certain sub-systems, which appeared to be present in the apparently globalized world. Regionalization formation could be distinguished into two types, i.e., the policy caused and market based. As described by B. Lévy (1995), *r*egionalization refers to the political formation of an economic grouping or

Table 1. **Types of regionalization measurement methods**

Structural analysis	Network analysis	Regional indexes	Gravity equations
• structural / correlation analysis	• intraregional and interregional network density • regional network indicators (e.g., clustering, centrality, etc.)	• revealed trade preference (RTP) index • intra-regional RTP • intra-regional relative geographic diversification index (IRGDI)	• gravity equations with regional or continent dummy • gravity equations using regional flows • intraregional and interregional gravity models • geographically weighted gravity equation

Note: compiled by the authors based on Claessens & Van Horen (2015), Kim & Shin (2002), Iapadre & Tajoli (2014), Lambert et al. (2015), Iapadre & Tironi (2008), Levis, Muradoğlu & Vasileva (2016), Brodzicki & Uminski (2018), Nelson & Zolnik (2013), Ko, Matsuzaki & Yoo (2020).

regional bloc that aims to strengthen its member countries by lowering the intraregional barriers to economic activity implying regionalization created by certain policy decisions. Regionalization analysis based on bilateral flows and interconnectedness within certain regional or global markets implies that regionalization could be described as increased connectedness at a regional level (Kim & Shin, 2002). In this research, market-based regionalization measurement methods, which take into account certain market dimensions of regionalization, are chosen for analysis.

Methods to measure regionalization could be understood as various methods used to identify preference of one country or region over the other while making asset or goods trade decisions in the market. Methods in previous literature vary and could be grouped into structural and correlation, network analysis, regional indexes and gravity equations to measure regionalization (see Table 1). The most commonly used methods in previous literature on regionalization are gravity equations and regional indexes, then network analysis and the least common method appears structural analysis. The main common feature of all regionalization measurement methods is that they all analyse the bilateral relationship between two participants (e.g., countries) and tend to identify the preference of one country or region over the other.

The structural analysis includes certain asset distribution measurement calculations such as cross border assets as a share of total assets, assets held within the same region as a share of total assets (Lambert et al., 2015). Correlation analysis involves the bilateral correlation between two, e.g., banks' stock returns after removing the effect of strong common factors (for instance, a shock to the whole banking industry) clusterization level within certain regions (Lambert et al., 2015).

Network analysis includes intraregional and interregional network density and regional network indicators. Formally, the density of a network is

calculated using the following formula (Martinez-Jaramillo et al., 2014):

$$d = \frac{\sum_{i=1}^{N}\sum_{j=1}^{N} x_{ij}}{N(N-1)} \qquad (1),$$

where N is the number of nodes and d ∈ [0, 1]. Intraregional density is calculated as a simple density (see formula 1), but of a network, which consists only of a certain region's countries' cross-border claim flows. Interregional density is also calculated as a simple density (see formula 1), but of a network, which consists only of between regions' cross-border claim flows. Clustering coefficient is a measure of the density of the connections around a node and is defined as (Martinez-Jaramillo et al., 2014):

$$c_j = \frac{2}{d_j(d_j-1)}\sum_{i,h} x_{ij}x_{ih}\,x_{jh} \qquad (2).$$

The clustering coefficient indicates if two nodes, which have a connection with a third node, have a connection between them, i.e., it indicates if they form a triad (Martinez-Jaramillo et al., 2014).

Regional indexes mostly focus on revealed trade preference (RTP) index or relative geographic diversification index (IRGDI). RTP calculation starts with 'homogeneous' bilateral trade intensity index (HIij), given by the ratio between a partner country's share of the reporting country's total trade (Sij) and its weight in total trade of the rest of the world (Vij) (Iapadre & Tajoli, 2014):

$$HI_{ij} = \frac{S_{ij}}{V_{ij}} = \frac{(T_{ij}/T_{iw})}{(T_{oj}/T_{ow})} \qquad (3),$$

where T_{ij} – trade (exports plus imports) between reporting country i and partner country j; T_{iw} – trade between reporting country i and the world; T_{oj} – trade between the rest of the world (excluding country i) and country j; T_{ow} – trade between the rest of the world and the world. Then, index HE_{ij}, which measures the intensity of trade relations between country i and all the other countries except country j, is calculated (Iapadre & Tironi, 2008):

$$HE_{ij} = \frac{(1-S_{ij})}{(1-V_{ij})} \qquad (4),$$

The ratio between HI_{ij} and HE_{ij} is used as an indicator of relative bilateral trade intensity and, hence, a bilinear transformation for bilateral revealed trade preference index (RTP_{ij}) is the following (Iapadre & Tajoli, 2014):

$$RTP_{ij} = (HI_{ij} - HE_{ij})/(HI_{ij} + HE_{ij}) \qquad (5),$$

RTP index can be used to map the intensity of trade within a region r. For each of its member countries, intra-regional revealed trade preferences can be computed by applying the formulas to the country's trade with the rest of the region, treated as a single partner. Finger-Kreinin index of similarity is also known as intra-regional relative geographic diversification index (IRGDIi) (Iapadre & Tironi, 2008):

$$IRGDI_i = 1 - \sum_{j\neq i} \frac{|IS_{ij} - IV_{IJ}|}{2} \qquad (6),$$

where IV_{ij} denotes each possible regional partner's share of the region's total extra-regional trade, net of country i's extra-regional trade. This index ranges from 0, when country i's intra-regional

trade is concentrated with partners having no extra-regional trade, to 1, when it is neutrally distributed across all its possible regional partners.

Gravity equations were originally developed for international trade by Tinbergen (1962) based on Newton's law of universal gravitation. The idea behind gravity in economics is that bilateral trade or asset flows between two countries i and j are directly proportional to the product of country masses (e.g., their GDP, GNP or population) and inversely proportional to their geographic distance (Fagiolo, 2010), Gravity equation applied for the simplified econometric model could have the expression as follows (adapted from Portes & Rey, 2005):

$$\log(T_{ij,t}) = \alpha_1 \log(mktcap_{i,t}) + \alpha_2 \log(mktcap_{j,t}) + \alpha_3 \log(distance_{ij}) + \alpha_4 \text{information variables} + \alpha_5 \text{transaction technology variables} + regional\ or\ continent\ dummies + time\ dummies + constant + \varepsilon_{ij,t} \quad (7)$$

where $mktcap_{i,t}$ represents equity market capitalizations of country i and $distance_{ij}$ represents the distance between country i and j. This way gravity equation can be applied for the estimation of the distance between countries' impact on asset trade between the two countries. Regional or continent variables could be added to enhance the econometric model and measure differences between regions. Other research constructed gravity equations using regional rather than country level flows (Brodzicki & Uminski, 2018), intraregional and interregional gravity equations to receive certain region parameter estimates (Nelson & Zolnik, 2013), or geographically weighted regression, which can detect how the coefficients of each independent variable are regionally dispersed (Ko, Matsuzaki & Yoo, 2020).

Previous research on regionalization reveals that regionalization denotes certain complex sub-systems, which appeared to be present in the apparently globalized world. Regionalization formation could be distinguished into two types, i.e., the policy caused and market based. Regionalization caused by policy included persistence of regional subsystems, hierarchies in the global systems formed by regional trade agreements regional custom unions and free trade areas. Market based regionalization could be described as the processes of spatial ordering and the flow of information within a region and, hence, increased connectedness at a regional level. Therefore, regionalization is understood as a complex, multidimensional market-based phenomenon, which requires a complex research method. Methods used in previous literature vary including structural and correlation analysis, network analysis, regional indexes and gravity equations methods. However, it is noted that each methodology tends to focus on a certain aspect of regionalization but may not be able to properly address regionalization as a complex, multidimensional phenomenon. In such a case, it is relevant to compare currently used regionalization methods, their similarities, differences and limitations to determine, how they could be improved in order to address regionalization as a complex, multidimensional phenomenon.

Research methodology

The analysis of regionalization measurement methods is performed using

a **comparative analysis of previous research** (*see* Figure 1). This analysis is performed via **2 stages**. Fist of all, during stage 1, regionalization measurement methods are compared according to the characteristics of the data sample used. Comparison of data sample characteristics allows to receive important insights on what type of data is analysed revealing the most researched sector on regionalization. In addition, data characteristics allows to check research reliability based on the sample size used for the analysis. During stage 2, regionalization measurement methods are compared according to regionalization measurement characteristics. Comparison according to regionalization measurement characteristics allows to receive important insights on the type of regionalization methods used in previous research, what regionalization aspects are being analysed, how much complexity does the chosen regionalization measurement method captures and what are the method's limitations.

During comparison stages, regionalization measurement methods are compared according to **8 comparison questions** formulated for data and regionalization measurement method's characteristics comparison (Table 2).

The first 4 questions are formulated for data characteristics comparison during stage 1 and include sample size, the period covered, type of data and sector, which is being analysed. Assessment criteria are formulated for each comparison question. Since sample size, the period covered, type of data may vary substantially in previous research, assessment criteria is formulated as a list. A sector of analysis will be classified according to the two most analysed sectors, i.e., financial and trade.

The next four questions formulated for regionalization measurement characteristics comparison during stage 2 include the type of method used, method's

Table 2. **Regionalization measurement methods' comparison research questions**

Stage	Methodological aspects	No.	Comparison questions	Assessment criteria
1	Data	Q1	What sample size is used?	List
		Q2	Which period is covered?	List
		Q3	What type of data is analysed?	List
		Q4	Which sector is analysed?	Financial / Trade
2	Regionalization measurement	Q5	What is the type of method used?	Structural / Network / Index / Gravity equations
		Q6	What is the level of the method's complexity?	Lower / Medium / Higher
		Q7	What regionalization aspect is analysed?	Causes / Formation
		Q8	What are methodological limitations?	List

Note: compiled by the authors.

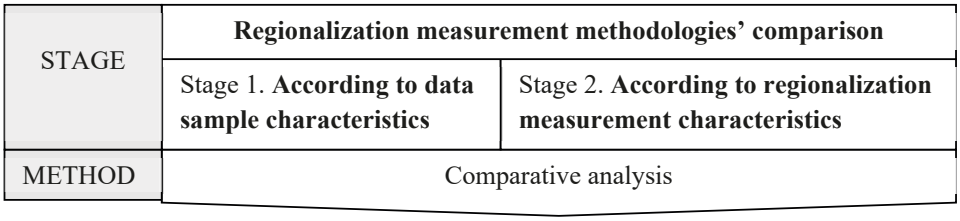

Fig. 1. **Logics of the research**

Note: compiled by the authors.

complexity, regionalization aspect analysed and method's limitations. The type of method used will be assessed according to criteria: structural, network, index and gravity equations, which appear to be the most commonly used methods for regionalization assessment and were presented in the literature review part. The level of the method's complexity assessment is relatively assigned to 3 levels, i.e., lower, medium and higher. The research method is considered of lower complexity if it includes structural or correlation analysis. The level of method's complexity is considered medium if it includes data aggregation and various indicators or indexes calculation. Higher complexity is assumed if the method includes econometric regression or spatial data analysis. Certain regionalization aspects are commonly analysed in previous literature: factors determining regionalization (i.e., its causes) and formation status of regionalization (i.e., is regionalization present or not). Therefore, 2 assessment criteria formulated are regionalization causes and fact of formation. Since the method's limitations may vary substantially in previous research based on a certain method used, assessment criteria is formulated as a list.

The research sample consists of 9 selected previous research on regionalization (Table 3).

Previous research selected for analysis focus on different aspects of regionalization including the impact of Global Financial Crisis on regionalization, emerging countries' participation in regionalization processes, home bias phenomenon, the historical formation of regions and regionalization effects on welfare.

Selected research covers the **period** 2002–2020, which is chosen to be broad in order to include many different regionalization measurement methods. The main **sources** of scientific research papers for the comparative analysis of regionalization measurement methods in previous studies are Taylor & Francis, EBSCO, JSTOR and other databases.

The research sample was restricted by the following **limitation**: only available previous research on regionalization could be included in the comparative analysis of regionalization measurement methods. The extension of the research included in the sample could enhance the results by providing more information on regionalization measurement methods.

Table 3. **Previous research on regionalization for regionalization measurement methods' comparison**

No.	Regionalization research	Title
1	Claessens & Van Horen, 2015	The impact of the global financial crisis on banking globalization
2	Lambert et al., 2015	International banking after the crisis: increasingly local and safer?
3	Kim & Shin, 2002	A longitudinal analysis of globalization and regionalization in international trade: A social network approach
4	Iapadre & Tajoli, 2014	Emerging countries and trade regionalization. A network analysis
5	Iapadre & Tironi, 2008	Measuring trade regionalization: The case of Asia
6	Levis, Muradoğlu & Vasileva, 2016	Home bias persistence in foreign direct investments
7	Brodzicki & Uminski, 2018	A gravity panel data analysis of foreign trade by regions: the role of metropolises and history.
8	Nelson & Zolnik, 2013	Regional effects of trade on income
9	Ko, Matsuzaki & Yoo, 2020	The geography of gravity

Note: compiled by the authors.

The results of regionalization measurement methods' comparative analysis

Stage 1. Regionalization measurement methods' comparison according to data sample characteristics. Previous literature on regionalization focuses mostly on trade regionalization (Table 4).

S. Claessens and N. Van Horen (2015) use share of foreign bank assets owned by banks from the same region 1995–2013 data of 138 countries. Their structural analysis reveals that global banking is not becoming more fragmented, but rather is going through some important structural transformations with a greater variety of players and a more regional focus. Lambert et al. (2015) performs structural and correlation analysis of the geographic breakdown of assets value of regions' banks of 62 countries during 1998–2007 and 2008–2014 and reveals that direct cross-border lending as a share of total banking assets declined, mostly because of retrenchment of European banks. Global banks refocused their activities on some key markets, leaving space for others to expand and, as a result, intraregional financial linkages deepened, especially in Asia (Claessens & Van Horen, 2015).

S. Kim and E. H. Shin (2002) in their research aimed to determine whether the world has been globalized and/or regionalized and what are the consequences of these processes. Using the pre-crisis data of trade volume of 105 countries in 1959, 1975 and 1996, authors construct a trade network and compute intraregional and interregional network density indicators. Findings of the research revealed that intraregional density appears to be greater than interregional density and both increased significantly between 1959 and 1996, indicating that world trade became regionalized, and that globalization and

Table 4. **Results of regionalization measurement methods' comparison by data sample characteristics**

No.	Regionalization research	Data characteristics			
		Q1. Sample size	Q2. Period	Q3. Type	Q4. Sector
1	Claessens & Van Horen, 2015	138 countries	1995–2013	Share of foreign bank assets owned by banks from same region	Finance (banking)
2	Lambert et al., 2015	62 countries	1998–2007 and 2008–2014	Cross-border lending as a share of total banking assets	Finance (banking)
3	Kim & Shin, 2002	105 countries	1959, 1975 and 1996	Trade volume	Trade
4	Iapadre & Tajoli, 2014	188 countries	1995, 2008 and 2011	Value of imports	Trade
5	Iapadre & Tironi, 2008	24 countries	1990–2005	Bilateral trade flows	Trade
6	Levis, Muradoğlu & Vasileva, 2016	34 countries	1981–2010	Bilateral FDI outflows	Finance
7	Brodzicki & Uminski, 2018	1 country	1999–2011	Bilateral partner country-Poland's NUTS region trade flows	Trade
8	Nelson & Zolnik, 2013	174 countries	1980–2005	Trade flows	Trade
9	Ko, Matsuzaki & Yoo, 2020	136 countries	1990	Bilateral export flows	Trade

Note: compiled by the authors.

regionalization are not contradictory processes.

P. L. Iapadre and L. Tironi (2008) in their research used 1990–2005 bilateral trade flows of 24 countries and calculated Revealed trade preference (RTP) index, intra-regional RTP, intra-regional relative geographic diversification index (IRGDI) and regional network indicators (clustering, centrality, etc.). Their results tend to confirm the strong increase in trade regionalization that has characterized the Asian area in the last decades. This process is particularly evident in ASEAN (Association of East Asian Nations) region, but also evolved also in SAFTA (South Asian Free Trade Area) and OESA (other East and South Asian countries) regions (Iapadre & Tironi, 2008). P. L. Iapadre and L. Tironi (2014) examined value of imports data of 1995, 2008 and 2011 in 188 countries and calculated RTP index, intra-regional RTP and network indicators (e.g., centrality). Their results revealed that the degree of trade regionalization, as measured by regional introversion indices, has fallen substantially between 1995 and 2011 in all four regions (SCM, CIS, SAFTA and ASEAN), showing that the forces driving

toward global integration have been so far stronger than the trade-diverting effects of regional integration. M. Levis, Y. G. Muradoğlu and K. Vasileva (2016) in their research used the Poisson pseudo-maximum likelihood (PPML) gravity model to study the role of physical, cultural, and institutional distances from home on FDI decisions taken by corporations. Results revealed that home bias is persistent over time even during the recent periods with higher degrees of globalization. In addition, the authors explain that physical distance from home, as well as cultural and institutional distances, plays a role in FDI decisions taken by corporations, even when controlled for known economic factors.

T. Brodzicki and S. Uminski (2018) used gravity equations using regional rather than country level flows and analyzed the determinants of bilateral partner country-Poland's NUTS region trade flows using an augmented PPML semi-mixed effects gravity model over the period 1999–2011. Their study revealed that metropolitan regions, ceteris paribus, trade more intensely, which proves their role as nodes in global trade flows.

A. J. Nelson and E. J. Zolnik (2013) aim to explore spatial variation in international trade patterns by using intraregional and interregional gravity equations for the trade data of 1980–2005. Intraregional trade considers each region separately – all other countries in all other regions are excluded while interregional trade drops all intraregional trade to consider each region separately (Nelson & Zolnik, 2013). Authors' results suggest that coefficient estimates from the intraregional and interregional gravity models of trade confirm that a regional approach better explains spatially complex trade flows and that intraregional trade is much better explained than is interregional trade. A. J. Nelson and E. J. Zolnik (2013) further highlights distance-decay effects on trade: as distance between potential trading countries and regions increases, the possible number of intervening opportunities increases.

J. H. Ko, A. Matsuzaki and D. Yoo (2020) employ geographically weighted regression (GWR), which can detect how the coefficients of each independent variable are regionally dispersed, approach to investigate the role of geography in trade gravity equation and reveals that the estimated parameters are locally clustered among selected economic masses. The impact of physical distance is different across the world, therefore, this differentiated impact of physical may be interpreted as economic distance (Ko, Matsuzaki & Yoo, 2020). Moreover, the authors conclude that the regional or continental dummy in the standard gravity model may not fully capture the geographical characteristics and that location itself impacts the sign and magnitude of coefficients.

The sample size of countries analysed in previous regionalization literature varies from 1 country to a large sample of 188 countries. It is noted that sample size depends on data availability and the regionalization aspect analysed. For instance, in case of 1 country sample, regionalization is analysed within 1 country's regions. In case of several countries in the sample, regionalization is analysed in certain world regions. The period analysed also depends on data availability and covers the earliest of 1959 until the

Table 5. **Regionalization measurement methods' comparison by regionalization measurement characteristics results**

No.	Regionalization research	Regionalization measurement characteristics			
		Q5. Methodology type	Q6. Relative level of complexity	Q7. Regionalization aspect analysed	Q8. Limitations
1	Claessens & Van Horen, 2015	Structural	Lower	Formation	Does not allow to consider interconnections among trading countries
2	Lambert et al., 2015	Structural	Lower	Formation	
3	Kim & Shin, 2002	Network	Higher	Formation	Does not allow to determine the causes certain regional trade or asset flow patterns
4	Iapadre & Tajoli, 2014	Network / Index	Higher / Medium	Formation	
5	Iapadre & Tironi, 2008	Index	Medium	Formation	Does not allow to consider interconnections among trading countries
6	Levis, Muradoğlu & Vasileva, 2016	Gravity equations	Higher	Causes	Does not allow to consider interconnections among trading countries
7	Brodzicki & Uminski, 2018	Gravity equations	Higher	Causes	
8	Nelson & Zolnik, 2013	Gravity equations	Higher	Causes	
9	Ko, Matsuzaki & Yoo, 2020	Gravity equations	Higher	Causes	

Note: compiled by the authors.

most recent 2015. On average, the timeframe usually chosen for analysis covers 10-20 years. The type of data is impacted by the sector analyzed. In case of the trade sector, bilateral export or important flows are usually chosen for analysis. In case regionalization is analysed in the finance sector, the type of data varies from a share of foreign bank assets owned by banks from the same region to bilateral FDI outflows. Therefore, it could be noted that previous regionalization literature covers mostly the trade sector and usually covers 10-20 years and Sample size and data type highly varies based on data availability and regionalization aspect analysed.

Stage 2. Regionalization measurement methods' comparison according to regionalization measurement characteristics. Methods used to measure regionalization in previous literature vary and could be grouped into structural and correlation, network analysis, regional indexes and gravity equations (Table 5).

Gravity equations method for regionalization measurement was used the most commonly in the sample analysed. The relative level of complexity of the methods used to measure regionalization is higher in most cases as gravity equations or network methodology is being used. This justifies the complexity of regionalization phenomenon and a complex, multidimensional regionalization concept, which requires a complex research methodology. However, it is noted that only in one research 2 methodologies are combined to measure regionalization, i.e., research by L. Iapadre and F. Tajoli, (2014), when network analysis and regionalization indexes were combined. In addition, the majority of previous research on regionalization focuses on the formation of regionalization and aims to identify if regionalization is present or not. There is also a strand of previous research, which aims at identifying the causes of regionalization phenomenon.

Regionalization measurement methods' comparative analysis also reveals certain limitations of regionalization measurement methods. Structural and correlation analysis reveals the amount of trade and regional indexes analysis focuses on the distribution of global trade and financial flows. However, structural and correlation and regional indexes analyses do not allow to consider interconnections among trading countries, i.e., does not allow to consider spatial network effects. Network structure analysis allows to consider spatial network effects, detect communities, compute various clustering measures and calculate intraregional and interregional network density. However, network structure analysis does not allow to determine the causes of certain regional trade or asset flow patterns. Gravity equations enable to fix this through analysis of factors, which impact international trade distribution among countries or regions.

Therefore, it could be noted that in previous regionalization literature higher complexity gravity equations method for regionalization measurement was used the most commonly. However, only in one research 2 methods are combined to measure regionalization. The majority of previous research on regionalization focuses on the formation of regionalization. However, structural, correlation, regional indexes and network analyses used for regionalization formation assessment do not allow to determine the causes of certain regional trade or asset flow patterns. Gravity equations enable to fix this through analysis of factors, which impact international trade distribution among countries or regions.

Discussion of the results and suggestions for further research

Conducted regionalization measurement methods' comparative analysis revealed that the gravity equations method for regionalization measurement was used the most commonly. Previous empirical literature on regionalization using gravity equations have traditionally and predominantly been performed at the country level. However, as argued by T. Brodzicki and S. Uminski (2018), a region can be regarded as a small, open economy, which is decentralized and highly interdependent. Even though physical distance, as well as cultural,

institutional and other distances, has been considered an important factor in international trade, spatial heterogeneity has not been fully investigated in standard gravity models (Ko, Matsuzaki & Yoo, 2020). The authors further explain that it is important to address the extent to which the gravity of a country's GDP can geographically reach and natural environments such as mountains, deserts, and rivers and many geographical factors as a reason to increase the trade costs.

Regional or continent dummy has been commonly used in previous literature to capture the spatial aspect of gravity, nevertheless, as argued by J. H. Ko, A. Matsuzaki and D. Yoo (2020), existing OLS-based regression analyses can give only global, rather than local parameter estimates. T. Brodzicki and S. Uminski (2018) suggest that gravity equations using regional rather than country level flows could be used in order to receive certain region parameter estimates. However, such an approach limits analysis on only one region and interregional as well intraregional effects are not taken into consideration. A. J. Nelson and E. J. Zolnik (2013) argues that intraregional and interregional gravity models could help to tackle this issue and confirm that a regional approach better explains spatially complex trade flows. However, J. H. Ko, A. Matsuzaki and D. Yoo (2020) notes that coefficients of each independent variable are regionally dispersed. J. H. Ko, A. Matsuzaki and D. Yoo (2020) suggest that the gravity model could be further altered with geographically weighted regression (GWR), which can detect how the coefficients of each independent variable are regionally dispersed under GWR regression. GWR allows for the coefficients of explanatory variables to differ by locality by giving relatively more weight to geographically close observations and the weight represents the adjacency effects for neighboring locations within a specified distance (Ko, Matsuzaki & Yoo, 2020). GWR does not need geographical variables in the regressions including regional dummies such as Africa, America, Asia, and Europe and can estimate a separate regression of each region (Ko, Matsuzaki & Yoo, 2020).

As discussed by De Bruyne et al. (2012), measures of distance captured in gravity models fail to capture network effects, which address multilateral international trade relationship nature in global matrices rather than bilateral ones. De Bruyne et al. (2012) suggest to add different weighted network measures to the vector of distance measures of the gravity models, introducing a more natural way to incorporate multilateral resistance into the bilateral models, thus, combining 2 higher complexity methods to measure regionalization and to capture more complexity of it. Previous research using gravity equations on regionalization still did not examine extensively the opportunities of adding different weighted network measures to the vector of distance measures of the gravity models, which could improve the measurement of regionalization in the future. This would also allow to measure regionalization as a complex, multidimensional phenomenon using a complex research method for financial sector regionalization assessment covering the most recent data.

Conclusions

The concept of regionalization denotes certain complex sub-systems, which appear to be present in the apparently globalized world. The regionalization concept initially included the persistence of regional subsystems, hierarchies in the global systems. Regionalization formation could be distinguished into two types, i.e., the policy caused (an economic grouping or regional bloc that aims to strengthen its member countries by lowering the intraregional barriers to economic activity implying regionalization created by certain policy decisions) and market based (based on bilateral flows and interconnectedness within certain regional or global markets as increased connectedness at a regional level). In this research, market-based regionalization measurement methods, which take into account certain market dimensions of regionalization, are chosen for analysis.

Methods used in previous literature vary including structural and correlation analysis, network analysis, regional indexes and gravity equations methods. However, it is noted that each method tends to focus on a certain aspect of regionalization but may not be able to properly address regionalization as a complex, multidimensional phenomenon.

Data sample characteristics, as well as regionalization measurement characteristics, were approached in this comparative analysis of the previous regionalization research. This analysis revealed that previous regionalization literature covers mostly trade sector and usually covers 10-20 years. Sample size and data type highly vary based on data availability and regionalization aspect analysed. In previous regionalization literature, the higher complexity gravity equation method for regionalization measurement was used the most commonly. Regional or continent dummy has been commonly used in previous literature to capture the spatial aspect of gravity, nevertheless, existing OLS-based regression analyses can give only global, rather than local parameter estimates. However, only in one research 2 methods are combined to measure regionalization and to capture its higher complexity level. The majority of previous research on regionalization focuses on the formation of regionalization not taking its causes into account. However, structural, correlation, regional indexes and network analyses used for regionalization formation assessment do not allow to determine the causes of certain regional trade or asset flow patterns. Gravity equations enable to fix this through analysis of factors, which impact international economic or financial flows distribution among countries or regions. However, previous research using gravity equations on regionalization still did not examine extensively the opportunities of adding different weighted network measures to the vector of distance measures of the gravity models, which could improve the measurement of regionalization in the future and could allow to capture higher complexity of this phenomena.

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REGIONALIZACIJOS MATAVIMO METODŲ LYGINAMOJI ANALIZĖ

Santrauka

Regionizacija nėra naujas reiškinys, tačiau pastarųjų metų tendencijos skatina į jį pažvelgti naujai. Regionizacijos koncepcija vystėsi kartu su globalizacijos samprata ir nusakė regionines posistemes, hierarchijas, egzistuojančias globalėjančiame pasaulyje (De Lombaerde ir kt., 2019). Šis fenomenas atspindėjo ir pagrindinius veiksnius, tuo metu darančius įtaką regionalizacijai, t. y. regioninius prekybos susitarimus, regionines muitų sąjungas ir laisvosios prekybos zonas. Vėlesniuose etapuose, formuojantis kompleksinei globalizacijos koncepcijai, regionalizacija buvo apibūdinama kaip erdvinio išsidėstymo (angl. *spatial ordering*) procesas (Soma ir kt., 2016), nulemtas tarpvalstybinių / tarpregioninių srautinių ryšių formavimosi, taigi ir padidėjusio susietumo tarp šalių (Kim, Shin, 2002). Taigi šiuo metu regionalizacija suprantama kaip sudėtingas, daugialypis reiškinys, kuriam reikalinga kompleksinė tyrimo metodika, apimanti ne tik geografinius ar ekonominius aspektus, bet ir besiformuojančias glaudaus susietumo struktūras.

Mokslinėje literatūroje aptinkama tiek regionalizacijos apibrėžimo, tiek ir vertinimo metodų įvairovė (Lambert ir kt., 2015; Kim, Shin, 2002; Iapadre, Tajoli, 2014; Nelson, Zolnik, 2013), apimančių struktūrinę ir koreliacijos analizę, tinklinę analizę, regioninius indeksus ir gravitacines lygtis. Pažymima, kad kiekviena metodika linkusi sutelkti dėmesį į tam tikrą regionalizacijos aspektą, tačiau nevertina jo kaip daugialypio reiškinio. Skirtingų metodikų fragmentiškumas skatina palyginti skirtingas regionalizacijos vertinimo metodikas ir aptarti jų panašumus bei skirtumus, siekiant nustatyti, kaip jas būtų galima patobulinti ar sujungti, jog tinkamai būtų galima įvertinti regionalizaciją kaip kompleksinį reiškinį.

Šiame straipsnyje siekiama palyginti įvairias regionalizacijos vertinimo metodikas, nustatyti jų panašumus, skirtumus ir ribotumus bei galimas tobulinimo kryptis.

Šis tyrimas atliekamas dviem etapais. 1 etape regionalizacijos matavimo metodikos lyginamos pagal duomenų charakteristikas (4 palyginimo klausimai). 2 etape lyginami matavimo metodai (4 palyginimo klausimai). Iš viso buvo suformuluoti 8 lyginamieji klausimai, remiantis regionalizacijos matavimo metodų ypatumais. Tyrimo imtį sudaro 9 atrinkti ankstesni regionalizacijos tyrimai, atlikti 2002–2020 m.

Tyrimo rezultatai atskleidė, kad ankstesnė regionalizacijos literatūra daugiausia apima prekybos sektorių ir paprastai 10–20 metų laikotarpį, o imties dydis ir duomenų tipas labai skiriasi priklausomai nuo duomenų prieinamumo ir analizuojamo regionalizacijos aspekto. Tik viename iš analizuotų tyrimų buvo sujungti 2 vertinimo metodai, kas leido įvairiapusiškiau įvertinti tiriamą objektą. Dauguma ankstesnių regionalizacijos tyrimų skirti vertinti jos formavimosi faktą, tačiau struktūriniai, koreliacijos ar regioniniai indeksai bei tinklinė analizė neapima veiksnių, sąlygojančių

prekybinių ar finansinių srautų judėjimo tendencijas. Gravitacijos lygčių metodas leidžia tai išspręsti ir įvertinti ne tik kokios struktūros susiformavo, tačiau ir kokie veiksniai tai lėmė.

Ankstesnėje literatūroje neretai pasitelkiamas regiono ar žemyno pseudokintamasis erdviniam gravitacijos aspektui užfiksuoti, tačiau vis vien pats tyrimas atliekamas globaliu mastu. Kituose tyrimuose sudaromos gravitacijos lygtys naudojant tarpregioninius, o ne šalies lygmens srautus ir taip pagal tarpregioninių ir regionų vidaus gravitacijos lygtis vertinamas regionalizacijos formavimasis. Taip pat pasitelkiamos ir regresijos lygtys su geografiniais svertais, leidžiančios įvertinti, kaip kiekvieno nepriklausomo kintamojo koeficientai pasiskirstę geografiškai. Ankstesni gravitacijos lygčių taikymo regionalizacijai matuoti bandymai retai atsižvelgia į galimybę sujungti keletą metodikų, pvz., įtraukti tinklinius rodiklius į šias lygtis, kas leistų vertinti regionalizaciją ne tik geografiniu ar ekonominiu aspektu, tačiau apimti ir šalių naujai susiformavusias tinklines struktūras. Taigi, tai gali būti vertinama kaip tolesnių regionalizacijos tyrimų viena iš tobulinimo krypčių.