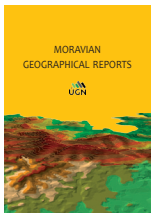

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A geography of creative networks: The case of a small European economy

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Abstract

This research project analyses the effects of networking by creative and conventional enterprises at regional and inter-industry levels. It relies on a unique dataset provided by the Slovak Creative Voucher Scheme and has some novel elements. We used direct evidence of industry locations from projects developed by creative industries rather than proxies. Network analysis was applied to establish major patterns in regional and inter-industry cooperation by creative and conventional firms. Regression models were used to analyse the network structure. The findings from quantitative analyses were complemented with evidence from qualitative methods. The network included a wide variety of cooperating partners. A sample of creative firms supported by the Creative Voucher Scheme cooperated with partners from no less than 60 industries. Spatial proximity was a key condition for cooperation, enabling face-to-face contacts and the development of a trusting relationship between creative firms and their clients.

Keywords: *creative industries; regional creative networks; inter-industry networks; network analysis; creative vouchers; Slovakia*

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1. Introduction

Creative industries (DCMS, 1998) are a flourishing sector of the modern economy. These industries have some specific features such as a distinct cultural geography, flexible organisation, use of advanced technologies and extensive employment of creative and technical talent (Lampel and Germain, 2016, p. 2332). The creative industries are both a precondition and an important factor of economic evolution. Entrepreneurship and novelty by creative firms support innovation and creative destruction and the establishment of new products and industries (Potts, 2009). Research on creative industries quantifies their direct and indirect impacts on national and regional economies. Direct impacts relate to growth in employment and value added. Indirect impacts refer to spillovers of knowledge and creativity to the rest of the economy (Potts and Cunningham, 2008; Bakhshi and McVittie, 2009).

This paper provides a new perspective on the role of creative industries in regional economies. It analyses spatial and industrial topologies of the creative industries in the Slovak Republic. The analysis is based on a unique dataset provided by the Creative Voucher Scheme, which supported the formation of partnerships or creative networks between firms from creative industries and conventional ones. We pair information on cooperating partners with data from annual accounts by creative and conventional firms, such as location, business industry and financial indicators. Our research approach is multi-perspective. We combine spatial analysis with network science and qualitative methods.

Our research has some novel elements:

(1) Our focus goes beyond the usual interest in developed economies;

(2) We use direct evidence of industry locations from projects developed by specific creative firms, rather than proxies;

(3) Territorial operations by creative networks are studied both on national and local (LAU 1) levels and combined with firm data;

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(4) We apply the network analysis to establish major patterns in regional and inter-industry cooperation by creative and conventional firms;

(5) Regression analysis is used to explain the network structure; and

(6) Findings from quantitative analyses are complemented with evidence from qualitative methods (participant survey).

The rest of the paper is organised as follows. In the Chapter 2, the literature review and theoretical background are presented, and the research gap is stated. Based on the literature review and research gap, the research hypotheses are stated. Chapter 3 briefly introduces the Slovak Creative Voucher Scheme, and then it turns to data sources and research methods. Chapter 4 presents findings from the regression analysis and network analyses on regional and industry levels and discusses important outcomes. The same chapter discusses the results of the qualitative analysis. The concluding section summarises the major findings, states some important limitations and suggests directions for further research.

2. Theoretical background

2.1 Literature review

The literature for review was primarily identified based on searches of the Web of Science, Scopus and Google Scholar pages for various keywords (e.g. "creative industries; creative vouchers; creative credits;" AND "networking; geography; region"). The geography of networks in creative industries, network formation and operation, and design and methods used in the research of creative networks, were of prime interest. The literature search aimed at journals and papers focussed on economic and cultural geography, and policy interventions targeting creative industries. In step one, a wide body of papers was established. In step two, a narrow body of influential papers was identified for literature review.

Based on the literature review, this section introduces theoretical foundations of the economic geography of creative industries. It firstly presents major perspectives on locations and clustering by creative industries. Then it turns to some distinctive properties of creative firms and their business models. The concluding part identifies some research gaps and formulates research hypotheses.

A recent literature review on cultural and creative clusters indicated that the most common research themes concerned (Chapain and Sagot-Duvaurou, 2020, p. 323):

i. The impact of territory, innovation milieux and networks on economic value chains; and
ii. Issues of governance and policy evaluation.

Creative firms tend to be highly clustered. The geographical concentration of creative industries is impacted by diverse factors, such as history and cultural heritage, localisation economies, urbanisation economies and a related variety of and decisions by the so-called 'creative class' (Florida, 2005; Lazzeretti et al., 2012, p. 1254). Theories in Economic Geography provide two different, but complementary perspectives on clustering by creative firms. The first perspective originates in Alfred Marshall's (1890, p. 152) ideas on external economies of agglomeration, while the second one relates to Jane Jacob's works (1969) on external economies arising from urbanisation, and innovations related to the diversity of inputs (Lorenzen, 2018, p. 308).

Agglomeration economies, operating on centripetal forces, are behind the distinctive geography of creative industries (Gong and Hassink, 2017, p. 587). Creative industries develop in highly urbanised areas. They usually concentrate around the capitals and/or the largest cities, but regional capitals and medium-sized cities may have their own creative systems specialised in a particular sector or type of creative activity (Boix-Domènech et al., 2016). Large cities attract talent and provide creative firms with a supply of skilled labour. Geographical proximity, extensive service industries, the presence of local institutions, and well-developed infrastructures allow firms to benefit from economies of scale and decrease transaction costs. The stock of skilled labour and transport infrastructures facilitate face-to-face contacts and boost knowledge spillovers. Tao et al. (2019, p. 149), for example, argue that diversity in service industries and availability of transport infrastructure are key factors behind the agglomeration economies of creative industries in China.

The Jacobian perspective (Jacobs, 1969) explains how the conditions created by co-location and the diversity of suppliers and customers create ideal environments for innovations. Clusters of creative industries are co-located and integrated into 'hubs, bunches and clouds' (Boix-Domènech et al., 2015, p. 770). Unlike manufacturing, creative industries rely on inputs of human and social capital rather than fixed investments. Human and social capital are not 'placeless'. Creative activities are always embedded in specific socio-cultural and institutional contexts (Kloosterman, 2010, p. 139) that contribute to different path-dependent trajectories of regional and local creative industries. Localisation decisions by creative firms are spatially grounded (Flew, 2010, p. 88) and informed by opportunities for networking. Creative firms and individuals cluster in specific localities 'for ideas, inspiration and face-to-face communication' (Clare, 2013, p. 56). Huggins and Thompson (2015, p. 104) argue that innovation performance by firms is impacted by their investment in 'network capital', i.e. building relationships with other firms and organisations to 'gain access to knowledge to enhance expected economic returns, principally via innovation'. The co-location provides firms with opportunities for accessing specific suppliers and customers, sharing tacit knowledge, and accumulating collective learning capacities. Collaborative models between traditional and creative firms enable acquiring and combining heterogeneous sources of knowledge and creating innovative solutions (Santoro et al., 2020, p. 6). Advances in transportation, logistic and digital technologies enabled a substantial decrease in transaction costs. Production, sharing and diffusion of knowledge in creative activities, however, is context- and place-specific, and informed by localities, institutions and networks (Watson, 2002, p. 626). Tacit knowledge is embedded in the high-trust local networks of individuals and companies. The spatial costs for accessing localised knowledge and learning, therefore remain high (Morgan, 2004; McCann, 2007).

Businesses in the creative industries have some specific features. The demand for creative goods and services is extremely volatile. Most deals are made case-by-case. Stable customers are the exception, rather than the norm. Daskalaki (2010, p. 1649) argues that repeated creative collaborations are semi-permanent and result in volatile relationships among network members. Volatile business environments are not beneficial for building long-term strategic alliances. The modules of cooperation build upon prior experience. Creative entrepreneurs must form alliances with potential

business partners they collaborate with and with whom they can cooperate well in the future (Gundolf et al., 2017, p. 156). Affective bonding and trust are important factors of cooperation in such a volatile environment (Radomska et al., 2019). A recent review of business models in the creative industries suggested emergence of some new trends (Li, 2020, p. 8). There was a transition from using one to several business models by the same firm, so as to sell diverse products and serve different markets. In most cases, the emergence of new business models is about recombining existing rather than introducing radically new ideas. Traditional business models, for example, are scaled up by the introduction of digital technologies. Digital technologies reduce costs and expand a portfolio of potential customers. The digital transformation of creative industries was speeded up by the Covid-19 pandemic (Hassink and Yang, 2021), as both creative firms and their customers had to look for new ways to access their customers.

2.2 The research gap and hypotheses

While there is a rich literature on creative industries, several literature reviews point to certain research gaps. The literature review by Chapain and Sagot-Duvaurou (2020, p. 310), for example, found that as for scale and geographical location, most studies consider either the neighbourhood scale or the city scale. Studies on sub-regional and regional scales are less common. Research on creative industries has rather disproportionally focused on metropolitan regions and specific occupations in cultural sectors (visual and performing arts, fashion, media). Creative industries located in national or regional capitals and/or those based on high technologies, were rather overlooked (Yin and Derudder, 2021). Some influential papers on creative industries have preferred targetting global networking and global capitals (Lorenzen, 2018). Smaller national and regional capitals from Central and Eastern Europe are rather under-represented in studies on creative industries. Studies on public support for creative industries focus on the effects of the support to firms. Research is lacking on the effects of these policies on meso-scale levels, i.e. regional, and inter-industry creative networks. Most research on creative industries looks at collaboration by two or more creative firms. Few studies explore patterns of interaction between creative and conventional firms (but see Santoro et al., 2020). Based on the literature reviews and research gaps, the following research hypotheses were formulated:

- Hypothesis 1: Cooperation by creative and conventional firms is informed by spatial proximity and co-location by creative industries. Proximity and agglomeration effects are more important for cooperation than co-location effects;
- Hypothesis 2: The modularity of the creative network is informed by geography, and the structure of regional economies;
- Hypothesis 3: The capital region develops a countrywide creative network; the regional capitals maintain their own regional networks; and
- Hypothesis 4: Creative networks benefit from repeated collaborations but are volatile.

The hypotheses are based on the review of literature on spatial patterns of creative industries (H1: Marshall, 1890; Florida, 2005; Lorenzen, 2018; Gong and Hassink, 2017; H2: Flew, 2010; Clare, 2013; H3: Boix-Domènech et al., 2016), and collaboration patterns by creative firms (H4: Daskalaki, 2010; Gundolf et al., 2017; Radomska et al., 2019).

3. Data and methods

3.1 The Slovak Creative Voucher Scheme: Intervention logic and implementation

Dynamic markets and the volatility of demand set some constraints for financing firms in the creative industries. The human capital of the owner/manager is often the key asset of a creative firm. Unlike manufacturing enterprises, creative firms have a limited stock of fixed capital to pledge. The asset structure makes it difficult for banks to evaluate the wealth and creditworthiness of creative firms. The public sector may address this market failure via specific support schemes for creative industries.

Many governments provide support to creative industries. Traditional tools of support include grants (Moreton, 2016) and tax incentives (Hemels and Goto, 2017). Creative vouchers (also known as creative credits or creative innovation awards) are a viable option to support creative industries. Several European countries have introduced creative voucher schemes (Shiach and Virani, 2017). Creative vouchers mimic basic properties of innovation vouchers (Virani, 2015): simple rules, easy access for potential applicants and standardised value of support. The key goal of voucher schemes is to bring together prospective partners (Flanagan et al., 2011). The vouchers promote the innovation capacity of small and medium enterprises (SMEs) via networking and the acquisition of external knowledge.

The Slovak Government launched its first national creative voucher scheme in 2018. The Government had noted the relatively low levels of development in the creative industries in Slovakia. The value added to enterprises in the cultural sectors accounted for 1.21% of the total business economy in 2019 (EU27 = 2.40%). In 2019, the share of persons working as creative and performing artists, authors, journalists and linguists in total employment was 0.58% in Slovakia, while it was 0.81% in the EU27 (Eurostat, 2021). Moreover, the shares of creative industries in total value added to the business economy and total employment declined in Slovakia in the period 2011–2019. The Creative Voucher Scheme aimed at 'increasing competitiveness of both SMEs benefitting from creative inputs, and the SMEs in creative industries'. The scheme supported networking for SMEs in creative industries with other enterprises. Four creative industries were eligible for support:

i. Architecture;
ii. Design;
iii. Advertising and marketing; and
iv. Software and information and communications technology (ICT) services.

The vouchers were distributed under the EU *de minimis* legal framework. The minimum value of a voucher was €1,000 and the maximum was €5,000 (€10,000 for architecture services).

The Slovak Innovation and Energy Agency (SIEA) administered the scheme. The SIEA established a matching webpage for SMEs from creative versus conventional industries. Conventional firms applied for a voucher and exchanged it for goods and services provided by creative ones. The scheme generated high interest from creative firms. Some 2,480 firms submitted 3,122 collaborative proposals. The proposals aimed at projects with a total value of €20.08m. Support by vouchers was planned for €14.75m, in the period 2018–2021. Actual support was lower. Some

651 vouchers were distributed to 375 creative firms in the period 2018–2021. The total value of vouchers was €3.564m. The average value of a voucher was €4,585.

3.2 Data sources

We focus on the districts (Local Administrative Units – LAU 1 level) to obtain detailed insights on territorial aspects of networking by creative industries. The Slovak Republic is divided into 79 districts, including five urban districts in Bratislava City and four urban districts in Košice City. In 2022, the average size of a Slovak district was 6,200 km^2 with an average population of 69,000. Nine districts received no support under the Creative Voucher Scheme. We considered Bratislava City and Košice City as whole entities. The regional analysis, therefore, is based on 65 districts. District codes and full names are provided in Appendix Table A2.

Regional economic accounts are available for NUTS 2 and NUTS 3 levels but not for (LAU 1 level) in Slovakia. Some studies use numbers of firms to compute localisation and concentration coefficients. This is problematic given differences in firm sizes. The computation of concentration and localisation coefficients further is complicated by the presence of some large firms in creative industries.

We assume that the location and concentration coefficients should be based on the value that was added rather than the number of firms. The value added is a good proxy for regional and/or sectoral gross domestic product (GDP). We introduce concepts of 'small business economy' and 'creative small business economy' to explore the importance of creative industries on the LAU 1 level. The concepts mirror populations of creative and conventional firms supported by the Creative Voucher Scheme. The 'small business economy' approximates 'business GDP' on national and regional levels via cumulative value added by SMEs in each district. The 'creative small business economy' is a subset of the 'small business economy' for industries supported by the scheme: architecture, design, advertising and marketing, and software and ICT services.

Two major datasets were used to analyse the role of creative firms in regional economies:

1. The first dataset refers to lists of creative and conventional firms supported by the Creative Voucher Scheme. The lists were provided by the SIEA upon request. Descriptive statistics on supported creative and conventional firms are provided in Table 1; and
2. The second dataset was extracted from the FinStat database. The database contained contact details, NACE codes and annual financial statements by all Slovak companies.

3.3 Research methods

Most of the most cited papers on creative clusters explore economic issues, such as value chains (Chapain and Sagot-Duvaurou, 2020, p. 323), but relatively few combined quantitative methods with purely economic or economic geographic perspectives. In contrast, see Tao et al., 2019; Boix-Domènech et al., 2015; and Bakshsi et al., 2015. Sociological and ethnographic perspectives ('relational geography') were the most common approaches in studying sets of formal and informal institutions constituting creative clusters (Harvey et al., 2012; Watson, 2012), structural relationships between cluster members (Daskalaki, 2010; Felton et al., 2015), and the impact of trust on cooperation by network members (Florida, 2005; Radomska et al., 2019). The prevalence of sociological approaches is explained from the higher numbers of case studies and a focus on individual clusters.

The research designs and methods differ widely in studies on the economic geography of creative industries. Many studies are exploratory. As for economic geography, localisation quotients have been widely used as proxies to identify local creative systems (see for example: Boix-Domènech et al., 2016, p. 936). Partial and ordinary least square regression methods have been applied to study determinants of clustering in creative industries (Lazzeretti et al., 2012). Econometric methods were employed to model direct and indirect macroeconomic impacts of creative industries in terms of production and employment (Bakhshi and McVittie, 2009; Boix-Domènech et al, 2021). Finally, several papers have analysed the effects of public support on creative industries. Some authors applied randomised controlled trial settings and sophisticated statistical methods (Bakhshi et al., 2015) to establish the effects of support on firm performance. Studies mapping the effects of support on the formation of creative networks have been missing so far.

	Assets	Equity	Sales	Profits	Value added
			Creative firms		
Mean	162,702	60,432	252,745	23,398	74,022
Median	72,077	25,796	93,080	7,481	27,407
Standard deviation	333,504	122,941	470,716	53,993	135,835
Minimum	3,326	– 197,540	3,556	– 21,943	932
Maximum	2,585,829	750,440	3,374,204	418,982	931,448
			Conventional firms		
Mean	655,954	215,985	561,926	68,061	230,869
Median	174,539	57,844	124,590	23,969	70,831
Standard deviation	1,309,240	467,723	1,300,986	132,727	415,138
Minimum	7,840	– 47,443	130	– 10,495	1,131
Maximum	9,974,802	4,198,810	12,714,100	1,471,481	2,566,733

Tab. 1: Descriptive statistics for participants in the Creative Voucher Scheme (EUR; Note: All values are in Euros and refer to the average of 2016–2019). Source: authors' computations

This paper benefited from a unique dataset on collaboration by creative and traditional firms. Dyadic data on co-operating partners have enabled us to employ network and regression analyses and to explore the importance of creative firms for regional economies. To the authors' best knowledge, this network analysis was used to explore the Economic Geography of creative industries for the first time.

The Creative Voucher Scheme supported both personal businesses and companies (legal entities). Financial data from the FinStat database were available for companies only. The data on value added in the business sector were used to compute concentration statistics (Fig. 1) – location quotients for creative industries (LQ_{ci}) on the LAU 1 levels (Fig. 2). The LQ_{ci} is computed as follows:

$$LQ_{ci} = \frac{d_{VAci}/d_{VAsbe}}{N_{VAci}/N_{VAsbe}}$$

The numerator compares the district's share of value added (*VA*) in creative industries to the district's value added in the small business economy (*sbe*). The denominator compares the national share of value added in creative industries to the national value added in the small business economy. An LQ_{ci} higher than 1 means that a district has above-average shares of creative industries with respect to the national average values.

The LQ_{ci} coefficients could be skewed by atypical cases and/or outliers. Firms included in the 'small business economy' and 'creative small business economy' should be commensurable with those participating in the Creative Voucher Scheme. The FinStat database was screened for outliers. The interquartile range (IQR) was used to identify and remove outliers. The scheme supported conventional and creative SMEs. The FinStat samples of 'total economy' and 'total creative economy' included firms with substantially higher values of economic indicators than those supported by the Creative Voucher Scheme. The inclusion of very large firms would bias the LQ_{ci} coefficients. Data from the FinStat database enabled computing these coefficients for 'small business economy' (*sbe*) and 'creative small business economy.' The original FinStat sample of 228,818 firms was reduced to 159,278 SMEs, including 16,004 creative ones fitting the value:

$$sbe_{ij} < max[c_{i,j}] + 0.25 * SD[c_{i,j}],$$

where the sbe_{ij} is the value of the j-th indicator of the i-th firm in the small business economy sample, $max[c_{i,j}]$ is the maximum value of the j-th indicator of the i-th firm in the respective conventional and creative firm samples and SD is the standard deviation. The final dataset approximated 'small business economy' and creative small business economy,' respectively, on the LAU 1 levels.

Figure 1 shows the percentage shares of specific districts in the national creative small business economy. Bratislava City represents a concentrated 52.1 and Košice City 7.4 percent of the total value added. The high concentration of creative industries suggested strong agglomeration effects for the Bratislava Region. The same pattern emerged for the co-location effects – the Bratislava Region accounted for the highest location quotients (Fig. 2). Figures 3 and 4 present the distribution of voucher support by regions of conventional and creative firms, respectively. Most of the support by vouchers was concentrated in regions with a high concentration of creative industries and/or high location quotients.

4. Results and discussion

4.1 Regression analysis

Ordinary linear regression models are used here to explain the geographical structure of the creative networks. Pairs of creative versus conventional firms are the unit of analysis. The value of vouchers transferred from conventional firms in region *a* ('target region') to creative firms in region *b* ('source region') is the dependent variable. The choice of explanatory variables was based on assumptions from geographic research on the effects of distance and location on cooperation patterns. We assumed that conventional firms would prefer creative partners coming from close districts and/or those specialised in creative industries.

We first produced statistics on location by creative industries. We then considered the physical distance between the regions of the creative and conventional firms. When the creative and conventional firms came from the same region,

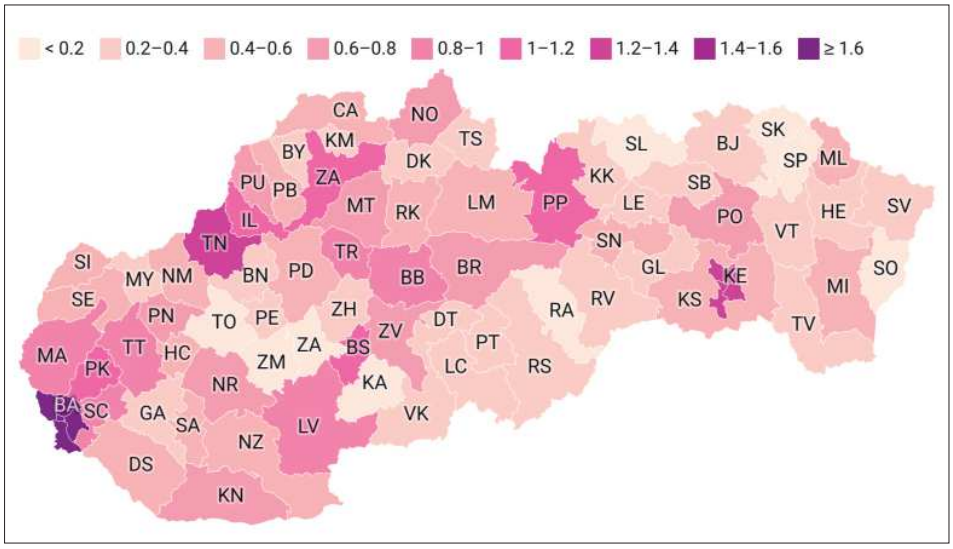

Fig. 1: Percentage shares of specific districts in the national creative small business economy
Source: authors' elaboration

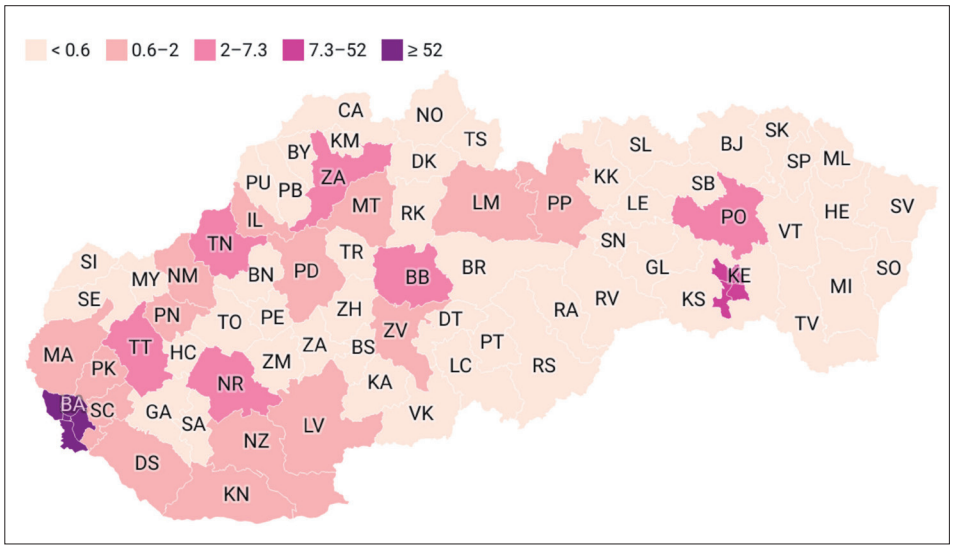

Fig. 2: Regional location quotients for creative industries
Source: authors' elaboration

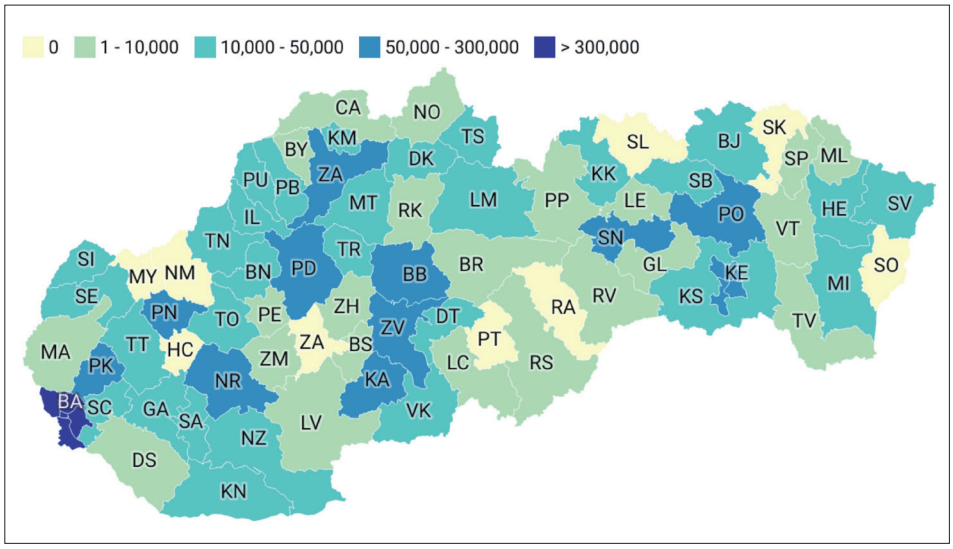

Fig. 3: Voucher support by region of conventional firms (EUR)
Source: authors' elaboration

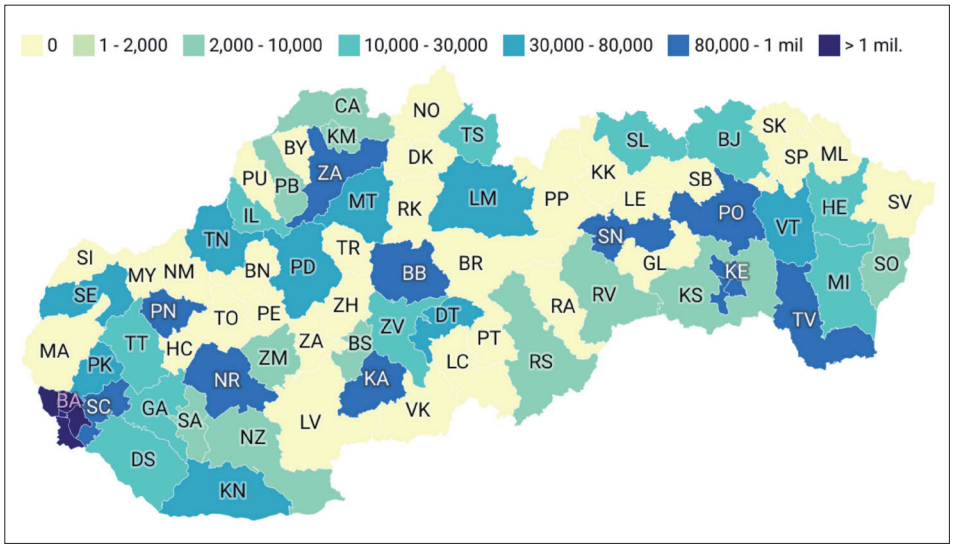

Fig. 4: Voucher support by region of creative firms (EUR)
Source: authors' elaboration

we specified a distance of 1 km. All variables had non-linear distributions, hence we used natural logs for variables on both sides of the model.

The regression analysis confirmed that distance was negatively, and the location quotient positively related to the sum of creative vouchers transferred from conventional to creative firms (Tab. 2). The variance inflation factor (VIF) statistics indicated no potential problems with collinearity. Both independent variables were significant on the 0.001 levels. The standardised Beta coefficient for distance was substantially higher than that for the location quotient. This suggests that short distance was more important for the formation of creative networks than co-location of creative industries in specific regions (Hypothesis 1 confirmed). While digital products accounted for a substantial part of the co-operation by the traditional and creative firms under the Creative Voucher Scheme, there was no 'death of geography' (Morgan, 2004). Spatial proximity and opportunities for face-to face contacts were important determinants of collaboration.

4.2 Network analysis

Economic geography assumes co-location and clustering by creative firms in urbanised and metropolitan areas (Florida, 2005; Boix-Domènech et al., 2015). We applied network science (Easley and Kleinberg, 2010) to map and analyse inter-industry and spatial networks by creative and conventional firms (see Figs. 5 and 6). The networks are constructed from nodes (depicted by circles) and edges (represented by curved lines). The nodes represent specific districts and industries, respectively. Districts are denoted by their national codes and industries by the standard NACE codes. The district code BA, for example, denotes Bratislava City, while the node code J62 refers to the computer programming industry. Node size ('degree') is then computed as the sum of its connection to other nodes weighted by edge thickness. Two types of degrees are recognised: the weighted indegree is identical to the size of weighted inflows, while the weighted outdegree is identical to weighted outflows from the node. Node sizes correspond with the sum of vouchers received by conventional firms in specific

	B	Std. Error	Beta	t	sig	VIF
(Constant)	10.112	0.144		69.991	0.000	
LN distance in km	– 0.252	0.031	– 0.477	– 8.257	0.000	1.000
LN location quotient for source region	0.320	0.074	0.249	4.306	0.000	1.000
Adjusted R squared = 0.281; SEE = 0.739; sig. 0.000						

Tab. 2: Regression analysis (log-log linear model). Source: authors' computations
*Note: Dependent variable: natural log of vouchers exchanged between conventional firms from region **a** to creative firms in region **b***

regions or industries (the 'weighted indegree' perspective). The largest node in Figure 6, for example, represents all vouchers received by Bratislava City-based conventional firms (€1.003m). Similarly, the edge thickness represents the size of the flow, i.e. the value of vouchers exchanged among pairs of districts or industries. The thickest (green) line in Figure 5, for example, denotes vouchers (€0.177m) provided by the J62 computer industry to the G47 retail industry.

Complex networks may be divided into specific modules (communities or clusters). The modules are defined as groups of densely interconnected nodes that have relatively few or no connections with the rest of the network. Figures 5 and 6 display modules of cooperation by creative and conventional firms from the industry and spatial perspectives, respectively. Gephi software was used to produce the network diagrams. Two force-directed algorithms (Fruchterman-Reingold and Force Atlas 2) were applied to arrange nodes to specific geographic and industry modules (Jacomy et al., 2014).

We first analyse inter-industry networks of cooperation. Then we turn to the regional networks. Finally, we combine the inter-industry and regional data to analyse creative networks by specific regions.

4.2.1 Inter-industry creative networks

Industries in cooperation modules are identified by their respective NACE codes on the two-digit level. Five distinctive modules emerged in the industry network diagram (Fig. 5):

1. The largest (blue) module distributed support €1.146m to 19 industries. The module interconnected industries F41 (construction of buildings), G46 (wholesale trade), L68 (real estate), M70 (management consultancy), M71 (architectural and engineering activities) and many small manufacturing industries;
2. The second largest (green) module contained 16 industries and distributed support (€0.896m). The module centred on the J62 industry (computer programming) and included very diverse manufacturing and service activities, such as F43 (specialised construction activities), G45 (sale and repair of motor vehicles), S96 (other personal services), and many more;
3. The third largest (violet) module included 17 industries and distributed support €0.711m. The module centred on industries G47 (retail trade), M73 (advertising), M74 (other professional, scientific, and technical activities). It included several service and manufacturing industries;
4. The orange module comprised six industries (€0.271m). The module connected industries M69 (legal and accounting activities) and N82 (office administrative) with four other small service and manufacturing industries; and
5. The minor dark green module consisted of two industries only: K64 (financial service activities), and K66 (activities auxiliary to financial services). This module distributed €0.018m in support.

Most modules referred to the vertical integration of industries. The blue module, for example, integrated architecture, construction, real estate, and management consultancy. The green module, on the other hand, reflected horizontal service inputs by the computing programming industry to the rest of the economy. The modules typically

showed a great diversity of manufacturing and service industries. The cooperation across sectors provided fertile ground for inter-industry knowledge spillovers.

4.2.2 Regional creative networks

The Slovak creative firms clustered in urbanised areas. Firms located in Bratislava City and the regional (NUTS 3) capitals benefitted from location and urbanisation economies. Spatial patterns of location and networking by creative firms in Slovakia resembled those in Western Europe (Branzanti, 2015; Boix-Domènech et al., 2016). Large cities accounted for the highest presence of creative industries (Fig. 6). The SMEs located in the largest cities had the highest participation in the Creative Voucher Scheme. By far the highest share of the total cooperation was concentrated in Bratislava City. Some 33.0 percent of total voucher support,

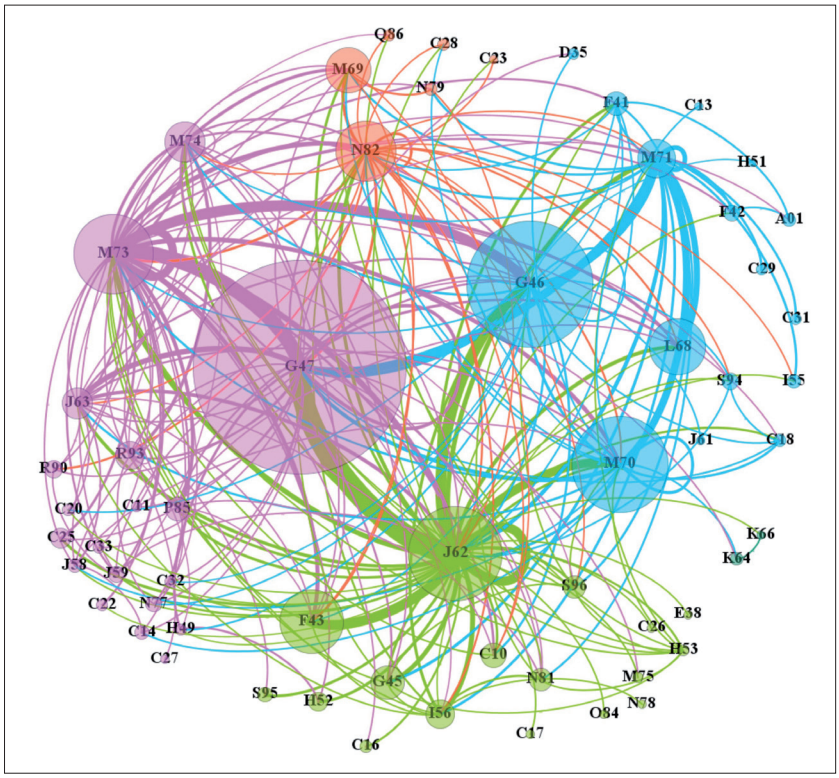

Fig. 5: Industry patterns of cooperation by creative and conventional firms
Source: authors' elaboration of NACE standard industry codes

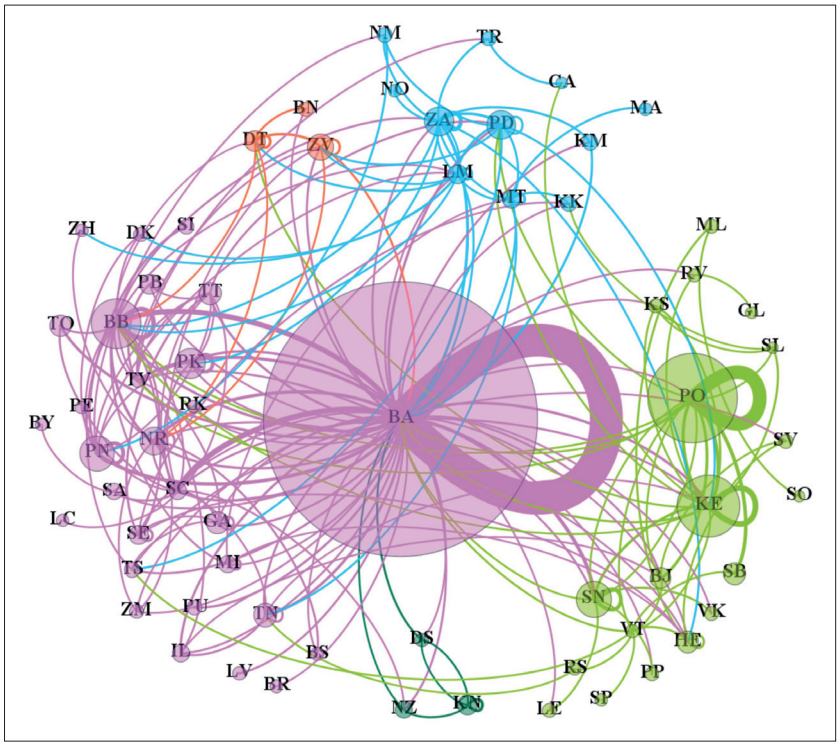

Fig. 6: Regional patterns of cooperation by creative and conventional firms
Source: authors' elaboration of district codes

for example, was received by companies in Bratislava City. Some 21.2 percent of the total support went to cases in which both creative and conventional firms came from Bratislava City. The situation is depicted by a distinctive loop-like flow in Figure 6. Similar albeit much smaller loops operated in Košice City and the Prešov region.

Geographical network analysis established five modules of cooperation. All five modules had distinctive regional dimensions:

1. Module 1, the largest (violet) module, included 29 districts and centred around Bratislava City (BA) and some regional and districts capitals. The module distributed support totalling €1.810m.;
2. Module 2, the second largest (green) module, included 19 districts in eastern Slovakia. It connected two regional capitals (Košice City and Prešov) with 17 smaller districts. The module distributed support totalling €0.801m.;
3. Module 3, the blue module, centred on the regional capital of Žilina (ZA) in northern Slovakia. The module connected 11 districts in total and distributed support totalling €0.262m.;
4. Module 4, the orange module, comprised three small districts in central Slovakia and distributed support totalling €0.107m.; and
5. Module 5, the dark green module, connected three district capitals in southern Slovakia. The districts had high proportions of the Hungarian-speaking population. The module distributed support totalling €0.064m.

The clustering of districts in specific modules was influenced by the physical distance and structure of regional economies. Module 1 centred on the highly urbanised and services-based economy of Bratislava City. Modules 2 and 3 focused on urbanised regional and district capitals with mixed service- and manufacturing-based economies. Modules 4 and 5 centred on semi-urbanised small district capitals with manufacturing-based economies. The formation of Module 5 was informed by the culture and language of the Hungarian minority population.

4.2.3 Regional patterns of inter-industry cooperation

Table 3 analyses the top ten industries benefitting from voucher support, by specific regional modules. The scheme supported creative firms in architecture, design, advertising and marketing, and software services. Products and services by creative firms (e.g. e-shops, webpages, showrooms, marketing campaigns and industrial designs) were used as intermediary inputs in regional economies. The conventional firms in the industries G46, G47, M70, M73 and M74 were major clients of the scheme and featured prominently in all regional modules. Each regional module, however, had its own composition of benefitting industries (Hypothesis 2 confirmed). Highly urbanised regions of Bratislava and Košice City and urban regions in northern Slovakia channelled most support by vouchers to service industries. The semi-urban regions in central and southern Slovakia (Modules 4 and 5) accounted for higher shares of manufacturing industries (such as C10, C11, C14, C23, C33) in their economies. Manufacturing firms featured as important clients of creative firms in Modules 4 and 5.

Our research findings agree with the findings by Cruz and Teixeira (2015, p. 173) that creative industries tend to agglomerate in limited numbers of locations, but geographical patterns differ by location and specific type of creative activity.

4.2.4 Centrality measures

The centrality measures identify positions of specific nodes within a network. Centrally located nodes are more important for the whole network than those located on the periphery. Over two hundred centrality measures have been proposed by researchers in network science (Jalili et al., 2015; Oldham et al., 2019). The most popular measures include closeness centrality and betweenness centrality.

Closeness centrality measures the speed of information spread, i.e. how many steps it takes from one specific node to all other nodes sequentially. Personal recommendation by a trusted source, rather than unreliable information acquired via several intermediate sources, is important in small

Total Slovakia	*%*	**Module 1 (Bratislava)**	*%*	**Module 2 (eastern Slovakia)**	*%*	**Module 3 (northern Slovakia)**	*%*	**Module 4 (central Slovakia)**	*%*	**Module 5 (southern Slovakia)**	*%*
G47	16.96	G47	14.92	G47	18.08	G47	27.64	G47	17.61	G47	17.82
G46	9.80	G46	9.69	G46	9.03	G46	12.01	F43	12.24	M74	15.06
M70	7.37	M70	8.56	J62	6.54	M70	9.49	G46	11.41	N82	12.23
J62	7.18	J62	7.72	F43	6.21	J62	7.93	C14	8.72	G46	10.29
M73	6.01	M73	6.41	M73	5.40	M73	7.02	L68	8.42	J62	7.86
F43	4.69	L68	4.86	M71	5.08	N82	5.13	C11	8.16	M73	7.23
N82	4.41	F43	3.95	N82	4.97	L68	4.48	M70	4.64	C10	6.37
L68	4.03	N82	3.95	M70	4.72	F43	3.63	M71	4.57	C23	6.03
M69	3.14	M69	3.23	I56	3.45	M69	3.24	E35	4.54	F41	6.02
M74	2.75	J63	2.93	M69	2.99	Q86	2.18	C33	4.31	I56	4.29
Top 10	**63.33**	**Top10**	**66.20**	**Top10**	**66.48**	**Top10**	**82.76**	**Top10**	**86.64**	**Top10**	**93.20**

Tab. 3: Regional patterns of inter-industry of cooperation
Source: authors' computations

businesses. A wholesale trader with hundreds of suppliers and customers is an example of a firm high in closeness centrality within the network. Betweenness centrality measures the extent to which a node lies on paths between all other nodes. Nodes high in betweenness centrality may interconnect remote modules and act as gatekeepers and/or brokers in the network. A creative firm, for example, could specialise in the marketing of food products, but it wishes to expand its business to the marketing of tourism products. An option is to contact its former client, a web hosting firm that is doing business with many diverse industries. The web hosting firm is an example of a node high in betweenness centrality. Specific centrality measures are not mutually exclusive. One firm may combine several or all centrality measures.

The centrality measures perform differently in highly connected versus highly modular networks (Oldham et al., 2019, p. 9). If all nodes are connected to many other nodes, then most nodes are likely high in the closeness centrality measure. The situation is different with highly modular networks, such as the regional and inter-industry networks of the Slovak creative firms. Many nodes high in closeness centrality have dense connections with other nodes inside their own module, but relatively sparse connections with nodes in other modules. This is the case of the Slovak regional networks of cooperation (Fig. 6). Nodes high in betweenness centrality, on the other hand, have numerous connections to nodes in other modules.

High scores in closeness and betweenness centrality may indicate some potential for recombining knowledge from diverse regions or industries. Regions (industries) high in closeness centrality may be important for the transfer of knowledge within a specific region (industry). Nodes high in betweenness centrality may be influential for inter-regional and/or inter-industry sectoral knowledge transfer. It should be noted that a high score in closeness and betweenness centrality is necessary but not a sufficient precondition for generating substantial knowledge transfer. The number of available resources (e.g. volume of business) equally is important for the propagation of knowledge through the network. We measure the amounts of available resources by the weighted indegree, i.e. the total amount of creative vouchers amassed by a region (industry). Regions and industries high in closeness and betweenness centrality and weighted indegree likely have major potential for knowledge spill overs (see Appendix Tabs. A1 and A2).

Unsurprisingly, Bratislava City featured a combination of the highest closeness and betweenness centralities and weighted indegree. The surprising feature is the sheer dominance of the Slovak capital over the whole network, given Bratislava's eccentric location in the southwest of the country and moderate population (eight percent of the total Slovak population). The regional capitals (Trnava, Trenčín, Nitra, Žilina, Banská Bystrica, Košice City and Prešov) displayed high closeness centralities, but quite low betweenness centralities (Appendix Tab. A2). In other words, the regional capitals were influential only within their own regional modules but relatively unimportant for the whole network. Only Bratislava City has developed dense connections across the whole country (Hypothesis 3 confirmed). It indicates that the Bratislava-centred module substantially benefitted from agglomeration effects and external economies of scale, i.e. a rich supply of skilled labour, well-developed communication infrastructure and proximity to institutions of national importance (government, universities, large suppliers). These findings resonate with those by Tao et al. (2019). At the same time, the Bratislava-centred cluster profited from co-location effects, i.e. the opportunities for networking, and accessing and sharing tacit knowledge.

As for the inter-industry network of cooperation, the computer programming (J62), retail (G47), wholesale trade (G46) and market research and advertising (M73) industries featured combinations of high closeness and betweenness centralities and weighted indegree. Computer programming accounted for a major turnover in voucher flows (measured by combined weighted indegrees and outdegrees) and profiled as a major hub and central industry for the whole network (as indicated by the highest values of the betweenness centrality measures, Appendix Tab. A1).

4.3 Evidence from qualitative research

We applied a mixed methods approach to obtain a more in-depth understanding of the creative networks. The quantitative analysis was complemented by qualitative research.

We approached the Slovak Ministry of Economy (parent organisation of the SIEA) and asked for a list of scheme participants and their contact details. We first conducted a small number of pilot interviews with creative and conventional firms. We were interested in whether they had already cooperated in the past and how this cooperation impacted participation in the scheme. The interviews indicated that previous personal experience was central for matching. The SIEA webpage was intended to provide a matching place for creative and conventional firms. The web portal, however, proved less important, while geographical proximity, the opportunity for face-to-face contacts and satisfaction with former cooperation, were essential for networking under the Creative Voucher Scheme.

The pilot interviews informed the questionnaire surveys for creative and conventional firms. The surveys addressed two topics:

1. Motivation for participation in the scheme and benefits of cooperation in the scheme; and
2. Patterns of past and future cooperation.

The first topic was addressed by short verbal protocols (SVP) and the second by 'yes/no' statements. The participant survey was implemented in June 2021. Some 124 conventional and 44 creative firms provided their responses. The structure of responses is summarised in Table 4. The geographical structure of responses followed the actual distribution of support: some 35.0% conventional

Sample	manager	owner	owner/manager	employee
Conventional firms; N = 124	14.5	13.7	57.3	14.5
Creative firms; N = 44	4.0	25.0	65.9	4.5

Tab. 4: Structure of survey respondents (%)
Source: author's survey

Plans for future co-operation	no	yes	total
	Conventional firms (N = 124)		
We have already co-operated before	36.3	23.4	59.7
This was our first-time co-operation	23.4	16.9	40.3
	Creative firms (N = 44)		
We have already co-operated before	34.1	22.7	56.8
This was our first-time co-operation	22.7	20.5	43.2

Tab. 5: History of cooperation and plans for future cooperation (%)
Source: authors' survey

and 40.1% creative firms came from the Bratislava region. The scheme mostly connected established partners. Some 59.7% of conventional firms confirmed previous cooperation with creative firms and 40.3% indicated plans for future cooperation (see Tab. 5).

The business of creative firms was significantly more volatile than that of conventional firms. We asked the SIEA for a list of supported firms. We then paired the list with financial accounts of supported enterprises. Creative firms accounted for much lower mean assets and sales than conventional ones (Tab. 1). Creative firms were the more vulnerable and proactive parties in the cooperation. Some creative firms persuaded as many as ten conventional ones to cooperate. Creative firms framed their motives for participation differently from conventional ones.

Cost-cutting in marketing and presentation was the most frequent motive for conventional firms to participate in the Creative Voucher Scheme. One firm commented:

> "We planned investment in marketing and presentation of the firm on the web. The scheme helped to pay for a good quality webpage".

Another firm noted:

> "We own a small network of private pharmacies. We wanted to unify their presentation to increase awareness of our network by customers".

A smaller number of conventional firms mentioned product and process innovations:

> "We aimed at improving intra-firm communication skills" and "We promoted our new product on the market".

Creative firms acknowledged cost-cutting intentions by their clients. One creative firm commented:

> "Most of our customers are price sensitive. The voucher pays for their creative expenditure, which would not happen otherwise".

Another creative firm confirmed:

> "It was a great opportunity for the clients to implement their projects at a discount price".

Creative firms considered the Creative Voucher Scheme an opportunity to engage in more complex projects. A webpage or digital marketing were typical products provided to partners. The creative firms wanted to go beyond the typical 'order and pay' relationship. They wished to build stable relationships with their customers. One creative firm noted:

> "There are some demanding projects with uncertain returns. We were able to do the project with existing clients only via the voucher scheme. It was a new opportunity to develop business relations".

Two other firms commented:

> "The client liked the voucher – it paid for 50% of the costs. The same client later commissioned more demanding projects with us" and "Some clients wanted to order more complex product packages but lacked money. The voucher helped to pay some costs".

The interviews indicated that creative firms flexibly adapted their business models to offer diverse products to specific clients. Most products referred to digital marketing, and recombined existing rather than introduced new ideas. These findings resonate with those by Li et al. (2008). Digital products enhanced internal economies of scale by the creative firms and helped to expand their client base (Lorezen, 2018).

The creative firms hoped to deepen their trust-based relations and approached their clients with above-standard services. The Creative Voucher Scheme distributed relatively low support but accounted for substantial administration. One conventional firm complained:

> "We were really glad to participate in the scheme, but the administrative burden was significant. Reference manuals were barely comprehensible. We had to rework our application three times, and it took one and a half years to be reimbursed for the voucher".

The administrative burden made many conventional firms hesitant about applying to the scheme. Some creative firms helped their partners to navigate complex procedures to get the cooperation done. Creative firms, for example, filled application forms and communicated with the SIEA in the name of their clients. Close cooperation was possible only via the parties' mutual knowledge and trust.

The above-standard trust-based relations and the history of former cooperation, however, did not necessarily result in permanent cooperation patterns. Some 59.7% of conventional and 56.8% of creative firms did not plan to cooperate with their project partners in the future (Tab. 2). Hence, cooperation by creative and conventional firms was opportunity-based. This finding supports Daskalaki's (2010, p. 1659) propositions about the semi-permanent but volatile nature of networks in creative industries. The survey results provide some support for Hypothesis 4.

5. Conclusions, limitations, and directions for further research

The Creative Voucher Scheme provided a unique opportunity to explore the operations of creative networks on regional and industry levels. Key findings relate to the geography of creative networks.

This research contributes to the understanding of agglomeration and co-location effects on development by creative industries. Prior research, for example, measured co-location effects indirectly, via location quotients for creative firms (Boix-Domènech et al., 2016). Dyadic data on projects by creative and traditional firms enabled more direct measures of co-operation. The network analysis revealed a distinctive core-periphery structure of the network, with the core identical with Bratislava City and the rest of the country as the periphery. The results of the network analysis are supported by those from the regression model: the Beta coefficient for distance from Bratislava was about twice the value as that for location. Results from the network analysis and qualitative research suggested that agglomeration effects and spatial proximity were key for business success. Proximity decreased transport costs and enabled face-to-face contacts and the development of a trusting relationship between creative firms and their clients (Gundolf et al., 2017; Radomska et al., 2019). The module membership was informed by spatial factors, and in the case of the fifth module, by language and cultural proximity. Short-haul partnerships were much more common than long-haul ones. Most creative firms originated in the computer programming industry and could access their clients online. They preferred trusted partners, however, whom they knew and could meet in person. Our findings that creative industries clustered in the capital region and several regional capitals confirm assumptions of agglomeration theory (Gibson and Kong, 2005). The central position of digital technologies in cooperation networks meant no 'death of distance' (Morgan, 2004). On the contrary, most networking happened on local and regional levels.

As for the co-location effects, the network analysis indicated that each regional cluster (module) had its own structure of inter-industry cooperation. The finding supports propositions by Cruz and Teixeira (2015, p. 174) and Yin and Derudder (2021, p. 9) about the presence of diverse cultural economies in smaller or peripheral cities. The Creative Voucher Scheme fostered dense and diverse creative networks. The sample of creative firms supported by the scheme cooperated with partners from no less than 60 industries. Substantial diversity of cooperating industries created opportunities for mutual learning, exchange of ideas and development of product, process, and marketing innovations (Jacobs, 1969).

Creative industries accounted for relatively minor shares in total regional economic outputs. Creative firms had to tailor their products and services to the incumbent structure of regional economies. Cooperation with conventional firms supported embeddedness by creative industries with respect to regional and local economies. The computer programming industry was a key facilitator of inter-industry cooperation in all regional modules. It contributed to the digitalisation of regional economies and boosted their resilience to technology shocks. These findings have important policy implications. The Creative Voucher Scheme seems a promising low-cost candidate for policies aimed at increasing the sophistication and embeddedness of regional economies.

Our research has some limitations concerning sample size and period of analysis. The sample of creative firms and their beneficiaries was large and well-structured in terms of industry and regional distribution. The support scheme, however, supported only four sectors of creative industries. Therefore, we do not claim the sample was representative of all creative industries and their partners in Slovakia. The sample refers to firms supported in 2019. Our research, therefore, provided a picture of inter-industry and regional creative networks in the last 'normal' year before the pandemic. The impact of the pandemic on creative firms has been strong but uneven across sub-industries. Lockdowns and other restrictive measures have impacted some firms more than others. Firms active in architecture and design, for example, have struggled to find clients, while ICT firms have benefitted from the rapid transition to the digital economy during the period.

Limitations in this work suggest directions for further research. The most intriguing question concerns the long-term impacts of the Creative Voucher Scheme on cooperation between creative firms and conventional ones. Structural economic transformation, speeded by the pandemic, increased demand for specific digital creative services. We would expect the ICT-based creative firms to expand and diversify their business across the regional economies. Follow-up research on firms supported by the voucher may improve our understanding of evolution by creative networks. Interviews with supported firms suggested that cooperation projects developed mostly between established partners. The question is how resilient this cooperation is to major external events such as pandemics and technology transition.

Flows of knowledge between and across regions, industries and firms is an important precondition of regional growth (Huggins and Thompson, 2014). The theory of recombinant growth proposes that technological advancement and economic growth do not rely primarily on the creation of new ideas, but on repurposing existing ones (Weitzman, 1998, p. 333). The theory suggests that existing ideas can be reconfigured in new ways to make new ideas. The degree of innovation is determined by the relatedness and diversity of recombined knowledge (Antonelli et al., 2010; Battke et al., 2016). Studies of inter-industry cooperation suggest that a recombination of closely related technologies results in more incremental innovations, while a high degree of unrelated variety (the recombination of very different ideas and technologies) may result in higher shares of breakthrough innovations (König et al., 2010). Follow-up research may explore whether the supported firms become more innovative and/or competitive over time. Data from the national patent office, for example, may help to identify firms applying for patents, trademarks, and industrial designs. The FinStat database enables monitoring of changes in financial indicators (e.g. sales, value added, profits) over time by supported firms. Both databases are well designed for longitudinal research, essential for research on economic evolution.

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References:

ANTONELLI, C., KRAFFT, J., QUATRARO., F. (2010): Recombinant Knowledge and Growth: The Case of ICTs. Structural Change and Economic Dynamics, 21(1): 50–69.

BAKHSHI, H., MCVITTIE, E. (2009): Creative supply-chain linkages and innovation: do the creative industries stimulate business innovation in the wider economy? Innovation: Organization & Management, 11(2): 169–189.

BAKHSHI, H., EDWARDS, J. S., ROPER, S., SCULLY, J., SHAW, D., MORLEY, L., RATHBONE, N. (2015). Assessing an experimental approach to industrial policy evaluation: Applying RCT+ to the case of Creative Credits. Research Policy, 44(8): 1462–1472.

BATTKE, B., SCHMIDT, T. S., STOLLENWERK, S., HOFFMANN, V. H. (2016): Internal or external spill overs – which kind of knowledge is more likely to flow within or across technologies. Research Policy, 45(1): 27–41.

BOIX-DOMÈNECH, R., HERVAS-OLIVER, J., MIGUEL-MOLINA, B. D. (2015): Micro-geographies of creative industries clusters in Europe: From hot spots to assemblages. Papers in Regional Science, 94(4): 753–777.

BOIX-DOMÈNECH, R., CAPONE, F., DE PROPIS, L., (2016): Comparing creative industries in Europe. European Urban and Regional Studies, 23(4): 935–940.

BOIX-DOMÈNECH, R., MOLINA, B. D., KÖSTER, P. (2021): The impact of cultural and creative industries on the wealth of countries, regions, and municipalities. European Planning Studies, 1–21.

BRANZANTI, C. (2015): Creative clusters and district economies: Towards a taxonomy to interpret the phenomenon. European Planning Studies, 23(7): 1401–1418.

CHAPAIN, C., SAGOT-DUVAUROUX, D. (2020): Cultural and creative clusters – a systematic literature review and a renewed research agenda. Urban Research & Practice, 13(3): 300–329.

CLARE, C. (2013): The essential role of place within the creative industries: Boundaries, networks, and play. Cities (34): 52–57.

CRUZ, S. S., TEIXEIRA, A. A. C. (2015): The neglected heterogeneity of spatial agglomeration and co-location patterns of creative employment: evidence from Portugal. The Annals of Regional Science, 54(1): 143–177.

DASKALAKI, M. (2010): Building 'Bonds' and 'Bridges': Linking Tie Evolution and Network Identity in the Creative Industries. Organization Studies, 31(2): 1649–1666.

DCMS (1998): The creative industries mapping document. DCMS, London.

EUROSTAT (2021): Data on the cultural sector [online]. Available at: https://ec.europa.eu/eurostat/web/culture/data/database

EASLEY, D., KLEINBERG, J. (2010): Networks, crowds, and markets reasoning about a highly connected world. Cambridge, Cambridge University Press.

FLANAGAN, K., UYARRA, E., LARANJA, M. (2011): Reconceptualising the 'policy mix' for innovation. Research Policy, 40(5): 702–713.

FELTON, E., COLLIS, C., GRAHAM, P. (2010): Making Connections: creative industries networks in outer-suburban locations. Australian Geographer, 41(1): 57–70.

FLEW, T. (2010): Toward a Cultural Economic Geography of Creative Industries and Urban Development: Introduction to the Special Issue on Creative Industries and Urban Development. The Information Society, 26(2): 85–91.

FLORIDA, R. (2005): Cities and the Creative Class, New York, Routledge.

GIBSON, C., KONG, L. (2005): Cultural economy: A critical review. Progress in Human Geography, 29(5): 541–561.

GONG, H., HASSINK, R. (2017): Exploring the clustering of creative industries, European Planning Studies, 25(4): 583–600.

GUNDOLF, K., JAOUEN, A., GAST, J. (2018): Motives for Strategic Alliances in Cultural and Creative Industries. Creativity and Innovation Management, 27(2): 148–160.

HARVEY, D. C., HAWKINS, H., THOMAS, N. J. (2012): Thinking creative clusters beyond the city: People, places, and networks. Geoforum, 43(3): 529–539.

HASSINK, R., YANG, C. (2021): Creative industries at the intersection between local agglomeration, national regulation, and global networks. Tijdschrift voor Economische en Sociale Geografie, 112(3): 217–219.

HEMELS, S. GOTO, K. (2017): Tax Incentives for the Creative Industries. Springer Science + Business Media Singapore 2017.

HUGGINS, R., THOMPSON, P. (2014): A Network-based view of regional growth. Journal of Economic Geography, 14(3): 511–545.

HUGGINS, R., THOMPSON, P. (2015): Entrepreneurship, innovation, and regional growth: a network theory. Small Business Economics, 45(1): 103–128.

JACOBS, J. (1969): The Economy of Cities. New York, Vintage.

JACOMY, M., VENTURINI, T., HEYMANN, S., BASTIAN, M. (2014): ForceAtlas2, a continuous graph layout algorithm for handy network visualization designed for the Gephi software. PLoS One, 9(6): e98679.

JALILI, M., SALEHZADEH-YAZDI, A, ASGARI, Y., ARAB, S. S., YAGHMAIE, M., GHAVAMZADEH, A., ALIMOGHADDAM, K. (2015): CentiServer: A comprehensive resource, web-based application, and R package for centrality analysis. PLoS ONE 10(11): e0143111.

KLOOSTERMAN, R. C. (2010): This is not America: Embedding the cognitive-cultural urban economy. Geografiska Annaler, Series B Human Geography, 92(2): 131–143.

KÖNIG, M. D., BATTISTONM, S., NAPOLETANO, M., SCHWEITZER, F. (2010): Recombinant knowledge and the evolution of innovation networks. Journal of Economic Behavior & Organization, 79(3): 145–164.

LAMPEL, J., GERMAIM, O. (2016): Creative industries as hubs of new organizational and business practices. Journal of Business Research, (69): 2327–2333.

LAZZERETTI, L., CAPONE, C., BOIX-DOMÈNECH, R. (2012): Reasons for Clustering of Creative Industries in Italy and Spain. European Planning Studies, 20(8): 1243–1262.

LI, F. (2020): The digital transformation of business models in the creative industries: A holistic framework and emerging trends. Technovation, 92: 102012.

LORENZEN, M. (2018): The Geography of the Creative Industries: Theoretical Stocktaking and Empirical Illustration. Chapter 16: 305–323. In: Clark, G. L., Feldman, M. P., Gertler, M. S., Wójcik, D. [eds.]: The New Oxford Handbook of Economic Geography, Oxford University Press.

MARSHALL, A. (1890): Principles of Economics. (8th ed). Macmillan and co. Online Library of Liberty, Available at: https://eet.pixel-online.org/files/etranslation/original/Marshall,%20Principles%20of%20Economics.pdf

MCCANN, P. (2008): Globalization and economic geography: the world is curved, not flat. Cambridge Journal of Regions, Economy and Society, 1(3): 351–370.

MORETON, S. (2016): Rethinking 'knowledge exchange': new approaches to collaborative work in the arts and humanities, International Journal of Cultural Policy, 22(1): 100–115.

MORGAN, K. (2004): The exaggerated death of geography: learning, proximity, and territorial innovation systems. Journal of Economic Geography, 4(1): 3–21.

OLDHAM, S., FULCHER, B., PARKES, L., ARNATKEVIČIŪTĖ, A., SUO, C., FORNITO, A. (2019): Consistency and differences between centrality measures across distinct classes networks. PLoS ONE 14(7): e0220061.

POTTS, J., CUNNINGHAM, S. (2008): Four models of the creative industries. International Journal of Cultural Policy 14(3): 233–247

POTTS, J. (2009): Why the Creative Industries Matter to Economic Evolution. Economics of Innovation and New Technology, 18(7): 663–673.

RADOMSKA, J., WOŁCZEK, P., SOŁODUCHO-PELC, L., SILVA, S. (2019): The Impact of Trust on the Approach to Management – A Case Study of Creative Industries. Sustainability, 11(3): 816.

SANTORO, G., BRESCIANI, S., PAPA, A. (2020): Collaborative modes with cultural and creative industries and innovation performance: the moderating role of heterogeneous sources of knowledge and absorptive capacity. Technovation, (92–93): 102040.

SHIACH M., VIRANI, T. (2017): Cultural Policy, Collaboration and Knowledge Exchange. In: Shiach, M., Virani T. [eds.]: Cultural Policy, Innovation and the Creative Economy (pp. 17–30). London, Palgrave Macmillan. Availablle at: https://doi.org/10.1057/978-1-349-95112-3_2

TAO, J., HO, C. Y., LUO, S., SHENG, Y. (2019): Agglomeration economies in creative industries. Regional Science and Urban Economics, 77: 141–154.

VIRANI, T. E. (2015): Do voucher schemes matter in the long run? A brief comparison of Nesta's Creative Credits and Creative works London's Creative Voucher schemes. Creativeworks London Working Paper 10 [online]. Available at: https://core.ac.uk/download/pdf/30697252.pdf

WATSON, A. (2012): Sociological Perspectives on the Economic Geography of Projects: The Case of Project-Based Working in the Creative Industries. Geography Compass, 6(10): 617–631.

WEITZMAN, M. L. (1998): Recombinant growth. Quarterly Journal of Economics, 113(2): 331–360.

YIN, M., DERUDDER, B. (2021): Geographies of cultural industries across the global urban system. Geography Compass, 15(6): e12564.

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Appendices

Industry code	Weighted degree	Weighted indegree	Weighted outdegree	Closeness centrality	Betweenness centrality	Industry code	Weighted degree	Weighted indegree	Weighted outdegree	Closeness centrality	Betweenness centrality
J62	1,142,651	218,436	924,215	0.7867	0.1443	R90	27,315	27,315	0	0.0000	0.0000
M73	813,369	182,778	630,591	0.7108	0.1190	N77	27,060	22,060	5,000	0.3010	0.0003
G47	660,182	516,179	144,003	0.5842	0.0569	S95	19,845	19,845	0	0.0000	0.0000
M71	452,799	78,765	374,034	0.5842	0.0215	C14	18,220	18,220	0	0.0000	0.0000
G46	387,869	298,167	89,702	0.5315	0.0512	I55	17,100	17,100	0	0.0000	0.0000
M70	342,877	224,154	118,723	0.5463	0.0317	A01	15,740	15,740	0	0.0000	0.0000
N82	291,128	134,195	156,933	0.5960	0.0568	K64	14,370	14,370	0	0.0000	0.0000
J63	183,687	59,235	124,452	0.5619	0.0186	C16	13,641	13,641	0	0.0000	0.0000
M74	171,927	83,569	88,358	0.5315	0.0245	C32	12,093	12,093	0	0.0000	0.0000
F43	148,706	142,861	5,845	0.4184	0.0100	C22	11,883	11,883	0	0.0000	0.0000
L68	122,636	122,636	0	0.0000	0.0000	C20	11,865	11,865	0	0.0000	0.0000
I56	113,657	55,814	57,843	0.4876	0.0087	C33	11,560	11,560	0	0.0000	0.0000
M69	102,574	95,624	6,950	0.3010	0.0014	C28	11,500	11,500	0	0.0000	0.0000
G45	94,025	66,155	27,870	0.4504	0.0006	Q86	10,709	10,709	0	0.0000	0.0000
P85	76,304	41,638	34,666	0.3831	0.0002	M75	9,935	9,935	0	0.0000	0.0000
F41	75,415	41,210	34,205	0.4876	0.0048	C29	9,700	9,700	0	0.0000	0.0000
R93	74,215	54,340	19,875	0.4245	0.0177	D35	9,590	9,590	0	0.0000	0.0000
S96	58,735	39,240	19,495	0.3882	0.0013	C31	9,335	9,335	0	0.0000	0.0000
J59	51,349	22,170	29,179	0.4917	0.0003	C23	8,823	3,833	4,990	0.3782	0.0000
C10	49,762	45,062	4,700	0.4184	0.0083	K66	8,700	3,750	4,950	1.0000	0.0003
H53	48,185	9,090	39,095	0.4836	0.0000	C11	8,700	8,700	0	0.0000	0.0000
N81	43,120	38,285	4,835	0.3512	0.0002	C17	5,000	5,000	0	0.0000	0.0000
J58	39,356	15,978	23,378	0.4646	0.0004	J61	4,580	4,580	0	0.0000	0.0000
C18	37,825	14,220	23,605	0.4126	0.0000	N78	4,325	4,325	0	0.0000	0.0000
H49	33,515	10,290	23,225	0.3782	0.0009	O84	4,315	4,315	0	0.0000	0.0000
C25	32,558	32,558	0	0.0000	0.0000	C26	4,101	4,101	0	0.0000	0.0000
H52	31,249	31,249	0	0.0000	0.0000	C13	4,000	4,000	0	0.0000	0.0000
S94	28,525	23,950	4,575	0.4436	0.0012	C27	3,980	3,980	0	0.0000	0.0000
N79	27,898	14,648	13,250	0.4504	0.0000	E38	3,600	3,600	0	0.0000	0.0000
F42	27,776	23,026	4,750	1.0000	0.0005	H51	1,125	1,125	0	0.0000	0.0000

Appendix 1: Industry network statistics (Notes: Values of all degrees are in Euros)
Source: authors' computations

District code	District name	Weighted degree	Weighted indegree	Weighted outdegree	Closeness centrality	Betweenness centrality
BA	Bratislava City	2,049,875	1,002,933	1,046,942	0.6966	0.3581
PO	Prešov	667,678	299,529	368,149	0.4806	0.0339
KE	Košice City	346,985	195,389	151,596	0.4882	0.0579
BB	Banská Bystrica	324,487	146,552	177,935	0.4662	0.0545
ZA	Žilina	183,744	68,676	115,068	0.4769	0.0209
SC	Senec	178,296	24,008	154,288	0.4844	0.0283
PN	Piešťany	177,802	91,153	86,649	0.3543	0.0290
SN	Spišská Nová Ves	177,512	93,165	84,347	0.4493	0.0019
NR	Nitra	159,741	63,003	96,738	0.4460	0.0195
PK	Pezinok	126,633	70,968	55,665	0.4133	0.0078
DT	Detva	100,043	37,333	62,710	0.3388	0.0020
PD	Prievidza	98,159	68,091	30,068	0.3780	0.0197
TV	Trebišov	91,488	4,895	86,593	0.4559	0.0032
ZV	Zvolen	84,667	56,099	28,568	0.4218	0.0061
TN	Trenčín	82,374	46,489	35,885	0.4336	0.0163
SE	Seninca	80,780	29,720	51,060	0.4336	0.0014
KN	Komárno	72,414	33,463	38,951	0.2995	0.0001
LM	Liptovský Mikuláš	72,028	30,349	41,679	0.4627	0.0188
MT	Martin	71,495	25,795	45,700	0.4559	0.0183
TT	Trnava	67,689	41,106	26,583	0.3713	0.0063
HE	Humenné	63,456	39,906	23,550	1.0000	0.0121
GA	Galana	60,789	41,741	19,048	0.4133	0.0045
MI	Michalovce	52,915	22,950	29,965	0.3464	0.0045
BJ	Bardejov	47,593	36,130	11,463	0.3464	0.0112
PB	Považská Bystrica	42,875	33,400	9,475	0.0000	0.0000
VT	Vranov nad Topľou	41,491	8,390	33,101	0.4593	0.0235
SB	Sabinov	41,305	41,305	0	0.0000	0.0000
IL	Ilava	40,960	22,152	18,808	0.4276	0.0007
TO	Topoľčany	38,138	38,138	0	0.0000	0.0000
TS	Tvrdošín	30,471	17,070	13,401	0.3298	0.0034
SA	Šaľa	27,898	19,440	8,458	1.0000	0.0087
NZ	Nové Zámky	26,749	21,749	5,000	0.4133	0.0074
DS	Dunajská Stredaa	24,295	8,375	15,920	0.4189	0.0156
KM	Kysucké Nové Mesto	24,045	15,450	8,595	0.4133	0.0000
KS	Košice-okolie	22,755	12,855	9,900	0.3298	0.0000
SL	Stará Ľubovňa	19,010	0	19,010	0.3500	0.0000
NM	Nové Mesto nad Váhom	18,410	14,110	4,300	0.2627	0.0010
ZM	Zlaté Moravce	16,825	8,675	8,150	0.4218	0.0000
SI	Skalica	16,205	16,205	0	0.0000	0.0000
KK	Kežmarok	15,225	15,225	0	0.0000	0.0000
PU	Púchov	14,120	14,120	0	0.0000	0.0000
BS	Banská Štiavnica	13,623	8,933	4,690	0.4161	0.0000
TR	Turčianske Teplice	13,315	13,315	0	0.0000	0.0000
BN	Bánovce nad Bebravou	13,125	13,125	0	0.0000	0.0000
SV	Snina	12,700	12,700	0	0.0000	0.0000
ML	Medzilaborce	12,450	12,450	0	0.0000	0.0000

Appendix 2: continuation on the next page

District code	District name	Weighted degree	Weighted indegree	Weighted outdegree	Closeness centrality	Betweenness centrality
VK	Veľký Krtíš	11,100	11,100	0	0.0000	0.0000
RV	Rožňavaa	11,052	7,927	3,125	1.0000	0.0087
DK	Dolný Kubín	10,360	10,360	0	0.0000	0.0000
LE	Levoča	9,470	9,470	0	0.0000	0.0000
LV	Levice	9,173	9,173	0	0.0000	0.0000
PP	Poprad	9,095	9,095	0	0.0000	0.0000
RS	Rimavská Sobota	6,600	4,290	2,310	0.3069	0.0002
CA	Čadca	6,114	1,214	4,900	1.0000	0.0013
ZH	Žiar nad Hronom	5,775	5,775	0	0.0000	0.0000
MA	Malacky	5,000	5,000	0	0.0000	0.0000
BR	Brezno	4,963	4,963	0	0.0000	0.0000
SO	Sobrance	4,950	0	4,950	1.0000	0.0000
NO	Námestovo	4,890	4,890	0	0.0000	0.0000
PE	Partizánske	4,528	4,528	0	0.0000	0.0000
RK	Ružomberok	4,450	4,450	0	0.0000	0.0000
LC	Lučenec	3,800	3,800	0	0.0000	0.0000
SP	Stropkov	3,800	3,800	0	0.0000	0.0000
BY	Bytča	3,708	3,708	0	0.0000	0.0000
GL	Gelnica	3,125	3,125	0	0.0000	0.0000

Appendix 2: Regional network statistics (Notes: Bratislava [BA] comprises five urban districts; Košice [KE] comprises four urban districts. Districts are ranked by their weighted degrees. Values of all degrees are in Euros.) Source: authors' computations