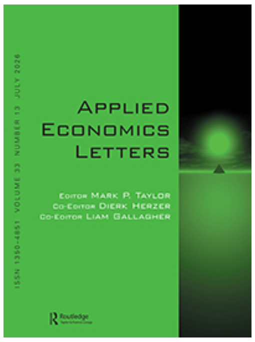


Applied Economics Letters

ISSN: 1350-4851 (Print) 1466-4291 (Online) Journal homepage: www.tandfonline.com/journals/rael20

No social capital without biodiversity

Anna Auza & José Alberto Fuinhas

To cite this article: Anna Auza & José Alberto Fuinhas (13 Apr 2025): No social capital without biodiversity, Applied Economics Letters, DOI: 10.1080/13504851.2025.2489780

To link to this article: https://doi.org/10.1080/13504851.2025.2489780

Published online: 13 Apr 2025.

APPLIED ECONOMICS LETTERS
https://doi.org/10.1080/13504851.2025.2489780

Routledge
Taylor & Francis Group

OPEN ACCESS Check for updates

No social capital without biodiversity

Anna Auza and José Alberto Fuinhas

Faculty of Economics, Centre for Business and Economics Research (CeBER), University of Coimbra, Coimbra, Portugal

ABSTRACT

One of the determinants of a more equal income distribution in society is social capital, measured by economic connectedness. This instance can be augmented by improving biodiversity as a necessary condition for the outcome. We find this by employing necessary condition analysis. On the other hand, qualitative comparative analysis results in a lack of sufficiency of biodiversity for the outcome or non-outcome of economic connectedness.

KEYWORDS
Biodiversity; social capital; sustainable development; United States; necessary condition analysis

JEL CLASSIFICATION
I39; Q57; C49

I. Introduction

While most say there is too much income inequality (Horowitz, Igielnik, and Kochhar 2020) and view climate change as a significant threat (Tyson, Funk, and Kennedy 2023) linked positively to income inequality (Grunewald et al. 2017). Here, biodiversity is understood as the variety of life on Earth, including species diversity, genes, and ecosystems (hereafter referred to as the diversity of species). Research with some exceptions (e.g. Ambrey, Fleming, and Manning 2016) keeps being largely unlinked to socioeconomic outcomes, especially on a smaller-than-macro scale (Eydam and Qualo 2023), and – as a consequence or reason – also does not integrate firmly and permanently into developed country policies (Reber et al. 2022) and globally in general (Petersson and Stoett 2022).

This paper addresses the lack of quantitative and qualitative exploration of causal mechanisms by conducting necessary condition analysis (NCA), drawing upon the capability approach as the theoretical basis. Hence, we define the functioning of economic connectedness as the end for the city (the unit of analysis). At the same time, means-related public good (biodiversity) is conversed into ends (see Figure 1 and data).

The need for modelling for biodiversity effects on social capital directly stems from the salience of social capital, as getting ahead, or upward income mobility, is strongly predicted by economic connectedness (Chetty et al. 2022), and the perception of mobility decrease has increased the perception of the problem of unequal opportunity as a serious domestic problem (Alesina, Stantcheva, and Teso 2018). We follow Chetty et al. (2022), defining cross-class interaction as economic connectedness, which is measured by the share of high socio-economic status friends between people with low and high socio-economic status. This salience of mobility, and therefore the importance of its cause – social capital, makes the biodiversity effects prominent on the research agenda, as biodiversity already does and is expected to undergo significant changes in the coming decades (Isbell et al. 2017).

Therefore, to find out how biodiversity impacts economic connectedness via NCA, we undertake this research and bridge the knowledge gap by:

- Linking biodiversity with social capital
- Undertaking city-level analysis on a national level.

We hypothesize the causality since higher biodiversity is associated with community empowerment and stronger social cohesion (Leong, Dunn, and Trautwein 2018) due to the luxury effect, that is, higher biodiversity in affluent neighbourhoods, while there is an unequal distribution of benefits of urban biodiversity in communities with higher minority populations, which do not suffer from a social capital deficit but do not experience the

CONTACT José Alberto Fuinhas fuinhas@uc.pt Faculty of Economics, Centre for Business and Economics Research (CeBER), University of Coimbra, Av Dias da Silva 165, Coimbra 3004-512, Portugal

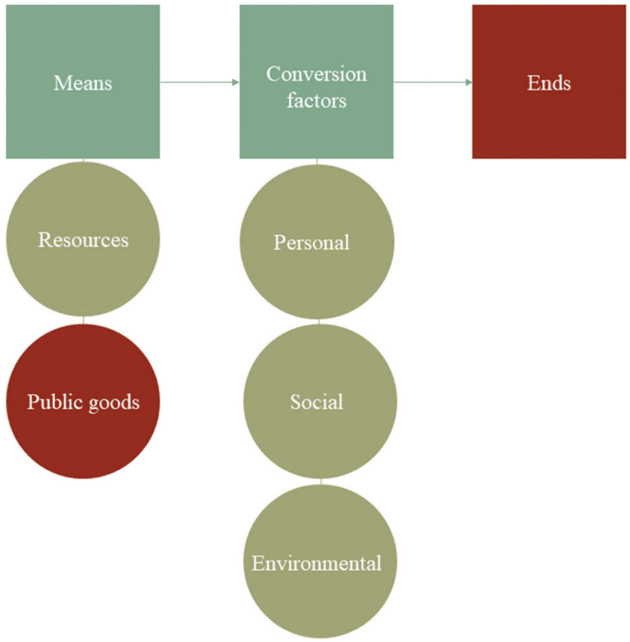


Figure 1. Capabilities approach. *Source*: based on (Robeyns and Fibieger Byskov 2023).

same return to social capital they have, thus inhibiting the economic connectedness (Baalbergen and Jaspers 2023). We find that biodiversity is insufficient but may be necessary for economic connectedness, and we call for further inquiry into the linkage.

II. Methodology and data

The analysis for continuous necessary conditions starts with plotting the data on a two-dimensional Euclidian space and drawing a ceiling line. The quantile regression is principally applied in this investigation because it has the highest accuracy score and empirically includes no observations in the ceiling zone (Dul 2016). Then, the effect size can be analysed, namely, the relative size of the no-observation zone to the outcome (scope, i.e. a potential area of observations). Regarding the data used, we draw the ceiling line for various conditions, all for one-by-one relations. The data used in the investigation are listed in Table 1.

The dataset used for QCA is calibrated from the original distributions shown in Figure 1. The dataset for the biodiversity variable BIOD was created as described in Appendix Table A1.

The sufficiency and necessity are then analysed within the primary framework of necessary conditions (NCA) shown in Figure 2(b), or sufficiency, in Figure 2(a). As NCA identifies necessary (but not sufficient) conditions, meaning a specific factor must be present for an outcome to occur but does not guarantee it, we also aid our analysis by employing QCA.

III. Results

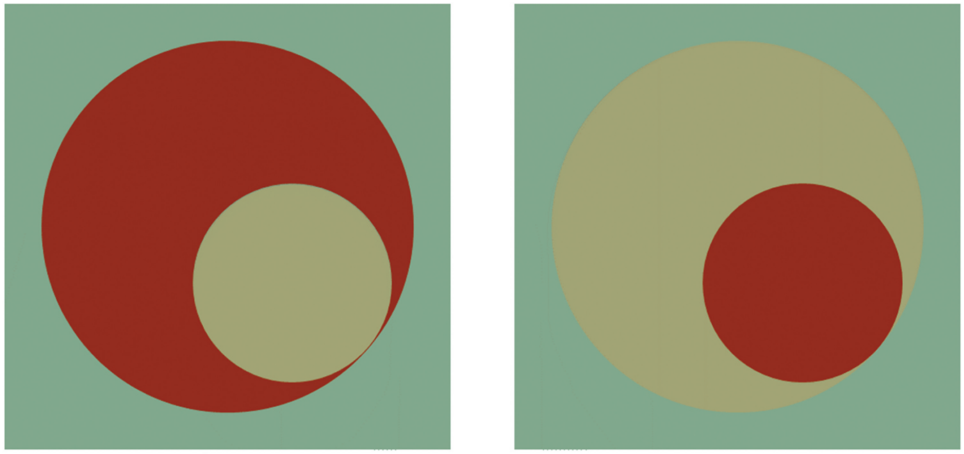
When drawing a ceiling line for the outcome *of economic connectedness in neighbourhoods and considering conditions where the biodiverse area overlaps* 5 and 10 km from the city's location, the results show that biodiversity has a medium effect on economic connectedness within 25, 50, and 100 km radiuses of the area.

Figure 1 shows the biodiversity conditions on a spatial scale to explain the biodiversity measure better. As previously stated, all data are from the US.

Table 1. Data sources.

Dataset name	Source	Variable/-s	Type	Spatiality	Temporality
Economic Connectedness	Opportunity Insights (n.d.)	EC; NBHD_EC; EC_GRP_MEM	Numerical	ZIP code	*instant*
Protected Areas Database (PAD-US) 3.0 Data[1]	U.S. Geological Survey (USGS) Gap Analysis Project (GAP) (2022)	BIOD; DIST	Geospatial	m^2	*instant*[1]
500Cities: City Boundaries	US Centers for Disease Control and Prevention	*construction factor for* BIOD; DIST	Geospatial	m^2	*instant*
US Major Cities	ArcGIS HUB	BIOD; DIST	Geospatial	m^2	*instant*
American Community Survey (ACS): Financial Characteristics	US Census Bureau (2021)	INC_SKEW; INC_MEAN INC_HH	Numerical	ZCTA5[2]	2011–2020
ACS: Age and Sex	US Census Bureau (2021)	POP, AGE_SIM	Numerical	ZCTA5[2]	2011–2020
ACS: Educational Attainment	US Census Bureau (2021)	EDU_SIM	Numerical	ZCTA5[2]	2011–2020
US Cities Database Basic	SimpleMaps	*conversion factor (see Table A1)*	Numerical	ZCTA5[2, 3]	*instant*

[1]The authors of the dataset recommend not comparing the different releases (different years), as many "changes reflect improvements to agency and organization GIS systems and data, rather than actual changes in protected area acquisition on the ground".
[2]ZCTA5 is a zip code tabulation area that roughly corresponds to US ZIP codes.



(a) (b)

Figure 2. Set relations are depicted in Euler diagrams. The red area of the graph on the left-hand side depicts the necessary condition for the outcome to occur, while the red area on the right-hand side depicts the sufficient condition. *Source*: redrawn from Mello (2021).

Table 2. The necessity of biodiversity for neighbourhood economic connectedness.

Win. 5	Biodiversity (win 5) for neighbourhood economic connectedness				
Biodiversity distance	10	25	50	75	100
Effect size		0.242	0.235		0.255
Accuracy		95.6	95.9		95.4
Fit		NA	NA		NA
Slope		0	0		0
Intrecept		1.315	1.32		1.32
Win. 10	Biodiversity (win 10) for neighbourhood economic connectedness				
Biodiversity distance	10	25	50	75	100
Effect size	0.262	0.250			0.247
Accuracy	95.3	95.6			95.4
Fit	NA	NA			NA
Slope	0	0			0
Intercept	1.287	1.315			1.287

Win signifies winsorising at the level of 10th or 5th percentile.

Drawing the ceiling line for the outcome of neighbourhood economic connectedness, only biodiversity within a 25, 50, and 100 km radius of the city counts, with the most significant effect size being for biodiversity further away. The results from the NCA are listed in Table 2.

These results show that biodiversity is necessary for individuals to be socio-economically connected within a neighbourhood, that is, the linkages between high- and low-socioeconomic-status individuals within an individual's neighbourhood to be high. Therefore, one can suggest no economic connectedness or biodiversity in a distant neighbourhood. The results at 25 and 100 km overlay distances hold for different winsorizing levels.

To further inquire about causality, we ask whether, in case there is biodiversity, there is also social capital measured by economic connectedness. That is why we test sufficiency by qualitative comparative analysis (QCA). We find that for a 50 km distance, results are weak in the sense of coverage sufficiency, and biodiversity represents a peripherical condition when in conjunction with distance to the nearest large city, income skewness, income similarity in households, education similarity, age similarity, and population size, as in Table 3. Supporting tables for analysis of calibrated necessary conditions one by one (Table A2) and sufficiency analysis (Table A3) are available in the Appendix.

Table 3. Intermediate solution for high (low) economic connectedness for BIOD-50 km data with QCA (sufficiency analysis).

Outcome		*Economic connectedness*		*Non-economic connectedness*						
Path		P1	P2	S1P1		S1P2		S2P1	S2P2	S2P3
BIOD		•	•	●				●	●	
DIST		●	●	⊗		⊗		⊗	⊗	⊗
INC_SKEW		●	●			⊗			⊗	⊗
INC_HH			•	●		●		●	●	●
EDU_SIM		•		•		•		•	•	•
AGE_SIM		•	⊗	•		•		•	•	•
POP		⊗	•			•		•		•
Consistency		0.877	0.914	0.921		0.893		0.928	0.930	0.893
Raw coverage		0.441	0.260	0.285		0.339		0.269	0.255	0.339
Unique coverage		0.186	0.005	0.045		0.099		0.029	0.015	0.099
Solution	Cons.	PRI	CovS	Cons.	PRI		CovS	Cons.	PRI	CovS
	0.877	0.720	0.446	0.887	0.687		0.383	0.887	0.687	0.383

● represents the core condition, • represents the peripheral (complementary) causal condition, and blank space represents the "no care" state for the condition. ⊗ represents a negation of the core condition and ⊗ represents a negation of the peripheral condition.

Table 4. QCA (sufficiency analysis) solution paths for economic connectedness.

Outcome	*Economic connectedness*		*Non-economic connectedness*				
Paths	P1	P2	S1P1	S1P2	S2P1	S2P2	S2P3
Consistency > 0.8	✓	✓	✓	✓	✓	✓	✓
Consistency > 0.9	(✓)	✓	✓	✓	✓	✓	✓
Frq. 20, cons. >0.8	(✓)	(✓)			✓		✓
PRI > 0.7	(✓)				(✓)		

✓ denotes that the same solution paths occur. (✓) denotes that the solution is comparable, but condition one is added, removed, or changed compared to the initial analysis.

Looking at the solution paths (see Table 4), the path of the main interest is P5, named Biodiverse connectedness, with case membership listed in Table A3 of the Appendix. While the consistency is relatively high, the coverage of the solution path is rather low, showing that the solution is trivial. Suffice it to say that merely high levels of BIOD do not lead to high EC for the 50 km distance variable when various socio-economic similarity indices are low (INC_MEAN, INC_HH, EDU_SIM, AGE_SIM) and the population is low, too.

Not only is the sufficiency condition trivial for 50 km, but it is also necessary when biodiversity is winsorized to the 10th percentile point.

IV. Discussion

With the backdrop of global environmental change, biodiversity is the key strategy for a sustainable ecosystem, partly because biodiverse communities are more resistant to it (Hong et al. 2022). However, how much does it impact the social sphere of living beings, such as the social capital of humans, that is so beneficial for income equality through upward income mobility (Chetty et al. 2022; Corak 2013)?

We find that biodiversity is seldom sufficient (by the QCA method) but quite often necessary (by the NCA method) to guarantee social capital accumulation within the neighbourhood. It opens doors to further investigation into the luxury effects of biodiversity recently noted by (Leong, Dunn, and Trautwein 2018). There is an unequal distribution of biodiversity benefits where the luxury effect exists, particularly in minority group-dominated neighbourhoods (Leong, Dunn, and Trautwein 2018) with lower social capital returns (Baalbergen and Jaspers 2023). Increasing biodiversity in these neighbourhoods may help attain social capital similar to that of the majority of neighbourhoods, which may allow for higher returns. There may also be cyclical causation whereby biodiversity enhances the return to social capital in some neighbourhoods but not others, which again feeds into the luxury effect of choosing biodiverse areas as living spaces for those better off. These effects need further investigation.

The main drawback of the studies today lies in focusing on neighbourhood or landscape effects within the boundaries of a research area. This study, in turn, aims to connect sociology, economics, and ecology – the three legs of sustainability by inquiring about the necessity aspect of causality. However, we warn against interpreting these effects as causal, as more research is needed to confirm the causality of this correlation. Significantly, concerning widening both the scope and methodologies applied to ecological economics, the study encourages further exploration of necessary conditions that join biodiversity to social capital and income inequality research.

Author contributions

CRediT: **Anna Auza:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Visualization, Writing – original draft; **José Alberto Fuinhas:** Funding acquisition, Investigation, Methodology, Supervision, Validation, Writing – review & editing.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported by the Portuguese Science and Technology Foundation under Grant [2023.01539.BD]. CeBER's research is funded by national funds through FCT —Fundação para a Ciência e a Tecnologia, I.P., through project UIDB/05037/2020, DOI 10.54499/UIDB/05037/2020.

References

Alesina, A., S. Stantcheva, and E. Teso. 2018. "Intergenerational Mobility and Preferences for Redistribution." *The American Economic Review* 108 (2): 521–554. https://doi.org/10.1257/aer.20162015.

Ambrey, C. L., C. M. Fleming, and M. Manning. 2016. "The Role of Natural Capital in Supporting National Income and Social Welfare." *Applied Economics Letters* 23 (10): 723–727. https://doi.org/10.1080/13504851.2015.1102839.

Baalbergen, I., and E. Jaspers. 2023. "Social Capital and Its Returns as an Explanation for Early Labor Market Success of Majority and Minority Members in the Netherlands." *Social Indicators Research* 165 (1): 53–76. https://doi.org/10.1007/s11205-022-03002-8.

Chetty, R., M. O. Jackson, T. Kuchler, J. Stroebel, N. Hendren, R. B. Fluegge, S. Gong, et al. 2022. "Social Capital I: Measurement and Associations with Economic Mobility." *Nature* 608 (7921): 108–121. https://doi.org/10.1038/s41586-022-04996-4.

Corak, M. 2013. "Income Inequality, Equality of Opportunity, and Intergenerational Mobility." *Journal of Economic Perspectives* 27 (3): 79–102. https://doi.org/10.1257/jep.27.3.79.

Dul, J. 2016. "Necessary Condition Analysis (NCA)." *Organizational Research Methods* 19 (1): 10–52. https://doi.org/10.1177/1094428115584005.

Eydam, U., and H. Qualo. 2023. "Income Inequality and Taxes–An Empirical Assessment." *Applied Economics Letters* 31 (18): 1828–1835. https://doi.org/10.1080/13504851.2023.2208328.

GAP (U.S. Geological Survey (USGS) Gap Analysis Project). 2022. "Protected Areas Database of the United States (PAD-US) 3.0: U.S. Geological Survey Data Release." https://www.usgs.gov/programs/gap-analysis-project/science/pad-us-data-download.

Grunewald, N., S. Klasen, I. Martínez-Zarzoso, and C. Muris. 2017. "The Trade-Off Between Income Inequality and Carbon Dioxide Emissions." *Ecological Economics* 142:249–256. https://doi.org/10.1016/j.ecolecon.2017.06.034.

Hong, P., B. Schmid, F. De Laender, N. Eisenhauer, X. Zhang, H. Chen, D. Craven, et al. 2022. "Biodiversity Promotes Ecosystem Functioning Despite Environmental Change." *Ecology Letters* 25 (2): 555–569. https://doi.org/10.1111/ele.13936.

Horowitz, J. M., R. Igielnik, and R. Kochhar. 2020. "Views of Economic Inequality." Pew Research Center. January 9. https://www.pewresearch.org/social-trends/2020/01/09/views-of-economic-inequality/.

Isbell, F., A. Gonzalez, M. Loreau, J. Cowles, S. Díaz, A. Hector, G. M. MacE, et al. 2017. "Linking the Influence and Dependence of People on Biodiversity Across Scales." *Nature* 546 (7656): 65–72. https://doi.org/10.1038/nature22899.

Leong, M., R. R. Dunn, and M. D. Trautwein. 2018. "Biodiversity and Socioeconomics in the City: A Review of the Luxury Effect." *Biology Letters* 14 (5): 20180082. https://doi.org/10.1098/rsbl.2018.0082.

Mello, P. A. 2021. *Qualitative Comparative Analysis: An Introduction to Research Design and Application*. Washington, DC: Georgetown University Press.

Opportunity Insights. n.d. *Commuting-Zone-Level Causal Place Effects and Covariates*. Cambridge, Massachusetts: Harvard University.

Petersson, M., and P. Stoett. 2022. "Lessons Learnt in Global Biodiversity Governance." *International Environmental Agreements: Politics, Law and Economics* 22 (2): 333–352. https://doi.org/10.1007/s10784-022-09565-8.

Reber, U., M. Fischer, K. Ingold, F. Kienast, A. M. Hersperger, R. Grütter, and R. Benz. 2022. "Integrating Biodiversity: A Longitudinal and Cross-Sectoral Analysis of Swiss Politics." *Policy Sciences* 55 (2): 311–335. https://doi.org/10.1007/s11077-022-09456-4.

Robeyns, I., and M. Fibieger Byskov. 2023. *The Capability Approach*. Stanford Encyclopedia of Philosophy. https://leibniz.stanford.edu/friends/info/copyright/.

Tyson, A., C. Funk, and B. Kennedy. 2023. "What the Data Says About Americans' Views of Climate Change." Pew Research Center. August 9. https://www.pewresearch.org/short-reads/2023/08/09/what-the-data-says-about-americans-views-of-climate-change/.

US Census Bureau. 2021. *Census Bureau Data*. January 9. https://data.census.gov/.

Appendix

Table A1. Dataset creation.

Step	Variable created	Data name	Description
1	BIOD	Protected Areas Database (PAD-US) 3.0 Data; CityBoundaries (REF),	Using QGIS 3.30 software, a layer was created by buffering 10 km/25 km/50 km/75 km/100 km for each USA city, and an intersection area between the respective buffer layers and protected areas layers was calculated.
2	DIST	PAD-US 3.0 (REF); City Boundaries (REF); State Capitals (REF US Major Cities)	Using QGIS 3.30 software, the hub distance between intersection layers BIOD and the closest state capital from the database of major US cities was calculated.
3	INC_SKEW	INC, ZCTA to city	Using R packages **moments**, and precisely function **scale** and **skewness** calculated similarity (Z-scores) between different household types (households, families, married couple families, nonfamily households) within estimated income groups (less than $10,000, $10,000 to $14,999, etc.) for each ZCTA. Afterwards, the calculated distribution (skewness) of the Z-scores across the income groups. Lastly, this constructed variable was joined to the data frame merging by year and city (based on the ZCTA-to-city dataset) via package **dplyr**.
4	INC_MEAN	INC, ZCTA to city	Using R packages **moments**, and precisely function **scale** and **skewness** calculated similarity (Z-scores) between different household types (households, families, married couple families, nonfamily households) within estimated income groups (less than $10,000, $10,000 to $14,999, etc.). Afterwards, the average(mean) of the Z-scores is calculated. Lastly, this constructed variable was joined to the data frame merging by year and city (based on the ZCTA-to-city dataset) via package **dplyr**.
5	INC_HH	INC, ZCTA to city	Using R packages **moments**, precisely function scale, similarity (Z-scores) between different household income groups was calculated. This constructed variable was joined to a data frame merging by year and city (based on the ZCTA-to-city dataset) via package **dplyr**.
6	EDU_SIM	EDU, ZCTA to city	Using R packages **moments** and a precise function scale, the similarity (Z-scores) between estimated counts for each highest attained education level (less than high school graduate, high school graduate (includes equivalency), etc.) was calculated. Lastly, this constructed variable was joined to the data frame merging by year and city (based on the ZCTA-to-city dataset) via package **dplyr**.
7	AGE_SIM	AGE, ZCTA to city	Using R packages **moments**, specifically function **scale**, calculated similarity (Z-scores) between estimated counts for each age group. Lastly, this constructed variable was joined to the data frame merging by year and city (based on the ZCTA-to-city dataset) via package **dplyr**.
8	POP	AGE, ZCTA to city	The total estimated population for each geographic area was used. Lastly, this constructed variable was joined to the data frame merging by year and city (based on the ZCTA-to-city dataset) via package **dplyr**.
9	EC; NBHD_EC; EC_GRP_MEM	Economic Connectedness, ZCTA to city	Used respective values from the dataset and merged the source data to the data frame using **dplyr** package by ZIP code.

Table A2. Analysis of necessary conditions.

	Economic connectedness		Non-economic connectedness	
Conditions	Consistency	Coverage	Consistency	Coverage
BIOD	0.502	0.699	0.504	0.704
~BIOD	0.787	0.613	0.785	0.612
DIST	0.721	0.726	0.602	0.608
~DIST	0.611	0.605	0.729	0.724
INC_SKEW	0.708	0.718	0.589	0.599
~INC_SKEW	0.605	0.595	0.723	0.713
INC_HH	0.547	0.637	0.596	0.698
~INC_HH	0.741	0.647	0.690	0.604
EDU_SIM	0.583	0.647	0.646	0.720
~EDU_SIM	0.748	0.678	0.683	0.621
AGE_SIM	0.573	0.628	0.654	0.719
~AGE_SIM	0.744	0.682	0.662	0.609
POP	0.573	0.649	0.633	0.716
~POP	0.749	0.670	0.690	0.620

Necessary condition analysis is presented when considering BIOD for the 50 km buffer zone and outcome EC_NBHD. The R package 'QCA' function 'pof' was used.

Table A3. Truth tables for outcome and nonoutcome of economic connectedness.

	Conditions for high economic connectedness							Freq.	Out.	Consistency	
	BIOD	DIST	INC_SKEW	INC_HH	EDU_SIM	AGE_SIM	POP			Raw	PRI
1	1	1	1	0	0	0	0	27	1	0.930	0.680
2	1	1	1	0	1	0	0	18	1	0.930	0.663
3	1	1	1	0	0	0	0	49	1	0.915	0.704
4	0	1	1	1	0	0	0	19	1	0.914	0.698
5	0	1	1	0	0	0	0	123	1	0.878	0.702
6	1	1	1	0	1	1	1	24	0	0.924	0.569
7	1	1	1	1	1	1	1	22	0	0.920	0.557
8	1	1	0	1	0	0	0	25	0	0.911	0.602
9	0	1	1	1	1	1	1	42	0	0.907	0.608
10	1	1	0	1	1	1	1	74	0	0.897	0.491
11	0	1	1	0	0	1	1	27	0	0.892	0.601
12	1	0	1	1	0	0	0	21	0	0.890	0.514
13	0	1	1	0	1	1	1	46	0	0.887	0.586
14	0	0	1	1	0	0	0	15	0	0.887	0.589
15	1	1	0	0	0	0	0	76	0	0.886	0.606
16	1	0	1	0	0	1	1	22	0	0.882	0.376
17	1	0	1	0	0	0	0	77	0	0.877	0.602
18	0	0	1	1	1	1	1	36	0	0.873	0.452
19	1	0	1	0	1	1	1	46	0	0.872	0.354
20	0	1	0	1	0	0	0	32	0	0.872	0.535
21	0	0	1	0	0	1	1	19	0	0.866	0.478
22	1	0	1	1	1	1	1	74	0	0.866	0.343
23	1	0	0	1	1	1	0	19	0	0.866	0.307
24	0	0	1	0	1	1	1	30	0	0.860	0.452
25	1	0	0	1	0	0	0	35	0	0.844	0.371
26	0	1	0	1	1	1	1	94	0	0.840	0.438
27	1	0	0	0	0	0	0	53	0	0.831	0.443
28	0	0	1	0	0	0	0	60	0	0.830	0.548
29	0	1	0	0	0	0	0	93	0	0.829	0.520
30	1	0	0	1	1	1	1	136	0	0.813	0.237
31	0	0	0	1	1	1	1	97	0	0.799	0.291
32	0	0	0	0	0	0	0	41	0	0.781	0.367
33-128				Logical reminders				?			
	Conditions for low economic connectedness							Freq.	~Out.	Consistency	
	BIOD	DIST	INC_SKEW	INC_HH	EDU_SIM	AGE_SIM	POP			Raw	PRI
1	1	0	0	1	1	1	0	19	1	0.941	0.693
2	1	0	0	1	1	1	1	136	1	0.938	0.745
3	1	0	1	1	1	1	1	74	1	0.930	0.657
4	1	0	1	0	1	1	1	46	0	0.929	0.643
5	1	0	1	0	0	1	1	22	0	0.929	0.624
6	0	0	0	1	1	1	1	97	1	0.910	0.681
7	1	0	0	1	0	0	0	35	0	0.908	0.629
8	1	1	1	1	1	1	1	22	0	0.900	0.443
9	1	1	0	1	1	1	1	74	0	0.900	0.506
10	1	1	1	0	1	1	1	24	0	0.899	0.429
11	0	0	1	1	1	0	1	36	0	0.895	0.545
12	1	0	1	1	0	1	0	21	0	0.883	0.486
13	0	0	1	0	1	1	1	30	0	0.883	0.542
14-128				Logical reminders				?			

Notes: Truth table for 50km buffer zone for city when calculating area for BIOD and outcome EC is presented. With 7 conditions, there are 2^7 logical reminders, that is, 128.