

Spillovers and regional complementarity in wellbeing

A Spatial Econometric Analysis of Domain-Specific Spillovers in Life Satisfaction

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Introduction

How wellbeing is monitored

Regional wellbeing monitoring frameworks consider quality of life within administrative borders.

- How does the region score across a set of domains
- Other regions serve as a benchmark
- Policy aims to raise scores on all domains and outperform other regions

Quality of life does not end at the border

Residents' wellbeing is not only determined by what happens inside a region's borders

Their **daily activity spaces** cross borders

- they commute, shop, visit family, use green space and amenities nearby

They are **exposed** to what happens next door

- pollution, crime, economic activity can spill over

They **compare** themselves to others, also those in neighbouring regions

Consequences of ignoring neighbours

Ignoring neighbours can lead to **under or overestimation of quality of life** in a region.

- an urban region with very little green space may still have excellent access to nature if its neighbouring regions are very green

If residents use sources of wellbeing from neighbouring regions, the optimal policy response may not be for every region to improve every domain.

Regions may benefit from neighbours that are strong on the domains where they fall short.

Research on wellbeing spillovers is still relatively thin:

- **Narrow in scope:** usually one or two domains, typically income and employment, or negative externalities such as pollution

Wellbeing monitors and policy are organised by domain. Including neighbours in monitoring requires knowledge of spillovers across domains and understanding which routes dominate

Burger, Kourtit, and Nijkamp (2026): future work (on wellbeing) should account for the position of places within broader urban systems

Research Questions

Research Questions

RQ1 To what extent and through which routes do quality of life conditions in neighbouring regions reach local residents?

RQ2 Is there a premium on wellbeing for having neighbouring regions whose quality of life profiles are different from the own region?

H1: Domains of quality of life differ in the extent to which they reach local residents, and in the route they travel by.

H2: Life satisfaction is higher where neighbouring profiles are different from the own region profile.

Conceptual Framework

The Netherlands' national framework for measuring regional quality of life (CBS 2025)

Domains:

- Outcome: subjective wellbeing (life satisfaction)
- Sources: wealth, health, employment, housing, social cohesion, safety, environment

Indicators are tracked over time and compared across regions. Forms the basis for regional policy evaluation.

Three routes

Receivable: the condition crosses the border

- works **through** local conditions (e.g. neighbouring pollution raises local pollution)
- **Positive** sign

Reachable: residents cross the border

- works **around** local conditions (e.g. a job in a neighbouring region)
- **Positive** sign

Comparable: information crosses the border

- residents evaluate their situation relative to neighbouring regions (e.g. positional domains such as income and housing) (Luttmer 2005; Rijnks, Koster, and McCann 2019; Ziogas et al. 2020)
- works **around, negative** sign

Borrowed size and complementarity

Borrowed Size

- (Smaller) regions benefit from proximity to neighbours that offer amenities they lack (Meijers and Burger 2017)
- For the Netherlands specifically, Burger (2021) shows rural residents are happier partly because accessibility lets them borrow the advantages of nearby cities

Complementarity

- Extends the same logic more broadly: not just smaller regions borrowing from larger ones, but regions of any type benefiting from neighbouring regions that offer different sources of quality of life than their own

Complementarity needs the **reachable** route: you have to be able to use what your neighbour has.

Data

Netherlands: 342 municipalities, 224 with life satisfaction data

- Outcome: share of residents 18+ scoring their life satisfaction **7 or higher**, CBS Broad Prosperity Monitor 2024 (CBS 2025)
- All domain indicators available for almost all 342, so neighbour averages use the full geography

Next step: UK **Understanding Society** data: individual level with dependent variables on the neighbourhood level

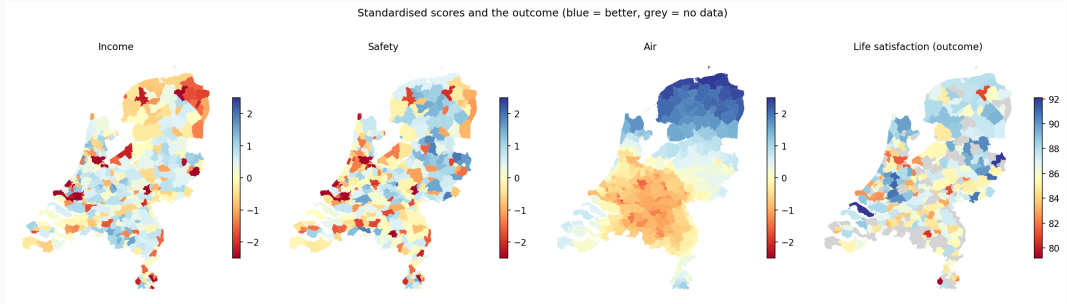
Domain indicators

Composite measures per domain, some domains are split as different routes are expected for subdomains

Domain	Sub-domain	Indicators
Material welfare	Income	median disposable income, % low income households, % problematic debt
Health	Health care	GPs per 10 000 residents
Labour & leisure	Jobs	jobs per 1000
	Amenities	retail and hospitality per 1000
Housing	Housing value	average WOZ value
Society	Social fabric	residential turnover, % informal carers
Safety	Crime	violent, property and vandalism offences per 1000
Environment	Green	nature share of land
	Air	PM2.5 concentration

- Borrowed size only makes sense for things residents can actually access
- So domain indicators should measure **sources** of wellbeing, not outcomes

Spatial distributions



All models include controls:

- Log population, log address density
- Share 65+

Empirical Strategy

SDEM: Spatial Durbin Error Model

$$LS_i = \alpha + \underbrace{\sum_{k=1}^K \beta_k x_{ik}}_{\text{own}} + \underbrace{\sum_{k=1}^K \theta_k \bar{x}_{ik}}_{\text{neighbours}} + \gamma H_i + \delta' \mathbf{c}_i + u_i, \quad u_i = \lambda \mathbf{W} u_i + \varepsilon_i$$

x_{ik}	this municipality's score on sub-domain k
$\bar{x}_{ik}$	its neighbours' average on that sub-domain
β_k	effect of own conditions
θ_k	effect of neighbours' conditions, the spillover
H_i	dissimilarity score

u_i	error: everything the model does not measure
$\mathbf{W}u_i$	the neighbours' average error
λ	how much of that error is shared with neighbours
ε_i	independent noise

SDEM rather than SDM

- We hypothesise that neighbouring conditions affect own life satisfaction, not neighbouring life satisfaction

The spatial error term removes the residual clustering: Moran's I on the residuals is $+0.18$ in SLX, -0.01 in SDEM.

In the SDEM, θ_k is the effect of neighbouring conditions **while holding a region's own conditions fixed**. It therefore captures only the **around** route.

It misses the **through** route: neighbouring conditions can also shape a region's own conditions, which in turn affect life satisfaction.

Separating the two requires a **decomposition**.

Decomposition

Flow One OLS regression per sub-domain, all 337 municipalities

- $x_{ik} = a_k \bar{x}_{ik} + \text{controls} + e_i$
- $a_k = \textbf{flow strength}$: how much a neighbour's score raises the local score

SDEM

- $LS_i = \sum_k \beta_k x_{ik} + \sum_k \theta_k \bar{x}_{ik} + \text{controls} + u_i$

Combined

- **Through** $= a_k \times \beta_k$: neighbour raises your score, which raises life satisfaction (bootstrap, 2 000 draws)
- **Around** $= \theta_k$: the neighbour's effect on top of that

W enters the analysis twice, through the neighbour lags and through the dissimilarity score, so weight sensitivity is extra important.

Queen contiguity: two municipalities are neighbours if they share at least one border point

- Simplest option: no tuning parameter, no isolates except islands
- Mean neighbours: 5.0 (range 1 to 14), 337 municipalities

Robustness checks: 25 km band, 8 nearest neighbours, inverse distance 50 km.

Sub-polygons below 4 km² removed.

Profile dissimilarity

Captures how different the wellbeing profile of a region is from its neighbours across all domains.

$$\text{dissimilarity}_i = \frac{1}{|N(i)|} \sum_{j \in N(i)} \frac{1}{K} \sum_{k=1}^K |z_{ik} - z_{jk}|$$

A higher score indicates a region's wellbeing profile is more different from its neighbours'. Computed on the nine standardised sub-domain scores, so all contribute equally.

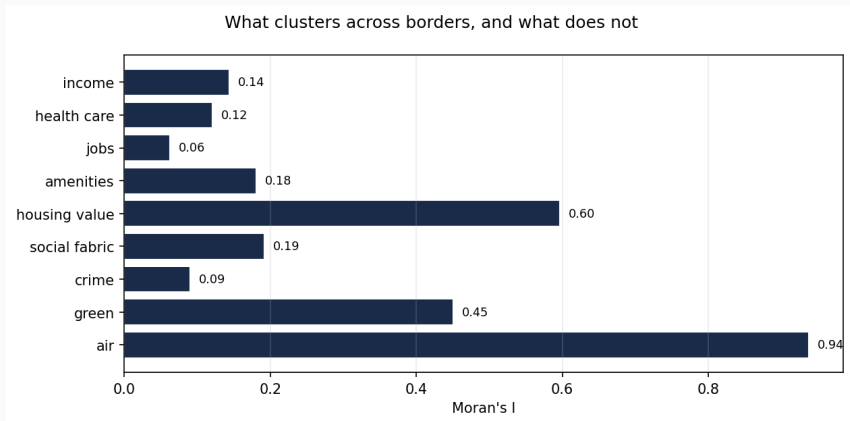
Four dissimilarity scores

Measure	What it captures
Dissimilarity	mean absolute difference to neighbours
Squared difference	emphasises larger gaps
Deficit coverage	how far the best neighbour exceeds you, most direct operationalisation of borrowed size
Neighbourhood spread	SD across neighbours, ignores own region, robust to own region being unusual, lower correlation with own extremity ($r = 0.14$ vs $r = 0.67$)

Each measure is estimated twice: with and without own extremity as a control.

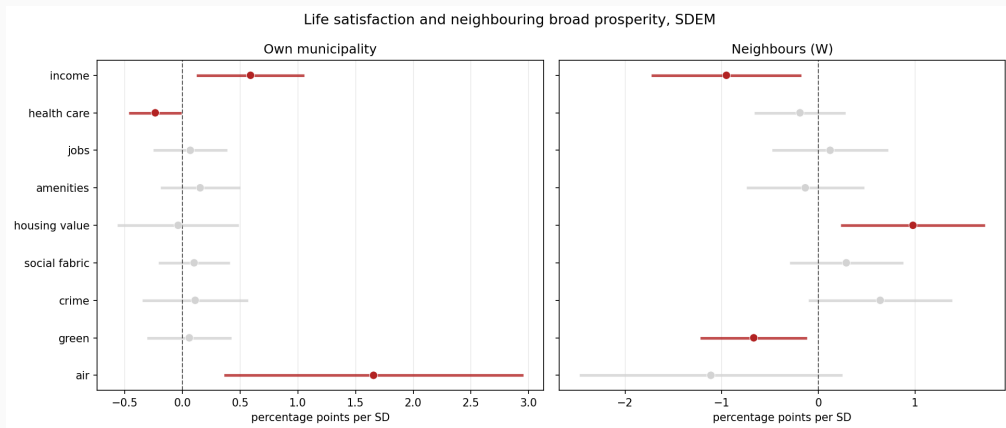
Results

What clusters across borders



Moran's I per sub-domain, Queen contiguity.

Domain spillovers



Full estimates

Sub-domain	Own (β)	Neighbours (θ)
Income	+0.59**	-0.95**
Health care	-0.23**	-0.19
Jobs	+0.07	+0.12
Amenities	+0.15	-0.14
Housing value	-0.04	+0.98**
Social fabric	+0.10	+0.29
Crime	+0.11	+0.64*
Green	+0.06	-0.67**
Air	+1.66**	-1.11

SDEM, $n = 224$, $\lambda = 0.31$. Outcome in percentage points, scores in SD. *** $p < .01$, ** $p < .05$, * $p < .10$.

The signs

Income: richer neighbours, **lower** life satisfaction (-0.95^{**}). Comparison dominates.

- symmetrical: richer neighbours -0.90 , poorer neighbours $+1.01$

Crime: safer neighbours, higher life satisfaction ($+0.64^*$)

Housing value ($+0.98^{**}$) and **green** (-0.67^{**}) grow as neighbours are defined further away $\rightarrow$ regional pattern

Robustness of the spillovers

Neighbouring sub-domain	Queen	25 km	KNN-8	IDW 50 km	Placebo <i>p</i>
Income	−0.95**	−1.22**	−0.91*	−1.17	0.060
Crime	+0.64*	+0.96**	+0.84**	+0.91	0.114
Housing value	+0.98**	+1.51***	+0.86**	+2.08***	0.016
Green	−0.67**	−1.20***	−0.76**	−2.39***	0.018

Income and crime lose significance with distance

All SDEM. Placebo: 500 draws with random neighbour sets of the real size

Flow strength by domain

Sub-domain	a_k	p	Flow
Housing value	0.99	0.000	strong
Green	0.99	0.000	strong
Air	0.97	0.000	strong
Amenities	0.55	0.000	moderate
Income	0.38	0.000	moderate
Social fabric	0.34	0.000	moderate
Health care	0.31	0.001	moderate
Crime	0.10	0.105	none
Jobs	0.08	0.392	none

House prices, green space and air are close to regional constants: your neighbour's level almost *is* yours. Crime and jobs do not flow.

Decomposition results

Sub-domain	α	β	Through	Around
Income	0.38***	+0.59**	+0.22 [†]	-0.95**
Health care	0.31***	-0.23**	-0.07	-0.19
Jobs	0.08	+0.07	+0.01	+0.12
Amenities	0.55***	+0.15	+0.08	-0.14
Housing value	0.99***	-0.04	-0.04	+0.98**
Social fabric	0.34***	+0.10	+0.03	+0.29
Crime	0.10	+0.11	+0.01	+0.64*
Green	0.99***	+0.06	+0.06	-0.67**
Air	0.97***	+1.66**	+1.60 [†]	-1.11

[†] bootstrap 95% interval excludes zero. Income works both ways: through your own income, and around it by comparison. Air works almost entirely through. Crime works entirely around.

Crime: not spreading, but feeling safe

We expected crime to work **through** local conditions: offenders travel, so crime next door raises crime here.

That is not what we find. Neighbouring crime barely predicts local crime ($a = 0.10$, not significant), so there is no through route.

The effect works **around**: a safer neighbour makes residents feel safer and more satisfied ($+0.64^*$), while local crime stays the same.

Does dissimilarity matter?

Measure	No control	Controlling own extremity
Profile dissimilarity	−0.05 (0.14)	+0.03 (0.17)
Squared difference	−0.10 (0.14)	−0.06 (0.17)
Deficit coverage	+0.03 (0.23)	+0.04 (0.23)
Neighbour spread	+0.07 (0.15)	+0.05 (0.15)

Nope! Every estimate is smaller than its own standard error, with or without the own extremity control.

Discussion

Limitations

Data. Municipalities with life satisfaction data are denser and larger. Results do not extend to the smallest and most rural municipalities.

Cross-sectional. No causal identification and residential sorting cannot be addressed (Hoogerbrugge and Burger 2022).

Survey noise. Some of the difference between municipalities is sampling noise.

Contiguity is not accessibility. A commuting-flow based weight would test the reachable route more directly.

Conclusion

Most results not significant but some evidence of spillovers and different regional scales

Little evidence of the reachable route so current results do not support the concept of borrowing on the municipal level

RQ2 No complementarity premium. Missing reachable route.

For monitoring

- Neighbours matter in different ways but more evidence is needed across domains and about routes and scale
- Relative position is part of wellbeing and a within-border monitor cannot see it

For policy

- Proximity does not replace provision: a municipality cannot necessarily lean on a nearby centre for amenities
- Inequality between neighbouring municipalities comes at a wellbeing cost
- Coordination rather than competition (Guevara-Rosero et al. 2026)

Continue the analysis with **Understanding Society** (UK)

- individual level life satisfaction, linked to the conditions of the neighbourhood (LSOA or MSOA) people live in

This will allow a better understanding of

- **scale**: do these effects work at the level of the neighbourhood, or only the wider region?
- **residential sorting**: follow people who move and people who stay
- **individual differences**

Questions and discussion

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Appendix

Nearly half the variance in the dissimilarity score ($R^2 = 0.45$) is explained by a region's own extremeness.

Neighbourhood spread never references the own region, correlates just $r = 0.14$ with own extremity, against $r = 0.67$ for dissimilarity.

Both give the same answer: $+0.07$ and -0.05 without the control, $+0.05$ and $+0.03$ with it, none significant. The null is not an artefact of the measure.

Sample selection

	In sample	Out of sample
Median population	45 472	19 031
Mean log address density	7.06	6.60

Share with life satisfaction data by population quintile, smallest to largest: 0%, 43%, 90%, 100%, 97%.

CBS does not report the figure below a minimum survey sample size, which disproportionately affects small rural municipalities.

Sample selection: profiles

How do municipalities with a life satisfaction score differ from those without?

	With score (225)	Without score (117)	Difference
Income	−0.19	+0.37	−0.56
Health care	−0.05	+0.10	−0.15
Jobs	+0.12	−0.24	+0.36
Amenities	−0.14	+0.26	−0.40
Housing value	−0.10	+0.20	−0.30
Social fabric	−0.12	+0.23	−0.35
Crime (higher = safer)	−0.21	+0.40	−0.61
Green	−0.14	+0.27	−0.41
Air	−0.00	+0.00	−0.00
Share 65+ (%)	22.5	23.7	−1.2

Sub-domain scores standardised over all 342 municipalities. The municipalities without a score are small, and score **better** on most sub-domains: richer, safer, greener. Only jobs are higher in the sample. Air is the same.

Weight sensitivity

Neighbouring sub-domain	Queen	25 km	KNN-8	IDW 50 km	Placebo p
Income	−0.95**	−1.22**	−0.91*	−1.17	0.060
Health care	−0.19	−1.11***	−0.58*	−0.80	0.204
Jobs	+0.12	−0.21	−0.18	+0.14	0.702
Amenities	−0.14	−0.45	−0.20	−1.45*	0.462
Housing value	+0.98**	+1.51***	+0.86**	+2.08***	0.016
Social fabric	+0.29	+0.02	−0.02	+1.20	0.386
Crime	+0.64*	+0.96**	+0.84**	+0.91	0.114
Green	−0.67**	−1.20***	−0.76**	−2.39***	0.018
Air	−1.11	−0.74	−1.15*	−0.19	0.000

All SDEM. Air's θ is not identified (own and neighbour correlate at 0.98).

Mediator equation and OLS

$$x_{ik} = a_k \bar{x}_{ik} + \text{controls} + e_i, \quad e_i = \lambda \mathbf{W} e_i + \varepsilon_i$$

The only substantive regressor is $\bar{x}_{ik}$, the spatial lag of the dependent variable. So two spatial terms compete to explain the same clustering: a_k attributes it to transmission from neighbours, λ to unmeasured shared factors. Nothing in the data separates them.

Reporting OLS for all sub-domains keeps the column internally consistent.

The outcome equation has eighteen sub-domain regressors plus controls, so its spatial error is identified without difficulty. That one is estimated by SDEM.

Model choice: diagnostics

	Statistic	p
LM lag	13.14	0.000
Robust LM lag	1.11	0.293
LM error	12.53	0.000
Robust LM error	0.50	0.479

Both simple tests are significant, the robust tests cannot separate them. The SDEM error term absorbs the clustering in life satisfaction: residual Moran's I is $+0.18$ in SLX, -0.01 in SDEM.

Clustering in the flow strengths

The mediator equation is OLS with no $\lambda \mathbf{W}e$ term, so residual spatial clustering is not corrected.

The point estimate a_k stays unbiased: spatial correlation makes OLS inefficient, not biased. Only the standard errors are understated, so the p values on a_k are optimistic.

Spatial HAC (Conley) standard errors correct the inference without requiring λ to be identified. Not yet implemented.

A boundary condition

Same model, second outcome: share **without** anxiety or depression symptoms (MHI-5, Gezondheidsmonitor 2024, 337 municipalities)

- **Income comparison disappears** (+0.06)
- **Crime** stays (+0.93*)
- **Amenities** appears (+1.16***)

Comparison is about how people **evaluate** their lives, not about symptoms.

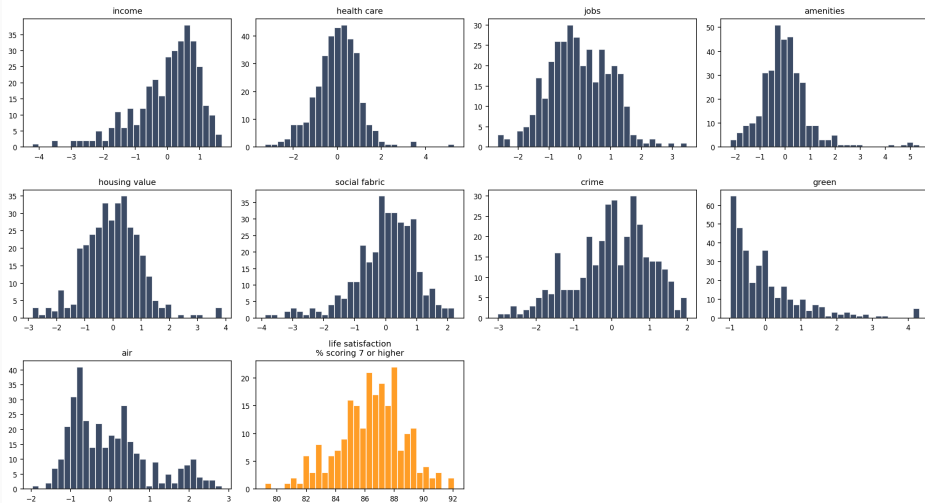
Composite scores

Each indicator: log transform, winsorise at p99 if still skewed, reverse where higher is worse, z-score, then average and standardise.

Equal weights, not PCA: the indicators are facets of a sub-domain, not symptoms of one latent variable.

Distributions

Sub-domain scores (standardised) and the outcome



Scores are standardised