Evolving Patterns of Ethnic Diversity and Segregation in Belgium: A Dynamic Matrix and Trajectory Approach to Spatial (In)equality

Keywords residential ethnic segregation – ethnic diversity – cities – register data – Belgium

Introduction

The spatial dynamics of ethnic diversity (ED) and ethnic residential segregation (ERS) have long been central to debates in population geography. Conventional approaches positioned these processes as conceptual opposites. Rooted in the Chicago School, early assimilation theory viewed segregation as a stage of spatial concentration that would eventually lead to integration (Park & Burgess, 1925), while later interpretations (Massey & Denton, 1993; Peach, 1996) portrayed ethnic clustering as the lingering residue of exclusion, expected to diminish with upward socio-economic mobility. In both accounts, diversity was thus framed as a sign of progress, whereas segregation indicated the persistence of inequality. Yet, such conceptual oppositions are themselves historically and epistemically situated, reflecting methodological nationalism and the universalisation of (urban) experiences derived from Western societies. More recent research has challenged this linear and oppositional understanding, showing that ED and ERS frequently coexist and form overlapping, multi-scalar configurations of social differentiation rather than sequential stages in a teleological process (Tasan-Kok et al., 2014; Tammaru et al., 2016). A further limitation concerns the reliance on static indices that rigidly categorise neighbourhoods according to pre-defined fixed thresholds of "high" or "low" diversity and segregation. While useful for comparison, such thresholds risk oversimplifying complex spatial structures and transformations. By re-examining these dynamics in the Belgian context, this study situates ethnic diversification and segregation within a broader relational geography of inequality, acknowledging that spatial patterns are not neutral but actively produced through institutional practices, discursive framings, and the performative power of categorisation itself (Kwan, 2002).

Building on these critiques, this study examines how ED and ERS evolve together over time. Focusing on Belgian neighbourhoods between 2000 and 2020, it traces how neighbourhoods shift and reconfigure within the diversity–segregation nexus: whether they move toward greater integrated, remain stable, or develop new forms of segregation. It also investigates how these distinct neighbourhood trajectories relate to local socio-economic conditions (e.g., income, education). To avoid imposing pre-defined fixed thresholds, the study introduces a Dynamic Matrix Model, classifying neighbourhoods according to their relative positions on diversity and segregation axes, thereby foregrounding temporal fluidity and relational change rather than status categorisation.

Aim, Data and Methods

This research examines the evolution of ethnic diversity and segregation in Belgium over the period 2000-2020, drawing on comprehensive yearly population register data from Statistics Belgium (STATBEL), covering over 11 million residents. Statistical sectors (N=19,781)—similar to census tracts or wards—serve as the spatial units of analysis. Migration background—approximating ethnic differentiation—is measured through current nationality, nationality at birth, and parental nationalities, aggregated into six groups (Belgium, EU, Non-EU, Maghreb, Turkey, Other), capturing the main axes of ethnic diversification in Belgium. Neighbourhoods with very small populations or limited heterogeneity (fewer than two migrant groups) are excluded to ensure comparability. While register data offer exceptional temporal and spatial coverage, they also reproduce categorical boundaries—between "national" and "migrant" or "EU" and "non-EU" populations—that are themselves the product of bureaucratic constructions. Working within these limitations, we can only think of these administrative categories not as fixed social realities but as classifications that structure access to space and resources (Amin, 2012).

The operationalisation of diversity and segregation relies on two specific indices for the time being: the Fractional Index (FI) for diversity and Location Quotient (LQ) for segregation. These indices allow for exploratory mapping, the design of the Dynamic Matrix, and quantitative analyses. ED is measured using the Fractionalization Index (FI), capturing the probability that two randomly selected individuals belong to different groups. FI varies between 0 and 1, and it computed as

$F = 1 - \sum_1^n p_i^2$ with p_i the proportion of group i in total population in area

ERS is assessed through Location Quotients (LQ), comparing each group's neighbourhood share to its corresponding national or citywide reference share. The LQ is thus an explicit spatial measure which portrays the concentration-evenness dimension of segregation (Brown & Chung, 2006), and reveals relative ethnic over- and underrepresentation in the Belgian landscape. LQ is calculated as

$LQ_i = \frac{(x_i/t_i)}{(X/T)}$ with x_i being the neighbourhood migrant population i, t_i the total population of neighbourhood I, X the sum of all x_i , and T the sum of all t_i

Our analytical strategy begins with year-specific correlation tests between FI and LQ to identify whether and how diversity and segregation co-occur over time. Hierarchical clustering with K-means refinement is then applied to FI and LQ scores for each selected year to detect distinct diversity–segregation configurations. These classifications feed into a Dynamic Matrix Model. Temporal dynamics are further examined through sequence analysis, treating each neighbourhood's classifications across the different measurement points as an ordered sequence. Pairwise dissimilarities are computed using Optimal Matching (OM), followed by hierarchical clustering to identify typical transformation trajectories. Finally, multinomial logistic regression models assess how initial and evolving socio-economic conditions shape neighbourhood trajectories.

Preliminary Findings and Conclusion

This section presents the first results of an ongoing analysis designed to trace the joint evolution of diversity and segregation. While the broader project aims to conduct a continuous year-by-year examination, the present analysis focuses on three benchmark years—2000, 2010, and 2020—to test the Dynamic Matrix framework and to map preliminary transition patterns. These initial results provide a basis for refining the approach and developing a more detailed temporal model in the next stage.

The correlation analyses reveal that, in 2000, diversity and segregation were moderately-to-strongly correlated, indicating that highly diverse neighbourhoods often displayed uneven group representation. This link weakened substantially by 2010 and became marginal by 2020, suggesting a gradual decoupling of diversity from spatial disproportionality. Cluster analysis reveals four neighbourhood types across the three time points: *homogeneous* (low diversity, low segregation); *diverse-transitional* (high diversity, low segregation); *highly segregated* (high migrant concentration and strong unevenness); *diverse-but-segregated* (high diversity with moderate unevenness). The Dynamic Matrix Model uncovers how neighbourhoods shift between states along the diversity–segregation axes (Figure 1). Homogeneous neighbourhoods show limited movement, underscoring their structural stability. In contrast, diverse neighbourhoods follow more variable trajectories, some showing integrative shifts (increased diversity accompanied by reduced segregation), others regressive shifts (heightened segregation despite stable or declining diversity). Although structurally consistent, the composition and distribution of clusters change substantially (Figure 2). Homogeneous neighbourhoods remain dominant and expand slightly, especially in suburban and semi-rural areas. Diverse-transitional neighbourhoods increase steadily, indicating a broader diffusion of urban diversity into peri-urban contexts. Highly segregated enclaves persist but remain relatively contained, showing entrenched forms of spatial

marginalisation. Diverse-but-segregated areas grow notably between 2000 and 2010 before contracting slightly by 2020, suggesting partial movement toward more balanced group representation.

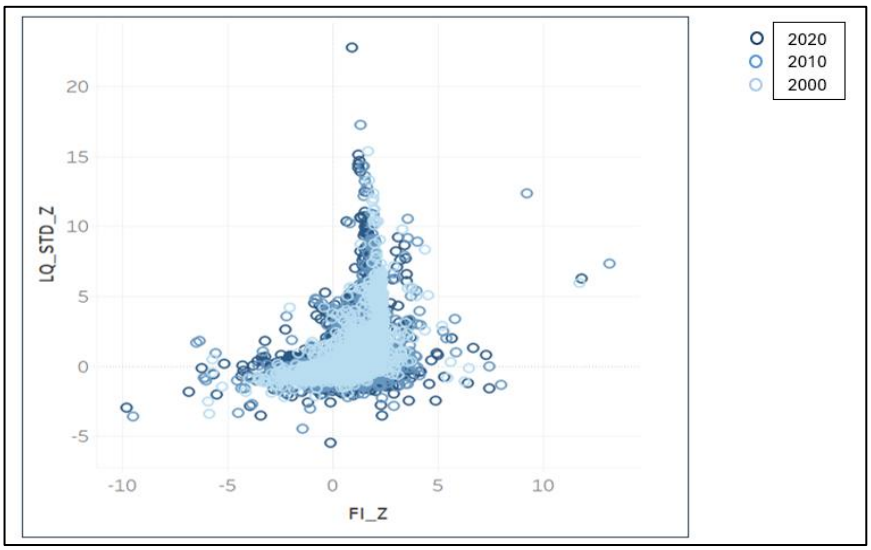

Figure 1. Dynamic Matrix

Sequence analysis then identifies four trajectory types: *stable enclave* trajectories, where neighbourhoods remain homogeneous or persistently segregated; *progressive diversification* trajectories, including neighbourhoods that gradually move toward more balanced diversity; *fluctuating diversity* trajectories, containing neighbourhoods which are marked by irregular shifts in group distributions; and *regressive segregation* trajectories, with areas where diversity declines or unevenness intensifies. These trajectories show that neighbourhood change unfolds in varied and often non-linear ways. Relying on multivariate modelling, socio-economic contextualisation reveals that progressive diversification is associated with rising incomes, higher educational attainment, and homeownership, while persistent or increasing segregation concentrates in low-income areas. Diversification alone therefore seemingly does not guarantee social mix or equality; more even residential outcomes depend on broader socioeconomic opportunities and housing conditions.

Overall, by combining diversity and segregation measures through a Dynamic Matrix Model and sequence-based trajectory analysis, the study provides a temporally grounded account of how Belgian neighbourhoods evolve within the diversity–segregation nexus. The results show that ED and ERS are not simple opposites but intertwined, path-dependent processes that unfold along multiple trajectories shaped by demographic change, housing dynamics, institutional practices and inequality.

Next steps

Building in these initial findings, future stages of the analysis will extend the Dynamic Matrix to a yearly typology covering the full 2000-2020 period, allowing for finer-grained temporal modelling of transitions within and across neighbourhood types. We will perform sensitivity analyses using alternative measures of both diversity and segregation to assess the robustness of our results. In parallel, forthcoming work will explore the role of neighbourhood compostion—including socioeconomic and socio-demographic characteristics—in shaping the transitional stages and typologies identified. Together, these extensions will (i) question how the very categories and measures used to describe diversity and segregation shape what becomes visible (or not), and (ii) contribute to a more

comprehensive understanding of how ethnic diversification and segregation unfold as entangled and temporally embedded processes.

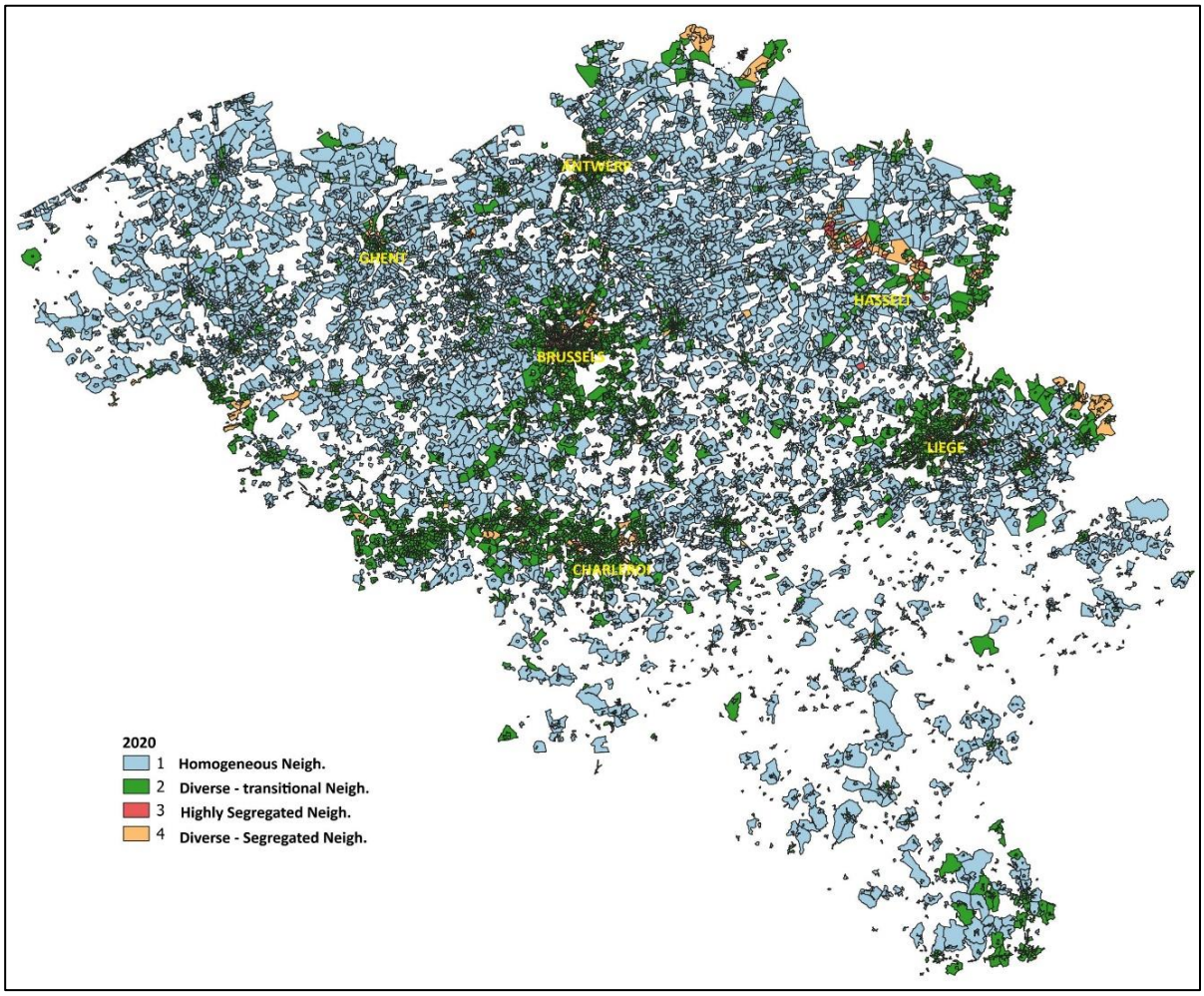

Figure 2. Distribution of clusters across Belgium

References

Amin, A. (2012). *Land of Strangers*. Cambridge: Polity.

Brown, L. A., & Chung, S.-Y. (2006). Spatial segregation, segregation indices and the geographical perspectives. *Population, Space and Place, 12,* 125-143.

Kwan, P.-P. (2002). Feminist visualization: Re-envisioning GIS as a method in feminist geographic research. *Annals of the Association of American Geographers, 92*(4), 645-661.

Massey, D. S., & Denton, N. A. (1993). *American Apartheid: Segregation and the Making of the Underclass*. Cambridge, MA: Harvard University Press.

Park, R. E., & Burgess, E. W. (1925). *The City: Suggestions for the Investigation of Human Behavior in the Urban Environment*. Chicago: University of Chicago Press.

Peach, C. (1996). Does Britain have ghettos? *Transactions of the Institute of British Geographers*, 21(1), 216–235.

Tammaru, T., Marcińczak, S., van Ham, M., & Musterd, S. (Eds.). (2016). *Socio-Economic Segregation in European Capital Cities: East Meets West*. London: Routledge.

Tasan-Kok, T., van Kempen, R., Raco, M., & Bolt, G. (2014). Towards hyper-diversified European cities: A critical literature review. *Urbani Izziv*, 25(supplement), S19–S30.