The Historical Evolution of the Education-Specific Mating Squeeze from a Sub-National Perspective

A case study using Austrian census data, 1981-2021

Authors:
Erich Striessnig[1], Nadia Steiber[1], Ruslan Basyrov[1],
Laura Samantha Zilian[2]

[1]Wittgenstein Centre for Demography and Global Human Capital (IIASA, ÖAW/VID, University of Vienna)
[2]University of Vienna

October 31, 2025

Extended Abstract

Submitted for the
European Population Conference (EPC 202)

— NOT TO BE CITED —

1 Short Abstract

Austria, Germany, and Switzerland have repeatedly been found to lag behind in the shift towards growing educational hypogamy that has followed the reversal in the gender gap in education. Here we use four decades' worth of Austrian census data to explore this phenomenon at the sub-national level. We construct a municipality-specific mate-market measure based on travel times extracted from *OpenStreetMap*. For each of these mate-markets, we derive various indicators of the education-specific mating squeeze. Relating the squeeze values to different demographic and economic, municipality-level covariates, we find the squeeze to be driven predominantly by developments in Austria's low-density areas. These sub-national variations still need to be explored further. Eventually, we hope to contribute to an improved understanding of educational assortative mating at the local, mate-market level.

2 Extended Abstract

The reversal of the gender gap in education (Buchmann et al., 2008) affects patterns of assortative mating (De Hauw et al., 2017; Van Bavel et al., 2018) via the "education-specific mating squeeze" (Van Bavel, 2012). Highly educated, heterosexual women increasingly face a lack of equally well-educated men to form unions, leading to an increase in shares of hypogamic heterosexual couples, where the woman is higher educated than the man (Esteve et al., 2012). This trend has major implications for demographic and economic behaviours (Van Bavel, 2012; Bertrand et al., 2015; Nitsche et al., 2018), as well as gender inequality (Van Bavel and Klesment, 2017; Qian, 2017). However, while education-specific mating squeezes and the decline in hypergamy along cohort lines are well documented at the national level (Erát, 2021; Han, 2022) and also sub-nationally, e.g., at the level of German Länder (Corti and Scherer, 2021), little is known so far about the structural drivers of changing assortative mating patterns within realistic geographies, i.e., the *local mate markets*, where individuals are likely to meet, interact and form romantic partnerships.

Geography matters in this context for several reasons: Firstly, while mate search is clearly driven by preferences regarding potential partners' age, income, education, race or religion, there is also a clear preference for spatial proximity, not just because it is easier to meet physically, but also because long-distance relationships tend to be more difficult to maintain and suffer from higher dissolution risk (Boyle et al., 2008; Krapf, 2018). Consequently,

not everyone within the same national boundaries is equally likely to become somebody else's partner. According to the First Law of Geography, "Everything is related to everything else, but near things are more related than distant things" (Tobler, 1969). Hence the availability of suitable partners (or the lack thereof) within "reasonable distance" from one's place of residence (or work) determines a person's chances of forming a union by their preferences.

Secondly, geography matters in determining "reasonable distance". When are people part of the same mate market? Given the recent shift to online dating that has increasingly replaced traditional ways of finding a partner (Rosenfeld et al., 2019), one might assume that spatial constraints play less of a role in contemporary mating environments. However, even in online dating, physical distance continues to play a key role in pre-structuring the market (Bruch and Newman, 2019). Previous studies that have sorted their "offline" samples into different mate markets have often been constrained concerning the geographical breakdown of their data. While Corti and Scherer (2021) used the very coarse level of the German Länder to study geographically varying mate market characteristics, Eckhard and Stauder (2019) study the validity of mate market measures within German districts. The influence of neighboring regions, particularly for people searching close to regional borders, remains unaccounted for.

Thirdly, geography matters as educational expansion (and possibly the reversal in the gender gap in education) has not evolved uniformly across space within national boundaries. This is confirmed by evidence from both the developed (van Maarseveen, 2021; Zahl-Thanem and Rye, 2024) and the developing world (Lounkaew, 2013; Xiang and Stillwell, 2023; Wen et al., 2023). Children growing up in urban areas are advantaged when it comes to educational attainment (van Maarseveen, 2021) and such urban-rural disparities in higher educational attainment may have become even more pronounced for the more recent cohorts (Zahl-Thanem and Rye, 2024). Therefore, the extent to which highly educated women experience an "education-specific mating squeeze" (Van Bavel, 2012) will likely vary between urban and rural areas. Research looking at the interaction between space and gender in determining educational outcomes, though, is still lacking.

In this paper, we aim to fill this gap in the literature by studying the implications of changes in educational attainment distributions by gender for the mating squeeze experienced across more than 2,000 Austrian municipalities over the 1981 to 2021 period. We do so by flexibly defining local mate

markets based on the actual travel times between municipalities, rather than limiting the analysis to static, administrative boundaries. To our knowledge, this is the first time mate markets are being modeled in this way and at such refined spatial scales for an entire country. Based on this definition of the mate market, we derive various indicators of the mating squeeze common in the literature and conduct spatially explicit, multivariate regression to see which structural characteristics drove the radical changes in the mating squeeze observed over the study period.

3 Data and Methods

The definition of the neighborhood matrix is a key problem in spatial econometrics (LeSage, 2015; Anselin, 2022) and has received much scholarly attention in ecological studies trying to establish exposure-response relations at the areal-/population-, rather than the individual-level (Best et al., 2001; Earnest et al., 2007; Harris et al., 2011). Although it has been widely criticized (Getis and Aldstadt, 2004; Briz-Redón et al., 2022), many studies still follow the conventional practice of defining neighborhoods based on the criterion of simple contiguity (adjacency), often due to a lack of spatially more refined data. An alternative approach is to apply a distance-based criterion, e.g., Euclidean distance (i.e., a straight line) between geo-coded centroids of nearby areal units (e.g., ZIP-codes; Gibbons and Machin, 2005), which potentially ignores topographic barriers (e.g., mountains and rivers; Jordan et al., 2004; Jones et al., 2010).

In the present study, we try to overcome these limitations by modelling mate markets based on the actual travel times (by car, which is usually the fastest way of getting from A to B) between municipalities' population-weighted gravity points. This is preferable for the purpose of our study for various reasons. First of all, some municipalities sharing a border on the map are indeed divided by hard-to-overcome barriers, particularly in a mountainous country like Austria. These can make physical encounters between inhabitants difficult. The actual travel times between municipalities give a more accurate picture of which ones are indeed part of the same mating environment. Secondly, centroids can often be located in the middle of a lake or far away from settlements, thus potentially distorting travel time estimates. Population-weighted gravity points, on the other hand, tend to be located close to roads and the travel times calculated between them more closely reflect the conditions that the majority of mate-market participants

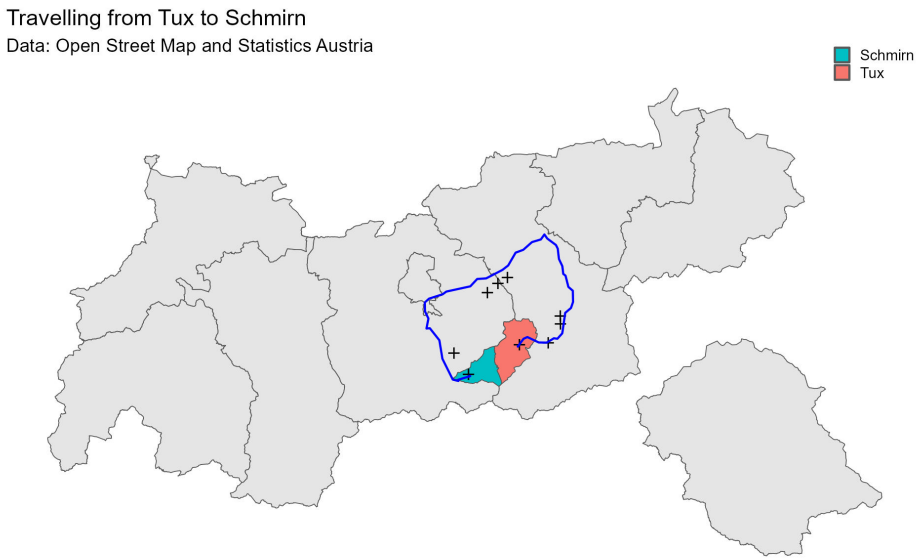

Figure 1: District-level map of Tyrol, Austria with crosses indicating population-weighted gravity points of Tux and bordering municipalities.

are facing in their mate search decisions.

To give an example, Figure 1 shows the "neighboring" municipalities of Schmirn and Tux in the Austrian province of Tyrol. The Euclidean distance between the population-weighted gravity points is indeed only a few kilometers. However, due to Hintertux Glacier in between these two villages, the fastest way to get from Schmirn to Tux in fact is a nearly two hours' drive via the provincial capital Innsbruck, making direct physical encounters between the two villages unlikely. The alternative conception of neighborhood that we are proposing here suggests that the mate market for people residing (or working) in Tux is more realistically described by the depiction in Figure 2, where we show the municipalities which have gravity points within 20-, 30- and 40-minutes distance, respectively, travelling by car from Tux.

As limiting the size of a municipality's mate market to either of these three travel time restrictions would again introduce a level of arbitrariness by simply imposing a different boundary, this time outside the municipality limits, we aggregate local, age-specific mate markets using the more flexible approach of inverse-distance weighting. This allows us to include geographically more distant potential partners, albeit with decreasing weight. The follow-up question of the weights to be used in accounting for so called

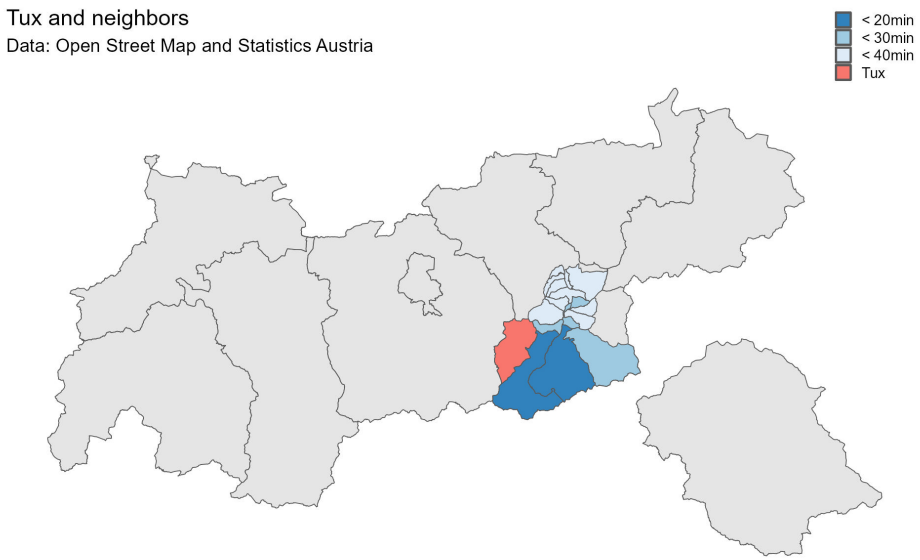

Figure 2: Travel time-based mate markets for Tux depending on acceptable distance.

"distance-decay" here has often been avoided by research on search behaviour within mate markets. Rather, researchers chose areas of analysis that were geographically small enough for distance not to be a significant deterrent for interaction (Bruch and Newman, 2018, 2019).

Yet the "Friction of Distance" has been widely covered in the transportation literature (Ellegård and Vilhelmson, 2004; Matous et al., 2013). Inheriting from this literature, we intend to approximate the speed at which the likelihood of being in the same mate market declines with travel time by comparing different distance-decay functions: our preliminary results presented below are based on the simple inverse of travel time, as well as the log of travel time, which imposes a smaller punishment on more distant, potential partners. However, future results will put this aspect of our work on a more solid, empirical basis, following a thorough analysis of people's willingness to move for the sake of union formation. For this, we aim to exploit registry data from the newly created Austrian Micro-Data Center (AMDC), where couples can be identified, including with their place of residence before and after cohabitation, starting in 2011. First results (which we are not yet allowed to show barring statistical disclosure control by Statistics Austria) suggest that the majority of Austrian couples find a partner from within relatively close distance too their place of origin, albeit with strong regional variation

due to differences in connectivity. Also, we find that the willingness to move increases with age and level of education, particularly for men.

3.1 Travel Times

To derive travel times between Austrian municipalities, we rely on publicly accessible information from Statistics Austria on the geo-coordinates of population-weighted gravity points in 2022, as well as travel times according to the *OpenStreetMap* (OSM) Routing Machine. The travel time information is available from OSM since 2013. While OSM considers changes in the road networks, including the quality of roads or ongoing maintenance and construction works, travel times are not affected by the actual traffic (e.g., during rush hour vs. middle of the night). In order for our results not to be distorted by changes in the network that took place during individual years, we base our mate market estimates on the average travel times over the entire available time span (always January 1st of 2013-2022).

We also looked into the variation over time in short-distance connectivity (i.e., within specific mate markets) measured by road travel times. For the 2013-2022 period, when OSM data is available, this variation appears to be minor and we are confident about using the same average travel times for more distant years (e.g., 1981), given that close neighbors of today were close already back then. Simultaneously, we limit the extent of the mate market to below 60 minutes travel time, which limits the potential disadvantage of municipalities that are close to the border and whose cross-border neighbors cannot be considered as part of the same mate market for lack of data.

In order to speed up the large number of individual data queries, the routing machine was installed locally. Here is a step-by-step list of the tools used in the process:

1. **Map data** - OpenStreetMap (OSM) provided as snapshots by Geofabrik.de. OpenStreetMap is a geographic database that changes every time someone edits it. The only way to get the data directly from OSM as a single file is to request it for the whole world, which is prohibitively large. Thankfully, there are extract providers such as Geofabrik that provide access to OSM data for specific countries. In the case of Geofabrik, the temporal breakdown of the snapshots ranges from days (more recent past) to years (further in the past).

2. **Program to operate the map data** - Open Source Routing Machine. OSRM is a program which constructs a route network (graph) based on the OSM data and returns the fastest route between any two points within a few milliseconds.

3. **Program to request the distances** - osrm library in R. For more straightforward interaction with the OSRM API, we used the osrm library in R, in particular, the osrmTable function, which returns travel time and distance tables between all provided points.

4. **Optional** - replicating the computing environment (Docker). To facilitate the replicability of our results, we used Docker containerization. In essence, it allows the computation to be isolated from other computer resources. By doing so, we can ensure replicability without dependency issues on any computer with Docker installed.

3.2 Age-Specific Squeeze Indicators

Once we have established the weights of different municipalities' sub-populations in each other's, age-specific mate markets, in a second step we calculate various characteristics of these local mate markets using information from the spatially harmonized, Austrian population census. The census data is available in decadal steps from 1981 to 2021. It provides information on each of 2115 municipalities' population by age, sex and level of educational attainment. As the territorial division of Austrian municipalities has not remained constant over the observation period, we harmonized the census data to the political boundaries of 2022. The harmonized census data allow us to not just derive standard demographic indicators of density and age structure, but also different indicators of the municipality-specific, "education-specific mating squeeze" within different, 5-yearly age brackets.

As a simplified squeeze indicator, Figure 3 shows the ratio of women to men with at least secondary education in the 30-34 age group for municipality-specific mate markets in decadal steps since 1981. Values close to 1 imply no educational imbalance in this mate market. Values larger than 1 indicate a female advantage in terms of education, values below 1 indicate an excess of higher-educated men. In order for outliers not to distort the color scale, a small number of values that were larger than 2 have been set to 2. For the time being, we use equal age brackets for both women and men. Future results will be based on more realistic assumptions regarding age- and gender-specific mate preferences.

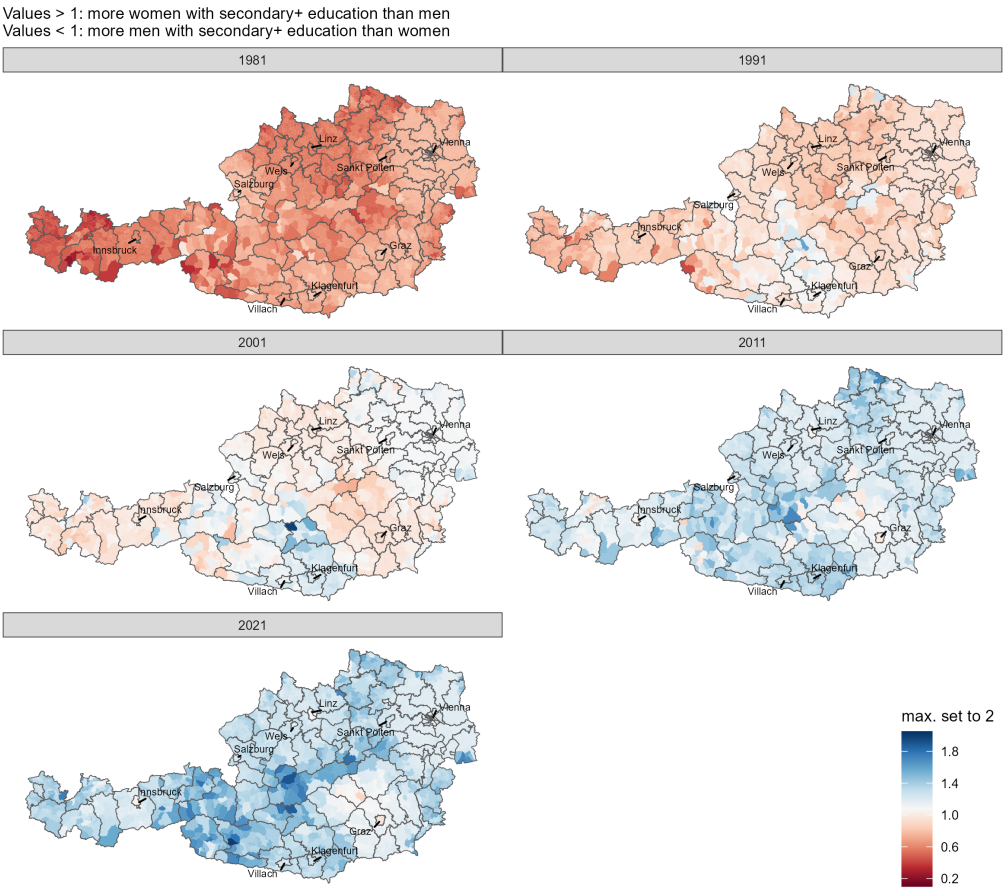

Figure 3: Higher-educated (upper secondary+) women to men ratio for the 30-34 age group at the municipality-level derived from census data, Austria, 1981-2021.

The most obvious change revealed by Figure 3 is the reversal of the gender gap in education, widely described in the literature (Buchmann et al., 2008). While back in 1981, there was hardly a place in Austria where highly educated women were outnumbering equally well-educated men, over the next couple of decades this pattern changed radically along cohort lines, as increasingly better-educated young women entered the mate market. By 2021, the vast majority of Austrian municipalities are characterized by female dominance in educational terms. What has not been shown by the literature so far is the sub-national breakdown of this reversal, which has not been taking place uniformly across space. The overall reversal seems to have been driven predominantly by changes in low-density areas. Urban areas, on the other hand, managed to preserve a relative balance between highly educated women and men in their mate markets (with potential consequences for the likelihood of hypogamous unions).

To test the hypothesis of the reversal in the gender gap in education being predominantly a rural phenomenon in Austria, in the final step of our analysis, we intent to use this simple, as well as other, more complex squeeze indicators as dependent variables in multivariate regression controlling for spatial dependence. Our prime research interest is in assessing the structural factors characterizing different mate markets that drove the radical changes in the mating squeeze observed over the study period. Apart from population density, we are interested in the role of gender-specific internal migration following the end of educational careers as a potential explanatory mechanism. Other factors to be explored include labor market characteristics, e.g., unemployment, the sector-specific distribution of the workforce, but also the share of the foreign-born population, as well as the age composition.

4 Preliminary Results

Table 1 shows simple linear regression results for the 30-34 age-group from 1981 to 2021. The dependent variable is the squeeze indicator displayed in Figure 3. The only independent variables used here is the log of population density. In line with our hypothesis, population density used to relate positively to the mating squeeze in the early 1980s. However, this relationship has reversed during the 90s and has become significantly negative in more recent years.

Table 1: Density-Effect on Squeeze, 30-34, 1981-2021

	Dependent variable:				
	squeeze				
	1981	1991	2001	2011	2021
log(density)	0.017***	0.001	−0.008***	−0.019***	−0.041***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Constant	0.577***	0.889***	1.075***	1.307***	1.468***
	(0.009)	(0.008)	(0.007)	(0.008)	(0.010)
Observations	2,114	2,114	2,114	2,115	2,115
R^2	0.032	0.0003	0.010	0.055	0.148
Adjusted R^2	0.031	−0.0001	0.009	0.054	0.147
Note:					*p<0.1; **p<0.05; ***p<0.01

Table 2 adds further covariates to the 2021 regression presented in the rightmost column of Table 1. In particular, we add the proportion of people with lower secondary education or less (p_lowedu_2021), the travel time to the nearest agglomeration ($mindist$), as well as the proportion of foreign-born population 10 years earlier ($foreign\_2011$). The relationship between density and squeeze obtained from the raw model is preserved, but appears weaker.

Table 2: Determinants of Squeeze in 2021, 30-34

	Dependent variable:			
	squeeze			
	(1)	(2)	(3)	(4)
log(density_2021)	−0.041***	−0.031***	−0.018***	−0.022***
	(0.002)	(0.003)	(0.003)	(0.003)
p_loedu_2021		0.310***	0.270***	0.296***
		(0.041)	(0.040)	(0.040)
mindist			0.001***	0.001***
			(0.0001)	(0.0001)
foreign_2011				0.301***
				(0.060)
Constant	1.468***	1.182***	1.112***	1.096***
	(0.010)	(0.039)	(0.039)	(0.039)
Observations	2,115	2,115	2,114	2,114
R^2	0.148	0.170	0.207	0.216
Adjusted R^2	0.147	0.169	0.206	0.214
Note:				*p<0.1; **p<0.05; ***p<0.01

5 Conclusion

The educational expansion, which has been observed as a global phenomenon in the 20th century (Schofer and Meyer, 2005), has certainly benefited women more than men and gradually led to a reversal in the gender gap in education. Austria, together with Germany and Switzerland, has been described repeatedly as lagging behind in in this process when compared to other developed nations (De Hauw, Grow, and Van Bavel 2017; Erát 2021). By looking at the reversal in this gender gap at the sub-national level, we hope to shed some light on this phenomenon in the Austrian context. Eventually, this research will contribute to our understanding of the role of mate market constraints in educational assortative mating (Stauder and Kossow, 2021).

References

Claudia Buchmann, Thomas DiPrete, and Anne McDaniel. Gender inequalities in education. *Annual Review of Sociology*, 34(1):319–337, jul 1 2008. ISSN 0360-0572. doi: 10.1146/annurev.soc.34.040507.134719.

Yolien De Hauw, André Grow, and Jan Van Bavel. The Reversed Gender Gap in Education and Assortative Mating in Europe. *European Journal of Population*, 33(4):445–474, oct 1 2017. ISSN 1572-9885. doi: 10.1007/s10680-016-9407-z.

Jan Van Bavel, Christine R. Schwartz, and Albert Esteve. The Reversal of the Gender Gap in Education and Its Consequences for Family Life. *Annual Review of Sociology*, 44(1):341–360, jul 30 2018. ISSN 0360-0572, 1545-2115. doi: 10.1146/annurev-soc-073117-041215.

Jan Van Bavel. The reversal of gender inequality in education, union formation and fertility in Europe. *Vienna Yearbook of Population Research*, 10:127–154, 2012. ISSN 1728-4414, 1728-5305. doi: 10.1553/populationyearbook2012s127.

Albert Esteve, Joan García-Román, and Iñaki Permanyer. The gender-gap reversal in education and its effect on union formation: the end of hypergamy? *Population and Development Review*, 38(3):535–546, 2012.

Marianne Bertrand, Emir Kamenica, and Jessica Pan. Gender identity and relative income within households. *The Quarterly Journal of Economics*, 130(2):571–614, 2015.

Natalie Nitsche, Anna Matysiak, Jan Van Bavel, and Daniele Vignoli. Partners' educational pairings and fertility across Europe. *Demography*, 55(4):1195–1232, 2018.

Jan Van Bavel and Martin Klesment. Educational pairings, motherhood, and women's relative earnings in Europe. *Demography*, 54(6):2331–2349, 2017.

Yue Qian. Gender asymmetry in educational and income assortative marriage. *Journal of Marriage and Family*, 79(2):318–336, 2017. publisher: Wiley Online Library.

Dávid Erát. Educational assortative mating and the decline of hypergamy in 27 European countries: An examination of trends through cohorts.

Demographic Research, 44:157–188, jan 28 2021. ISSN 1435-9871. doi: 10.4054/DemRes.2021.44.7.

Sinn Won Han. Is It Only a Numbers Game? A Macro-Level Study of Educational Hypogamy. *Demography*, 59(4):1571–1593, aug 1 2022. ISSN 0070-3370, 1533-7790. doi: 10.1215/00703370-10126742.

Giulia Corti and Stefani Scherer. Mating Market and Dynamics of Union Formation. *European Journal of Population*, 37(4-5):851–876, 11 2021. ISSN 0168-6577, 1572-9885. doi: 10.1007/s10680-021-09592-2.

Paul J. Boyle, Hill Kulu, Thomas Cooke, Vernon Gayle, and Clara H. Mulder. Moving and union dissolution. *Demography*, 45(1):209–222, feb 1 2008. ISSN 0070-3370, 1533-7790. doi: 10.1353/dem.2008.0000.

Sandra Krapf. Moving in or Breaking Up? The Role of Distance in the Development of Romantic Relationships. *European Journal of Population*, 34(3):313–336, 8 2018. ISSN 0168-6577, 1572-9885. doi: 10.1007/s10680-017-9428-2.

Michael J. Rosenfeld, Reuben J. Thomas, and Sonia Hausen. Disintermediating your friends: How online dating in the United States displaces other ways of meeting. *Proceedings of the National Academy of Sciences*, 116(36):17753–17758, sep 3 2019. ISSN 0027-8424, 1091-6490. doi: 10.1073/pnas.1908630116.

E. Bruch and M. Newman. Structure of Online Dating Markets in U.S. Cities. *Sociological Science*, 6:219–234, 2019. ISSN 23306696. doi: 10.15195/v6.a9.

Jan Eckhard and Johannes Stauder. Partner market opportunities and union formation over the life course—A comparison of different measures. *Population, Space and Place*, 25(4):e2178, 2019. ISSN 1544-8452. doi: 10.1002/psp.2178. _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1002/psp.2178.

Raoul van Maarseveen. The urban–rural education gap: do cities indeed make us smarter?*. *Journal of Economic Geography*, 21(5):683–714, sep 1 2021. ISSN 1468-2702. doi: 10.1093/jeg/lbaa033.

Alexander Zahl-Thanem and Johan Fredrik Rye. Spatial inequality in higher education: a growing urban–rural educational gap? *European Sociological Review*, page jcae015, mar 21 2024. ISSN 0266-7215, 1468-2672. doi: 10.1093/esr/jcae015.

Kiatanantha Lounkaew. Explaining urban–rural differences in educational achievement in Thailand: Evidence from PISA literacy data. *Economics of Education Review*, 37:213–225, dec 1 2013. ISSN 0272-7757. doi: 10.1016/j.econedurev.2013.09.003.

L. Xiang and J. Stillwell. Rural–Urban Educational Inequalities and Their Spatial Variations in China. *Applied Spatial Analysis and Policy*, 16(2): 873–896, jun 1 2023. ISSN 1874-4621. doi: 10.1007/s12061-023-09506-1.

Wen Wen, Lu Zhou, Mingyu Zhang, and Die Hu. Urban/Rural Disparities in Access to Elite Higher Education: The Case of Tsinghua University. *International Journal of Chinese Education*, 12(2):2212585X231189338, may 1 2023. ISSN 2212-585X. doi: 10.1177/2212585X231189338. publisher: SAGE Publications Ltd.

James LeSage. *Spatial econometrics*, pages 23–40. Edward Elgar Publishing, 2015. URL https://www.elgaronline.com/downloadpdf/edcoll/9780857932662/9780857932662.00007.pdf. [Online; accessed 2024-09-19].

Luc Anselin. *Spatial econometrics*, pages 101–122. Edward Elgar Publishing, nov 15 2022. ISBN 978-1-78990-394-2. URL https://www.elgaronline.com/edcollchap/book/9781789903942/book-part-9781789903942-14.xml. section: Handbook of Spatial Analysis in the Social Sciences.

Nicky Best, Samantha Cockings, James Bennett, Jon Wakefield, and Paul Elliott. Ecological regression analysis of environmental benzene exposure and childhood leukaemia: sensitivity to data inaccuracies, geographical scale and ecological bias. *Journal of the Royal Statistical Society: Series A (Statistics in Society)*, 164(1):155–174, 2001. ISSN 1467-985X. doi: 10.1111/1467-985X.00194. _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1111/1467-985X.00194.

Arul Earnest, Geoff Morgan, Kerrie Mengersen, Louise Ryan, Richard Summerhayes, and John Beard. Evaluating the effect of neighbourhood weight matrices on smoothing properties of Conditional Autoregressive (CAR) models. *International Journal of Health Geographics*, 6(1):54, nov 29 2007. ISSN 1476-072X. doi: 10.1186/1476-072X-6-54.

Richard Harris, John Moffat, and Victoria Kravtsova. In Search of 'W'. *Spatial Economic Analysis*, 6(3):249–270, sep 1 2011. ISSN 1742-1772. doi: 10.1080/17421772.2011.586721. publisher: RSA Website _eprint: https://doi.org/10.1080/17421772.2011.586721.

Arthur Getis and Jared Aldstadt. Constructing the Spatial Weights Matrix Using a Local Statistic. *Geographical Analysis*, 36(2):90–104, 7 2004. ISSN 0016-7363, 1538-4632. doi: 10.1111/j.1538-4632.2004.tb01127.x.

Álvaro Briz-Redón, Adina Iftimi, Juan Francisco Correcher, Jose De Andrés, Manuel Lozano, and Carolina Romero-García. A comparison of multiple neighborhood matrix specifications for spatio-temporal model fitting: a case study on COVID-19 data. *Stochastic Environmental Research and Risk Assessment*, 36(1):271–282, 1 2022. ISSN 1436-3240, 1436-3259. doi: 10.1007/s00477-021-02077-y.

Stephen Gibbons and Stephen Machin. Valuing rail access using transport innovations. *Journal of Urban Economics*, 57(1):148–169, jan 1 2005. ISSN 0094-1190. doi: 10.1016/j.jue.2004.10.002.

Hannah Jordan, Paul Roderick, David Martin, and Sarah Barnett. Distance, rurality and the need for care: access to health services in South West England. *International Journal of Health Geographics*, 3(1):21, sep 29 2004. ISSN 1476-072X. doi: 10.1186/1476-072X-3-21.

Stephen G Jones, Avery J Ashby, Soyal R Momin, and Allen Naidoo. Spatial Implications Associated with Using Euclidean Distance Measurements and Geographic Centroid Imputation in Health Care Research. *Health Services Research*, 45(1):316–327, 2 2010. ISSN 0017-9124. doi: 10.1111/j.1475-6773.2009.01044.x. PMID: 19780852 PMCID: PMC2813451.

E. Bruch and M. Newman. Aspirational pursuit of mates in online dating markets. *Science Advances*, 4(8):eaap9815, aug 3 2018. ISSN 2375-2548. doi: 10.1126/sciadv.aap9815.

Kajsa Ellegård and Bertil Vilhelmson. Home as a Pocket of Local Order: Everyday Activities and The Friction of Distance. *Geografiska Annaler: Series B, Human Geography*, 86(4):281–296, 2004. ISSN 1468-0467. doi: 10.1111/j.0435-3684.2004.00168.x. _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.0435-3684.2004.00168.x.

Petr Matous, Yasuyuki Todo, and Dagne Mojo. Boots are made for walking: interactions across physical and social space in infrastructure-poor regions. *Journal of Transport Geography*, 31:226–235, jul 1 2013. ISSN 0966-6923. doi: 10.1016/j.jtrangeo.2013.04.001.

Evan Schofer and John W. Meyer. The Worldwide Expansion of Higher Education in the Twentieth Century. *American Sociological Review*,

70(6):898–920, 12 2005. ISSN 0003-1224, 1939-8271. doi: 10.1177/000312240507000602.

Johannes Stauder and Tom Kossow. Opportunities and Constraints of the Partner Market and Educational Assortative Mating. *Journal of Family Issues*, 42(11):2554–2588, nov 1 2021. ISSN 0192-513X. doi: 10.1177/0192513X20984494. publisher: SAGE Publications Inc.