Received: 21 February 2021 | Revised: 6 June 2021 | Accepted: 16 June 2021

DOI: 10.1111/pirs.12627

FULL ARTICLE

Are old regions less attractive? Interregional labour migration in a context of population ageing

Paula Prenzel

Institute for Geography and Geology, Greifswald University, Germany

Correspondence
Paula Prenzel, Institute for Geography and Geology, Greifswald University, Friedrich-Ludwig-Jahn-Str. 17a, 17489 Greifswald, Germany.
Email: paula.prenzel@uni-greifswald.de

Abstract

Regional demographic change is often conceptualized as a circular process, where out-migration continuously worsens conditions of population ageing and shrinkage. Thus, if migration acts as a consequence as well as cause of ageing, migration patterns should be influenced by the age structure of origin and destination regions. This paper analyses individual-level migration decisions of full-time employees across 326 German regions between 1997 and 2013 using binary choice models. The results show that individuals are more likely to migrate out of and less likely to migrate towards ageing regions. Moreover, the identified patterns are consistent with age-selective migration reinforcing ageing processes and polarization of demographic structure.

KEYWORDS
demographic change, interregional migration, regional polarization, selective migration

JEL CLASSIFICATION
J10; J62; R1; R23

1 | INTRODUCTION

Migration affects the size and composition of population and is, therefore, a fundamental component of demographic shifts. With fertility rates falling below replacement level in most industrial nations, migration has

Correction added on 30 August 2021 after first online publication: The figure 2 layout has been updated in this version and appendix is moved to supporting information.

This is an open access article under the terms of the Creative Commons Attribution License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.
© 2021 The Author. *Papers in Regional Science* published by John Wiley & Sons Ltd on behalf of Regional Science Association International.

become the primary driver of population growth on a national and regional level. Moreover, since migration is often selective, for example, with respect to age, gender, or skill-level, it also shapes the composition of population and thus contributes to population ageing. However, although migration clearly affects demographic structure, regional demography could in turn influence migration behaviour. Despite the current and predicted future extent of population ageing in Europe and globally (Coleman, 2006), the question of how these changes in the age structure may affect regional migration patterns has so far received relatively little attention.

Theoretically, population ageing may directly affect aggregate migration rates through shifts in the population composition: older regions have fewer individuals in the most mobile life stages. However, demographic change is also associated with changes in regional characteristics, which may influence a region's attractiveness for migrants on an individual level. Strongly ageing regions may simultaneously experience adverse economic and labour market conditions, which reinforces out-migration. Moreover, as public services and amenities are adapted to an older population, ageing regions may become less attractive for younger individuals specifically. The relationship between migration and population ageing may therefore be bi-directional as well as mutually reinforcing. This is reflected in conceptualizations of regional demographic change as a circular process (e.g., Bontje & Musterd, 2012; Hoekveld, 2012): regions with declining and ageing population may become continuously less attractive to migrants. The interplay between migration and population ageing could thus lead to a polarization of demographic structures.

Demographic change has far-reaching socio-economic effects, for example, on economic growth and productivity, provision of public services, and social cohesion. In this sense, the potentially reinforcing roles of population ageing and migration are directly relevant for issues of regional development. However, despite progressing demographic change on a global scale, there is limited theoretical and empirical literature on how a region's demographic structure affects individual migration behaviour. Micro-level studies emphasize the relevance of an individual's age in migration decisions (e.g., Goetzke & Rave, 2013; Millington, 2000) but neglect the effect the regional age structure may have on individuals. Aggregate studies of migration often include the share of young population (e.g., Biagi et al., 2011; Hatton & Williamson, 2005; Rodríguez-Pose & Ketterer, 2012) but usually limit its discussion to that of a control variable. While the impact of cohort size on mobility has been analysed for example for the baby boomers (Plane, 1992; Plane & Rogerson, 1991), these studies focus purely on demographic effects and do not include regional characteristics.

This paper therefore focuses on investigating the link between regional age structure and migration behaviour explicitly and on an individual level. Using German administrative labour force data, we test whether regional age structure affects employees' propensity to migrate as well as their destination choice. While descriptive in nature, the analysis allows testing whether the patterns of labour migration are consistent with migration and ageing as reinforcing or opposing processes, which is relevant in the discussion on policy responses to population ageing.

With a median age of 45.9 in 2015, Germany ranks as the second-oldest country in the world (after Japan) (UN, 2019) making it a relevant case to better understand the impact of further ageing around the world. We analyse the effect of regional age structure on interregional migration decisions for employees in Germany between 1997 and 2013. Focusing on interregional migration is particularly interesting because it allows capturing the effects on both sending and receiving regions. In contrast to international migration, which represents an addition of external population, interregional migration flows illustrate the growth of some regions at the cost of depopulation in others. Moreover, because interregional migrants are more similar to the resident population, institutional factors that may constrict international migration (language, transferability of degrees) do not apply.

This paper proceeds as follows. First, the theoretical and empirical background is summarized. Second, the data and methodology are described. Third, the results are presented for migration propensity and destination choice before, fourth, discussing them and offering concluding remarks.

2 | BACKGROUND

2.1 | Migration in times of demographic change

Demographic change in industrial countries is characterized by falling fertility rates and rising life expectancy. Jointly, these effects slow population growth and lead to ageing. In Germany, where demographic change is relatively far progressed, the number of deaths has exceeded births since 1973 (Destatis, 2015), indicating that, for almost 50 years now, population growth has been exclusively due to international migration. On a regional scale, the negative natural balance means that shrinking German regions do not necessarily experience out-migration—some regions shrink despite positive net migration. Simultaneously, the population is ageing: Between 1990 and 2013, the share of population above 65 years increased from 15% to 21%, and the median age rose from 37 to 45 years (Destatis, 2015).

Within Germany, roughly 9% of the population changes residence per year, which is intermediate in international comparison (Sander, 2018). East–West migration was the prominent pattern in Germany for most of the 1990s. From 1991 to 2018, the total net migration from East Germany to the West is estimated at 1.2 million people although migration has been balanced recently (Bundesinstitut für Bevölkerungsforschung, 2020). East–West migration is not only relevant due to its sheer volume but also because of its selective nature. Migrants from the East are relatively young (Hunt, 2006; Kemper, 2004) and often female (Kröhnert & Vollmer, 2012). In line with the Roy model, which predicts that higher-skilled individuals are motivated by relative earnings (e.g., Borjas et al., 1992), East–West migrants are found to be positively selected on education (Arntz et al., 2014; Hunt, 2006) and earnings potential (Brücker & Trübswetter, 2007).

As the driver of population growth in countries facing a birth deficit and with its selective qualities, migration is relevant from perspectives of regional development. Although the net effect of immigration is still a contested topic in the literature, migration clearly implies a redistribution of human capital with ambiguous consequences on both sending and receiving regions (Faggianet al., 2017). For sending regions, selective migration of young and high-skilled individuals is a loss of human capital but also implies that those who could contribute most to preventing or reversing negative consequences of demographic change are more likely to leave. In contrast, more vulnerable population groups (e.g., the elderly, low-skilled or those with low incomes) may not be able to migrate and thus get left behind in shrinking and ageing regions, which may then act as "spatial traps" (Iammarino et al., 2019). This aligns with research suggesting that interregional migration does not sufficiently support regional economic convergence (e.g., Fendel, 2016; Kubis & Schneider, 2016) and may even lead to further divergence, especially when migrants are high-skilled (Granato et al., 2015).

In this sense, if population ageing reinforces selective migration of young and highly educated individuals, demographic change could deepen regional disparities in economic terms and lead to increasing polarization of age structures across regions. This is both because young individuals may be more likely to leave and because their leaving further reinforces the process of ageing.

2.2 | Theories of age and migration behaviour

Age is a central factor in models of migration, especially on an individual level. In frameworks of human capital theory (Becker, 1962; Schultz, 1961) and following Sjaastad (1962), migration is an investment decision evaluated by its costs and benefits. A person migrates if the expected utility in the destination region less the cost of moving outweighs the utility of staying in the origin region. Both costs and benefits of migration may depend on the potential migrant's age. For instance, expected utility differences between origin and destination region (e.g., wage differences) accrue over the remaining lifetime. A younger individual will have a longer period of activity remaining and thus accumulates the benefits of moving for a longer time. Additionally, migration costs may increase with age, for example, because older

individuals have collected a larger amount of local social or human capital (see e.g. Shaw, 1991) or face higher costs of job search. Frameworks based on human capital theory as well as lifecycle approaches predict that, *ceteris paribus*, moving will be more profitable and more frequent for a younger person than an older one (Newbold, 2018).

Migration propensity thus peaks in the early 20s and generally declines with age, implying that migrants represent, on average, younger segments of the regional age distribution. In this sense, the role of ageing as a consequence of migration is evident: if migrants are predominantly young, regions experiencing out-migration are expected to age. Especially in the context of historical (global) migration patterns, such as rural-to-urban migration, this notion of migration pulling away the young and leaving behind the old is intuitive. However, if we consider migration decisions to be affected by origin and destination characteristics, limiting the consideration of ageing to a consequence of migration assumes that these regional characteristics are independent of demographic structure. For instance, disequilibrium perspectives of migration suggest that sustained out-migration of young population eventually causes rising wages and falling housing costs in the origin region thus incentivizing a turn-around in migration flows. But if regions are, over time, shaped by the demographic structure of their population, initial shifts in the population age structure (whether caused by out-migration of the young or gradually due to changes in fertility and mortality rates) may be accompanied by changes in regional characteristics, which condition future migration behaviour. In the context of equilibrium models of migration, which acknowledge the relevance of amenities that may only partially be compensated by wages (e.g., Clark et al., 2003), ageing could (e.g., through changes in regional amenities) itself become a relevant push or pull factor rather than simply a consequence of migration.

More specifically, when considering potential links between regional age structure and migration, three channels of influence can be distinguished: population composition, cohort effects, and age-specific sorting. Composition effects arise because the age distribution of out-migrants depends on the age composition of the overall local population (Little & Rogers, 2007). A region with a relatively old age structure should see less out-migration in absolute terms simply because there are fewer individuals in the most mobile age groups. Empirical support for this notion is established in the literature on the determinants of migration flows (e.g., Hatton & Williamson, 2005), although significance may depend on model specification (Zaiceva & Zimmermann, 2016). On a regional level, Rodríguez-Pose and Ketterer (2012) illustrate that young European regions face relatively more out-migration. While composition effects may explain differences in mobility, it should be noted that they work on the aggregate rather than individual level. Fewer people may leave older regions overall, but this does not imply differences in an individual's migration propensity.

In contrast, the literature on mobility differences across generations shows that cohort size could affect individual migration behaviour. Drawing on Easterlin's (1980) work, this stream of literature argues that large cohorts face increased labour and housing market competition, leading to an increase in the prevalence of two-worker households, which are less mobile. The large baby-boom generation could thus explain the reduction in internal migration rates for the US (Cooke, 2018; Plane, 1992; Plane & Rogerson, 1991), although this result may not hold in other contexts (e.g., Australia; Sander & Bell, 2016). Moreover, if large cohorts also reduce labour and housing market opportunities for following cohorts, such "generational crowding" could reduce mobility for all age groups (Cooke, 2018; Zaiceva & Zimmermann, 2016). In this sense, a relatively old regional age structure would be expected to reduce migration propensity overall.

Lastly, migration may be influenced by regional age structure due to sorting mechanisms. Besides the costs and benefits of migration varying with individual age, migration incentives may also differ depending on an individual's life stage. The extensive literature on graduate mobility emphasizes labour market factors as motivating both migration propensity and destination (e.g., Haussen & Uebelmesser, 2018; Venhorst et al., 2011). For older individuals, labour market aspects diminish in importance, whereas housing costs and amenities become more relevant in explaining migration patterns (Chen & Rosenthal, 2008; Clark & Hunter, 1992; Dorfman & Mandich, 2016; Millington, 2000; Schaffar et al., 2019). Goetzke and Rave (2013) show that age groups evaluate combinations of employment opportunities and amenities (capitalized into wages or property values) differently, with ages 30–49 being particularly sensitive to employment and younger groups more sensitive to amenities.

Thus, there may be sorting across regions based on the relative importance age groups place, for example, on labour market factors versus amenities. Moreover, age groups may also have different preferences for types of amenities, for example, in terms of public services demanded. If the provision of public services reflects local age structure, this could affect a region's attractiveness for certain age groups. For example, school provision may be a concern for families and thus factor especially in relocation decisions for these age groups but not for older ones. In contrast, Dorfman and Mandich (2016) emphasize the relevance of health care access for migration among the elderly. If such sorting mechanisms exist, we would expect differences in how migration decisions vary with regional age structure for younger and older individuals.

Although the relevance of ageing for migration is thus theoretically acknowledged and touched upon in the described literature, few studies empirically test the role of age structure as an explanatory factor in migration. A notable exception is an analysis by Johansson et al. (2018), who show that European NUTS 3 regions with higher shares of elderly population may receive smaller net migration but draw this conclusion from a cross-sectional aggregate analysis with few control variables. This paper contributes to the literature by investigating whether an ageing population may influence overall regional attractiveness for migration. In contrast to Johansson et al. (2018) and most literature on age-specific migration determinants, this study analyses individual-level data. It should be noted here that we do not claim a causal relationship between age structure and individuals' migration decisions but rather focus on the reduced form effects of regional ageing. For instance, the regional age structure could capture the presence of age-specific amenities that facilitate sorting of individuals via migration. Nevertheless, using individual level data avoids concerns of endogeneity of age structure that apply in aggregate analyses of migration flows. Moreover, individual data allows distinguishing not only whether migration behaviour varies with the regional age composition but also whether this effect differs by migrants' ages. Age groups may seek out regions where they are highly represented, as documented for elderly migrants in France (Schaffar et al., 2019). Such sorting would imply that migration reinforces population ageing, which may explain previous empirical results of demographic polarization (e.g., Gregory & Patuelli, 2015; Sabater et al., 2017) and raises concerns for future polarization of age structures. This is an aspect of the interrelation between ageing and migration that has so far not received much attention in the literature but is addressed explicitly in this study.

3 | DATA

The individual-level migration data is derived from the Sample of Integrated Labour Market Biographies (SIAB7514[1]). This dataset represents a 2% sample of administrative labour force records in panel form and is representative of employees covered by compulsory social security *(sozialversicherungspflichtig Beschäftigte)*. Although the self-employed and public servants are not included in this data, it represents the most detailed labour market records available for Germany. Due to the data structure and because location is derived from the region of employment, the sample is limited to full-time employees aged 18 to 62.

Individuals are classified as migrant or non-migrant for each year by considering the location of full-time employment spells that include June 30.[2] If the current employment region differs from the following year's, the individual is considered a migrant. We also collect age, gender, education level and daily wage for their current job (i.e., prior to migration). The final sample comprises almost 6.2 million observations for 758,542 individuals. Between 1997 and 2013, 355,589 interregional migration events are observed, corresponding to 5.74% of the sample.

The geographic unit of analysis is an unbalanced panel of 326 district-regions as defined in the SIAB7514 dataset. These regions represent an adjusted version of German NUTS 3 regions where regions with less than

[1]Data access was provided via Scientific Use File by the Research Data Centre (FDZ) of the German Federal Employment Agency (BA) at the Institute of Employment Research (IAB).

[2]For a small number of cases, multiple full-time employment spells are recorded. If the location of these alternative spells was the same, the first spell was used. Otherwise, the observations were excluded.

100,000 inhabitants are aggregated upwards. The individual data is combined with regional characteristics obtained from the Federal Statistical Offices' Regional Database Germany and INKAR, the database of the Federal Office for Building and Regional Planning. The core variable of interest, regional age structure, is measured via the share of population above 65 years (elderly share). The results are robust to using labour market regions instead of NUTS 3 regions and alternative measures of ageing (mean age of the labour force and the Billeter J index). Results for the robustness checks, variable descriptions and summary statistics are provided in the Appendix.

4 | METHOD

We analyse individual-level labour migration in a separate framework for migration propensity and destination choice. A caveat of this approach is that it assumes sequential decision-making, while the decision whether to migrate may be interrelated with the destination choice. Nevertheless, the literature on individual migration commonly models generation and distribution components separately as it is computationally and intuitively simpler (Cushing & Poot, 2004). As we are primarily interested in whether migration patterns are differentiated by regional age structures and not by the fundamental migration decision, we follow this approach and investigate the role of regional age structure separately for propensity to migrate and for destination choice.

4.1 | Propensity to migrate

To examine the relationship between regional age structure and propensity to migrate, we estimate a model with a binary dependent variable of migration ($y = 0$ for non-migrants or $y = 1$ for migrants). The logistic regression model is derived from an underlying latent variable specification where the decision to migrate depends on the main variable of interest, share of elderly population, a set of individual controls (IC_i) and a set of regional controls for the origin region (RC_r).

$$y_i^* = \alpha + \beta\, elderly_r + \gamma IC_i + \delta RC_r + e_i \qquad y_i = I\left[y_i^* > 0\right], \tag{1}$$

$$P(y_i = 1|x) = P(y_i^* > 0|x) = P[e_i > (\alpha + \beta\, elderly_r + \gamma IC_i + \delta RC_r)|x]. \tag{2}$$

The individual controls include age, age squared (to account for the non-linear shape of migration propensity), gender, education level, wage at the current job (i.e., pre-migration) and a dummy for whether this individual has migrated previously. In line with the literature on regional determinants in migration (e.g., Biagi et al., 2011; Rodríguez-Pose & Ketterer, 2012) we control for economic conditions (GDP *per capita*, unemployment rate, share of manufacturing in value added) as well as population size, share of employees with tertiary education and dummy variables for urban and East German regions (excluding Berlin). As a proxy of broad regional attractiveness due to non-economic factors (such as landscape or cultural amenities), we follow previous studies (e.g., Tanis, 2020) in including population-normalized hotel capacity. Since the microdata here refers only to interregional labour migration, international migration is not captured. However, differences in the scale of international migration may affect interregional migration patterns, for example, because of increased competition on the labour or housing market or, in the sense of Florida's (2002) melting pot arguments, because (cultural) diversity itself increases regional attractiveness. To roughly account for the relevance of international migration, the share of foreign citizens in the regional population is included as a control variable. Assuming that e_i has a standard logistic distribution, we can estimate propensity to migrate in a logistic regression model through maximum likelihood estimation of:

$$P(y_{i,t} = 1|x) = \frac{exp(\alpha + \beta elderly_{r,t-1} + \gamma IC_{i,t} + \delta RC_{r,t-1} + \mu_t)}{1 + exp(\alpha + \beta elderly_{r,t-1} + \gamma IC_{i,t} + \delta RC_{r,t-1} + \mu_t)} \tag{3}$$

Since each migrant also contributes to the regional age structure, there is potential simultaneity, which is lessened by lagging the regional characteristics in (3) by one year. To account for unobserved period effects, year fixed effects are included. Also, although the microdata has a panel structure, the results reported here are estimated using the pooled dataset with standard errors clustered by individual.[3] Finally, as an extension to the model, interaction effects between the individual and regional characteristics are included to test whether the effect of the regional age structure varies across age groups and education levels.

4.2 | Destination choice

As a second stage, this paper addresses the question whether regional age structure is related to migrants' destination choices. For this purpose, the sample is restricted to migrants only. Every migrant has a choice of 325 - district-regions (i.e., all but the origin region) and a dummy variable denotes the region that gets selected.

To estimate the destination choice, we restrict the dataset to yearly cross-sections for two reasons. First, multiple observations in the unbalanced panel dataset may confound the analysis because movers may be observed more than once, implying that their decision is weighted more than that of a single mover. Second, the choice model has large computational requirements as the dataset requires one row per potential destination per individual. Thus, the choice model for the 355,589 observed migration events requires simultaneous analysis of 115 million rows of data. We therefore follow Davies et al. (2001) in implementing yearly cross-sections in order to reduce the computational demands and solve the issue of multiple movers as each individual is only recorded once per year.

The destination choice can be analysed in the context of a random utility model where the utility of choosing region *j* for each individual *i* is given by a systematic part $(\beta' z_{ij})$ that depends on a vector of characteristics of the alternative (z_{ij}) and an immeasurable one (ε_{ij}):

$$U_{ij} = \beta' z_{ij} + \varepsilon_{ij.} \tag{4}$$

Utility maximization implies that region *j* gets selected if its utility exceeds the utility of all other options. The probability that individual *i* chooses region *j* is:

$$P(y_i = j) = P(U_{ij} > U_{ik}) = P\left[\varepsilon_{ik} < \beta' z_{ij} + \varepsilon_{ij} - \beta' z_{ik}\right] \quad \forall k \in N, j \neq k \tag{5}$$

According to McFadden's (1974) conditional logit model, the probability of observing individual *i* choosing region *j* is then:

$$P(y_i = j) = \frac{exp(\beta' z_{ij})}{\sum_{k=1}^{N} exp(\beta' z_{ik})} = \frac{exp(\beta_1 elderly_{j,t-1} + \delta RC_{j,t-1})}{\sum_{k=1}^{N} exp(\beta_1 elderly_{k,t-1} + \delta RC_{k,t-1})} \quad \forall k \in N, j \neq k. \tag{6}$$

We estimate (6) by maximum likelihood estimation with the main variable of interest, elderly share, and the same set of regional controls (RC_j) plus a measure of distance. To lessen simultaneity, the independent variables are again lagged by one year, which implies that individuals are expected to choose destinations based on past rather than current regional characteristics. The conditional logit model does not allow including individual characteristics directly because they are constant across alternatives. However, by interacting individual characteristics with regional ones, we can test whether the effect of the regional age structure varies with an individual's age or education.

It should be noted that conditional logit models rely on the assumption of independence of irrelevant alternatives (IIA): the probability of choosing region A over region B should not depend on other alternatives in the choice

[3]We can control for unobserved heterogeneity among individuals by estimating (3) as a panel logit model. However, besides absorbing time-invariant individual characteristics, a panel logit estimation identifies effects only from individuals who are observed at least once as both a migrant and non-migrant, which is why we present the pooled version as our preferred specification.

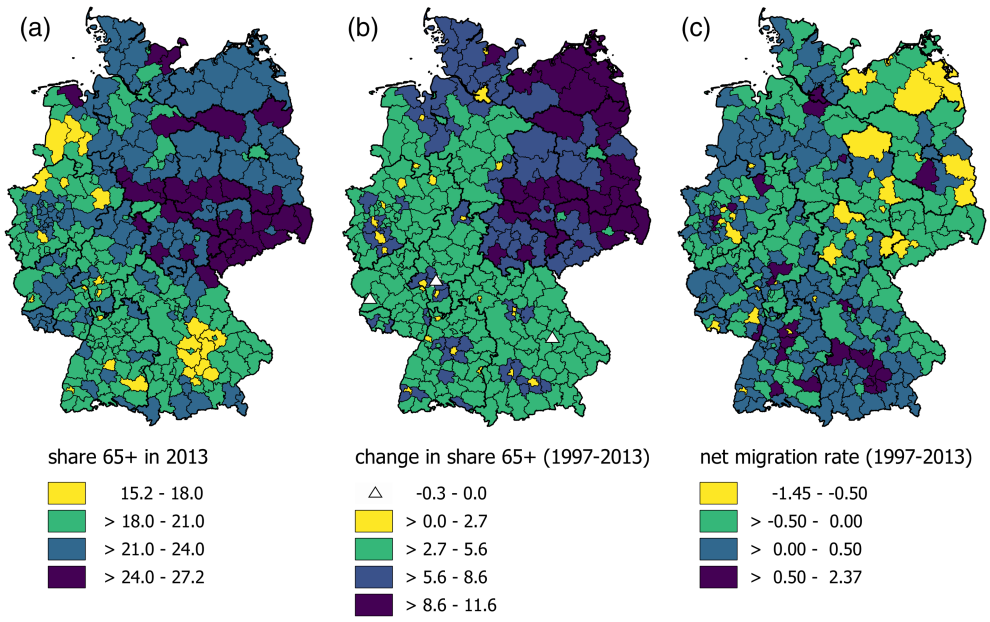

FIGURE 1 Share of population above 65 years in 2013 (a), change in elderly share between 1997 and 2013 (b), and overall interregional net migration rates from the SIAB data (c)

set. To test this assumption, the model could be re-estimated for combinations of different choice subsets, but, as Davies et al. (2001) point out, testing all possible combinations is infeasible for models with many alternatives. Due to size distortions, tests based on restricted choice sets may also not be reliable in empirical applications (Cheng & Long, 2007). Moreover, Christiadi and Cushing (2007) argue that, especially when estimating average preferences rather than substitution between alternatives, the conditional logit model serves as a good approximation regardless of potential violations of IIA.

5 | RESULTS

Regions with a high share of elderly population are geographically concentrated in the east and north of Germany (Figure 1a) and these are also the regions experiencing a strong degree of ageing between 1997 and 2013 (Figure 1b). Indeed, the average increase in the share of elderly population is 8.7 percentage points in East German regions compared to 4.6 in the West. However, it should be emphasized that population ageing occurs in almost all German regions. Only three regions show a slight decrease in the share of population above 65 years: Trier (−0.33 percentage points), Regensburg (−0.11) and Frankfurt am Main (−0.08). Panel (c) illustrates the overall extent of the individual migration decisions captured in the SIAB microdata: it shows the net migration rate for the entire time period normalized by population size. Geographical patterns are visible: regions in the centre and east of Germany largely show out-migration, except for Berlin and its surroundings. However, interregional migration deficits are not limited to the east of Germany. While large agglomerations, for example, areas around Munich and Hamburg, experience positive net migration, more peripheral regions in the west also experience out-migration. Moreover, the majority of observed migration events are relatively short distance: the average (centroid-to-centroid) distance migrated is 113 km with a median of 47 km.[4]

[4]The same measures were calculated for interregional migration flows from the German Migration Database (Sander, 2014). The measures for the sample of individual moves are close to those in aggregate data (average 124.8 km and median 54.2 km). Thus, the migration of employees covered in the SIAB7514 data seems comparable in scale to aggregate migration flows.

TABLE 1 Logit model results for propensity of migration

	(1)	(2)	(3)
share elderly	0.0095***	0.0847***	0.0162***
	(0.0013)	(0.0027)	(0.0014)
age * elderly		−0.0021***	
		(0.0001)	
medium educ * elderly			−0.0173***
			(0.0026)
high educ * elderly			−0.0340***
			(0.0023)
Individual Controls			
age	−0.0478***	−0.0123***	−0.0486***
	(0.0013)	(0.0019)	(0.0013)
age^2	0.0001***	0.0002***	0.0001***
	(0.0000)	(0.0000)	(0.0000)
female	−0.2160***	−0.2150***	−0.2138***
	(0.0040)	(0.0040)	(0.0040)
medium educ	0.2456***	0.2453***	0.5637***
	(0.0062)	(0.0062)	(0.0475)
high educ	0.4539***	0.4553***	1.0781***
	(0.0057)	(0.0057)	(0.0418)
ln wage	−0.4474***	−0.4459***	−0.4460***
	(0.0035)	(0.0035)	(0.0035)
repeat migrant	2.4771***	2.4886***	2.4786***
	(0.0041)	(0.0041)	(0.0041)
Regional Controls			
ln population	−0.1750***	−0.1743***	−0.1760***
	(0.0036)	(0.0036)	(0.0036)
ln GDP p.c.	−0.0978***	−0.0985***	−0.0997***
	(0.0108)	(0.0108)	(0.0108)
unemployment	−0.0104***	−0.0108***	−0.0102***
	(0.0008)	(0.0008)	(0.0008)
share manufacturing	−0.0101***	−0.0101***	−0.0100***
	(0.0002)	(0.0002)	(0.0002)
share high educ	0.0097***	0.0096***	0.0099***
	(0.0007)	(0.0007)	(0.0007)
ln hotel	−0.1108***	−0.1129***	−0.1119***
	(0.0033)	(0.0033)	(0.0033)
sh. foreign	0.0181***	0.0180***	0.0176***
	(0.0007)	(0.0007)	(0.0007)
urban	0.0430***	0.0414***	0.0441***
	(0.0064)	(0.0064)	(0.0064)
east	0.0799***	0.0853***	0.0734***
	(0.0108)	(0.0108)	(0.0108)
Constant	2.5813***	1.2611***	2.4749***
	(0.0693)	(0.0819)	(0.0696)
Observations	6,194,622	6,194,622	6,194,622

(Continues)

TABLE 1 (Continued)

	(1)	(2)	(3)
pseudo R^2	0.155	0.156	0.155
$p > \chi^2$	0	0	0

Notes: Pooled model with year fixed effects and standard errors clustered by individual (in parentheses).
***p < 0.01. **p < 0.05. *p < 0.1.

5.1 | Migration propensity in ageing regions

The estimated coefficient for the share of elderly population is significantly positive across specifications (Table 1). This indicates that, *ceteris paribus*, individuals in regions with an older age structure are more likely to leave than in younger regions. The average marginal effect of a one percentage point increase in elderly population is a 0.05 percentage point increase in the probability of labour migration.

The individual-level explanatory variables are in line with theory and the empirical literature. An individual's age is significantly negative for migration propensity with a positive squared term, and female full-time employees are significantly less likely to migrate than men. Using the lowest educational attainment as base category, individuals with medium and higher education levels are significantly more likely to migrate. Average hourly wage at the current job is significantly negative, which is consistent with relocation to improve job prospects. The dummy variable accounting for repeat migration is, as expected, significantly positive and quite large in magnitude, which implies that migration is more likely if an individual has previously moved.

Regional population size and GDP *per capita* are significantly negative for migration propensity, indicating that individuals are less likely to leave high-income regions and those with large populations. At first glance, the negative coefficient for unemployment seems counterintuitive as adverse labour market conditions should act as a push factor. However, the sample consists only of individuals who are currently employed and for whom migration would be "job-to-job" (i.e., with employment in both the origin and destination region). High unemployment in the origin region may imply that the individual is comparatively well-off, thus reducing the likelihood to migrate. Prevalence of the manufacturing sector is associated with lower and the share of highly skilled employees with higher likelihood of out-migration. In line with the literature on amenities (e.g., Rodríguez-Pose & Ketterer, 2012), we find that individuals are less likely to leave regions with larger hotel capacity. In contrast, individuals in regions with a higher share of foreign population are more likely to out-migrate. Employees are also more likely to move away from urban and East German regions than from rural and West German ones, although the model does not distinguish East–West from within-East (or urban–rural from urban–urban) migration.

The baseline results show that individuals in older regions are more likely to leave. To investigate whether these individual decisions are consistent with age- or skill-selective migration, columns (2) and (3) include interactions with the elderly share. Including these interactions does not affect the signs or significances of the other variables and the elderly share remains significantly positive. The interaction term between the share of elderly population and individual age, however, is significantly negative. Although individuals in older regions are more likely to out-migrate, the effect of the regional age structure decreases with an individual's age. The average marginal effects of the share of elderly population at different individual ages are plotted in the first panel of Figure 2. For individuals younger than 40 years, an increase in the share of elderly population is expected to increase migration propensity. In contrast, for those 50 and older, the same change would be expected to decrease the likelihood of migration. This finding is consistent with age-selective migration and sorting, where young individuals are more likely to leave ageing regions whereas older individuals are more likely to stay. The results thus support the notion that individual migration patterns are reinforcing regional ageing processes in German regions.

Column (3) shows the results of interacting elderly share and individuals' education levels. The interaction terms are negative and use the lowest educational degree as base category. The average marginal effects plotted in the

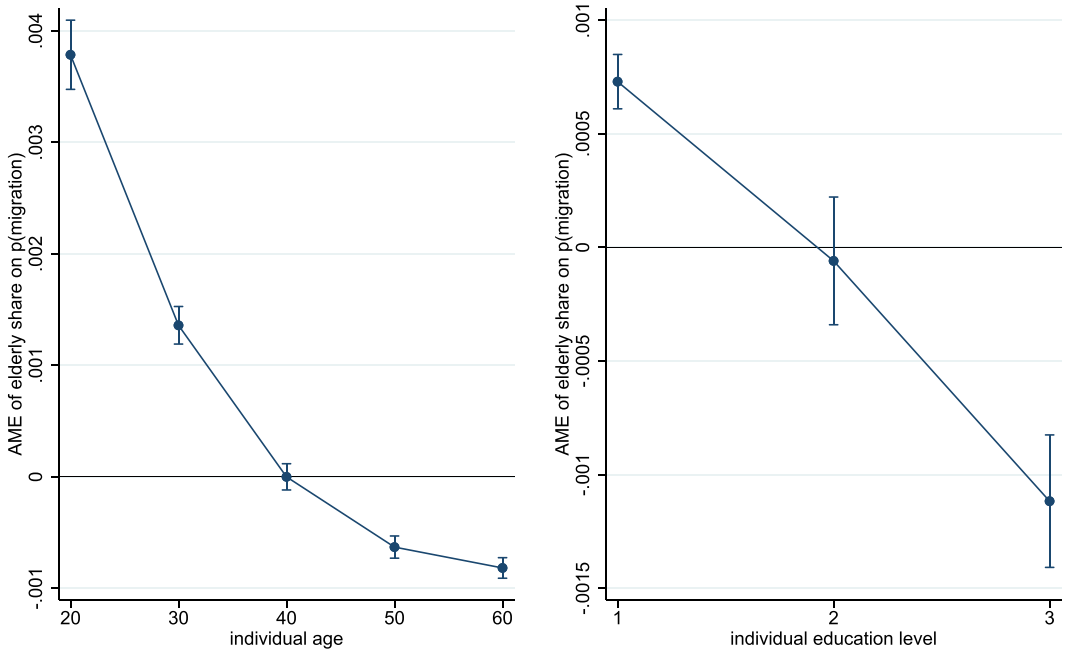

FIGURE 2 Average marginal effects (AME) of elderly share on migration probability by individual age and individual education level

second panel of Figure 2 illustrate that an increase in the share of elderly population is expected to increase migration propensity for those with low educational attainment but decreases it for those with the highest educational attainment. Thus, rather than reinforcing the out-migration of high-skilled human capital, ageing seems to support out-migration of those with the lowest educational attainment. This result contradicts the idea that population ageing could also reinforce brain-drain mechanisms and suggests instead that it may even support retention of high-skilled labour.

5.2 | Destination choice among ageing regions

After having considered the effect of age structure on the likelihood of out-migration, we now turn to analysing where migrants move to. Table 2 shows the conditional logit results of destination choice for internal migrants in Germany using 17 yearly cross-sections of identical model specifications. The variable of interest, share of population above 65 years, is negatively significant for all years with similar coefficient sizes across time. The probability of being selected as a destination region decreases with the share of elderly population: regions with an older age structure are significantly less likely to be selected than younger ones. If we understand the probability of being chosen as a measure of regional attractiveness for migrants, this implies that, *ceteris paribus*, older regions are significantly less attractive destinations than younger ones.

Besides the relevance of the regional age structure, the results in Table 2 also show other features of regional attractiveness. As expected from gravity models of migration, distance is significantly negative. The coefficients for GDP *per capita*, population size, and the number of hotel beds are significantly positive, which suggests migration towards large, high-income regions with high amenity values. Keeping in mind that we only analyse employed individuals, the labour market situation does not emerge as a pull factor: the coefficients are insignificant or positive

TABLE 2 Conditional logit model of destination choice for yearly cross-sections

	(1) 1997	(2) 1998	(3) 1999	(4) 2000	(5) 2001	(6) 2002	(7) 2003	(8) 2004
elderly share	−0.0403*** (0.0055)	−0.0378*** (0.0053)	−0.0433*** (0.0053)	−0.0332*** (0.0052)	−0.0254*** (0.0055)	−0.0287*** (0.0058)	−0.0399*** (0.0059)	−0.0341*** (0.0060)
ln distance	−1.8327*** (0.0093)	−1.8389*** (0.0087)	−1.8341*** (0.0085)	−1.7888*** (0.0081)	−1.7829*** (0.0086)	−1.7867*** (0.0091)	−1.7623*** (0.0094)	−1.7700*** (0.0097)
ln GDP p.c.	0.9473*** (0.0443)	0.8781*** (0.0420)	0.9391*** (0.0388)	0.9089*** (0.0386)	0.9032*** (0.0409)	0.8161*** (0.0427)	0.7709*** (0.0458)	0.8982*** (0.0460)
ln population	1.0011*** (0.0151)	0.9895*** (0.0142)	0.9924*** (0.0135)	0.9853*** (0.0129)	0.9750*** (0.0139)	0.9751*** (0.0152)	1.0302*** (0.0158)	1.0035*** (0.0157)
unemployment	0.0041 (0.0038)	0.0032 (0.0035)	−0.0005 (0.0033)	−0.0053 (0.0033)	−0.0032 (0.0036)	0.0167*** (0.0037)	0.0115*** (0.0039)	0.0153*** (0.0038)
manufacturing	−0.0079*** (0.0009)	−0.0061*** (0.0009)	−0.0067*** (0.0008)	−0.0054*** (0.0008)	−0.0076*** (0.0009)	−0.0045*** (0.0010)	−0.0043*** (0.0010)	−0.0046*** (0.0010)
sh. educ high	−0.0273*** (0.0039)	−0.0177*** (0.0036)	−0.0225*** (0.0033)	−0.0144*** (0.0029)	−0.0151*** (0.0032)	−0.0096*** (0.0033)	−0.0113*** (0.0035)	−0.0123*** (0.0034)
ln hotel	0.1097*** (0.0128)	0.1102*** (0.0127)	0.1242*** (0.0120)	0.1020*** (0.0116)	0.1156*** (0.0122)	0.0721*** (0.0129)	0.0962*** (0.0133)	0.1201*** (0.0138)
sh. foreign	−0.0070*** (0.0027)	−0.0031 (0.0026)	−0.0006 (0.0025)	0.0023 (0.0024)	−0.0039 (0.0025)	−0.0005 (0.0028)	−0.0069** (0.0030)	−0.0097*** (0.0031)
urban	0.0483* (0.0253)	0.0029 (0.0241)	0.0057 (0.0231)	−0.0158 (0.0222)	0.0132 (0.0235)	−0.0380 (0.0252)	−0.0205 (0.0260)	−0.0028 (0.0265)
east	0.6423*** (0.0510)	0.4810*** (0.0519)	0.4164*** (0.0487)	0.3080*** (0.0446)	0.3383*** (0.0503)	0.2492*** (0.0527)	0.3058*** (0.0550)	0.3026*** (0.0570)
Observations	6,112,806	6,900,236	7,710,872	8,304,944	7,234,166	6,277,939	5,836,825	5,589,695
pseudo R^2	0.314	0.320	0.320	0.309	0.307	0.307	0.300	0.301
$p > \chi^2$	0	0	0	0	0	0	0	0

Notes: Robust standard errors in parentheses.
***p < 0.01. **p < 0.05. *p < 0.1.

TABLE 2 (Continued)

	(9) 2005	(10) 2006	(11) 2007	(12) 2008	(13) 2009	(14) 2010	(15) 2011	(16) 2012	(17) 2013
elderly share	−0.0316*** (0.0059)	−0.0358*** (0.0056)	−0.0404*** (0.0053)	−0.0462*** (0.0053)	−0.0420*** (0.0054)	−0.0388*** (0.0050)	−0.0418*** (0.0050)	−0.0447*** (0.0051)	−0.0423*** (0.0050)
ln distance	−1.7753*** (0.0095)	−1.7906*** (0.0091)	−1.7726*** (0.0086)	−1.7783*** (0.0089)	−1.7776*** (0.0091)	−1.8143*** (0.0087)	−1.8160*** (0.0086)	−1.8136*** (0.0091)	−1.8183*** (0.0092)
ln GDP p.c.	0.8256*** (0.0455)	0.9529*** (0.0424)	1.0501*** (0.0395)	0.9151*** (0.0420)	0.8266*** (0.0442)	0.8815*** (0.0407)	0.8147*** (0.0417)	0.9298*** (0.0446)	0.8230*** (0.0443)
ln population	0.9982*** (0.0154)	1.0133*** (0.0144)	1.0235*** (0.0137)	1.0337*** (0.0144)	1.0187*** (0.0150)	0.9874*** (0.0139)	0.9874*** (0.0139)	1.0255*** (0.0147)	1.0335*** (0.0148)
unemployment	0.0194*** (0.0036)	0.0101*** (0.0030)	0.0062** (0.0031)	0.0118*** (0.0034)	0.0249*** (0.0037)	0.0117*** (0.0038)	0.0135*** (0.0040)	0.0185*** (0.0039)	0.0106*** (0.0039)
manufacturing	−0.0075*** (0.0010)	−0.0031*** (0.0010)	−0.0040*** (0.0009)	−0.0050*** (0.0010)	−0.0073*** (0.0010)	−0.0022** (0.0010)	0.0012 (0.0009)	−0.0028*** (0.0010)	−0.0025** (0.0010)
sh. educ high	−0.0076** (0.0034)	−0.0183*** (0.0031)	−0.0222*** (0.0027)	−0.0160*** (0.0029)	−0.0175*** (0.0029)	−0.0127*** (0.0027)	−0.0101*** (0.0027)	−0.0129*** (0.0026)	−0.0112*** (0.0025)
ln hotel	0.0946*** (0.0138)	0.1656*** (0.0128)	0.1511*** (0.0125)	0.1395*** (0.0129)	0.1361*** (0.0135)	0.1634*** (0.0124)	0.1892*** (0.0126)	0.1509*** (0.0134)	0.1648*** (0.0135)
sh. foreign	−0.0099*** (0.0031)	−0.0071** (0.0030)	−0.0129*** (0.0029)	−0.0120*** (0.0030)	−0.0136*** (0.0031)	−0.0187*** (0.0030)	−0.0120*** (0.0030)	−0.0248*** (0.0030)	−0.0187*** (0.0030)
urban	−0.0711*** (0.0259)	−0.0492** (0.0246)	0.0028 (0.0231)	−0.0429* (0.0239)	−0.0513** (0.0250)	−0.0284 (0.0232)	0.0039 (0.0229)	−0.0361 (0.0241)	−0.0291 (0.0248)
east	0.2252*** (0.0539)	0.4062*** (0.0454)	0.4577*** (0.0430)	0.3404*** (0.0429)	0.3658*** (0.0423)	0.3615*** (0.0408)	0.3626*** (0.0397)	0.3274*** (0.0385)	0.3923*** (0.0389)
Observations	5,794,846	6,430,898	7,230,027	6,914,793	6,374,479	7,315,425	7,328,979	6,680,049	6,632,925
pseudo R^2	0.305	0.305	0.301	0.304	0.298	0.303	0.307	0.306	0.307
$p > \chi^2$	0	0	0	0	0	0	0	0	0

Notes: Robust standard errors in parentheses.
***p < 0.01. **p < 0.05. *p < 0.1.

across the years. In contrast, the manufacturing share and the share of tertiary degrees in the region are estimated to be significantly negative, as is the share of foreign population after 2003. Since the indicator refers to the stock of foreign population rather than a migration flow, this only implies that places with more international populations are less frequently chosen as destination by domestic labour migrants and not necessarily that international and inter-regional migrants choose different regions. The results show that, controlling for other factors, employees are not more likely to move to urban rather than rural regions. Interestingly, the dummy denoting alternatives in the East of Germany is significantly positive. Thus, regions in East Germany are significantly more likely to be selected as destination regions than West German regions. It should be noted that this may be due to higher within-east mobility than east-to-west mobility (Sander, 2014) and does not contradict patterns of migration from the east to the west on an aggregate level. Instead, it shows that, controlling for regional characteristics and holding all individual characteristics constant (due to the conditional logit specification), East German regions are not inherently less attractive than those in the west.

Figure 3 shows the point estimate and 95%-confidence intervals when testing for age-selection in the conditional logit model. While the main term remains significantly negative, the interaction term with individual age is significantly positive at confidence levels of 5% in 12 of the 17 years. A negative main and positive interaction term jointly indicate that the negative effect of age structure on destination choice decreases with an individual's age: an increase in the share of population above 65 years in region *r* is associated with a larger decrease in the probability of a migrant choosing *r* if the migrant is relatively young. To further decompose this effect, the lower panels of Figure 3 show the coefficient and confidence intervals for the share of elderly population for three split samples based on individual age.[5] For individuals younger than 50 years, destination choice is significantly negatively associated with the regional elderly population. While the coefficient is also significantly negative for older individuals for some years, it is insignificant most of the time. These results are in line with sorting of individuals by age, where *ceteris paribus*, younger migrants are moving towards "young" rather than "old" regions. We therefore do not find evidence of the notion that migration could balance age structures across space but rather for patterns of continuous spatial polarization of age structures.

The results for education level are less conclusive and clearly show changes over time (Figure 4). Before 2000, the interaction terms with individual education are significantly positive, indicating that migrants with medium or high educational attainment are relatively more likely to choose older destination regions than migrants with low educational attainment. But from 2004 onwards, the deterring effect of regional age structure on the probability of destination choice is larger in absolute value (i.e., more negative) for more highly educated individuals. In this sense, we find some evidence of selective migration based on education level. Specifically, while the effect of ageing either does not differ between educational groups or even deters the least educated migrants more strongly in the first years of the sample, highly-educated migrants seem relatively more sensitive to age structure in recent years. The result that more highly educated individuals are less likely to choose old regions than those with lower educational attainment may point towards an association between population ageing and regional capacity to attract human capital after 2004.

6 | DISCUSSION AND CONCLUSION

This paper investigated the relationship between population ageing and internal migration patterns on an individual level by examining employees' propensity to migrate and destination choice among regions with different demographic structures. Controlling for individual and regional characteristics, the share of elderly population of the origin region is significantly positively related to the probability of out-migration. Among migrants, the destination choice model showed that region alternatives with a higher share of elderly population are less likely to get chosen as destination.

[5]Full results available upon request.

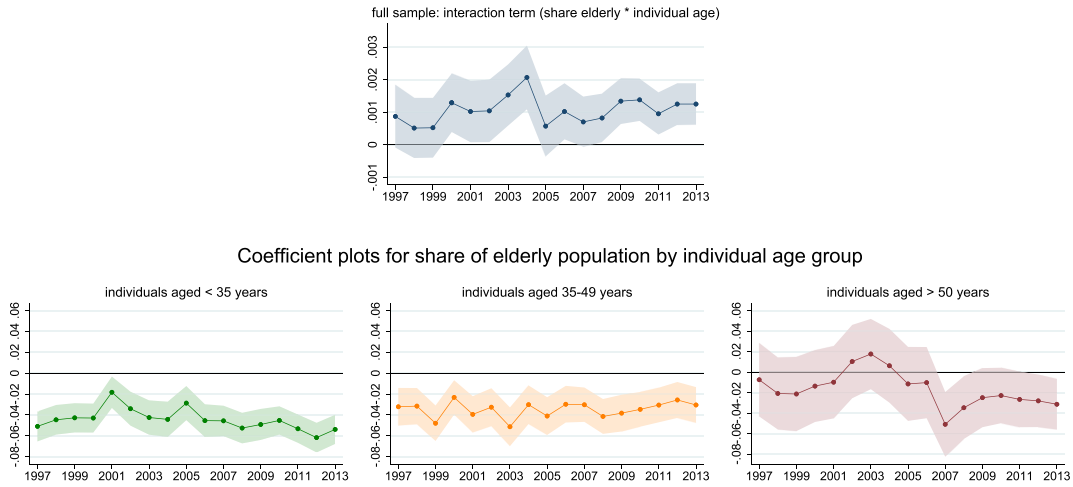

FIGURE 3 Coefficient plots for the interaction term between elderly share and individual age in the full sample destination choice model (top panel) and for the share of elderly population across three subsamples split by individual age group (lower panels)

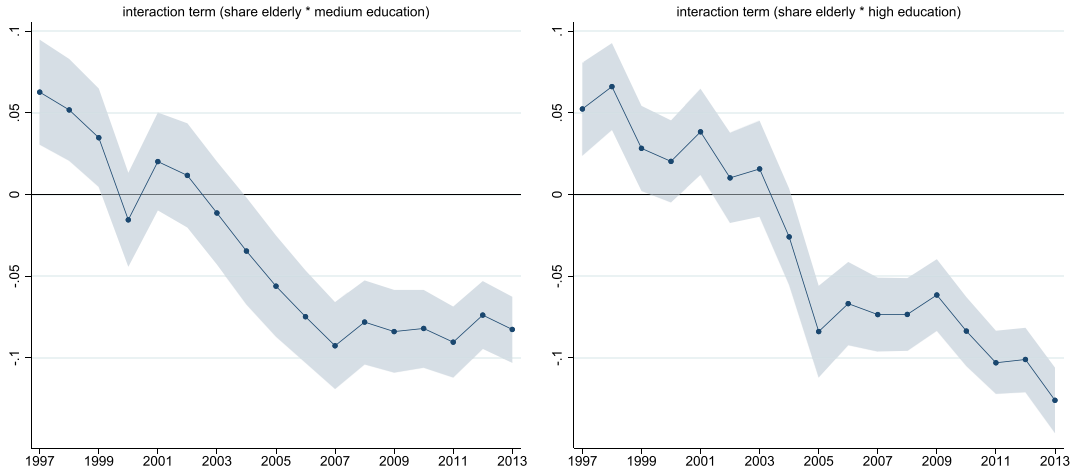

FIGURE 4 Coefficient plots for interaction terms with individual education in the destination choice model

We further tested whether the results are consistent with patterns of age- and skill-selective migration. Interactions between individual age and share of population above 65 years were significant for both migration propensity and destination choice. This implies that younger individuals may be more sensitive to regional age structure both in deciding to leave and in choosing a destination region. The evidence for education-specific effects in migration patterns is more mixed. Individuals with lower educational attainment seem to be more likely to leave older regions than higher-educated individuals, which contradicts the notion of skill-selective out-migration. Potentially, the result could be related to the ease of switching jobs in different skill categories. In general, the finding that high-skilled individuals are not more likely to leave ageing regions is encouraging as it may imply that the human capital loss in ageing regions is less severe than feared. However, there is some evidence that in recent years highly educated individuals may be more sensitive to regional age structure in their destination choice. Thus, while population ageing may not

be associated with a substantial loss of human capital, the results indicate potential difficulties in attracting high-skilled individuals to ageing regions.

Concerning the role of population ageing in shaping labour migration, the results yield two core conclusions. First, population ageing is a relevant explanatory variable of migration patterns. Even when controlling for a range of individual and regional characteristics, the share of elderly population was consistently significant in all estimations. Although we do not claim causal effects of age structure on an individual's decision to migrate, the results indicate that population ageing is not merely a consequence of migration but may in turn be relevant in explaining migration behaviour, for example, through sorting across regions with age-specific amenities.

Second, the direction of the estimated coefficients shows that, if anything, migration seems to reinforce rather than oppose the processes of demographic change. The presented results show that migration flows from relatively old to relatively young regions. Moreover, the identified interaction effects suggest that the migration flows may be selected based on age, with younger individuals more likely to leave older regions. If this is true, older regions do not only see an outflow of population but specifically an outflow of the younger age groups, which will increase the average age of the region further. Although we do not consider the net effect of the migration flows here, the findings illustrate that age-selective migration in Germany may indeed lead to a polarization of age structures consistent with regional demographic change as a circular process.

Two important caveats to the presented analysis should be noted: the nature of the data used and the focus on interregional migration. Although the administrative labour force data is of high quality, the dataset only allows us to identify the geographic location of employers, thus reducing the sample to those employed. While covering a large share of the population, it should be noted that individuals who are not in the labour force (including retirees) or the unemployed may take into account a different set of factors to decide whether and where to move.

The second caveat of the analysis is that international migration is not considered beyond a proxy of the share of foreign population as a control variable. Restricting the focus to internal labour migration allowed us to assume relative homogeneity of migrants and residents and thus ignore a range of factors that would be relevant for international migration. It also grants detailed and comprehensive information on migrants and their pre-migration circumstances at a small spatial scale, which is difficult to obtain for international migrants. However, considering only internal migration patterns treats German interregional migration as if it were a closed system. In reality, international immigrants of course represent a crucial factor in shaping regional demographic structure, especially when they represent the primary source of population growth.

With respect to the internal labour migration patterns examined here, the relevance of our discussion for migration more generally depends on whether international migrants' regional location decisions differ from interregional migrants'. Although we cannot distinguish by citizenship or country of birth, the sample is representative of regional labour markets and therefore also includes employees with a migrant background. Moreover, Tanis (2020) analyses initial and subsequent location choices for international immigrants in West German districts and finds a significantly negative impact of the share of elderly population consistent with the results presented here. Thus, the empirical evidence suggests that both international and interregional migrants may prefer younger over older regions. On a national scale, "replacement" immigration will not be able to halt or reverse population ageing (Coleman, 2008), but this result further suggests that even national-level population growth through immigration may not alleviate these demographic challenges at a regional scale. In this sense, regions aiming to benefit from the demographic effect of immigration may require more targeted strategies of attracting and retaining migrants.

The results of this analysis tie into broader questions on policy making to address the consequences of demographic change on a regional level. In terms of the patterns documented here, it seems that labour migration and population ageing are indeed reinforcing processes leading to polarization of demographic structure. These changes are, in turn, drivers of economic and social consequences. Contrary to some theoretical suggestions, population ageing does not seem to counteract out-migration, thus raising the question of whether policy should and can influence migration patterns directly. With progressing demographic change on a global scale, many countries will face new demographic circumstances of ageing and shrinking populations, similar to the conditions already observed in

Germany. Therefore, the potential of policy initiatives aiming to increase regional attractiveness in ageing and shrinking regions, particularly for those age and skill groups most prone to out-migration, and the impact of demographic polarization on regional development more broadly, remain a relevant area for future research.

ACKNOWLEDGEMENTS

I would like to thank for their helpful comments and suggestions Andrea Ascani, Alessandra Faggian, Steve Gibbons, Simona Iammarino, Vassilis Monastiriotis, and the participants of the 65th NARSC Congress, San Antonio as well as three anonymous reviewers.

ORCID

Paula Prenzel https://orcid.org/0000-0002-6490-125X

REFERENCES

Arntz, M., Gregory, T., & Lehmer, F. (2014). Can regional employment disparities explain the allocation of human capital across space? *Regional Studies*, *48*(10), 1719–1738. https://doi.org/10.1080/00343404.2014.882500

Becker, G. S. (1962). Investment in human capital: A theoretical analysis. *Journal of Political Economy*, *70*(5), 9–49. https://doi.org/10.1086/258724

Biagi, B., Faggian, A., & McCann, P. (2011). Long and short distance migration in Italy: The role of economic, social and environmental characteristics. *Spatial Economic Analysis*, *6*(1), 111–131. https://doi.org/10.1080/17421772.2010.540035

Bontje, M., & Musterd, S. (2012). Understanding Sshrinkage in European regions. *Built Environment*, *38*(2), 153–161. https://doi.org/10.2148/benv.38.2.153

Borjas, G. J., Bronars, S. G., & Trejo, S. J. (1992). Self-selection and internal migration in the United States. *Journal of Urban Economics*, *32*(2), 159–185. https://doi.org/10.1016/0094-1190(92)90003-4

Brücker, H., & Trübswetter, P. (2007). Do the best go west? An analysis of the self-selection of employed East-West migrants in Germany. *Empirica*, *34*(4), 371–395. https://doi.org/10.1007/s10663-006-9031-y

Bundesinstitut für Bevölkerungsforschung. (2020). Wanderung zwischen West- und Ostdeutschland, 1991 bis 2018 [Migration between West and East Germany, 1991 to 2018]. URL: https://www.bib.bund.de/Permalink.html?id=10287054

Chen, Y., & Rosenthal, S. S. (2008). Local amenities and life-cycle migration: Do people move for jobs or fun? *Journal of Urban Economics*, *64*(3), 519–537. https://doi.org/10.1016/j.jue.2008.05.005

Cheng, S., & Long, J. S. (2007). Testing for IIA in the multinomial logit model. *Sociological Methods & Research*, *35*(4), 583–600. https://doi.org/10.1177/0049124106292361

Christiadi, & Cushing, B. (2007). Conditional logit, IIA, and alternatives for estimating models of interstate migration. Regional Research Institute Publications and Working Paper 65. URL: https://researchrepository.wvu.edu/rri_pubs/65

Clark, D. E., Herrin, W. E., Knapp, T. A., & White, N. E. (2003). Migration and implicit amenity markets: Does incomplete compensation matter? *Journal of Economic Geography*, *3*(3), 289–307. https://doi.org/10.1093/jeg/3.3.289

Clark, D. E., & Hunter, W. J. (1992). the impact of economic opportunity, amenities and fiscal factors on age-specific migration rates. *Journal of Regional Science*, *32*(3), 349–365. https://doi.org/10.1111/j.1467-9787.1992.tb00191.x

Coleman, D. (2006). Europe's demographic future: Determinants, dimensions, and challenges. *Population and Development Review*, *32*(S1), 52–95. https://doi.org/10.1111/j.1728-4457.2006.tb00003.x

Coleman, D. (2008). The demographic effects of international migration in Europe. *Oxford Review of Economic Policy*, *24*(3), 453–477.

Cooke, T. (2018). United States: Cohort effects on the long-term decline in migration rates. In T. Champion, T. Cooke, & I. Shuttleworth (Eds.), *Internal migration in the developed world: Are we becoming less mobile?* (pp. 101–119). Routledge.

Cushing, B., & Poot, J. (2004). Crossing boundaries and borders: Regional science advances in migration modelling. *Papers in Regional Science*, *83*(1), 317–338.

Davies, P. S., Greenwood, M. J., & Li, H. (2001). A conditional logit approach to U.S. state-to-state migration. *Journal of Regional Science*, *41*(2), 337–360. https://doi.org/10.1111/0022-4146.00220

Destatis. (2015). Bevölkerung Deutschlands bis 2060: Ergebnisse der 13. koordinierten Bevölkerungsvorausberechnung [German population until 2060: results of the 13th coordinated population projection]. Statistisches Bundesamt. https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Bevoelkerung/Bevoelkerungsvorausberechnung/Publikationen/Downloads-Vorausberechnung/bevoelkerung-deutschland-2060-presse-5124204159004.pdf?__blob=publicationFile

Dorfman, J. H., & Mandich, A. M. (2016). Senior migration: Spatial considerations of amenity and health access drivers. *Journal of Regional Science*, *56*(1), 96–133. https://doi.org/10.1111/jors.12209

Easterlin, R. A. (1980). *Birth and fortune: the impact of numbers on personal welfare*. University of Chicago Press.
Faggian, A., Rajbhandari, I., & Dotzel, K. R. (2017). The interregional migration of human capital and its regional consequences: A review. *Regional Studies*, *51*(1), 128–143. https://doi.org/10.1080/00343404.2016.1263388
Fendel, T. (2016). Migration and regional wage disparities in Germany. *Jahrbücher Fur Nationalokonomie Und Statistik*, *236*(1), 3–35. https://doi.org/10.1515/jbnst-2015-1001
Florida, R. (2002). Bohemia and economic geography. *Journal of Economic Geography*, *2*(1), 55–71. https://doi.org/10.1093/jeg/2.1.55
Goetzke, F., & Rave, T. (2013). Migration in Germany: A life cycle approach. *International Regional Science Review*, *36*(2), 167–182. https://doi.org/10.1177/0160017611435358
Granato, N., Haas, A., Hamann, S., & Niebuhr, A. (2015). The impact of skill-specific migration on regional unemployment disparities in Germany. *Journal of Regional Science*, *55*(4), 513–539. https://doi.org/10.1111/jors.12178
Gregory, T., & Patuelli, R. (2015). Demographic ageing and the polarization of regions—an exploratory space–time analysis. *Environment and Planning A*, *47*(5), 1192–1210. https://doi.org/10.1177/0308518X15592329
Hatton, T. J., & Williamson, J. G. (2005). What fundamentals drive world migration? In G. J. Borjas & J. Crisp (Eds.), *Poverty, International Migration and Asylum* (pp. 15–38). Palgrave Macmillan UK.
Haussen, T., & Uebelmesser, S. (2018). Job changes and interregional migration of graduates. *Regional Studies*, *52*(10), 1346–1359. https://doi.org/10.1080/00343404.2017.1381335
Hoekveld, J. J. (2012). Time-space relations and the differences between shrinking regions. *Built Environment*, *38*(2), 179–195. https://doi.org/10.2148/benv.38.2.179
Hunt, J. (2006). Staunching emigration from East Germany: Age and the determinants of migration. *Journal of the European Economic Association*, *4*, 1014–1037. https://doi.org/10.1162/JEEA.2006.4.5.1014
Iammarino, S., Rodríguez-Pose, A., & Storper, M. (2019). Regional inequality in Europe: Evidence, theory and policy implications. *Journal of Economic Geography*, *19*(2), 273–298. https://doi.org/10.1093/jeg/lby021
Johansson, M., Nilsson, P., & Westlund, H. (2018). Migration and ageing in expanding and shrinking European regions. In R. R. Stough, K. Kourtit, P. Nijkamp, & U. Blien (Eds.), *Modelling aging and migration effects on spatial labor markets* (pp. 107–131). Springer.
Kemper, F.-J. (2004). Internal migration in Eastern and Western Germany: Convergence or divergence of spatial trends after unification? *Regional Studies*, *38*(6), 659–678. https://doi.org/10.1080/00343042000240969
Kröhnert, S., & Vollmer, S. (2012). Gender-specific migration from eastern to western Germany: Where have all the young women gone? *International Migration*, *50*(5), 95–112. https://doi.org/10.1111/j.1468-2435.2012.00750.x
Kubis, A., & Schneider, L. (2016). Regional migration, growth and convergence—a spatial dynamic panel model of Germany. *Regional Studies*, *50*(11), 1789–1803. https://doi.org/10.1080/00343404.2015.1059932
Little, J. S., & Rogers, A. (2007). What can the age composition of a population tell us about the age composition of its out-migrants? *Population, Space and Place*, *13*(1), 23–39. https://doi.org/10.1002/psp.440
McFadden, D. (1974). Conditional logit analysis of qualitative choice behavior. In P. Zarembka (Ed.), *Frontiers in econometrics* (pp. 105–142). Academic Press.
Millington, J. (2000). Migration and age: The effect of age on sensitivity to migration stimuli. *Regional Studies*, *34*(6), 521–533. https://doi.org/10.1080/00343400050085648
Newbold, K. B. (2018). Aging and migration: An overview. In R. R. Stough, K. Kourtit, P. Nijkamp, & U. Blien (Eds.), *Modelling aging and migration effects on spatial labor markets* (pp. 19–30). Springer.
Plane, D. A. (1992). Age-composition change and the geographical dynamics of interregional migration in the U.S. *Annals of the Association of American Geographers*, *82*(1), 64–85.
Plane, D. A., & Rogerson, P. A. (1991). Tracking the baby boom, the baby bust and the echo generations: How age composition regulates US migration. *The Professional Geographer*, *43*(4), 416–430. https://doi.org/10.1111/j.0033-0124.1991.00416.x
Rodríguez-Pose, A., & Ketterer, T. D. (2012). Do local amenities affect the appeal of regions in Europe for migrants? *Journal of Regional Science*, *52*(4), 535–561. https://doi.org/10.1111/j.1467-9787.2012.00779.x
Sabater, A., Graham, E., & Finney, N. (2017). The spatialities of ageing: Evidencing increasing spatial polarisation between older and younger adults in England and Wales. *Demographic Research*, *36*(1), 731–744. https://doi.org/10.4054/DemRes.2017.36.25
Sander, N. (2014). Internal migration in Germany, 1995–2010: New insights into East-West migration and re-urbanisation. *Comparative Population Studies*, *39*(2), 217–246.
Sander, N. (2018). Germany: Internal migration within a changing nation. In T. Champion, T. Cooke, & I. Shuttleworth (Eds.), *Internal migration in the developed world: Are we becoming less mobile?* (pp. 226–241). Routledge.
Sander, N., & Bell, M. (2016). Migration of the baby boomers in Australia. *Population, Space and Place*, *22*, 617–630.
Schaffar, A., Dimou, M., & Mouhoud, E. M. (2019). The determinants of elderly migration in France. *Papers in Regional Science*, *98*(2), 951–972. https://doi.org/10.1111/pirs.12374
Schultz, T. W. (1961). Investment in human capital. *The American Economic Review*, *51*(1), 1–17.

Shaw, K. L. (1991). The influence of human capital investment on migration and industry change. *Journal of Regional Science*, *31*(4), 397–416. https://doi.org/10.1111/j.1467-9787.1991.tb00157.x

Sjaastad, L. A. (1962). The costs and returns of human migration. *Journal of Political Economy*, *70*(5), 80–93. https://doi.org/10.1086/258726

Tanis, K. (2020). Regional distribution and location choices of immigrants in Germany. *Regional Studies*, *54*(4), 483–494. https://doi.org/10.1080/00343404.2018.1490015

United Nations. (2019). *World population prospects 2019*. United Nations.

Venhorst, V., van Dijk, J., & van Wissen, L. (2011). An analysis of trends in spatial mobility of Dutch graduates. *Spatial Economic Analysis*, *6*(1), 57–82. https://doi.org/10.1080/17421772.2010.540033

Zaiceva, A., & Zimmermann, K. F. (2016). Migration and the demographic shift. In J. Piggott & A. Woodland (Eds.), *Handbook of the economics of population aging* (Vol. 1) (pp. 119–177). Elsevier B.V. https://doi.org/10.1016/bs.hespa.2016.08.002

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

How to cite this article: Prenzel, P. (2021). Are old regions less attractive? Interregional labour migration in a context of population ageing. *Papers in Regional Science*, *100*(6), 1429–1447. https://doi.org/10.1111/pirs.12627

DOI: 10.1111/pirs.12627

Resumen. El cambio demográfico regional se suele conceptualizar como un proceso circular, en el que la emigración empeora continuamente las condiciones de envejecimiento y reducción de la población. Por lo tanto, si la migración actúa tanto como consecuencia como causa del envejecimiento, los patrones de migración deberían estar influenciados por la estructura de edad de las regiones de origen y destino. Este artículo analiza las decisiones de migración a nivel individual de empleados a tiempo completo en 326 regiones alemanas entre 1997 y 2013 mediante la utilización de modelos de elección binaria. Los resultados muestran que las personas son más propensas a emigrar fuera de las regiones envejecidas y menos a emigrar hacia ellas. Además, los patrones identificados están en consonancia con la migración selectiva por edades que refuerza los procesos de envejecimiento y la polarización de la estructura demográfica.

抄録: 地域の人口統計額的な変化は循環的なプロセスとして概念化されることが多いが、地域の外への移住は高齢化と人口縮小の問題を悪化させ続ける。すなわち、移住が高齢化の結果でも原因でもあるとすると、移住パターンはその出発地と目的地の住民の年齢構成の影響を受けるはずである。本稿では、1997~2013年のドイツの326地域を対象に、二値選択モデルを用いて、個人レベルでのフルタイムで働く労働者の移住に関する意思決定を分析した。結果から、高齢化が進む地域から移動する確率が高く、高齢化が進む地域に移動する確率が低いことが示された。さらに、確認された移住のパターンは、高齢化と人口統計学的構成の二極化に拍車をかける年齢選択的な移住と一致するものである。

© 2021 The Author. *Papers in Regional Science* published by John Wiley & Sons Ltd on behalf of Regional Science Association International.