Open Peer Review on Qeios

RESEARCH ARTICLE

Diversity in Motion: The Role of Immigrant Human Capital in Danish Second-Tier Towns and Rural Areas

Nino Javakhishvili-Larsen[1], Hans Thor Andersen[1]

1 Department of the Built Environment, Aalborg University, Denmark

Funding: BUILD, AAU

Potential competing interests: No potential competing interests to declare.

Abstract

This study explores the impact of diversified human capital (HC) among inter-regional immigrants on local economies in Denmark, using data from 2009 to 2020. It introduces a Regional Entropy Index (REI) model to measure HC diversification, including education, age, socioeconomic status, sector, wage level, and occupation.

Findings show that the effects of diversified HC on wages differ between urban and rural areas. Both benefit from diverse age and wage levels, but the impact of education and occupation diversity varies. Rural areas gain more from diverse age, wage, and occupation levels, while urban areas benefit from diversity in age, wage, and education.

The study highlights significant spillover effects, with stronger impacts on urban and neighbouring areas. Proximity to urban centres enhances the economic benefits of diversified HC immigration, especially in secondary towns, challenging traditional views on regional economic growth and emphasizing the need for tailored policies.

Corresponding author: Nino Javakhishvili-Larsen, ninojl@build.aau.dk

1. Introduction

The COVID-19 pandemic has dramatically altered global work patterns, sparking what many call an "urban exodus" and generating renewed optimism for population growth in rural areas[1]. This shift, coupled with the rise of remote work, has the potential to reshape migration patterns and preferences, making secondary towns and rural areas increasingly attractive destinations.

Our study examines the economic impact of these changing migration patterns, focusing specifically on II-tier towns and III-tier villages in Denmark. We analyse how the diversification of inter-regional human capital migrants influences local economies in these smaller geographical entities. This research is particularly timely, as it addresses the potential effects of changing migration patterns on regional economic development.

We utilize Danish micro-register data and geographical data between 2009 and 2020 to study migrants moving from large

cities and central municipal cities to smaller cities and villages. We apply the definition and typologies of II-tier Towns and III-tier Villages provided by Javakhishvili-Larsen & Andersen[2].

Traditionally, human capital has been primarily measured through formal education levels[3][4][5][6]. However, our study challenges this narrow definition, and besides the education levels, we incorporate a broader range of attributes including age, occupation, socioeconomic status, and wage levels. By employing this more comprehensive approach, we aim to provide a nuanced understanding of how different aspects of human capital contribute to value creation in smaller towns and rural areas.

To achieve this, we introduce the Regional Entropy Index (REI) Model, an innovative approach to measuring the geographical diversification of human capital attributes. This model allows us to assess how different tiers of localities receive varied or segmented inter-regional human capital immigrants, and by applying pooled Ordinary Least Squares (OLS) and year Fixed Effect (FE) models, test how this diversity impacts local wages of the destination municipalities.

Our analysis reveals significant variations in the impact of diversified human capital on wages between urban and rural municipalities. These differences are influenced by factors such as specific migration patterns, human capital attributes, and the strength of economic connections to larger metropolitan areas. For instance, we find that diverse age and wage levels consistently benefit both urban and rural areas, while the impact of education and occupation diversity differs based on the municipality type.

This study contributes to the fields of regional economics and migration studies in several ways. First, it provides new insights into the economic impact of inter-regional migration patterns, particularly in the context of II-tier towns and III-tier villages. Second, it introduces novel research methods for studying human capital impacts outside of major urban centres. Finally, it challenges conventional wisdom about human capital measurement, suggesting that a more holistic approach may be necessary when analysing smaller towns and rural areas.

In the following sections, we review relevant literature, detail our data sources and methodology, present our findings, and discuss the implications of our results for both theory and practice in regional economic development.

2. Conceptual background and related research

This study aims to explore the economic outcomes of immigration to II-tier towns and rural areas by examining the diversification of immigrant human capital attributes. Our review of the literature focuses on three key areas: counterurban migration trends, evolving concepts of human capital, and the debate between diversification and specialization in regional economic development.

Counterurban Migration Trends

Counterurban migration, defined as the flow of individuals from large cities and metropolitan areas to suburban, peri-urban, and rural areas, has been subject to fluctuating patterns influenced by various economic and social

factors[7][8][2][9][10][11]. In Denmark, for instance, the early 2000s saw a wave of counterurban migration driven by rising urban living costs[12][13]. This trend reversed following the financial crisis, with migration flows shifting back towards urban centres[14][15]. More recently, the COVID-19 pandemic has reignited interest in counterurbanization, facilitated by increased remote work opportunities[16][17][18].

Importantly, recent research challenges long-held stereotypes about rural migrants. Contrary to expectations of attracting primarily lower-educated, low-skilled, and elderly individuals, studies by Javakhishvili-Larsen and Andersen[2] and others[8][6][19][20][21] have observed an increasing trend of highly educated and skilled individuals moving to rural areas. This shift suggests a transformation in the demographic composition of small towns and rural areas, driven by both economic opportunities and lifestyle preferences.

Evolving Concepts of Human Capital

The definition and measurement of human capital have expanded beyond traditional metrics of education and job-related skills[3][22][6][23][5]. Javakhishvili-Larsen and Andersen[2] propose a more comprehensive framework that includes attributes such as age, socioeconomic status, wage level, and occupations for working-age individuals. This broader conceptualization allows for a more nuanced understanding of human capital, particularly in the context of non-urban and non-central locations.

Diversification vs. Specialization in Regional Economic Development

The role of diversification versus specialization in driving regional economic growth has been a subject of ongoing debate. While earlier theories emphasized the importance of agglomeration and specialization[24][25][26][27], more recent studies have highlighted the potential benefits of diversity. Noseleit and Söllner[28] argue that diversity in human capital enhances innovation and productivity, leading to improved economic performance. Similarly, Ejdemo and Örtqvist[29] suggest that regions with higher levels of entrepreneurship and related variety tend to experience better economic performance and growth.

Research Gap and Study Contributions

Despite the rich body of literature on regional economic growth, there remains a significant knowledge gap regarding the dynamics of human capital and economic development in non-urban and non-central locations. This study aims to address this gap by: (1) Analysing interregional counterurban migration processes using detailed Danish micro-register data, allowing for a granular examination of secondary towns and rural villages. (2) Exploring the impact of immigrants through a comprehensive set of human capital attributes, providing a more holistic understanding of their contribution to local economies outside of economic and administrative centres. (3) Investigating the role of diversity or segmentation of immigrant human capital attributes in the economic development of secondary towns and rural villages.

By focusing on these areas, our study contributes to a more nuanced understanding of the relationship between human

capital, migration patterns, and regional economic development in smaller towns and rural areas. This research has important implications for policymakers and planners working to address economic and demographic challenges in these often-overlooked localities.

The following section provides a detailed description of the data and empirical strategies chosen to achieve the goals of this paper.

3. Data and Empirical Steps

This research applies unique longitudinal micro register data per person for whole Danish population between 2009 and 2020, provided by Statistics Denmark. In order to meet the aim of this paper, we propose three empirical steps of data structuring and measurements. In the first step, we define the spatial and geographical specification of the immigrants' destination municipalities, secondary towns and villages. In the second step, we explain our empirical strategy for how to measure the diversification or segmentation of the human capital attributes, and in the third step, we apply diversification index to the linear regression model, in order to measure the impact of the diversification of the immigrants' characteristics to the aggregate local economy of the destination municipality (i.e., average wage level).

3.1. *Spatial identification and definition of migration*

Denmark has approximately 5.8 million inhabitants distributed across 98 administrative municipalities, with a relatively consistent demographic and economic profile. However, a pronounced urban-rural divide exists. Copenhagen, the capital, accounts for one-third of the country's population and labour market. Beyond Copenhagen, four major cities and their surrounding areas represent urbanized Denmark, while the remainder of the country is largely rural and peripheral, including various island communities[30].

Hansen et al.[30] provide a typology based on fourteen socioeconomic characteristics for each municipality. This typology is widely used in other Danish studies[2][8][22][6][5]. Using this typology, Denmark can be differentiated into urban and rural municipalities (see map in Figure A1 in the Appendix).

We define an immigrant as an individual who migrates (i.e., changes residential address within a year) from an origin municipality *i* to a destination municipality *j*. Based on the urbanization typology, we further distinguish immigrants into two distinct immigration flows:

1. **Urban immigrants** –the migration flow from rural municipalities to urban municipalities.
2. **Counter immigrants** (i.e. counterurban)–the migration flow from urban municipalities to rural municipalities.

Figure 1 illustrates the trends of immigrant flows, demonstrating more than a 1 percent share increase in counter immigrants among total migrants per year after 2013, while showing insignificant change in the share of urban immigrants.

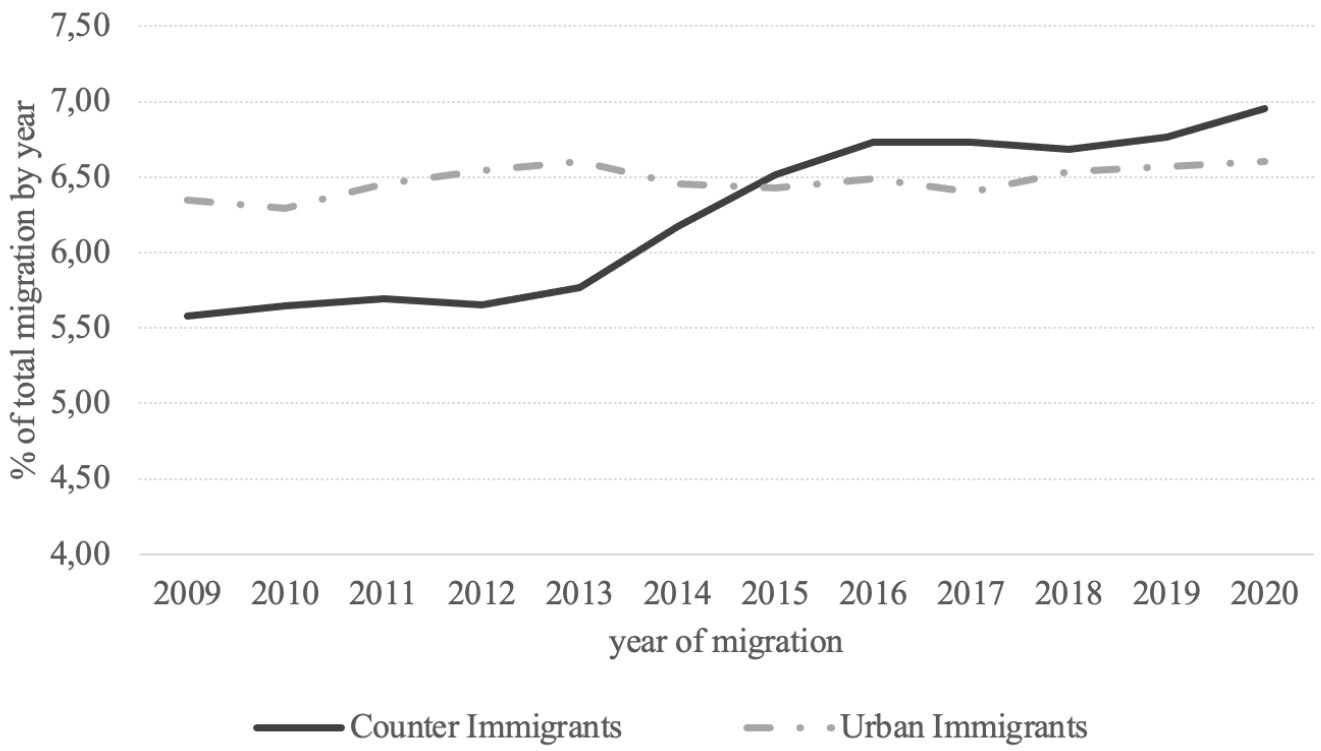

Figure 1. Share of immigrant flows in total migration per year from 2009 to 2020

Note: *The figure illustrates the tendences of percent-share of urban and counter immigrants of total interregional migration per year in Denmark, where the urban immigrant is defined as the flow of interregional immigrants from rural to urban municipalities and the counter, or counterurban, immigrants are defined as the flow of interregional immigrants from urban to rural municipalities.*

Source: *Authors' calculation, based on the micro register data from Statistics Denmark*

However, as Javakhishvili-Larsen and Andersen[2] argue, the administrative structure of Danish municipalities (at NUTS-III level) is too broad. It includes not only main cities or municipality centres but also smaller towns and rural villages, which do not necessarily follow the central city socioeconomic trends. Thus, they introduce a three-tier spatial division of Danish administrative units in both urban and rural municipalities. They identify such settlements as secondary, or II-tier towns and III-tier villages. Spatially decomposing the broader administrative units in Denmark allows for more fine-tuned analyses of the different socioeconomic problems that more remote or outskirt areas face. To study immigration in II-tier towns and rural areas, we adopt the spatial identification method provided by Javakhishvili-Larsen and Andersen[2].

This paper studies inter-municipality migration flows through the II-tier and III-tier geographical scopes in both urban and rural types of municipalities, thus identifying four distinct pools of immigrants (see also Figure 2):

1. Urban immigrants in II-tier Towns
2. Urban immigrants in III-tier Villages
3. Counter immigrants in II-tier Towns
4. Counter immigrants in III-tier Villages.

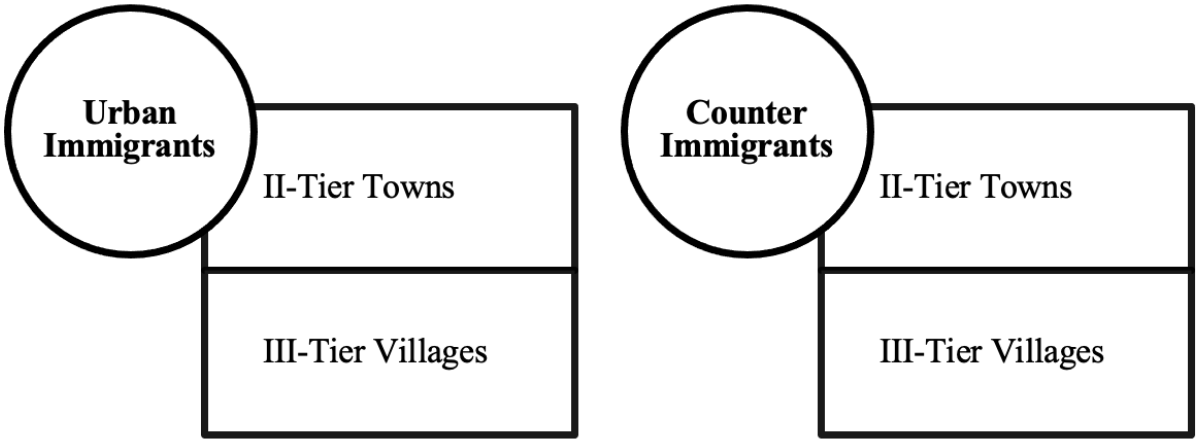

Figure 2. Spatial selection of immigrant pools and scope for study

***Note**: The figure illustrates the classification structure of interregional immigrants from rural to urban (i.e. urban immigrants) and from urban to rural (i.e. counter immigrants) which immigrate to II-Tier towns and III-tier Villages. These four distinct pools or flows of immigrants are applied throughout the study.*

***Source**: Authors' elaboration, based on Javakhishvili-Larsen & Andersen [2] and Hansen et al[30]*

With the geographical scope defined, in the following sections, we explain our approach to this study. We aim to determine whether diversified or specialized human capital inflow contributes positively to local economies by introducing the Regional Entropy Index (REI) modelling.

3.2. *Human Capital Attributes and Diversification Measurement*

In the second step, we identify immigrant human capital (HC). We focus on immigrants aged 18-67, as children and retirees are not typically classified as human capital (see HC attributes in Table A1 in the Appendix). Using the micro register dataset, we identify these immigrants, their HC characteristics, and their origin and destination municipalities, including second-tier towns and third-tier villages.

We then propose a novel method for measuring human capital characteristics and their diversification level by applying a regional entropy index based on the Shannon entropy measure. Shannon entropy, a concept introduced by Claude Shannon in 1948 in information theory, has been widely applied across various fields, including regional development.

In regional development, Shannon entropy is used to analyse and assess the distribution and diversity of various socio-economic factors. For instance, it has been applied to analyse the diversity of income and employment sectors within regions. Regions with high entropy values demonstrate a balanced distribution of income levels and employment types, which is often associated with economic stability and resilience[31][32][33][34].

The Regional Entropy Index (REI) method is also used to study socio-economic inequalities and segregation. By evaluating the distribution of socio-economic indicators, researchers can identify regions with high levels of inequality, guiding policy interventions aimed at fostering inclusivity and equity[32][31][33][34].

In this study, this method provides a quantitative measure of diversity and distribution, offering insights into various

aspects of human capital and its impact on local economies. With the REI, we can measure the geographical diversification of immigrant human capital characteristics, such as education level, age, socioeconomic status, economic sector of workplace, wage level, and occupation level.

For example, when measuring the entropy index for education levels, we select eight education levels such as primary education, secondary, Bachelor, Master, etc., as described in Table A1 in the Appendix. A higher entropy index for education suggests that the human capital is diverse, with migrants representing most education levels. The maximum entropy index indicates that the migrant pool includes individuals from every education level – thus, the diversified HC. Conversely, a low entropy index suggests that migrants pool consists with only one or a few education levels. An entropy of zero means all persons in the migrant pool have the same education level.

It is crucial to measure human capital entropy at a specific time *t*. Since migration involves mobility from one residence to another, immigrants bring their human capital attributes (education, age, wage, occupation etc.) to their new location. Therefore, we calculate the REI for immigrants one year before they register their address change. Figure 3 illustrates the sample selection process. For example, if we measure the immigration flow in 2020, we identify these immigrants by their personal numbers in 2019 at their municipality of origin and measure their REI prior to migrating.

Thus, we construct the panel for 98 municipalities from 2009 to 2020 (in total 1176 observations) as the immigrants' flow from origin (98) municipality *i* to destination II-tier Towns (in total 439 observations) and III-tier Villages (in total 732 observations), where the inflows are measured by entropy indexes (REIs) for education, age, socioeconomic status, the economic sector, wage and occupation from each origin municipality from the previous year.

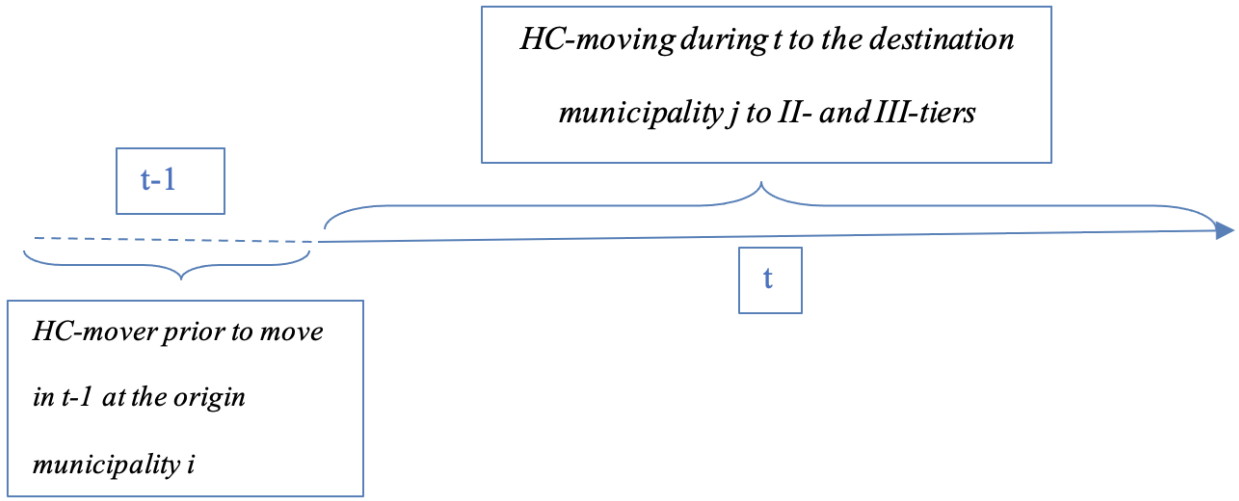

Figure 3. Timeline and Sampling of Human Capital

Note: *The figure illustrates when we measure the human capital attributes, such as age, socioeconomic status, sector of workplace, wage, skills at occupations. We measure diversification of these HC attributes in each immigrant pool (i.e. urban town, urban village, counter town and counter village) prior of their movement of address.*

Source*: Authors' framework*

The HC diversification for each characteristic and municipality for each immigrant pool (i.e. urban town, urban village,

counter town and counter village) is measured according to the Equation 1.

$$REI_{kit-1} = -\sum_{i=1}^{N} P_{kit-1} * \ln\left(P_{kit-1}\right) \qquad \text{(Eq.1)}$$

Where,

REI_{kit-1} is the Regional Entropy Index (by variable of interest, where k is Education, Age, SocEcon Status, Sectors, Wage, Skills at Occupation, in region of origin in -1.

P_{kit-1}represents the proportion of the variable of interest within region in -1 year $\ln(P_{kit-1})$ is the natural logarithm of P_{kit-1} in the *t-1* year.

N is the total number of regions.

Following this equation, the REI is a continuous value ranging from 0 (no randomness, or complete segmentation) to ln(n) (maximum uncertainty with n equiprobable outcomes, i.e., maximum diversification). The interpretation of the index is as follows: a higher index indicates a wider spread of human capital (HC) characteristics in the region, thus representing more diversified HC attributes of immigrants. Conversely, a lower REI index suggests that the HC attributes of the immigrants are narrowly spread and segmented.

Following steps 1 and 2, we obtain 24 diversification measures (six for HC attributes for four pools of immigrants) per municipality per year. Table A2 in the Appendix provides the descriptive statistics for these variables.

3.3. *Modelling the impact of immigration*

In the third step, we aim to understand how the immigration of human capital (HC) to second-tier towns and third-tier villages affects the overall wage premium in the destination municipality. Specifically, we analyse the relationship between HC immigration and the average wage level across the entire municipality *j*. This helps determine if attracting diverse human capital can positively contribute to the local economy.

We use the destination municipality's average wage as the dependent variable and the pre-calculated Regional Entropy Indices (REIs) for HC attributes of immigrants as the independent variables. This allows us to test the following hypotheses:

- *H0: The average wage level of destination municipalities is higher when both urban and counter immigrants to second-tier towns and third-tier villages have specialized (segmented) human capital attributes.*

This hypothesis is based on research showing that specialized local economies attract specialized human capital[24][25][26][27]. For example, highly specialised towns may attract only highly educated, employed individuals with managerial roles and high incomes.

However, recent studies suggest that diverse immigrant types contribute significantly to the development of secondary towns and villages[2][8][14][15]. Based on these findings, we propose an alternative hypothesis:

- *H1: The average wage level of destination municipalities is higher when both urban and counter immigrants to second-tier towns and third-tier villages have diversified human capital attributes.*

As shown in Figure 1, urban immigrant trends are relatively static, while counter immigrant trends show a slight increase. This suggests the 2009-2020 period may not exhibit significant outcome variations. Therefore, we initially test the hypotheses using a pooled OLS linear regression with robust standard errors for each immigrant pool (i.e. urban town, urban village, counter town and counter village), as described in Equation 2.

$$\log\hat{INC}_j = \alpha_j + \beta_1 REI_{Edu,i} + \beta_2 REI_{Age,i} + \beta_3 REI_{SocSt,i} + \beta_4 REI_{Sect,i} + \beta_5 REI_{\text{Wage},i} + \beta_6 REI_{Skill,i} + \varepsilon_j \quad \text{(Eq.2)}$$

Where,

- $\log\hat{INC}$ is logged average income in the destination municipality j
- α_j is the intercept
- $\beta_{(1\ldots6)}$ are the coefficients for IV (Immigrants' REIs for Education, Age, SocEcon Status, Sectors, Wage and Skills at Occupation, measured at the origin municipality i prior of migration.
- ε_j is the error term measured at the destination municipality.

This model enables us to compare various attributes of human capital (HC) as well as the outcomes for urban and counter immigrants in secondary towns and villages. Although Figure 1 indicates that there are no significant variations in the trends of urban and counter immigrants, we must consider the unobserved heterogeneity over the 12-year period from 2009 to 2020. This period includes the Danish economy's recovery from the financial crisis between 2009 and 2013 or 2014, as well as the initial waves and lockdowns of the COVID-19 pandemic in 2020[1]. These major macroeconomic events may have had unobserved impacts on the results. Therefore, we incorporate a time variable and time fixed effects (FE) into Equation 3. And same as before, adopted for each immigrant pool (i.e. urban town, urban village, counter town and counter village).

$$\log\hat{INC}_{jt} = \alpha_{jt} + \beta_1 REI_{Edu,it-1} + \beta_2 REI_{Age,it-1} + \beta_3 REI_{SocSt,it-1} + \beta_4 REI_{Sect,it-1} + \beta_5 REI_{\text{Wage},it-1} + \beta_6 REI_{Skill,it-1} + \varphi_t + \varepsilon_{jt} \quad \text{(Eq.3)}$$

Where, t is the year of the registry of change of residential address - immigration $t-1$ is the year of REI is measured for HC attributes of immigrants, and φ_t is the immigration year fixed effects (FE), i.e.: 2009 to 2020.

There is ongoing debate among researchers regarding the appropriateness of using Ordinary Least Squares (OLS) versus Fixed Effects (FE) models[35]. To address this, we apply both models to assess the consistency of our results.

In the following section, we present the results from Equations 2 and 3 and analyse whether these models provide valuable insights into the impact of urban and counter immigrants on the average wage premium in the overall destination municipality.

4. The Results

Before presenting the results from the Ordinary Least Squares (OLS) model (Equation 2) and the Fixed Effects (FE) model (Equation 3) to test our hypotheses, it is essential to understand how immigrants differ from the residents of the destination's secondary towns and villages. Immigrants move from their origin municipalities, bringing a diversity of attributes that can either enhance the existing diversity among residents or contribute to segregation. To address this, we conduct a robustness check of our models by comparing the means of the Regional Entropy Index (REIs) for human capital (HC) attributes of the residents (mean1) with those of the immigrants (mean2). The results of this t-test are presented in Table 1.

Table 1. T-test comparison of REI means between the residents at the destination municipalities and immigrants.

	Urban Immigrants: II-tier Towns	Counter Immigrants: II-tier Town	Urban Immigrants: III-tier: Villages	Counter Immigrants: III-tier Villages
REI: Education	-0,145***	0,317***	-0,347***	0,242***
REI: Age	0,011*	-0,074***	-0,052***	-0,081***
REI: Socioeconomic Status	0,007	-0,092***	-0,087***	-0,133***
REI: Sector of workplace	-0,002	-0,033***	-0,206***	-0,040***
REI: Wage	-0,400***	-0,294***	-0,498***	-0,364***
REI: Occupation at workplace	0,082***	-0,105***	-0,089***	-0,076***

***Note**: Significant difference at *** p<0.01, ** p<0.05, * p<0.1*

This table shows difference in means of diversification index of HC attributes between the destination municipality and for each immigrant pool (i.e. urban town, urban village, counter town and counter village) based on the unpaired sample t-test.

***Source:** Authors' calculations*

According to Table 1, the means of immigrants' REIs are significantly different from the means of residents' REIs in the destination secondary towns and rural villages. The values in Table 1 represent the difference (*d*) between mean1 (residents' REIs) and mean2 (immigrants' REIs). A negative value indicates that residents have a more segmented structure than immigrants for that specific HC attribute.

For example, in education diversification, residents of second-tier towns in urban municipalities have more segmented education levels than immigrants, while in second-tier towns in rural municipalities, immigrants have more diverse education levels than the residents.

The stars in the table indicate whether the difference (*d*) between the two means is statistically significant. Table 1 shows that immigrants' HC attributes generally differ significantly from residents' HC attributes, except for REI: Socioeconomic Status and REI: Sectors in the second-tier towns of urban municipalities. This suggests that immigrants to secondary towns in urban areas have similar dispersions of socioeconomic conditions and sectors as residents in those localities.

Given the generally significant differences in means between residents and immigrants, we can assume that the models from Equations 2 and 3 yield significant and interesting results.

4.1. *Economic outcome of HC Immigrants in II-tier Towns*

This section provides results, displayed on the Table2. The results comparing the OLS and FE models, estimating the relationship between the dependent variable—logarithm of the average wage in the destination municipality—and the independent variables, which include the entropy index of immigrants in secondary (II-tier) towns based on education, age, socioeconomic status, sector, wage, and occupation.

Table 2. *Comparison of OLS and FE. Effect of immigrant entropy on average* wages of destination municipality at the II-tier level

Y= log. Average Wage	**(1)**	**(2)**	**(3)**	**(4)**
	Urban Town	**Count Town**	**Urban Town**	**Count Town**
	OLS: Robust	**OLS: Robust**	**FE: Robust**	**FE: Robust**
REI: Education	0.469***	-0.080**	0.329***	-0.062*
	(0.058)	(0.035)	(0.069)	(0.034)
REI: Age	1.544***	0.148***	1.622***	0.137***
	(0.099)	(0.040)	(0.103)	(0.040)
REI: Socioeconomic Status	0.075	-0.078**	0.010	-0.139***
	(0.059)	(0.039)	(0.065)	(0.043)
REI: Sector at workplace	-0.173*	-0.028	-0.200**	-0.000
	(0.091)	(0.036)	(0.094)	(0.033)
REI: Wage	0.315***	0.248***	0.330***	0.284***
	(0.079)	(0.043)	(0.082)	(0.048)
REI: Occupation at workplace	-0.404***	0.098***	-0.542***	0.073**
	(0.089)	(0.030)	(0.098)	(0.030)
Constant	9.406***	11.068***	9.831***	11.017***
	(0.279)	(0.113)	(0.299)	(0.121)
Control: Years	No	No	Yes	Yes
Observations	439	732	439	732
R-squared	0.734	0.402	0.746	0.446

***Note**: Robust standard errors in parentheses and significant at *** p<0.01, ** p<0.05, * p<0.1*

This table shows how much the diversification of each HC attribute of each immigrant pool in II-tier towns (i.e. urban town and counter town) associates with the average wages of destination municipality.
Source: *Panel dataset created by the authors based on the micro register data from Statistics Denmark*

The first and second columns of Table 2 present the Ordinary Least Squares (OLS) results for urban immigrants and counter immigrants in secondary towns. Since the OLS model treats all observations as independent and does not account for individual-specific effects, we assume that unobserved factors do not correlate with the independent variables. Consequently, these results reflect the average effect of the independent variables on the dependent variable across all observations (see Table 2, columns 1 and 2).

In contrast, columns 3 and 4 of the table display the same model using Fixed Effects (FE). This approach removes the influence of time-invariant characteristics, thereby controlling for unobserved heterogeneity. The FE model is particularly beneficial when we suspect that omitted variables may vary across entities but remain constant over time, as these could bias the results. By using FE, we obtain more consistent estimates that reflect the average effect of the independent variables on the dependent variable within the same entity over time (see Table 2, columns 3 and 4).

This distinction between OLS and FE models is crucial for understanding the robustness of our findings regarding the impact of immigrant human capital attributes on average wage levels in secondary towns.

Since the dependent variable is logged, we can interpret the coefficients as follows: for positive coefficients, a one-unit increase in the independent variable (e.g., REI: Education) is associated with a *100*β percentage point* increase in the dependent variable. And conversely, if β is negative, we would expect a decrease in the dependent variable.

According to Table 2, we observe that immigrants in secondary towns within urban municipalities have positive association on destination municipality wages when they possess diversified education levels, ages, and wage levels. However, they exhibit negative association when they have diversified sectors and occupations.

In contrast, immigrants in secondary towns within rural municipalities show positive association on destination municipality wages when they have diversified age levels, wage levels, and occupations. However, they experience significant negative association when they have diversified education levels and socioeconomic status.

These findings highlight the varying association of immigrant human capital diversification on average wages, depending on the type of municipality and the specific attributes being considered.

4.2. *Economic outcome of HC Immigrants in III-tier Villages*

Next, we examine the correlation of immigrants in third-tier villages on the average wages of destination municipalities. Table 3 presents the results for both the Ordinary Least Squares (OLS) model (columns 1 and 2) and the Fixed Effects (FE) model (columns 3 and 4). The β-coefficients are interpreted in a manner similar to those in Table 2.

The coefficients from both the OLS and FE models appear to be consistent for immigrants in third-tier villages, as also observed in Table 2. This suggests that the relationship between immigrant human capital attributes and average wages in these municipalities remains stable across different modelling approaches.

Table 3. Comparison of OLS and FE. Effect of immigrant entropy on average wages of destination municipality at the III-tier level

Y= log. Average Wage	(1)	(2)	(3)	(4)
	Urban Rural	Count Rural	Urban Rural	Count Rural
	OLS: Robust	OLS: Robust	FE: Robust	FE: Robust
REI: Education	0.082	-0.151***	0.068	-0.147***
	(0.058)	(0.029)	(0.062)	(0.033)
REI: Age	0.653***	0.055*	0.674***	0.049*
	(0.092)	(0.028)	(0.098)	(0.029)
REI: Socioeconomic Status	-0.028	-0.068**	-0.064	-0.098***
	(0.051)	(0.029)	(0.056)	(0.034)
REI: Sector at workplace	-0.282***	-0.101***	-0.282***	-0.096***
	(0.057)	(0.029)	(0.060)	(0.033)
REI: Wage	0.300***	0.166***	0.324***	0.183***
	(0.063)	(0.029)	(0.067)	(0.029)
REI: Occupation at workplace	-0.400***	0.182***	-0.431***	0.163***
	(0.062)	(0.034)	(0.064)	(0.036)
Constant	11.521***	11.398***	11.516***	11.411***
	(0.083)	(0.071)	(0.100)	(0.076)
Control: Years	No	No	Yes	Yes
Observations	433	732	433	732
R-squared	0.338	0.283	0.349	0.298

***Note**: Robust standard errors in parentheses and significant at *** p<0.01, ** p<0.05, * p<0.1*
This table shows how much the diversification of each HC attribute of each immigrant pool in III-tier villages (i.e. urban village and counter village) associates with the average wages of destination municipality.
***Source**: Panel dataset created by the authors based on the micro register data from Statistics Denmark*

According to Table 3, we observe that immigrants in third-tier villages within urban municipalities positively associate with the average wages of destination municipalities when they have diversified age and wage levels. However, they exhibit negative correlation when they have diversified sectors and occupations.

Conversely, immigrants in third-tier villages within rural municipalities show positive association on destination municipality average wages when they have diversified age levels, wage levels, and occupations. In contrast, they experience

significant negative outcomes when they have diversified education levels, socioeconomic status, and workplace sectors.

These findings indicate that the relation of immigrant human capital diversification on average wages vary significantly between urban and rural municipalities, highlighting the importance of considering the specific attributes of immigrants in these geographical contexts.

4.3. *Geographical Spillover of immigrant HC*

As demonstrated in the previous sections, the diversification of human capital attributes among immigrants leads to varied outcomes when considering each attribute separately while holding all other variables constant. In this section, we analyse the overall predicted impact of these diversifications on the average wage levels in destination municipalities, both in urban and rural areas.

Figures below illustrate the association of diversified human capital in second-tier towns (Figure 4) and third-tier villages (Figure 5). The darker areas on the map indicate a higher outcome of increased diversification on the income levels of destination municipalities, while lighter areas represent lower outcomes. This visual representation helps to highlight the patterns of geographical spillover from immigration. An interesting observation from the analysis is that the diversified human capital of immigrants to second-tier towns has the highest positive association on the average wages of destination municipalities when they are located closer and adjacent to metropolitan and urban centres, such as Copenhagen, Aarhus, Odense, and Aalborg (Figure 4). Conversely, the lowest aggregate outcome is seen within these large city-municipalities themselves. This suggests that the spillover effect of immigration is greater in neighbouring municipalities.

Figure 4. The aggregate economic outcome of diversified immigrant human capital on destination municipality when the immigration is to II-tier towns

Note: *The map shows the predicted overall outcome of the diversified HC immigrants to the II-tier towns in both urban and rural areas. The dashed municipalities are the four main urban centres: Copenhagen (see enlarged Copenhagen areas for more details), Odense, Aarhus and Aalborg. Their background is the lightest shade of grey that indicates the lowest predicted outcome of the diversified HC immigrants there. The darker the shades higher is the overall effect of diversification of HC attributes on the local economy.*

The grey shade categories are automatically selected based on the Jenks Natural Breaks method.

Source*: Authors' calculations based on the Equation 3. The map is created in www.datawrapper.de*

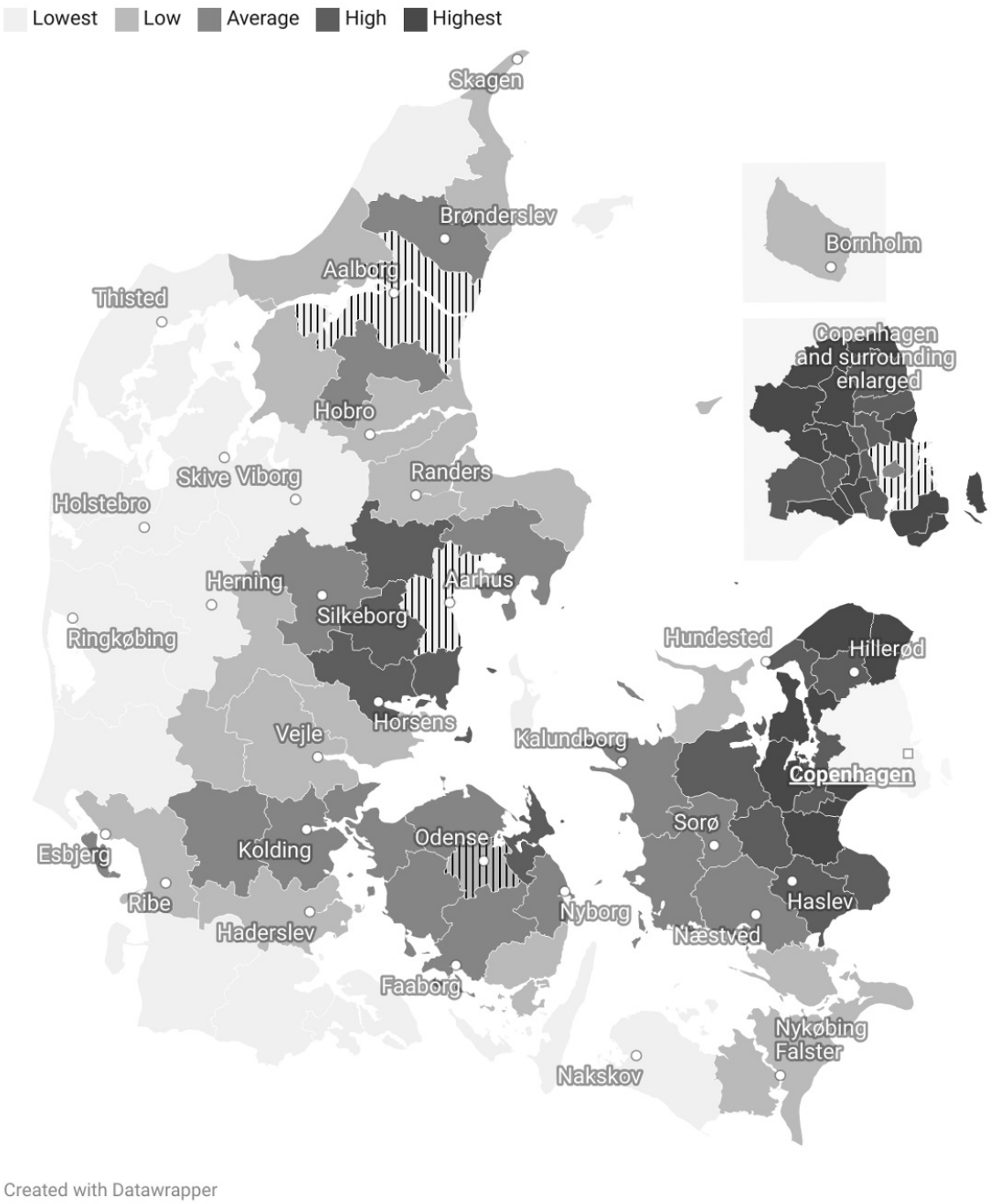

Figure 5. The aggregate economic outcome of diversified immigrant human capital on destination municipality when the immigration is to III-tier villages

Note: *The map shows the predicted overall outcome of the diversified HC immigrants to the III-tier villages in both urban and rural areas. The dashed municipalities are the four main urban centres: Copenhagen (see enlarged Copenhagen areas for more details), Odense, Aarhus and Aalborg. Their background is the lightest shade of grey that indicates the lowest predicted outcome of the diversified HC immigrants there, except in Odense municipality, which has a shade code "Low". The darker the shades higher is the overall effect of diversification of HC attributes on the local economy.*

The grey shade categories are automatically selected based on the Jenks Natural Breaks method.

Source: *Authors' calculations based on the Equation 3. The map is created in www.datawrapper.de*

These neighbouring municipalities generally have close economic connections with the large cities, serving as commuting

and value chain areas[36]. This proximity could explain why the impact of diversity is most pronounced in these locations. Overall, we observe an average to low impact of second-tier town immigrants in most rural municipalities across Denmark.

The Figure 5 shows the overall economic outcome of diversified HC immigrants in third-tier villages. A similar geographic pattern emerges, but the effect is much lower than in second-tier towns. The effect is highest around the capital city Copenhagen and moderate to average around the rest of the large cities. This indicates that the spatial spillover weakens when diversified HC immigrants settle in third-tier villages, especially in rural municipalities.

In summary, the diversification of human capital among immigrants has a notable positive associated effect on wages in municipalities near urban centres, particularly in second-tier towns. However, as the distance from these centres increases, the association weakens, especially in third-tier villages. This suggests that geographic proximity to urban centres is crucial in amplifying the economic benefits of diversified HC immigration, primarily in secondary towns.

5. Discussion and Conclusive Remarks

This paper investigates the associated outcome of increasing diversification among inter-regional human capital migrants on the local economies of destination municipalities, specifically when immigration occurs in second-tier towns and third-tier villages. Our findings reveal that the effect of diversified human capital on wages significantly differs between urban and rural municipalities, shaped by factors such as migration patterns, human capital attributes, and economic connections.

In second-tier towns, the results indicate that the associated effects of diversified human capital on wages vary based on the municipality type (urban or rural) and the specific characteristics of the immigrant population. Attributes such as diversified age and wage levels consistently yield positive association in both urban and rural settings. However, other attributes, like education and occupation, can have mixed outcomes depending on the context. For instance, diversified educational attributes tend to benefit urban municipalities while negatively impacting rural ones. Conversely, diversified occupational attributes positively influence rural municipalities but have a negative outcome in urban areas.

Similarly, in third-tier villages, diversified age and wage levels also show positive correlation across both urban and rural contexts. The patterns observed in educational and occupational attributes are consistent with those in second-tier towns. Thus, we conclude that rural municipalities gain the most from immigrants with diverse age, wage, and occupation levels, while urban municipalities benefit from diversity in age, wage, and education levels. Other attributes, such as socioeconomic status and sector, may have varying outcomes, underlying the importance of considering local labour market conditions and economic structures when assessing the impacts of human capital diversification.

Overall, this study emphasizes the significant spillover effects of diversified human capital immigration on urban and neighbouring municipalities, while the associated effects diminish in rural areas further from large cities. In urban settings, diversified human capital can lead to higher average wages, particularly when second-tier town immigrants move to municipalities adjoining and near to the metropolitan centres. In contrast, the outcomes of diversified human capital in

rural areas is generally less pronounced, with modest improvements in income attributed to occupational diversity and wage levels in third-tier villages. Weaker economic connections in rural areas further contribute to the reduced significance of spillover effects from nearby urban centres.

This research provides valuable insights into the economic implications of inter-regional migration patterns, particularly in second-tier towns and third-tier villages. The findings hold important implications for policymakers and researchers interested in the interplay between human capital, migration, and regional economic development. By employing a Regional Entropy Index model, this study challenges traditional views on the positive impact of specialization and agglomeration in regional economic growth.

Furthermore, this research questions the common practice of solely measuring formal educational attainment as an indicator of human capital, particularly in areas beyond major cities. we argue that diversified occupational attributes have a more substantial benefit for rural areas than diversified education levels.

The study can assist policymakers and planning professionals in rural municipalities in addressing the economic and demographic challenges they face. Attracting migrants with diverse age and wage levels could provide key advantages for both urban and rural localities.

Ultimately, the findings highlight the necessity for tailored policies and support systems that account for the unique characteristics of immigrant populations in different municipal contexts. Understanding how diversified human capital effects wage dynamics in urban and rural areas is crucial for fostering economic growth and improving wage outcomes across all regions. By challenging traditional conceptions of human capital and introducing innovative research methodologies, this study contributes to a new understanding of the relationship between migration patterns, human capital, and regional economic development.

Thus, the findings have important implications for policymakers and planning professionals. As they point to the need for the targeted human capital attraction strategies. Policies should aim to attract immigrants with diversified age and wage levels to both urban and rural areas. Additionally, policies should focus on attracting human capital immigrants with diverse educational backgrounds to urban municipalities and those with diverse occupational skills to rural municipalities. Furthermore, the rural development initiatives could focus on strengthening economic connections between rural areas and urban centres to enhance the positive spillover effects of diversified human capital. Investments in transportation, infrastructure, and business development in rural areas could contribute to attracting and retaining a more diverse workforce.

This study provides a closer understanding into the impact of human capital diversification on local economies in Denmark, however, it is important to consider some limitations. Firstly, we primarily use average wage level as the indicator of economic impact. While average wage is an important measure of economic well-being, it does not capture the full complexity of economic development. Other factors, such as job creation, income inequality, and the growth of specific industries, could provide additional understanding of the impacts of human capital diversification. Secondly, we apply Danish data, a country with a relatively homogenous population and strong social welfare system. The findings

might not be directly generalizable to countries with different economic structures, cultural contexts, and socioeconomic and regional policies. And thirdly, even though our study provides empirical strategy by using and comparing Ordinary Least Squares (OLS) versus Fixed Effects (FE) models, we do not account for endogeneity, thus the findings cannot conclude the causality of the impact of diversified human capital on the local economy, but rather association of it. We acknowledge that while using both models helps assess the consistency of results, there might be unobserved factors that could lead to endogeneity issues, where the independent variables (REIs) are correlated with the error term, potentially biasing the estimates.

These limitations do not diminish the value of the study's findings but highlight areas where further research can enhance our understanding of the complex relationship between human capital diversification, counterurban migration, and the local economy. Addressing these limitations can help policymakers develop more effective and context-specific strategies for attracting and retaining diverse talent and promoting inclusive economic growth.

From the scientific perspective, further research is needed to explore the long-term impacts of diversified human capital on local economies not only in Denmark but in other countries as well. The other country cases can implicate whether this study provides uniquely Danish phenomena or whether it can be generalised more broadly. Another interesting following research question could be to investigate the role of social capital and networks in facilitating the integration and economic success of immigrant human capital in rural areas and whether social network is the contributing factor for retaining workforce there. From the policy perspective, further research is needed to examine the impact of specific policy interventions designed to attract and retain diverse human capital in different regional contexts.

By employing this new methodology of how to measure the human capital and addressing the limitations and research gaps, the future study will contribute to a more comprehensive understanding of the role of human capital in both urban and rural communities.

Appendix

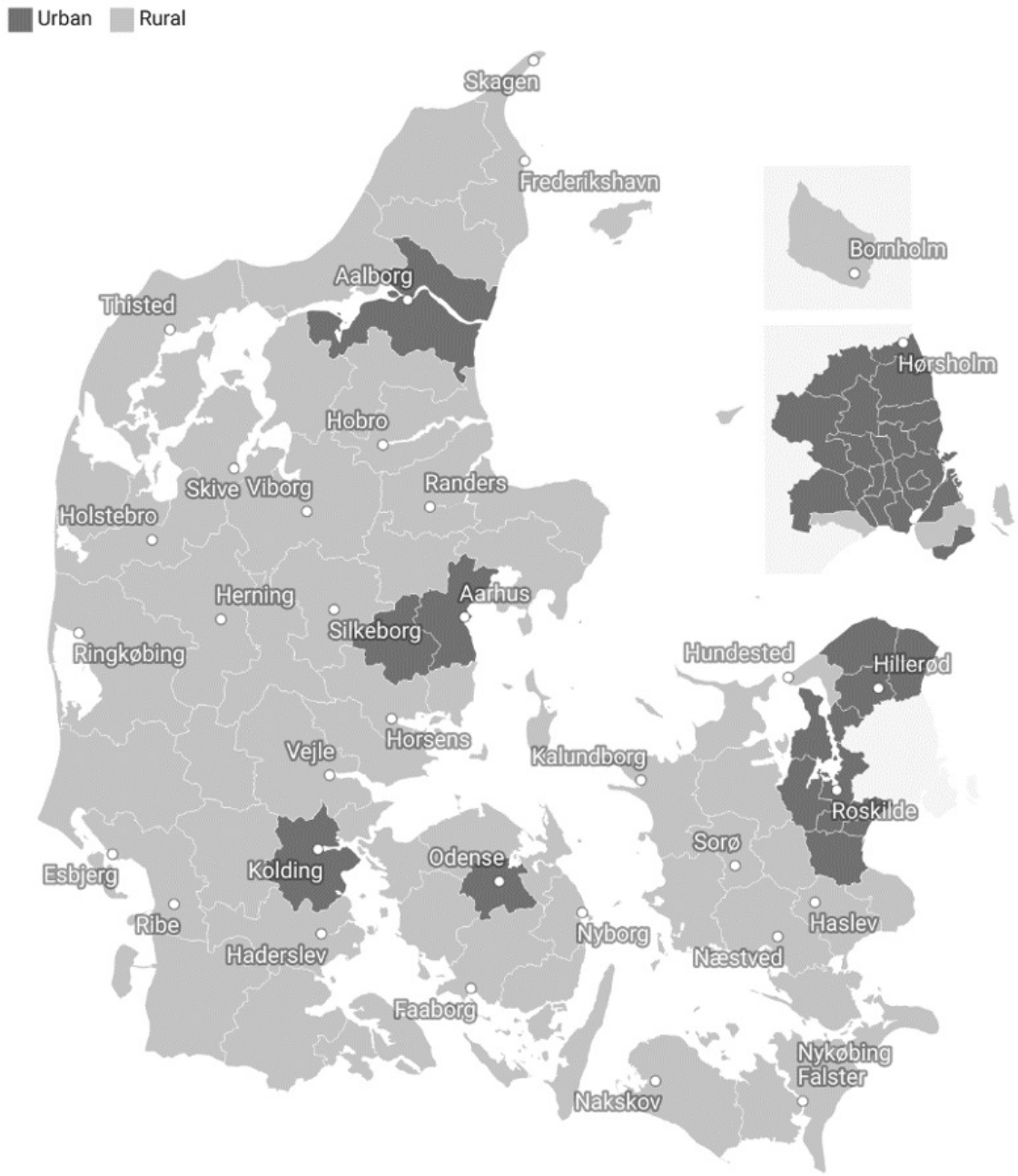

Figure A1. The Urban-Rural typology of Danish Municipalities.

Source: *This map is used in the Javakhishvili-Larsen and Andersen 2023*

Table A1. Identification of human capital attributes and selection of categories

Human Capital Attributes	***Categories***
Education (highest accomplished by the time of measurement)	1) Primary education: ISCED 1 2) High School: ISCED 2 3) Vocational education: ISCED 3 4) Short Tertiary: ISCED 4 5) Middle Tertiary: ISCED 5

	6) Bachelor: ISCED 6 7) Long Tertiary (MA): ISCED 7 8) Research Education (PhD): ISCED 8
Age (by the time of measurement)	1) 18/24 years old 2) 25/29 years old 3) 30/49 years old 4) 50/59 years old 5) 60/67 years old
Socioeconomic status (by the time of measurement)	1) Employed 2) Unemployed 3) Outside of labour force, retired and early retired 4) Under education 5) Sick leave, maternity and paternity leave
Economic Sector of the workplace (by the time of measurement)	1) Primary/Basic 2) Manufacturing (C) 3) Provision (D-E) 4) Construction (F) 5) Sales (G) 6) Transport (H) 7) Hotel-Restauration (I) 8) Info-communication (J) 9) Finance-real-estate (K-L) 10) Business services (M-N) 11) Public (O, P, Q) 12) Culture, sport, org. (R) 13) Private service (S-T) 14) Other and unknown (U)
Wage (By the time of measurement *K* =1000)	1) <100000 DKK (<13.2 *K* EURO) 2) 100-200 *K* DKK (13.2-27 *K* EURO) 3) 200-300 *K* DKK (27-40 *K* EURO) 4) 300-400 *K* DKK (40-54 *K* EURO)

	5) 400-500 *K* DKK (54-67 *K* EURO) 6) 500< *K* DKK (67< *K* EURO)
Occupation on the workplace (By the time of measurement)	1) Managers 2) Professional 3) Technicians and associate professionals 4) Clerical support workers 5) Service and sales workers 6) Skilled agricultural, forestry and fishery workers 7) Craft related trades workers 8) Plant and machine operators, and assemblers 9) Elementary occupations

Table A2. Descriptive Statistics of Dependent and Independent Variables

Variable	Obs.	Mean	Std. Dev.	Min	Max
log average_wage (at destination)	1176	11.506	.201	10.927	12.04
Counter Immigrants to II-tier Towns:					
REI: Education	732	1.828	.133	1.011	2.061
REI: Age	732	1.23	.149	.5	1.52
REI: Socioeconomic Status	732	.974	.149	.287	1.56
REI: Sector at workplace	732	2.053	.149	.95	2.311
REI: Wage	732	1.249	.17	.271	1.661
REI: Occupation at workplace	732	1.765	.191	.5	2.069
Urban Immigrants to II-tier Towns:					
REI: Education	439	1.614	.13	1.192	1.895
REI: Age	439	1.347	.123	.914	1.547
REI: Socioeconomic Status	439	.983	.16	.59	1.421
REI: Sector at workplace	439	2.1	.084	1.498	2.338
REI: Wage	439	1.209	.153	.821	1.639
REI: Occupation at workplace	439	1.822	.101	1.484	2.099
Counter Immigrants to III-tier Villages:					
REI: Education	731	1.753	.149	.9	2.107
REI: Age	731	1.224	.179	.37	1.526
REI: Socioeconomic Status	731	.933	.157	.377	1.424
REI: Sector at workplace	731	2.047	.213	0	2.336
REI: Wage	731	1.179	.215	0	1.631
REI: Occupation at workplace	731	1.795	.171	.562	2.063
Urban Immigrants to III-tier Villages:					
REI: Education	439	1.412	.346	0	1.927
REI: Age	439	1.283	.302	0	1.595
REI: Socioeconomic Status	439	.888	.288	0	1.583
REI: Sector at workplace	433	1.895	.43	0	2.346
REI: Wage	438	1.111	.307	0	1.68
REI: Occupation at workplace	439	1.651	.385	0	2.146
Residents of destination mun.:					
REI: Education	1176	1.605	.16	1.302	2.009
REI: Age	1176	1.316	.046	1.094	1.374
REI: Socioeconomic Status	1176	1.031	.104	.722	1.34
REI: Sector at workplace	1176	2.093	.039	1.956	2.194
REI: Wage	1176	1.568	.073	1.298	1.714
REI: Occupation at workplace	1176	1.821	.088	1.515	1.966

***Source**: Authors' calculations based on the micro register dataset from Statistics Denmark*

Footnotes

[1] See https://covid19.ssi.dk/-/media/arkiv/subsites/covid19/presse/tidslinje-over-covid-19/covid-19-tidslinje-for-2020-2022-lang-version---version-1---april-2022.pdf?la=da

Notes

JEL: R11, R23, J24, J61, O15

About the Authors

Nino Javakhishvili-Larsen is an Assistant Professor at the Department of the Built Environment at Aalborg University in Denmark. She has PhD in Economic Geography from the University of Southern Denmark and an MSc from the London School of Economics, UK. She studies the human capital creation, labour mobility, and local economic development in urban and rural areas.

Hans Thor Andersen is the Head of the Division of Town, Housing and Property at the Department of the Built Environment at Aalborg University in Denmark. He is a PhD and dr. scient. (habil) in Urban Geography from Copenhagen University, DK. He studies a wide variety of topics within human geography, housing conditions and policy, urban development under global conditions, marginalization and exclusion in big cities, strategic planning and big city policy, segregation, and homelessness.

Statements and Declarations

Acknowledgements

This study was disseminated at the 63rd ERSA Congress and several internal and international scientific seminars. The authors thank Professor Jos Van Ommeren and other pairs for their valuable comments and reviews.

Conflicts of interest

The authors have no conflicts of interest to declare. All co-authors have seen and agree with the contents of the manuscript and there is no financial interest to report. We certify that the submission is original work and is not under review at any other publication.

Funding

This study was conducted at the authors' affiliated institution and received support from it.

Data availability

Due to the sensitive nature of the micro-register data used in this study, the raw data cannot be shared without approval from Statistics Denmark. However, the aggregated municipality-level REI indexes are available upon request from the corresponding author.

References

1. ^*Marsh S (2020). "Escape to the country: How COVID is driving an exodus from Britain's cities". The Guardian. https://www.theguardian.com/world/2020/sep/26/escape-country-covid-exodus-britain-cities-pandemic-urban-green-space.*
2. a, b, c, d, e, f, g, h, i *Javakhishvili-Larsen N, Andersen HT (2024, in press). "Is the Danish rurality becoming a human capital magnet?". In: Grabski-Kieron U, Greinke L, eds. Rural geographies in transition: Rethinking sustainable futures of rural areas. LIT Verlag, Bind 11: Rural areas: Issues of local and regional development, Münster. Preprint-Doi: 10.13140/RG.2.2.28361.11365.*
3. a, b *Mitze T, Javakhishvili-Larsen N (2020). "Graduate Migration and Early-career Labor Market Outcomes: Do Education Programs and Qualification Levels Matter?". Labour. 34(4): 477-503.*
4. ^*Storper M, Scott AJ (2009). "Rethinking human capital, creativity and urban growth." Journal of Economic Geography. 9 (2): 147-167.*
5. a, b, c *Hansen HK, Winther L (2015). "Employment growth, human capital and educational levels: Uneven urban and regional development in Denmark 2002–2012". Geografisk Tidsskrift-Danish Journal of Geography. 115(2): 105-118.*
6. a, b, c, d *Hansen HK, Aner LG (2017). "On the location dynamics of highly educated people migrating to peripheral regions of Denmark". Population, Space and Place. 23(8): e2076.*
7. ^*Andersen HT, Møller-Jensen L, Engelstoft S (2011). "The end of urbanization? Towards a new urban concept or rethinking urbanization". European Planning Studies. 19(4): 595-611.*
8. a, b, c, d *Andersen HT, Egsgaard-Pedersen A, Hansen HK, Lange ES, Nørgaard H (2022). "Counter-Urban Activity Out of Copenhagen: Who, Where and Why?". Sustainability. 14(11): 6516.*
9. ^*Bijker RA, Haartsen T (2012). "More than counter-urbanisation: Migration to popular and less-popular rural areas in the Netherlands". Population, Space and Place. 18(5): 643-657.*
10. ^*Halfacree K (2008). "To revitalise counterurbanisation research? Recognising an international and fuller picture". Population, Space and Place. 14(6): 479-495.*
11. ^*Halfacree K (2012). "Heterolocal identities? Counter-urbanisation, second homes, and rural consumption in the era of mobilities". Population, Space and Place. 18(2): 209-224.*
12. ^*Andersen HT, Winther L (2010). "Crisis in the resurgent city? The rise of Copenhagen". International Journal of Urban and Regional Research. 34(3): 693-700.*
13. ^*Remoundou K, Gkartzios M, Garrod G (2016). "Conceptualizing mobility in times of crisis: towards crisis-led*

counterurbanization?" Regional Studies. 50 (10): 1663-1674.

14. [a, b]*Nørgaard H, Andersen HT, Lange ES, Ruud MS (2023a). Myter og realiteter om flyttemotiver, bolig- og bosætningspræferencer: Hvem vil gerne bo hvor, hvordan og hvorfor? København: Institut for Byggeri, By og Miljø (BUILD), Aalborg Universitet. 139 s. (BUILD Rapport; Nr. 18, Bind 2023).*
15. [a, b]*Nørgaard H, Hansen HK, Andersen HT (2023b). "Modurbanisering-flytninger fra by til land". Økonomi & Politik. 96(1).*
16. [^]*Tammaru T, Kliimask J, Kalm K, Zālīte J (2023). "Did the pandemic bring new features to counter-urbanisation? Evidence from Estonia." Journal of Rural Studies. 97: 345-355.*
17. [^]*Delventhal MJ, Kwon E, Parkhomenko A (2022). "JUE Insight: How do cities change when we work from home?". Journal of Urban Economics. 127: 103331.*
18. [^]*Ramani A, Bloom N (2021). "The Donut effect of COVID-19 on cities". National Bureau of Economic Research. (No. w28876).*
19. [^]*Herslund L (2012). "The rural creative class: counterurbanisation and entrepreneurship in the Danish countryside". Sociologia Ruralis. 52(2): 235-255.*
20. [^]*Sandow E, Lundholm E (2020). "Which families move out from metropolitan areas? Counterurban migration and professions in Sweden." European Urban and Regional Studies. 27 (3): 276-289.*
21. [^]*Sandow E, Lundholm E (2023). "Leaving the City: Counterurbanisation and Internal Return Migration in Sweden." European Journal of Population. 39 (1): 7.*
22. [a, b]*Naveed A, Javakhishvili-Larsen N, Schmidt TD (2017). "Labour mobility and local employment: building a local employment base from labour mobility?". Regional Studies. 51(11): 1622-1634.*
23. [^]*Hansen HK, Winther L (2014). "Regional development and the impact of the public sector in Denmark: Employment growth and human capital". Geografisk Tidsskrift-Danish Journal of Geography. 114(2): 156-168.*
24. [a, b]*Kemeny T, Storper M (2015). "Is specialization good for regional economic development?". Regional Studies. 49(6): 1003-1018.*
25. [a, b]*Boschma RA, Martin RL, eds. (2010). The handbook of evolutionary economic geography. Edward Elgar Publishing.*
26. [a, b]*Capello R (2016). "What makes Southern Italy still lagging behind? A diachronic perspective of theories and approaches". European Planning Studies. 24(4): 668-686.*
27. [a, b]*Duranton G, Puga D (2004). "Micro-foundations of urban agglomeration economies". In: Handbook of regional and urban economics. Vol. 4, pp. 2063-2117. Elsevier.*
28. [^]*Noseleit F, Söllner R (2010). "Diversity of human capital and regional growth". ECONSTOR. http://hdl.handle.net/10419/119067.*
29. [^]*Ejdemo T, Örtqvist D (2021). "Exploring a leading and lagging regions dichotomy: does entrepreneurship and diversity explain it?". Journal of Innovation and Entrepreneurship. 10(1): 1-26.*
30. [a, b, c]*Hansen IW, Larsen N, Andreasen SA, Larsen MB, Andreasen SAL, Neumann C (2012). Herfra min verden går. Landdistriktsredegørelse. Indenrigs- og Sundhedsministeriet. Ministeriet for Fødevarer, Landbrug og Fiskeri.*

31. [a, b]*Hitt MA, Hoskisson RE, Kim H (1997). "International diversification: Effects on innovation and firm performance in product-diversified firms". Academy of Management Journal. 40(4): 767-798.*
32. [a, b]*Chakravorty S (2003). Capital, Inequality, and Growth in Developing Countries. Oxford University Press.*
33. [a, b]*Czyż T, Hauke J (2015). "Entropy in regional analysis". Quaestiones Geographicae. 34(4): 69–78. doi:10.1515/quageo-2015-0037.*
34. [a, b]*Punia M, Singh L (2012). "Entropy approach for assessment of urban growth: a case study of Jaipur, India". Journal of the Indian Society of Remote Sensing. 40: 231-244.*
35. [^]*Collischon M, Eberl A (2020). "Let's talk about fixed effects: Let's talk about all the good things and the bad things". KZfSS Kölner Zeitschrift für Soziologie und Sozialpsychologie. 72(2): 289-299.*
36. [^]*Wachsmuth D (2017). "Infrastructure alliances: Supply-chain expansion and multi-city growth coalitions." Economic Geography. 93 (1): 44-65. doi:10.1080/00130095.2016.1199263.*