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The role of immigrant human capital in Danish second-tier towns and rural areas

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ABSTRACT

This study uses data from 2009 to 2020 to explore the impact of diversified human capital (HC) among inter-regional immigrants on local economies in Denmark. 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 hubs enhances the economic benefits of diversified HC immigration, especially in secondary towns. This study challenges traditional views on regional economic growth and emphasizes the need for tailored policies.

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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 (Marsh 2020). 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

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and villages. We apply the definition and typologies of II-tier Towns and III-tier Villages provided by Javakhishvili-Larsen and Andersen (2025).

Traditionally, human capital has been primarily measured through formal education levels (Hansen and Aner 2017; Hansen and Winther 2015; Mitze and Javakhishvili-Larsen 2020; Storper and Scott 2008). However, our study challenges this narrow definition, incorporating a broader range of attributes including age, job skills, 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 will 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: counter-urban migration trends, evolving concepts of human capital, and the debate between diversification and specialization in regional economic development.

2.1. Counter-urban migration trends

Counter-urban 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 (Andersen, Møller-Jensen, and Engelstoft 2011, 2022; Bijker and Haartsen 2012; Halfacree 2008, 2012; Javakhishvili-

Larsen and Andersen 2025). In Denmark, for instance, the early 2000s saw a wave of counter-urban migration driven by rising urban living costs (Andersen and Winther 2010; Remoundou, Gkartzios, and Garrod 2016). This trend reversed following the financial crisis, with migration flows shifting back towards urban centres (Nørgaard et al. 2023a, 2023b). More recently, the COVID-19 pandemic has reignited interest in counter-urbanization, facilitated by increased remote work opportunities (Delventhal, Kwon, and Parkhomenko 2022; Ramani and Bloom 2021; Tammaru et al. 2023).

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 (2025) and others (Andersen et al. 2022; Hansen and Aner 2017; Herslund 2012; Sandow and Lundholm 2020, 2023) 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.

2.2. Evolving concepts of human capital

The definition and measurement of human capital have expanded beyond traditional metrics of education and job-related skills (Hansen and Aner 2017; Hansen and Winther 2014, 2015; Mitze and Javakhishvili-Larsen 2020; Naveed, Javakhishvili-Larsen, and Schmidt 2017). Javakhishvili-Larsen and Andersen (2025) 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.

2.3. 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 (Boschma and Martin 2010; Capello 2016; Duranton and Puga 2004; Kemeny and Storper 2015), more recent studies have highlighted the potential benefits of diversity. Noseleit and Söllner (2010) argue that diversity in human capital enhances innovation and productivity, leading to improved economic performance. Similarly, Ejdemo and Örtqvist (2021) suggest that regions with higher levels of entrepreneurship and related variety tend to experience better economic performance and growth.

2.4. 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 counter-urban 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 municipalities 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 the 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 (Hansen et al. 2012).

Hansen et al. (2012) provide a typology based on fourteen socioeconomic characteristics for each municipality. This typology is widely used in other Danish studies (Andersen et al. 2022; Hansen and Aner 2017; Hansen and Winther 2015; Javakhishvili-Larsen and Andersen 2025; Naveed, Javakhishvili-Larsen, and Schmidt 2017). 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** – 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.

However, as Javakhishvili-Larsen and Andersen (2025) 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 (2025).

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):

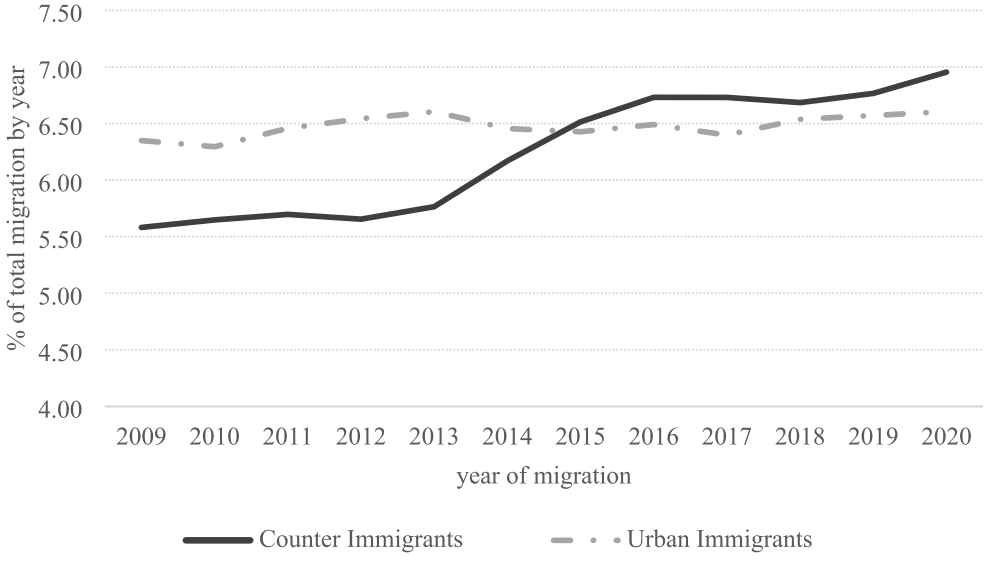

Figure 1. Share of immigrant flows in total migration per year from 2009 to 2020. Source: Authors' calculation, based on the micro register data from Statistics Denmark

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.

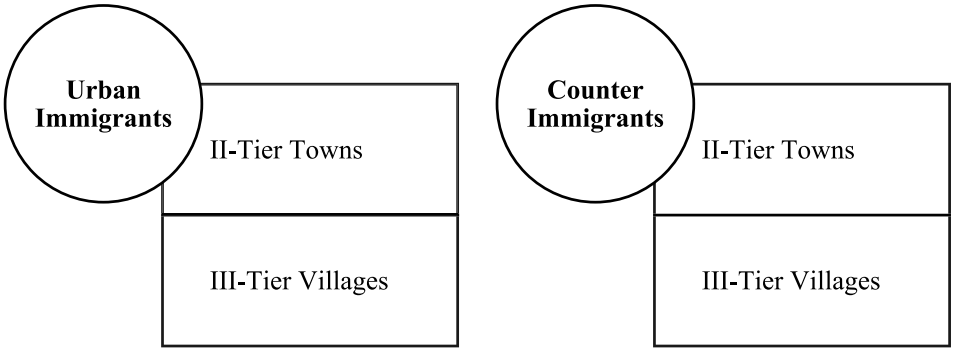

Figure 2. Spatial selection and scope for study. Source: Authors' elaboration, based on Javakhishvili-Larsen and Andersen (2025) *a*nd Hansen et al. (2012)

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.

(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.

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 economic growth 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 (Chakravorty 2003; Czyż and Hauke 2015; Hitt, Hoskisson, and Kim 1997; Punia and Singh 2012).

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 (Chakravorty 2003; Czyż and Hauke 2015; Hitt, Hoskisson, and Kim 1997; Punia and Singh 2012).

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 regional development. 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 come from 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, 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),

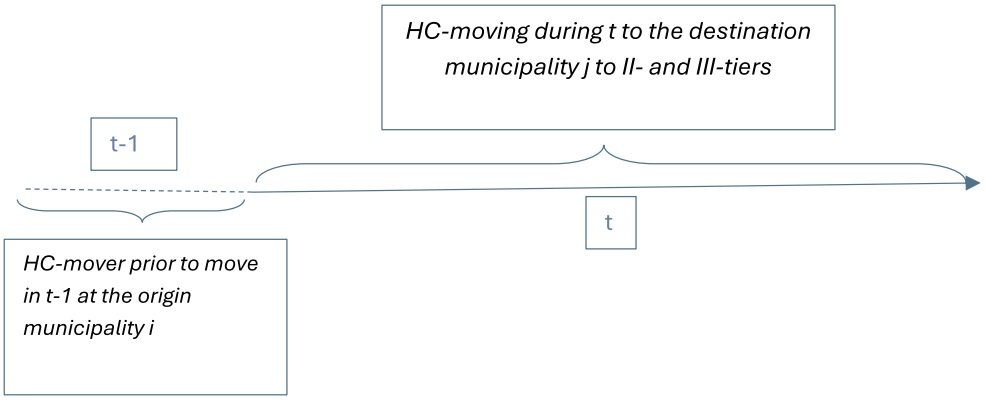

Figure 3. Timeline and sampling of human capital. Source: Authors' framework

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.

where the inflows are measured by entropy indexes (REIs) for education, age, socioeconomic status, the economic sector, wage and occupation by all municipalities taken from the previous year.

The HC diversification for each characteristic and municipality is measured according to Equation (1).

$$REI_{kit-1} = \; - \sum_{i=1}^{N} P_{kit-1} * \ln(P_{kit-1}) \tag{1}$$

where, REI_{kit-1} is the Regional Entropy Index (by k variable of interest), where k is Education, Age, SocEcon Status, Sectors, Wage, Skills at Occupation, in i region of origin in $t-1$, P_{kit-1} represents the proportion of the variable of interest within region i in $i-1$ 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 will analyse the relationship between HC immigration and the average wage level across the entire municipality j. This will help determine if attracting diverse human capital can positively contribute to the local economy.

We will use the municipality's average wage as the dependent variable and the pre-calculated Regional Entropy Indices (REIs) for HC attributes as the independent variables. This will allow 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 (Boschma and Martin 2010; Capello 2016; Duranton and Puga 2004; Kemeny and Storper 2015). For example, secondary towns may attract 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 (Andersen et al. 2022; Javakhishvili-Larsen and Andersen 2025; Nørgaard et al. 2023a, 2023b). 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 will initially test the hypotheses using a pooled OLS linear regression with robust standard errors, as described in Equation (2).

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

where, $\log \widehat{INC}_j$ is logged average income in the destination municipality j, α_j is the intercept, $\beta_{(1 \ldots 6)}$ 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 will enable 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 will incorporate a time variable and time fixed effects (FE) into Equation (3).

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

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.: 2009–2020.

There is ongoing debate among researchers regarding the appropriateness of using Ordinary Least Squares (OLS) versus Fixed Effects (FE) models (Collischon and Eberl 2020). To address this, we will apply both models to assess the consistency of our results.

In the following section, we will 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

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*

diversity of attributes that can either enhance the existing diversity among residents or contribute to segregation. To address this, we will 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.

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 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) will yield significant and interesting results.

4.1. Economic outcome of HC immigrants in II-tier towns

This section provides results, displayed on Table 2. 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.

Y = log. Average Wage	(1) Urban town OLS: Robust	(2) Count town OLS: Robust	(3) Urban town FE: Robust	(4) Count town 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: Effect of immigrant entropy on average wages of destination municipality at the II-tier level.
*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 $100^{*}\beta$ *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 effects on destination municipality wages when they possess diversified education levels, ages, and wage levels. However, they exhibit negative effects when they have diversified sectors and occupations.

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

These findings highlight the varying impacts 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 impact 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.

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

Conversely, immigrants in third-tier villages within rural municipalities show positive effects on destination municipality 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.

Table 3. Comparison of OLS and FE.

Y = log. Average Wage	(1) Urban rural OLS: Robust	(2) Count rural OLS: Robust	(3) Urban rural FE: Robust	(4) Count rural 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: Effect of immigrant entropy on average wages of destination municipality at the III-tier level
*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*

These findings indicate that the effects 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 will analyse the overall predicted impact of these diversifications on the average wage levels in destination municipalities, both in urban and rural areas.

Figure 4 illustrates the effects of diversified human capital in second-tier towns on the left and in third-tier villages on the right. The darker areas on the map indicate a higher impact of increased diversification on the income levels of destination municipalities, while lighter areas represent lower impacts (see Figure 4). 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 impact 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. Conversely, the lowest aggregate effect is seen within these large city-municipalities themselves. This suggests that the spillover effect of immigration is greater in neighbouring municipalities.

These neighbouring municipalities generally have close economic connections with the large cities, serving as commuting and value chain areas (Wachsmuth 2017). 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 map on the right side of Figure 5 shows the overall economic impact 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 impact 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 effect on wages in municipalities near urban centres, particularly in second-tier towns. However, as the distance from these centres increases, the impact weakens, especially in third-tier villages. This suggests that geographic proximity to urban hubs is crucial in amplifying the economic benefits of diversified HC immigration, primarily in secondary towns.

5. Discussion and conclusive remarks

This paper investigates the outcome of increasing diversification among inter-regional human capital migrants on the local economies of destination municipalities, specifically in second-tier towns and third-tier villages. Our findings reveal that the impact of

Figure 4. The aggregate outcome of diversified immigrant human capital on municipality (Immigrants to II-tier towns (left) and III-tier villages (right)). Source: Authors' calculations based on the Equation 3. The map is created in www.datawrapper.de

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.

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.

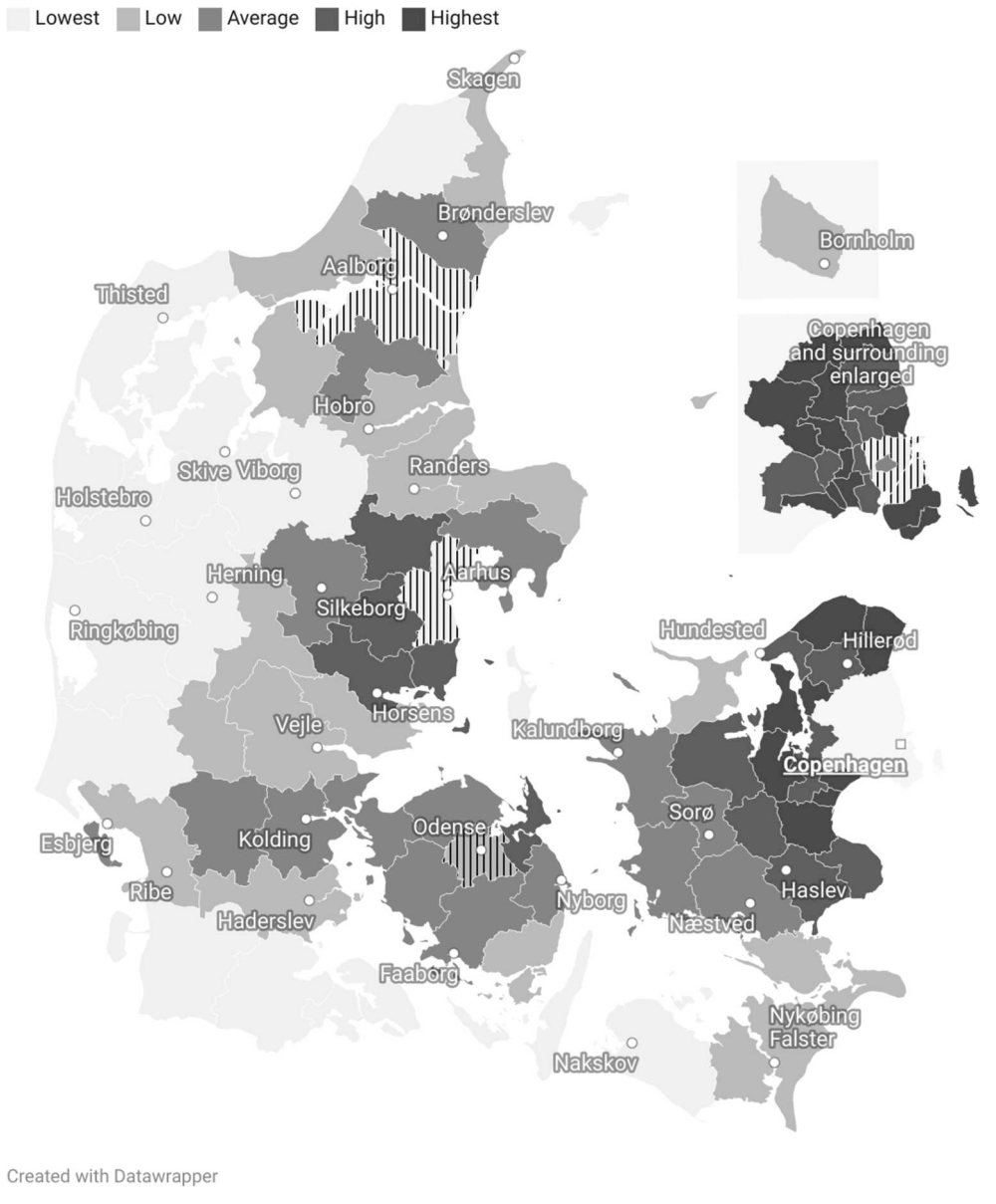

Figure 5. The aggregate economic outcome of diversified immigrant human capital on destination municipality when the immigration is to III-tier villages. **S**ource: Authors' calculations based on the Equation 3. The map is created in www.datawrapper.de

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.

In second-tier towns, the results indicate that the 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 impacts in both urban and rural settings. However, other attributes, like education and occupation, can have mixed effects 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 effect in urban areas.

Similarly, in third-tier villages, diversified age and wage levels also show positive impacts 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 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 are concentrated near metropolitan centres. In contrast, the impact 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 interregional 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 model, this study challenges traditional views on the positive impacts 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. It argues that diversified occupational attributes have a more substantial benefit for rural areas than diversified education levels.

The insights gained from this study can assist policymakers and planning professionals in second-tier towns and third-tier villages 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 affects 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.

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. For example, 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 diversified human capital on the local economy. 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 generalized 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.

Note

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

Data availability statement

Considering the sensitivity of micro-register data applied to this study, the data sharing is not available without the clearance from Statistics Denmark. However, the REI indexes in the aggregated municipality level can be provided on request by contacting the corresponding author.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used Grammarly and Microsoft Copilot to improve gramma and readability. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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