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Effects of Regional Creative Milieu on Interregional Migration of the Highly Educated in Korea: Evidence from Hierarchical Cross-Classified Linear Modeling

Ye Seul Choi and Up Lim *

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Department of Urban Planning and Engineering, Yonsei University, 50 Yonsei-ro, Seodaemun-gu, Seoul 03722, Korea; yeseul.choi@yonsei.ac.kr
* Correspondence: uplim@yonsei.ac.kr; Tel.: +82-2-2123-5897; Fax: +82-2-393-6298

Abstract: This study empirically investigates the effects of a regional creative milieu on the migration inflows and outflows of the highly educated between urbanized areas in Korea. To estimate the push and pull effects, we use the 5% Population and Housing Census (2005) and employ a hierarchical cross-classified linear model as an empirical modeling framework. The graduate migration between areas is generally affected by regional and individual characteristics. To this effect, the literature suggests that highly-educated individuals tend to significantly value diverse and creative regional amenities in migration decision making. Our results reveal that, regarding the push and pull effect for the highly educated, talent and tolerance in a region and a high level of the creativity index in a region are likely to increase the likelihood of in-migration and decrease that of out-migration by lowering the barriers to entry for the highly educated. Our findings emphasize the role of regions with well-established amenities as a creative milieu for attracting the highly educated and, thus, have significant implications for sustainable regional development policies.

Keywords: creative milieu; interregional migration; highly educated; push and pull effects; hierarchical cross-classified linear modeling

1. Introduction

Over the past few decades, most cities in industrialized countries have been characterized by a population decline [1–4] or a significant population loss within a short time span, a phenomenon known as "shrinking cities" [5,6]. Thus, a population decline with low fertility rates has become a key issue in policies aiming at sustainable regional development, because a shrinking population can reduce regional productivity, impose severe social benefit cuts and unfairly burden future generations with rising social costs. In particular, Korea has been experiencing a slowdown in the economic growth rate, with a constantly decreasing rate of population growth since the 1960s.

The growth and decline of a region's population are mainly driven by migration flows, because a natural increase in a region's population can be limited by low fertility rates [4,7]. Thus, the ability of a region to attract and compete for potential migrants, particularly the highly skilled and educated, has long been acknowledged as an important aspect in sustainable regional development policies [8–13]. The relevant literature often emphasizes that the factors underpinning regional economic development are the highly skilled and educated, and their migration behavior can significantly affect the regional stocks of human capital [14].

In recent times, both academics and policy makers have begun paying increasing attention to the potential of creative capital and the highly educated in fostering economic growth and attracting

these new residents to their regions [15]. This is because historically, it has long been recognized that a large number of highly-educated individuals is the main engine of Korea's economic growth and development. However, when we see a picture of the geographical distribution of the highly educated in Korea, we find that it is very fragmented. That is, while the importance of attracting and retaining the highly educated in more peripheral regions has been recognized as a key factor for regional success, the reality is that these individuals tend to cluster in the capital region. Not surprisingly, according to the 2005 Population and Housing Census (PHC), the capital region constitutes the top 10% of the 69 urbanized areas in Korea, and a major proportion of college graduates resides in this region. We found that the proportion of college graduates is greatest in Goyang (23.78%), followed by Gunpo (21.66%), Seongnam (21.22%) and Seoul (21.22%). As mentioned before, the highly educated appear to be very unevenly spread, with the capital region having a very high concentration of college graduates.

Among the various factors influencing a city's attractiveness to attract the highly educated, policy makers have recently emphasized the implementation of strategies that encourage cities and regions to become more "creative". In line with this, Florida [16] claims that cities and regions must create an attractive environment, since creativity has been associated with the increasingly central role of a city's competitiveness [15]. However, studies on creative cities have mainly focused on the migration of the creative classes as a factor influencing overall migration [16,17]. Indeed, most of the extant literature has failed to analyze a "regional creative milieu" that affects the interregional migration of the highly educated.

A considerable number of migration studies have examined factors influencing the migratory decisions of the highly educated. However, despite the existence of regional effects on migratory behavior, many studies have considered factors at either the individual or regional level, not both [4,14,18–23]. Moreover, few interregional migration studies have paid significant attention to the interdependence of individual and regional characteristics and migratory behavior. Both individual and family characteristics, as well as those of the origin and destination regions can influence the likelihood of migration. Thus, migration can be selective from both the individual and regional perspective. Furthermore, migratory behavior results from push and pull factors that repel and attract individuals [24,25]; however, only a few studies have recently posed the question, "what are the push and pull mechanisms underlying the migration of the highly educated?"

This study empirically examines the effects of a regional creative milieu on the migration inflows and outflows of the highly educated between urbanized areas in Korea using a hierarchical cross-classified linear model. Applying such a model allows us to consider the characteristics of individuals and families, as well as those of the origin and destination regions. In addition, it details the characteristics of individuals, families and the origin and destination regions that affect migratory behavior between regions and their effects.

The remainder of this paper is structured as follows. Section 2 reviews the theoretical literature on human migration, especially highly-educated individuals, and the individual and regional characteristics influencing interregional migration flows. It also discusses the concept and measurement of a creative milieu as a characteristic of a region. Section 3 introduces the hierarchical cross-classified linear model. Section 4 describes the data and variables used for the analysis. Section 5 reports the empirical results. This paper closes with concluding remarks in Section 6.

2. Literature Review

Migration is the movement of individuals from one region to another. Migration theory largely focuses on factors influencing individual's migratory decisions [4]. More specifically, substantial theoretical and empirical research has discussed individual and regional characteristics, such as push or pull factors that repel or attract migrants. In addition, studies have identified factors determining an individual's utility differentials that offer migration incentives to potential migrants across regions [11,26–28]. Individuals consider migration as a means to maximize utility. To elaborate,

they decide whether to move by assessing net individual gains from moving from one region to another, thus maximizing their total lifetime utilities.

Much of the migration literature arrives at the common conclusion that individuals with a higher level of education are more likely to migrate [14,17,29–33]. According to human capital theory, migration results from variations in individual economic utility in different regions [26,34–36]. In addition to human capital theory, individuals' graduation approaches and job search theory state that graduating students search for better opportunities in a more diverse geographical area and, thus, are more likely to contribute to the increase in migration levels [20,37]. These theories often suggest that the highly educated are more likely to move.

The theoretical and empirical migration literature examines the determinants of migration at either the individual or regional level [14,19,38]. These determinants include individual-specific characteristics, such as age, gender, educational attainment, earnings, marital status, job skills and migration history [14,18,39,40]. Characteristics of the origin and destination regions, e.g., job opportunities, economic structure, housing market conditions, educational attainment and regional amenities, may also provide an incentive for migratory decision making [18,40]. These characteristics pose as push and pull factors [24,25]. Push factors act as disincentives to live in the present location, whereas pull factors make the attributes of the location seem appealing. Among the various regional characteristics, regional amenities denoting the features of an urban environment seem to play a more important role in influencing the location choice of the highly educated.

Regional amenities, a people climate characteristic, affect the level and geographical distribution of education and skill [12]. People climate is a mix of factors that make a region appealing, thereby not only attracting people to a given region, but also retaining them [17]. According to Roback [41], migratory behavior depends on wage levels and land rent, which can be categorized as quality-of-life amenities. Glaeser *et al.* [42], among various other studies, focus on the role of a widely-ranging set of sociocultural amenities, such as restaurants, theaters and museums, in migration. Lloyd and Clark [43] and Clark *et al.* [44] suggest that the educated populous considers urban amenities, such as parks, art galleries and signature buildings, attractive. Cities that are filled with such attractions are deemed "entertainment machines" or "sand boxes" [43–45].

Nevertheless, the recent literature is paying increasing attention to the importance of strategies to develop creative cities [16,46,47]. A substantial body of research has focused on the migration of the "creative class", as proposed by Florida [16]. However, to the best of our knowledge, only a few works focus on a regional creative milieu, which possibly influences the migratory behavior of highly-educated individuals. According to creative class theory, regions with favorable creative activities are more likely to attract creative and talented individuals, regardless of their profession [48]. These individuals generally qualify as highly-educated individuals with a high human capital value. Thus, the educated population often emphasizes a creative milieu, which in turn leads to a creative city. Given the aforementioned concerns regarding the role of regional amenities in attracting or repelling potential migrants, it seems imperative to consider the effects of a regional creative milieu on the migration flow of the educated population.

Until recently, there has been no consensus among researchers on the concept of creativity and creative milieu, leaving the concept somewhat vague [48,49]. Because of the ambiguity of this concept, the relevant literature exhibits an ongoing debate on how to define and measure a creative milieu. Some note that a creative milieu is a region where face-to-face interactions create new ideas, products and services across diverse creative domains [50–52]. Others consider it to be a "milieu with strong cultural amenities" or an "artistic milieu" that attracts bohemians and artists, who in turn lure more creative workers, thus benefiting the regional economy [48].

After reviewing the creative milieu literature, we decided to focus on creative class theory when defining the concept of a creative milieu [16,53], because the idea of a certain "milieu" affecting migration and attracting "talented" and "highly-educated" individuals is one of the cornerstones of creative class theory [54]. One of the key aspects of this theory is the idea that creative people

attract other creative people [53,54]. Therefore, regions with a desirable climate for creative or highly-educated people or, in other words, with a rich creative scene (determined by the proportion of workers in creative occupations or the creative class in a region), produce an environment or milieu that attracts and retains individuals with high human capital [54].

Florida [16], who was first to discuss the concept of a creative class, mentions some key professionals, labeled the "creative class". The creative class encompasses a wide range of key professions, such as the "super-creative class" and "creative professionals". In Florida's [53] own words, "the super-creative core of creative class includes scientists and engineers, university professors, poets and novelists, artists, entertainers, actors, designers, architects, writers, editors, cultural figures, think-tank researchers, analysts, and other opinion-makers". Beyond this creative core group, creative professionals include "people in business and finance, law, healthcare and related fields". The creative cities literature has mostly applied a common criterion in defining the creative core based on creative class theory: the U.S. context [16,53], the U.K. context [55,56], and other European contexts [56,57]. Thus, it seems that the characteristics of the creative core do not depend on cultural elements.

To better understand the concept of a creative milieu, Florida [53] suggests the creativity index as a measure of a region's underlying creative capabilities. The creativity index incorporates the critical factors of creativity and economic development, which Florida calls the 3Ts: technology, talent and tolerance. Florida defines technology as a function of both innovation and high-tech concentration in a region. Talent includes people with a bachelor's degree and above, whom Clifton [55] refers to as highly-educated individuals. Finally, tolerance is defined as openness and inclusiveness toward all people and cultures. According to Florida's [53] theory, a region must have all three factors to attract creative or highly-educated individuals.

As suggested by creative class theory [53], the creativity index is a mix of three equally-weighted factors: talent, measured by the proportion of the workforce employed in creative occupations or the proportion of people with bachelor's degrees and above; technology, which can be measured with the tech-pole index (patents per capita); tolerance, measured with the gay index (the proportion of gays and lesbians), the bohemian index (the proportion of bohemians), the melting pot index (the proportion of foreigners) or the minority index (the proportion of ethnic minorities or disadvantaged groups), which represent a region's openness to different kinds of people, societies and cultures. As discussed above, regions possessing a strong creative class and the 3Ts can be referred to as "regions with a creative milieu".

3. Empirical Modeling Framework

As mentioned, an individual's migration decision is affected by both individual and regional characteristics. To this effect, a nested data structure indicates that individuals are nested within regions (Figure 1a). Because the model comprises a nested structure of data, individuals belonging to the same region are more likely to have correlated errors, resulting in a violation of the independence assumption. By relaxing this assumption, the hierarchical modeling provides more statistically-efficient estimates of regression coefficients and more conservative standard errors than those in nested data [58]. In addition, the hierarchical modeling approach allows us to properly examine mechanisms, using regional characteristics that operate at the individual level. A simple two-level hierarchical model for the i-th Level 1 unit within the j-th Level 2 unit can be written as follows:

$$y_{ij} = \beta_{0j} + \beta_{1j} X_{ij} + r_{ij} \tag{1a}$$

$$\beta_{0j} = \gamma_{00} + \gamma_{01} W_j + u_{0j} \tag{1b}$$

$$\beta_{1j} = \gamma_{01} + \gamma_{11} W_j + u_{1j} \tag{1c}$$

$$E\left(r_{ij}\right)=0,\ Var\left(r_{ij}\right)=\sigma^2,\ E\begin{pmatrix}u_{0j}\\u_{1j}\end{pmatrix}=\begin{pmatrix}0\\0\end{pmatrix},\ Var\begin{pmatrix}u_{0j}\\u_{1j}\end{pmatrix}=\begin{pmatrix}\tau_{00}&\tau_{01}\\\tau_{10}&\tau_{11}\end{pmatrix} \tag{1d}$$
$$Cov\left(u_{0j},r_{ij}\right)=Cov\left(u_{1j},r_{ij}\right)=0$$

where $i = 1, \ldots, n_j$ Level 1 units nested with $j = 1, \ldots, J$ Level 2 units. β_{0j}, β_{1j} are Level 1 coefficients; $\gamma_{00}, \ldots, \gamma_{11}$ are Level 2 coefficients and are also called fixed effects; X_{ij} is a Level 1 predictor; W_j is a Level 2 predictor; r_{ij} is a Level 1 random effect; u_{0j}, u_{1j} are Level 2 random effects; σ^2 is the Level 1 variance; and τ_{00}, τ_{01}, τ_{11} are Level 2 variance-covariance components.

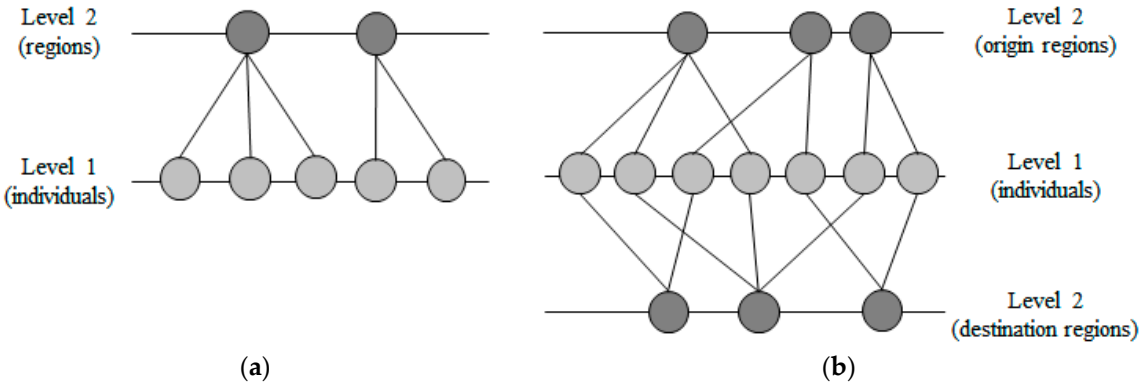

Figure 1. Multilevel structures. (**a**) Two-level hierarchical structure; (**b**) two-level hierarchical cross-classified structure.

The hierarchical linear modeling allows us to explore the effects of both individual and regional characteristics on interregional migration within a single model. However, migration has a more complex data structure in which the individual level units are cross-classified by two regional level units: origin and destination. Individuals are classified by origin region, that is where they come from, and destination region, where they currently live. Because an individual's migratory behavior is influenced by individual, as well as origin and destination region characteristics, we adopt a hierarchical cross-classified linear model as our research model (Figure 1b). This is a two-level structure with individuals at Level 1 nested within the cells of the Level 2 cross-classification [59]. A general hierarchical linear model or classical approach is insufficient to treat individuals classified by origin and destination, that is the cross-classification of individuals by region [60]. Thus, the hierarchical cross-classified linear modeling allows us to analyze two-way data and estimate the push effects from the origin region and pull effects from the destination region.

First, to illustrate the empirical modeling framework, we suggest the unconditional two-way cross-classified variance component model, which is a modified version of standard hierarchical notation and written as follows:

$$y_{i(jk)} = \pi_{0jk} + e_{ijk},\ e_{ijk} \sim N(0,\ {\sigma_e}^2) \tag{2a}$$

$$\pi_{0jk} = \theta_0 + b_{00j} + c_{00k} + d_{0jk} \tag{2b}$$

$$b_{00j} \sim N\left(0,\ \tau_{b00}\right),\ c_{00k} \sim N\left(0,\ \tau_{c00}\right),\ d_{0jk} \sim N\left(0,\ \tau_{d00}\right) \tag{2c}$$

where indices i, j and k denote an individual within cell jk ($i = 1, \ldots, n_{jk}$), an origin region in 2000 ($j = 1, \ldots, J$) and a destination region in 2005 ($k = 1, \ldots, K$), respectively. $y_{i(jk)}$ denotes whether an individual migrates from origin region j to destination region k over the period from 2000 to 2005. π_{0jk} is the mean likelihood of the migration of an individual in cell jk, that is individuals who lived in region j in 2000 and then migrated to k in 2005. e_{ijk} is the random "individual effect", that is the individual level error term assumed to be normally distributed with mean zero and constant variance ${\sigma_e}^2$. θ_0 is the grand mean likelihood of migration of all individuals; b_{00j} is the random main effect of

neighborhood j, that is the contribution of the origin region j averaged over all destination regions, assumed normally distributed with mean zero and variance τ_{b00}. c_{00k} is the random main effect of destination region k, that is the contribution of destination region k averaged over all origin regions, assumed normally distributed with mean zero and variance τ_{c00}, and d_{0jk} is the random interaction effect, that is the deviation of the cell mean from that predicted by the grand mean and the two main effects, assumed normally distributed with mean zero and variance τ_{d00}.

We apply a logistic function to $y_{i(jk)}$ because the dependent variable is binary (moving = 1, otherwise = 0) as follows:

$$y_{i(jk)} \sim Binomial\left(N, \pi_{i(jk)}\right) \tag{3a}$$

$$ln\left(\frac{\pi_{i(jk)}}{1-\pi_{i(jk)}}\right) = logit\left(\pi_{i(jk)}\right) \tag{3b}$$

$$\pi_{0(jk)} = \alpha + u_j + u_k \tag{3c}$$

$$logit\left(\pi_{i(jk)}\right) = \alpha + \sum_{m=1}^{M} \beta_m X_{mi} + u_j + u_k + \varepsilon \tag{3d}$$

where $logit\left(\pi_{i(jk)}\right)$ is individual i's likelihood to migrate from region j to region k. α refers to all individuals' grand mean likelihood of migration u_j is the random effect of origin region j, considered as the "push effect" from the origin region. u_k is the random effect of destination region k, considered as the "pull effect" from the destination region. ε is the error term, which contains unobserved factors for individual i that affect his or her migration. X_{mi} is the m-th independent variable for individual i, which may affect migration decisions at the individual level. β_m is the fixed coefficient of independent variable X_{mi} at the individual level.

After the hierarchical cross-classified linear modeling, we develop multiple regression equations to explore the effects of a regional creative milieu on regional push and pull effects, as shown in Equations (4a) and (4b), respectively. Formally, the models for the regional level can be written as follows:

$$u_j = \delta_0^O + \sum_{p=1}^{P} \delta_p^O creative\ milieu_{pj} + \sum_{q=1}^{Q} \varphi_q^O w_{qj} + \varepsilon_{0j} \tag{4a}$$

$$u_k = \delta_0^D + \sum_{p=1}^{P} \delta_p^D creative\ milieu_{pk} + \sum_{q=1}^{Q} \varphi_q^D w_{qk} + \varepsilon_{0k} \tag{4b}$$

where u_j is to the random effect of origin region j and u_k is the random effect of destination region k. These random effects indicate the average regional effects on the likelihood of individuals' migration at the regional level. Thus, u_j and u_k are regarded as the push effects from origin region j and pull effects from destination region k. The two random effects, u_j and u_k, act as dependent variables at the regional level. $creative\ milieu_{pj}$ and $creative\ milieu_{pk}$ are the characteristics of origin region j and destination region k as explanatory variables, which represent a regional creative milieu. The effects of a regional creative milieu in the origin region and destination regions on the likelihood of migration at the individual level are δ_p^O and δ_p^D, respectively. w_{qj} and w_{qk} denote the q-th control variable, and φ_q^j and φ_q^k are the q-th coefficients associated with control variables. ε_{0j} and ε_{0k} represent the regional level error terms at the origin and destination regions, respectively, assumed normally distributed with mean zero, and have constant variances.

One of the main concerns in estimating the effect of a regional creative milieu on the migration of the highly educated is the issue of endogeneity. Endogeneity arises when an explanatory variable is correlated with the error term. According to Wooldridge [61], endogeneity may occur because of omitted variable bias, simultaneity (or reverse causality) or measurement error. In general, analyses including migration flows and the characteristics of region are prone to endogeneity, which

is sometimes used to refer only to simultaneity [62]. In our study, endogeneity arises when the regions with a creative milieu attract the highly educated, while the existence of the highly educated contributes to engendering the regions with a creative milieu, and *vice versa*. The issue of endogeneity may be problematic because its existence makes it difficult to establish causality. Hence, a substantial body of migration studies have attempted to cope with the issue of endogeneity by estimating an instrumental variable (IV) specification. In line with this, recent empirical analyses in migration studies have been concerned with the use of IV, which is assumed to be uncorrelated with the error term, but correlated with the endogenous variable [63–66]. Among others, Fratesi and Percoco [63] find that net migration has a negative effect on regional growth when the endogeneity of migration is taken into account via an IV approach. In a similar vein, Kubis and Schneider [65] use a spatial dynamic panel model to deal with the problem of the endogeneity of migration flows as well as unobserved regional heterogeneity. Accounting for the endogeneity of migration and human capital, they find that out-migration has a negative but modest effect on regional growth in post-reunification Germany. Using microdata from the 1880 and 1910 US censuses, Rodríguez-Pose and von Berlepsch [66] address the potential issue of endogeneity not only by using lagged independent variables but also by resorting to IV specification.

For a multilevel model, it is far from unusual to contain a regressor that can be regarded as an endogenous variable [67]. In principle, the most frequently-used methods for overcoming endogeneity problems are to remove the cause of the endogeneity or to use an IV [67,68]. However, endogeneity is a very difficult problem to detect and to correct, especially in a multilevel model. In practice, removing the cause is usually not feasible, and finding the proper IV is a very challenging issue in multilevel models [69]. This is because the stochastic part of a multilevel model is more structured than that of a single-level model. As Fielding *et al.* [70] pointed out, the procedures for adapting to endogenous covariates in a multilevel model are often unavailable in empirical work. In line with this, very few multilevel studies have used an IV estimation with the instruments for the endogenous variable [67].

4. Data and Variables

Our data are based on the 5% PHC (cross-sectional data), constructed by Statistics Korea at the individual level. Various regional data are obtained from the Korean Statistical Information Service and the Statistical Yearbook for each municipality in Korea. By matching individuals' unique personal identifier across the data, we provide rich data for 2000 to 2005 on Korea's residents. The data on individuals or households and region of residence can be merged with individual records. The large dataset contains information on individual characteristics (e.g., age, gender, educational attainment, socioeconomic activity and residence in 2000 and 2005) and household's characteristics (e.g., type and size of family and home ownership status).

As for issues with the cross-sectional data, difficulty in handling self-selection for migration can arise from a lack of longitudinal data, which is closely linked to issues of selectivity. The lack of longitudinal data does not allow for a proper assessment of the long-term effects of migration [71]. As pointed out by ADBI *et al.* [71], data that track migrants over time would allow researchers to overcome the issue of selection in the analysis of the effects of migration. In line with this, Borjas *et al.* [72] tried to deal with the self-selection issue by using data from the National Longitudinal Survey of Youth (NLSY). However, we have difficulty in getting around the issue of self-selection because our study used the 5% PHC dataset which is cross-sectional data. Although the dataset we used includes information on the place of residence five year ago, it does not provide any other longitudinal information on the characteristics of migrants and nonmigrants. Consequently, this dataset is still insufficient to handle the self-selection problem in this study.

In addition, this study sets explanatory variables that represent a regional creative milieu and various control variables at the regional level, such as job opportunities, housing conditions, educational attainment and social welfare facilities. The location-specific characteristics are measured

at the regional level. The spatial units for the analysis are 69 urbanized areas, as defined by Statistics Korea as of December 2007. An urbanized area is defined as a functional area that comprises one or more economic nodes, as well as surrounding municipalities that are economically related to the nodes. The primary factor determining economic relationships among municipalities is labor commuting patterns that delineate the local labor markets, such that each urbanized area includes the place of work and residence.

The 5% PHC dataset contains long-form information. The sample was restricted on the basis of the following criteria. First, among the individuals, householders were selected because family relationships may restrict the mobility of its members [40]. Second, only individuals who graduated from a tertiary educational institution were selected to represent high human capital value. Third, individuals 25 years or older who had completed their education were considered. As a result, the final sample numbered 53,133 individuals.

Table 1 provides a brief description of the variables used in the empirical analysis. The dependent variable, migration, includes a change in the urbanized area-level residence during 2000 to 2005 (migration = 1, otherwise = 0). The explanatory variables used in our empirical model comprised a wide range of factors found to influence migratory behavior. These factors are divided into three categories: individual, household and regional characteristics. Individual characteristics include gender, age, commuting time, marital status and employment status. Under household characteristics, we included family and housing types.

Table 1. Description of explanatory variables.

Variable	Description
	Individual Characteristics
Male	1 if male, 0 otherwise
Age	Age in years
Married	1 if married, 0 otherwise
Employment	1 if employed, 0 otherwise
Commuting time	1 if commuting time is more than an hour, 0 otherwise
With family	1 if living with family, 0 otherwise
House owner	1 if owner is the occupier of a house, 0 otherwise
	Regional Characteristics
Creative core and professional	Share of employed labor force in super-creative core occupation and creative professional occupation
Bachelor	Proportion of people with a bachelor's degree and above in a region
Patent	Proportion of patents registered in a region
Foreigner	Proportion of foreigners in a region
Female employee	Proportion of female employees in a region
Student-to-teacher	Regional ratio of students to teachers in elementary schools
Welfare	Regional ratio of social welfare facilities to millions of people
Livelihood	Proportion of livelihood program recipients in a region
Job opportunities	Regional job opportunities (ratio of employees to working age population)
LQ manufacturing	Location quotient for the manufacturing industry in a region
LQ service	Location quotient for the service industry in a region
New house	Proportion of new houses in a region
Old house	Proportion of old houses in a region
Aged 65+	Proportion of population aged 65 years and above in a region

Faggian *et al.* [73], who studied this topic in the U.K., suggested several explanatory variables, such as the subject the graduates studied, the type of higher education institution and graduates' final grades. While the research of Faggian *et al.* [73] was based on survey data, which came from "Students in Higher Education" and "Destinations of Leavers from Higher Education", we used the 5% PHC dataset owing to data availability. Although the 5% PHC constituted a large dataset, it only contained

information on general individual characteristics (e.g., age, gender, educational attainment and place of residence) and household characteristics (e.g., type and size of family and home ownership status). The survey data that Faggian *et al.* [54] used contained detailed information on individuals, including demographic characteristics (such as gender, age and ethnicity), subject of study, mode (full time *versus* part time), level of study (postgraduate *versus* undergraduate), degree results and type of institution attended. Generally, surveys that have a specific target provide more detailed and plentiful information than census data. However, as pointed out by Faggian *et al.* [73], the lack of comparative research is linked to the issue of data limitation. Faggian *et al.* [54] also mention that studying the migration behavior of highly educated individuals is not an easy task because sophisticated micro-data on highly educated individuals have not been available until recently.

In addition to individual and household characteristics, we adopt variables that represent the characteristics of the origin and destination region. We propose explanatory variables to describe a regional creative milieu, such as the regional proportion of its super-creative core and creative professionals, bachelors, patents, foreigners and female employees. Specifically, we use the share of an employed labor force to measure the super-creative core occupations and creative professional occupations. Super-creative core individuals include those who are, for example, scientists, engineers, university professors, poets, artists, entertainers, designers and architects. The creative class also includes creative professionals. These professionals engage in a wide range of knowledge-based fields, such as technologically-advanced sectors, financial services, law, healthcare and business management [53]. In addition, the proportion of people with a bachelor's degree and above in a region as a measure of talent is regarded as the level of human capital in a region. Generally, regions with a high level of human capital in a region experienced rapid regional economic growth and development. Furthermore, the proportion of registered patents elucidates the degree of innovation and technological concentrations in the region. This technological advance can contribute to attracting more creative people.

As mentioned, tolerance, as openness to all ethnicities and minorities, inclusiveness and diversity are the key variables characterizing a creative milieu. From this perspective, we describe a regional creative milieu as one with a higher proportion of foreigners or female employees. As for the aforementioned concerns about the measurement of a creative milieu, a creative milieu has the multidimensional characteristics of creativity and economic development. To reflect the multidimensional concept of a regional creative milieu, we have implemented principal component analysis. Principal component analysis is one of the most notable multivariate techniques employed in composite indexing [74,75]. In our study, principal component analysis is used to transform the multiple variables into a single index that provides an information summary of the multiple indicators that represent various aspects of a creative milieu. Thus, the single composite index represents aggregate measures of a combination of complex creative milieu by integrating various talent, technology and tolerance aspects of the regional creative milieu in the measurement. Regarding the results of the principal component analysis, we extracted a single composite index from the six indicators of creative milieu. We named the single composite index the "creativity index" according to creative class theory [53]. The resulting index explains approximately 58% of the variation in all of the indicators. The underlying factors load reasonably strongly with all six creative milieu measures. This provides support for reducing the six variables to a single creativity index for our analysis.

To describe a region's characteristics, we include various other variables, which are regarded as control variables in the empirical model. The control variables at the regional level represent socioeconomic characteristics: regional ratio of students to teachers in an elementary school; regional ratio of social welfare facilities to people; regional ratio of employees to the working age population, which represents regional job opportunities; location quotient for the manufacturing industry in a region; location quotient for the service industry in a region; proportions of new and old housing in

a region; and proportion of the population aged 65 years and over, which represents the aging index. Descriptive statistics for variables at both levels are shown in Table 2.

We checked for multicollinearity in our model by looking at the correlation coefficient and variance inflation factor (VIF), which are the most popular ways to measure it. There were no correlation coefficients higher than 0.7 for any of the explanatory variables in our model. Generally, the presence of high correlations (0.90 and above) is the first indicator of substantial collinearity [76]. Furthermore, our model presented a mean VIF value of 3.02. When we looked at the VIFs for all variables, the greatest was just 5.9066, that for "student-to-teacher". As a rule of thumb, a VIF of 10 indicates excessive or serious multicollinearity [76,77]. Hence, there does not seem to be a serious multicollinearity problem in our model.

Table 2. Descriptive statistics.

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
Dependent Variable					
Migration	53,133	0.7428	0.4370	0	1
Independent Variables					
Individual Characteristics					
Male	53,133	0.8850	0.3190	0	1
Age	53,133	37.1870	8.3431	27	80
Married	53,133	0.7598	0.4272	0	1
Employment	53,133	0.9958	0.0646	0	1
Commuting	53,133	0.2236	0.4167	0	1
With family	53,133	0.7699	0.4208	0	1
House owner	53,133	0.3775	0.4847	0	1
Regional Characteristics					
Creative core and professional	69	10.3966	4.6680	1.8150	29.5863
Bachelor	69	12.7823	3.7957	6.8000	23.7800
Patent	69	1.8479	3.2309	0.1486	18.5997
Foreigner	69	5.4784	4.4781	0.7716	25.3497
Female employee	69	9.0820	2.5818	4.6144	16.1644
Student-to-teacher	69	27.7466	5.3831	17.5899	37.3456
Welfare	69	2.6091	2.0376	0.0000	10.2150
Livelihood	69	34.0214	17.2122	10.0174	92.6445
Job opportunities	69	52.9997	31.7203	20.9770	223.2242
LQ manufacturing	69	1.2983	0.9075	0.1924	5.5063
LQ service	69	0.9300	0.2872	0.4620	2.1318
New house	69	26.3398	9.4807	3.8468	50.1846
Old house	69	18.0731	8.2663	3.6540	35.8856
Aged 65+	69	3.1918	1.5410	0.8820	7.7571

5. Empirical Results

In this section, we first discuss the analysis results for cross-classified structures using the hierarchical model. We then turn to the results for the multiple regression analysis, examining the effects of a regional creative milieu on the push and pull effects at the regional level. The empirical results for hierarchical cross-classified linear modeling are shown in Table 3. First, we estimate the effects of individual characteristics on the likelihood of migration between urbanized areas as fixed effects. The analysis results reveal that most of the estimated coefficients have statistical significance and signs in accordance with previous empirical findings. However, gender and employment status do not have statistical significance in explaining migratory behavior. Further, individuals who are younger, married or report commuting time (*i.e.*, from their residence to the workplace) of over an

hour have an increased probability to migrate. The results also indicate that the impact of home ownership and living with family on the likelihood of migration is negative. Thus, house owners and individuals living with their family are found to have lower migration probability.

However, the sign of the marital status coefficient is not in accordance with our expectations and previous findings. Migration theory generally examines the tendency to migrate using a simple distinction between married and single individuals [78], and most studies suggest that married individuals are more likely to migrate than single individuals. However, many previous studies do not consider more detailed conditions, such as a spouse's education and labor market status, which can affect a householder's migratory behavior. In line with this finding, some studies state that marital status can encourage, as well as discourage interregional migration, as it is contingent on two potential workers, one of whom may need to source job opportunities in a new location, while the other may be uprooted from a job [37,79]. For example, if a spouse has a high education level and is underemployed, the householder is more likely to migrate than an individual who is single. However, there is insufficient evidence in the literature supporting the notion that married individuals tend to migrate more than single individuals.

Table 3 reports the estimated variance components at the regional level. The estimates refer to the variances of random effects in both the origin and destination region. The statistically-significant variances indicate the effects of the origin and destination region on individuals' migration. The relative magnitude of variance in the random effects of the destination region is relatively larger than that in the origin region. In other words, the predicted effects of the destination region (pull effect) on migratory behavior are likely to be stronger than those of the origin region (push effect). Accounting for this phenomenon in the model, we predict the empirical estimates for the push effects (u_j) and pull effects (u_k) with their associated standard errors for 69 urbanized areas in Korea, controlling for the effects of individual characteristics.

Table 3. Hierarchical cross-classified linear model results.

Variable	Coefficient	Standard Error
Fixed effect		
Male	0.0820	(0.0526)
Age	−0.0191 ***	(0.0021)
Married	0.2686 ***	(0.0601)
Employment	−0.1590	(0.2038)
Commuting	0.0951 **	(0.0412)
With family	−1.0837 ***	(0.5540)
House owner	−0.7023 ***	(0.0364)
Constant	28.0979 ***	(1.9487)
Random effect	Variance of component	
Origin region	132.2064 ***	42.2057
Destination region	139.1745 ***	45.2812

Notes: * p-value < 0.1, ** p-value < 0.05, *** p-value < 0.01.

Next, the empirical results supported our expectation that the characteristics of both the origin and destination regions would significantly affect the likelihood of interregional migration. Table 4 summarizes the regression results for the estimated push effects of a region's creative milieu. The estimated push effects for each urbanized area acted as dependent variables for each regression model. Model 1 of Table 4 provides information on the influence of five variables ("creative core and professional", "bachelor", "patent", "foreigner" and "female employee") representing a regional creative milieu on the push effect of one's origin region and controlling for other regional characteristics. These five variables are considered to be key explanatory variables. For the origin region, the findings indicated that the coefficients of the "creative core and professional", "foreigner" and "location quotient (LQ) manufacturing" variables were statistically significant. When we

interpreted the results of the key explanatory variables, we saw that a greater proportion of creative core and professionals in a region was negatively associated with out-migration, controlling for other regional characteristics. Moreover, regions with a large proportion of foreigners were less likely to experience out-migration of the highly educated. Model 2 of Table 4 reports the regression results of the effects of the "creativity index" on the push effects from the origin region, controlling for other regional characteristics. When the "creativity index" was included in the regression instead of the five key explanatory variables, a high level of "creativity index" in a region was negatively associated with the out-migration of highly-educated individuals, controlling for other regional characteristics. In other words, the highly educated were less likely to out-migrate in regions with a high level of regional creative milieu. The results also show that the "LQ manufacturing" variable was still statistically significant.

Table 4. Regression results for the effects of a regional creative milieu on push effects.

Variable	Model 1		Model 2	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**
Creative core and professional	−0.0767 **	(0.0370)	-	-
Bachelor	0.0077	(0.0417)	-	-
Patent	−0.0055	(0.0346)	-	-
Foreigner	−0.0728 ***	(0.0274)	-	-
Female employee	−0.0498	(0.0748)	-	-
Creativity index	-	-	−0.5489 ***	(0.1399)
Student-to-teacher	−0.0076	(0.0371)	−0.0046	(0.0331)
Welfare	0.0625	(0.0465)	0.0644	(0.0481)
Livelihood	0.0077	(0.0078)	0.0037	(0.0077)
Job opportunities	−0.0010	(0.0030)	−0.0021	(0.0030)
LQ manufacturing	0.2841 **	(0.1154)	0.1872 *	(0.1075)
LQ service	0.1735	(0.4011)	0.4444	(0.3705)
New house	−0.0046	(0.0107)	−0.0137	(0.0095)
Old house	0.0183	(0.0163)	0.0176	(0.0167)
Aged 65+	0.0645	(0.1233)	0.0184	(0.1210)
Constant	0.4668	(1.1521)	−0.7129	(1.0779)
F-statistic	6.4725 ***	-	7.5002 ***	-
Adjusted R^2	0.5296	-	0.4889	-

Notes: * p-value < 0.1, ** p-value < 0.05, *** p-value < 0.01.

Table 5 provides information on the regression results for the estimated pull effects of a region's creative milieu. Table 5 also is composed of two models, like Table 4. Model 1 of Table 5 reports the regression results of the effects of five explanatory variables ("creative core and professional", "bachelor", "patent", "foreigner" and "female employee") representing a regional creative milieu on the pull effect of one's destination region, controlling for other regional characteristics. As a result of the regression analysis for the destination region, the coefficients of the "creative core and professional", "foreigner", "welfare" and "LQ manufacturing" variables were statistically significant. When we looked at the key explanatory variables, a greater proportion of creative core and professionals in a region was positively associated with in-migration, controlling for other regional characteristics. In other words, regions with a greater proportion of creative core and professionals employed in technologically-advanced sectors, financial services, law, healthcare, business management, and so on, were more likely to attract the highly educated. Moreover, a large proportion of foreigners in regions were positively associated with in-migration, controlling for other regional characteristics. This result reveals that regions with a large proportion of foreigners were more likely to attract the highly educated. Model 2 of Table 5 shows the effects of the "creativity index" on the pull effects from the destination region, controlling for other regional characteristics.

According to this result, a high level of the "creativity index" was positively associated with the in-migration of the highly educated, controlling for other regional characteristics. In other words, regions with a high level of regional creative milieu were more likely to attract the highly educated. The result shown in Model 2 of Table 5 also indicates that "welfare", "LQ service" and "new house" as control variables had statistically significant effects on the pull effect from the destination region.

When we looked at our empirical results, we noticed that they were supported by previous studies on the flow of talent among regions. In line with creative class theory, a regional creative milieu is more likely to act as an incentive that attracts and retains the highly educated. As we focus on talent and tolerance among the dimensions of a regional creative milieu, many recent creative class studies on the relationship between human capital and regional amenities have shown that talent and tolerance might affect the geographical distribution of education and skill. Among the various characteristics representing regional creative milieu, the roles of talented individuals and foreigners, indicating the degree of diversity in a region, were highlighted; this is because tolerance can serve as a low barrier to entry, especially for human capital. In line with this, as mentioned in Section 2, the "creative core and professional" variable implied that the degree of talent is a creativity index of a region, while "foreigner" represented the degree of openness to diversity as an indicator of tolerance in a region. From the viewpoint of creative class theory and creative city literature, the outcomes for these variables are in line both with our theoretical hypotheses and with the extant literature. Thus, a large proportion of the labor force employed in the super-creative core or creative professional field and a large proportion of foreigners, representing a regional creative milieu, are more likely to act as disincentives for the highly educated to leave their residence in Korea. Moreover, regarding the pull effect for the highly educated, a large proportion of the labor force being employed in the super-creative core or creative professional field and the presence of a large proportion of foreigners are more likely to act as incentives for attracting the highly educated to certain regions.

Table 5. Regression results for the effects of a regional creative milieu on pull effects.

Variable	Model 1		Model 2	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**
Creative core and professional	0.1616 ***	(0.0504)	-	-
Bachelor	−0.0930	(0.0568)	-	-
Patent	0.0105	(0.0472)	-	–
Foreigner	0.1024 ***	(0.0373)	-	-
Female employee	−0.0260	(0.1020)	-	-
Creativity index	-	-	0.6115 ***	(0.2010)
Student-to-teacher	0.0101	(0.0505)	0.0141	(0.0475)
Welfare	−0.1365 **	(0.0634)	−0.1385 **	(0.0691)
Livelihood	−0.0133	(0.0107)	−0.0038	(0.0111)
Job opportunities	0.0047	(0.0041)	0.0062	(0.0044)
LQ manufacturing	−0.2848 *	(0.1574)	−0.1729	(0.1544)
LQ service	−0.2337	(0.5467)	−0.9413 *	(0.5322)
New house	0.0203	(0.0146)	0.0337 **	(0.0137)
Old house	−0.0222	(0.0223)	−0.0271	(0.0241)
Aged 65+	−0.0823	(0.1680)	−0.0709	(0.1738)
Constant	0.1415	(1.5704)	0.6757	(1.5483)
F-statistic	6.7524 ***	-	6.5001 ***	-
Adjusted R^2	0.5419	-	0.4473	-

Notes: * p-value < 0.1, ** p-value < 0.05, *** p-value < 0.01.

Some results regarding the control variables are worth mentioning. Most of the results for the regional characteristics used as control variables were in line with what we found in the migration literature. However, the estimation results of "LQ manufacturing" were the opposite of what we

expected. As shown in both Model 1 and Model 2 of Table 4, the likelihood of the out-migration of graduates is positively related to local specialization in manufacturing in the origin region. Although the estimation results of "LQ manufacturing" and "LQ service" in Table 5 were not robust, the likelihood of in-migration of graduates is negatively associated with local specialization in manufacturing and service in the destination region. Similarly, Faggian *et al.* [80] found that for late migrants, higher specialization in manufacturing or service increased the likelihood of migration to other regions, although stronger manufacturing specialization in a region discouraged any graduate migration behavior relative to the case of non-migrants. From the viewpoint of the creative class theory, these results suggest that higher specialization in manufacturing acts as a disincentive for the highly educated to stay in their residence. In other words, the highly educated who live in regions with higher specialization in manufacturing are more likely to migrate out of their residences, and higher concentrations of manufacturing in a region increase the likelihood of out-migration of the highly educated.

6. Conclusions

Our study empirically examined the effects of a regional creative milieu on the flow of highly-educated individuals using a hierarchical cross-classified linear model. In particular, we considered a regional creative milieu that affects the geographical distribution of education and skill by analyzing the push and pull effects on the inflow and outflow of the highly educated. Drawing on previous studies, we measured the regional creative milieu according to the proportion of its super-creative core and creative professionals, bachelors, patents, foreigners and female employees. We hypothesized that a regional creative milieu is characterized by the strong presence of a regional creative class and creative amenities. We estimated the region's push and pull effects from the results of hierarchical cross-classified linear modeling. On the basis of these effects, the study analyzed the relationship between the estimated regional push and pull effects and a regional creative milieu using a multiple regression analysis.

From our results, we arrive at the following conclusion. We find that regarding the push effect for the highly educated, individuals who lived in a region where a large proportion of the labor force was employed in the super-creative core or creative professional field were less likely to migrate away from their residence. In addition, individuals who lived in a region with a large proportion of foreigners were less likely to have a propensity for out-migration. When we looked at the pull effect for the highly educated, a large proportion of the labor force employed in the super-creative core or creative professional field and a large proportion of foreigners are more likely to act as incentives for attracting the highly educated to certain regions. Based on the empirical findings, we saw that talent and tolerance in a region and a high level of the creativity index in a region are likely to increase the likelihood of in-migration and decrease that of out-migration by lowering the barriers to entry for the highly educated.

This study makes a theoretical, as well as a methodological contribution. Theoretically, we introduce the concept of creativity to cities that attract in-migrants and prevent out-migrants in Korea. Methodologically, our empirical model, which is methodologically appropriate for capturing the broad system of interregional migration, showed the significant role of a regional creative milieu on the inflow and outflow of the highly educated by focusing on both the characteristics of the origin and destination region, as well as those of the highly educated that affect migratory behavior. Specifically, to estimate the push and pull effects from each urbanized area in Korea, we employ a hierarchical cross-classified linear model as an empirical modeling framework. Our findings emphasize the role of regions with well-established amenities as a creative milieu to attract the highly educated and, thus, have significant implications for sustainable regional development policies, particularly city administrators from shrinking cities.

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