Rural Migration in Korea: Patterns and Implications Under Rapid Fertility Decline

Seong Cheon Choi[1] and Tongjoo Suh[2]*

[1] Korea Rural Economic Institute, Republic of Korea
[2] Department of Food and Resource Economics, Pusan National University, Republic of Korea
* Tongjoo Suh, corresponding author. Email: tjsuh@pusan.ac.kr
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Abstract

Studies on South Korea's population have primarily relied on aggregate data or focused exclusively on urban areas. However, rural population dynamics differ significantly from national trends, making it challenging to apply national population projections directly to rural and agricultural populations. This study estimates the in-migration and out-migration rates of rural areas using municipality-level statistical data from 2012 to 2022 and forecasts regional net migration rates. The population is categorized by gender and age group, and in-migration and out-migration rates are estimated for each cohort. Given that regional migration rates are non-negative, the Tobit model is employed for the estimation. The analysis reveals heterogeneity in migration behaviors across different demographic groups. In particular, young adults in their twenties exhibit the highest out-migration rates, mainly due to limited access to higher education and employment opportunities in rural areas. In contrast, for individuals in their thirties and early forties, the availability of childcare and family-supportive environments plays a significant role in migration decisions. These findings highlight the need for differentiated policy strategies tailored to the specific needs of each age group. This study enhances understanding of rural population dynamics and provides evidence to inform the formulation of regional revitalization policies.

Keywords

Age-group analysis; population forecasting; rural migration rates; Tobit model

Introduction

Since peaking in 2020 at 51.84 million, South Korea's population has been in decline since 2021 (Statistics Korea, 2024). In particular, the total fertility rate fell below 1, to 0.98 births per woman in 2018, and this downward trend has continued, with the total fertility rate reaching 0.72 births per woman by 2023 (Oh, 2024). Due to the low birthrate trend in South Korea, issues such as population decline and aging are becoming increasingly prominent, prompting calls for measures to address these population-related challenges (Ju, 2023). Consequently, both academia and the government are actively engaged in research on population estimation, forecasting population dynamics, and proposing policy alternatives based on these findings. These efforts are reflected in recent policy initiatives in Korea, including the Framework Act on Low Fertility and Population Aging, the Special Act on Decentralization and Balanced National Development, and the Special Act on Support for Areas with Population Decline (Moon, 2024).

On the other hand, in rural areas, population decline is more severe than in other regions due to both declining natural fertility rates and out-migration (An et al., 2022). Although South Korea has made various efforts—including exploring policy alternatives such as regional consolidation and administrative mergers—to prevent regions facing acute demographic decline from being marginalized in governmental support, the population's structural composition continues to pose significant challenges. The outflow of younger adults, particularly, reduces the working-age population and hinders population growth in rural areas. Therefore, identifying and predicting population mobility in rural areas is essential for analyzing rural populations.

While research on the rural population and migration is increasing, studies on these topics remain relatively underdeveloped compared with studies of the overall and urban populations. Furthermore, although the Korean Statistical Office provides population estimates for South Korea, estimates for rural populations are not reported separately. Moreover, the pattern of rural population change differs from that of the overall population in South Korea, making it challenging to project overall population changes onto rural populations and agricultural workers (Han, 2015).

Regional migration directly affects demographic change, with shifts in regional population composition by gender and age closely linked to regional birth and death rates. These factors are pivotal in influencing future demographic trends in the region. Prior studies often relied on aggregated estimates and failed to disaggregate migration by demographic cohorts. Given this heterogeneity, this study adopts a cohort-based approach to reflect demographic diversity in migration patterns better and to obtain more accurate predictions of rural population change.

This study aims to estimate rural migration rates by disaggregating migration flows by demographic cohort and examining how regional socioeconomic and demographic conditions influence migration behavior across these cohorts. This study proposes three main hypotheses: that (i) the determinants of migration differ across age and gender cohorts; (ii) economic factors exert a more substantial influence on migration decisions among individuals in the working-age population; and (iii) family-supportive environments play a more critical role in shaping migration decisions among individuals in child-rearing age groups. Based on these hypotheses, a gender- and age-disaggregated Tobit-based econometric framework is

employed to identify cohort-specific determinants of rural migration and to reveal regional heterogeneity in population change. The findings provide insights into how regional demographic structures and socioeconomic environments interact to shape rural population dynamics, offering practical implications for more targeted, differentiated policy design in regions experiencing rapid aging and low fertility.

Literature review

Between 1960 and 1990, South Korea transitioned from a predominantly agrarian to an urbanized society (Kwon, 1992), experiencing rapid economic growth accompanied by a marked acceleration in rural-to-urban migration (Seo & Park, 2022). As the growing industrial sector absorbed surplus rural labor, the share of agricultural employment in the total labor force declined continuously, manufacturing employment rose initially before tapering off, and the service sector experienced sustained long-term growth (Lewis, 1954; Rodrik, 2016; Vollrath, 2009). In recent years, there has been a growing trend of urban-to-rural migration. Nevertheless, this movement remains insufficient to offset the broader pattern of rural population decline (Seo & Park, 2022). The trend has continued in recent years, and with sustained urban-centric growth, declining fertility, and accelerated aging, South Korea is now experiencing population decline, which is expected to deepen further regional and urban–rural disparities (Koo, 2021).

Rural population outflow is not unique to Korea; it is a global phenomenon observed in many regions (Roberts, 2016). While developed countries have long faced chronic net out-migration from rural areas (Newsham & Rowe, 2023), developing countries have undergone rapid urbanization propelled by rural-to-urban migration (Anríquez & Stloukal, 2008). A key factor driving rural migration in both developed and developing countries is the wage disparity associated with industrialization (Andersson & Molinder, 2025; Mazumdar, 1987; Parida, 2019). Rural workers typically earn lower hourly wages than their urban counterparts (Ananian & Dellaferrera, 2024). In addition, sustained out-migration weakens rural economies by reducing the viability of local enterprises and diminishing social networks (Li et al., 2019), thereby reinforcing regional inequalities and deepening the divide between urban and rural regions (Chung et al., 2024). In light of the structural and enduring patterns of rural population outflow, it is necessary to examine the various theoretical perspectives proposed in existing migration research.

Existing studies on rural migration offer a range of theoretical perspectives, which provide useful interpretive tools. A representative theoretical perspective on migration is the life-cycle perspective, which suggests that individuals' migration decisions are driven by age-specific needs and preferences (Kley, 2011; Polachek & Horvath, 2012). This perspective highlights the importance of accounting for cohort-based heterogeneity when modeling migration intentions. Another key migration framework is the human capital framework, which highlights the role of individual-level cost-benefit calculations in migration behavior (Sjaastad, 1962). This perspective emphasizes that migration is an investment decision aimed at improving long-term well-being, with education, skills, and expected future income playing central roles. The framework is particularly pertinent to understanding the motivations of younger cohorts, who are more responsive to educational and labor-market incentives.

A third major migration theory is the push–pull theory, which offers a foundational framework for understanding the determinants of migration (Lee, 1966). According to this

framework, migration decisions arise from a combination of push factors and pull factors. In rural areas, key push factors include limited access to education, insufficient welfare provision, limited social and cultural opportunities, and underdeveloped infrastructure (Camarero & Oliva, 2019; Kang & Park, 2013). In urban areas, pull factors include higher education opportunities, childcare and early education services, cultural amenities and infrastructure, and economic opportunities and accessibility (Kim & Lee, 2025; Rostamalizadeh, 2017). Among these factors, educational and childcare services—particularly the availability and quality of schools and early childhood education—significantly influence residential attractiveness and population dynamics (Lehtonen, 2021). Compared with rural areas, urban areas generally offer more abundant educational resources, including childcare centers, well-equipped schools, and diverse learning facilities, thereby providing greater educational opportunities (Maher et al., 2008; Wood, 2023). This theory is particularly relevant for analyzing how regional disparities in economic and social infrastructure affect population flows between rural and urban areas.

Within the broader applicability of the push-pull framework, South Korea's unique context, characterized by intense educational competition and regional inequality, further reinforces migration motivations. South Korea is highly committed to children's education and places great importance on academic achievement. A strong societal emphasis on the link between educational background and career success has led to the development of a highly competitive education system. As a result, schools and private academies are not merely educational institutions, but powerful tools that determine success in entrance exams and, ultimately, future opportunities. However, educational opportunities are not equally accessible across regions. In general, rural areas in South Korea have poorer educational facilities compared to urban areas. Students' access to elementary, middle, and high schools is primarily influenced by where they live and their academic performance (Sorensen, 1994).

However, as the economic gap between urban and rural areas has widened, the number of students and schools in rural areas has declined (Koo, 2023). Consequently, rural residents often face longer school commutes and fewer educational options than their urban counterparts. In addition, specialized education—such as foreign language instruction—in rural areas often lacks the diversity and quality available in urban settings, resulting in lower overall educational quality. Furthermore, the scarcity of private educational infrastructure, such as academies and tutoring services, in rural areas can perpetuate learning gaps between rural and urban students, with adverse implications for educational equity and the long-term sustainability of rural communities amid rapid fertility decline.

In addition to education, culture is a key push-pull factor driving migration from rural to urban areas. Cultural facilities are not merely places for leisure. They can also enhance residents' quality of life and strengthen their attachment to the region by providing access to meaningful cultural experiences. However, rural areas in South Korea generally have poorer cultural infrastructure than urban areas. Rural regions have far fewer cultural facilities, such as theaters, performance halls, and libraries, and these are often located in areas difficult to reach without a car, making them inconvenient to use. Even when such facilities exist, they are often small-scale and lack programming diversity. This can lead to a lower quality of life for rural residents and may act as a motivating factor for migration.

The effects of educational and cultural factors can vary depending on individuals' demographic characteristics. For example, university entrance may be a key consideration for young adults, while families with children may place greater importance on access to childcare services and educational facilities. In addition, cultural factors may exert greater

influence on younger cohorts, who have a strong demand for diverse leisure and cultural experiences. From this perspective, this study analyzes migration rates while accounting for cohort-based heterogeneity.

A comprehensive understanding of rural migration behavior can be achieved by integrating push-pull dynamics, life-cycle perspectives, and human capital factors. This study draws on migration theories to contextualize key explanatory variables and to interpret the observed behavioral patterns. Building on this theoretical foundation, the study designed the selection of explanatory variables and the cohort segmentation framework.

Methods

In this study, the in-migration and out-migration rates are estimated to forecast the net migration rate. The equation of the net migration rate M is represented as the difference between the predicted in-migration rate $\widehat{Y_{\text{in}}}$ and the predicted out-migration rate $\widehat{Y_{\text{out}}}$, as follows:

$$M = \widehat{Y_{\text{in}}} - \widehat{Y_{\text{out}}}$$

The function of the in-migration rate or out-migration rate is composed of regional factors that affect the migration rate as follows:

$$Y = f(X)$$

where Y denotes the in-migration rate or out-migration rate, and X denotes regional factors such as cultural and educational facilities.

In this study, the Tobit model is used to estimate migration rates. This statistical method is commonly applied to censored data, where some observations are only partially observed or restricted by a threshold. The Tobit model has the advantage of allowing the dependent variable to be censored, with observations falling within a specific range but not fully observed (Wooldridge, 2010). This model is particularly suitable when the dependent variable cannot take values below or above a certain bound, and it helps prevent unrealistic predictions beyond this range. The dependent variables in the analysis are the in-migration and out-migration rates.

By definition, these variables represent directional population flows and can only assume non-negative values. A negative in-migration rate would, in principle, indicate out-migration, and vice versa. Therefore, both variables are inherently bounded below by zero. When ordinary least squares regression is applied to such data, there is a risk of generating negative predicted values, which are not meaningful in this context. In contrast, the Tobit model accounts for the non-negative nature of the dependent variable and constrains predictions accordingly (Greene, 2003). Given that the study aims to forecast migration rates using these bounded variables, the Tobit model offers a more methodologically appropriate framework.

The models used to estimate the in-migration and out-migration rates take the form of a two-limit Tobit model, specified as follows:

$$Y^* = X\beta + \varepsilon$$

where Y^* denotes the latent variable of the in-migration rate or out-migration rate, X represents the independent variables that influence the migration rate, such as educational, cultural, and economic factors, and ε denotes the error term.

The dependent variable Y can be represented by the following conditions:

$$Y = Y^* \text{ if } 0 \leq Y^* \leq 100$$
$$Y = 0 \text{ if } Y^* \leq 0$$
$$Y = 100 \text{ if } Y^* \geq 100$$

where Y means the in-migration rate or out-migration rate of the region, X denotes the Vector of regional regressors, and ε means the error terms. The log-likelihood function $\beta \; and \; \sigma$ for region i can be represented as follows:

$$\boldsymbol{L_i}(\beta, \sigma) = 1(Y_i = 0) ln[\Phi(-X_i\beta/\sigma)] + 1(0 < Y_i < 100) ln[(1/\sigma)\phi\{(Y_i - X_i\beta)/\sigma\}] + 1(Y_i = 100) ln[1 - \Phi((100 - X_i\beta)/\sigma)]$$

where Φ denotes the cumulative distribution function, and ϕ denotes the probability density function.

Data

This study used municipal-level statistical data to forecast the net migration rate in rural areas, covering the period 2012 to 2022. The dataset used in the models was constructed from data from the Korean Statistical Information Service on regional population movements and characteristics. The population movement data are categorized by age groups at five-year intervals and by gender, and each category includes information on migration rates for both inflows and outflows. The dataset was organized into cohorts by age and gender for this study, and models were used to calculate age- and gender-specific net migration rates. In each model, age-and gender-specific migration rates for inflows and outflows were used as dependent variables.

The data on regional characteristics include information on the Gross Regional Domestic Product (GRDP), population per administrative area (PAA), the number of universities (NU), the number of kindergartens and childcare facilities (NKCF), the number of private academic institutes (NPAI), and the number of cultural facilities (NCI) in each region. These data on regional characteristics were used as regressors in the model estimation. Table 1 presents a data summary of the variables used in the model. The lagged dependent variable at t-1, GRDP, and PAA were used as basic independent variables in the regression analysis. Other regional variables were applied differently across cohort-specific models, reflecting the life-cycle perspective that factors influencing population movement may vary by age cohort. For instance, in models for the 20–24 and 25–29 age cohorts, NU was included as a variable, whereas it was not considered in other age cohorts.

In the models for the 30–34 and 35–39 age cohorts, NKCF was included as a variable; however, it was excluded from the models for the other age cohorts. In the models for the 40–44 and 45–49 age cohorts, NPAI was included; however, it was excluded from the models for the other age cohorts. Meanwhile, NCI was not considered as a variable in the model for the 40–44 age cohort, but it was considered in models for other age cohorts. Given that the main objective of this study is to examine the relationship between the independent and dependent variables

and ultimately to predict the net migration rate in rural areas, the variables specified in the model may influence model fit and, in turn, affect the reasonableness of the predicted values.

Table 1: Data Summary

Variable			Unit	Mean	SD	Min	Max
Move-out Rate	Male	Aged 20–24	%	18.65	3.58	11.4	41.9
Move-out Rate	Male	Aged 25–29	%	27.9	4.62	17.2	65.7
Move-out Rate	Male	Aged 30–34	%	25.21	3.54	15.5	43.3
Move-out Rate	Male	Aged 35–39	%	18.68	3.29	9.6	34.1
Move-out Rate	Male	Aged 40–44	%	14.38	2.74	6.9	29.4
Move-out Rate	Male	Aged 45–49	%	12.07	2.59	5.7	32.4
Move-out Rate	Female	Aged 20–24	%	22.57	5.17	12.9	47.6
Move-out Rate	Female	Aged 25–29	%	27.77	4.46	17.8	54.8
Move-out Rate	Female	Aged 30–34	%	24.14	3.73	12.6	42.4
Move-out Rate	Female	Aged 35–39	%	17.92	3.42	8.6	37.5
Move-out Rate	Female	Aged 40–44	%	13.92	2.81	5.4	30
Move-out Rate	Female	Aged 45–49	%	11.72	2.42	5.6	25.6
Move-in Rate	Male	Aged 20–24	%	17.48	5.66	7.4	79.4
Move-in Rate	Male	Aged 25–29	%	25.43	5.63	13.1	69.7
Move-in Rate	Male	Aged 30–34	%	23.99	5.07	13.1	63.9
Move-in Rate	Male	Aged 35–39	%	18.52	4.33	9	56.7
Move-in Rate	Male	Aged 40–44	%	14.54	3.52	7.6	49.8
Move-in Rate	Male	Aged 45–49	%	12.53	2.94	6.2	40.2
Move-in Rate	Female	Aged 20–24	%	19.54	5.64	9.6	50
Move-in Rate	Female	Aged 25–29	%	25.61	5.26	13.6	68.3
Move-in Rate	Female	Aged 30–34	%	23.38	5.04	11.9	68.7
Move-in Rate	Female	Aged 35–39	%	17.68	4.44	8.9	58.6
Move-in Rate	Female	Aged 40–44	%	14.05	3.68	6.6	51.4
Move-in Rate	Female	Aged 45–49	%	12.31	3.09	5.9	42.6
Gross Regional Domestic Product (GRDP)			1B KRW	7,109	9,293	22	81,900
Population per Administrative Area (PAA)			capita/ 100km^2	393,038	621,882	1,925	2,873,867
Kindergarten and Daycare Center (NKCF)			Count	214	238	7	1,499
Private Academy Institutes (NPAI)			Count	341	412	1	2,361
University (NU)			Count	1.49	1.82	0	12
Cultural Infrastructure (NCI)			Count	11	9	1	73

Note: N = 2,519; each observation is based on administrative districts (municipal level) as the unit of analysis.

Results

In this study, rural migration was analyzed as the sum of in- and out-migration rates, and predictions for the net migration rate were derived by subtracting the estimates of in- and out-migration rates. The Tobit model was applied to estimate the in- and out-migration rates, and lagged variables of the dependent variables GRDP, PAA, NU, NKCF, NPAI, and NCI served as independent variables. The regression analysis was conducted by gender and age group, incorporating five variables expected to have a significant impact on cohorts within each age group.

As a result of the estimation of in-migration rate models and out-migration rate models (see Tables 2–4), most of the lagged dependent variables show statistically significant and positive coefficients. This indicates that regions with higher in-migration or out-migration rates in the previous period tend to exhibit similarly high rates in the current period. This suggests that past migration patterns persist over time. Therefore, rural migration can be interpreted as structural and path-dependent, suggesting that one-time policy interventions may be insufficient and that sustained, cumulative efforts are required.

The GRDP and PAA showed statistically significant effects in several models, especially among individuals in their 20s and early 30s (see Tables 2 and 3). This suggests that population movement is more active in areas with higher GDP or population density, consistent with previous research showing that increases in regional economic activity stimulate interregional migration rates (Kim & Lee, 2021). However, when both the in-migration rate model and the out-migration rate model yield coefficients of the same sign, this indicates that the relative size of GRDP between regions or PAA does not clearly determine the net direction of migration.

The estimation results reveal distinct patterns across age and gender cohorts regarding the effects of local characteristics on migration behaviors. Among males aged 20–24, NU is significantly positively associated with in-migration, suggesting that the presence of higher-education institutions plays a critical role in attracting young men to specific regions. Simultaneously, the PAA shows a positive effect, indicating that younger individuals prefer more densely populated areas to sparsely populated areas. For females in the same age group, the overall pattern remains similar. NU contributes positively to in-migration, although the effect size is smaller than that for their male counterparts. PAA again has a significantly positive influence, reinforcing younger females' preference for populated areas.

Regarding out-migration patterns among the 20–24 cohort, PAA is negatively associated with out-migration for both genders, further supporting the hypothesis that youth are likely to leave low-density areas. Notably, for women, lower levels of GRDP are associated with higher out-migration, suggesting that regional economic vitality plays a stronger role in women's relocation decisions at younger ages. In the 25–29 age group, GRDP becomes a more dominant factor. Higher GRDP levels are significantly associated with higher in-migration for both men and women, highlighting the growing importance of economic conditions in shaping migration decisions as individuals age. Conversely, NU becomes less influential, implying that educational infrastructure has diminishing returns for attracting older youth. Out-migration among 25–29-year-olds is significantly influenced by lower GRDP and lower PAA, suggesting that both economic underdevelopment and low population density intensify the likelihood of regional outflows in this cohort.

For individuals aged 30–34, the factors influencing migration exhibit notable gender differences. Among males, both GRDP and NKCF are positively associated with in-migration. This indicates that regions with stronger local economies and accessible childcare infrastructure are more attractive to young adult men seeking settlement opportunities. In contrast, for females within the same age group, none of the examined regional variables show statistically significant effects on in-migration. This suggests that women's migration decisions at this stage may be more strongly influenced by individual or household-level factors, such as employment opportunities for spouses, child-rearing responsibilities, or family proximity, rather than by structural regional characteristics.

Regarding out-migration, the results show a consistent pattern across both men and women. PAA is positively associated with out-migration, while NKCF is negatively associated. These findings imply that more populated regions with higher mobility and fewer childcare facilities tend to experience declines in younger populations. In particular, the lack of childcare infrastructure appears to contribute to the outflow of 30–34-year-olds, who are more likely to have young children and thus require adequate family-supportive environments. These results underscore the critical role of demographic balance and care infrastructure in retaining working-age adults.

For individuals aged 40–44, the analysis indicates that regional characteristics have a limited influence on in-migration decisions. Specifically, no variables are statistically significant in their association with male in-migration. For women, the number of kindergartens and childcare facilities is marginally negatively associated with in-migration, suggesting that childcare availability is not a straightforward pull factor for this cohort. In contrast, out-migration patterns for this age group are more clearly influenced by local conditions. Both male and female out-migration rates are positively associated with population density, indicating that higher mobility in more populated rural municipalities is driven more by residential adjustment and job-related transitions.

Additionally, NKCF is negatively associated with out-migration for women. For men, the coefficient also shows a negative sign in the same direction, although the relationship is weaker and not statistically significant. This pattern suggests that insufficient childcare services may lead families with school-age children or caregiving needs to relocate. These results imply that, for middle-aged populations, regional deficits in care infrastructure and demographic imbalance—remarkably rapid aging—can serve as push factors in migration decisions, even when pull factors for in-migration remain weak or inconclusive.

The statistically significant variables NU, NKCF, and NPAI showed positive effects on the in-migration rate and negative effects on the out-migration rate across several models. Therefore, areas with factors that can increase residents' utility indicate population inflow, whereas areas lacking such factors indicate population outflow. On the other hand, some variables do not achieve statistical significance, or their coefficients exhibit inconsistent signs. This is believed to be due to the division of the analysis group by age or gender, which may not capture cohort-specific tendencies that could affect the relationship between the dependent and independent variables in the model. Additionally, the unit of observation is at the municipal level; therefore, the model does not capture the specific circumstances of each area. Consequently, the estimates are deemed sensitive, and the results of the analysis are not robust.

Despite these limitations, the model in this study estimates the in-migration and out-migration rates separately, rather than the net migration rate. This provides the advantage of generating predictions for both in-migration and out-migration. Moreover, while existing

population-related studies often use a top-down approach, in which the total population is predetermined based on national trends and then distributed according to regional estimates, with migration rates treated as single estimates, this study employs a bottom-up approach. It conducts its own municipal-level estimation, obtaining individual estimates for each region, and uses these values to calculate national population-related figures. Therefore, the analytical approach of this study enables detailed prediction of regional net migration rates, with the sign direction varying across units. This can be useful for forecasting regional migration rates and for illuminating how cohort effects may differ across regions.

These findings underscore the need for differentiated policy strategies tailored to the demographic characteristics of each age group. For younger adults in their 20s, the presence of higher education institutions and stronger regional economic conditions was a key driver of in-migration, suggesting that university-centered urban development and youth employment support can be practical tools for attracting and retaining this population. In contrast, individuals in their 30s and 40s were more responsive to family-related infrastructure, particularly the availability of childcare and public care services. Regions with limited childcare facilities and a high proportion of older adults experienced significantly higher out-migration rates, suggesting that the lack of family-supportive environments acts as a decisive push factor. Policymakers aiming to mitigate rural depopulation and regional decline should therefore pursue an integrated approach: investing in education and economic infrastructure to attract young people, while simultaneously improving caregiving to support family settlement and long-term retention. Such a multifaceted strategy may foster more sustainable demographic structures and enhance regional vitality across life stages.

Table 2: Results of Tobit Model: Individuals Aged 20–29

		Male in-migration rate			Female in-migration rate			Male out-migration rate			Female out-migration rate		
Age	**Variable**	**Coef.**	**SE**	**t**	**Coef.**	**SE**	**t**	**Coef.**	**SE**	**t**	**Coef.**	**SE**	**t**
20–24	Intercept	3.8941	0.2568	15.16	2.7752***	0.2344	11.84	4.3043***	0.2551	16.87	4.1771***	0.2967	14.08
	GRDP	0.0001	0.0001	0.70	0.0001	0.0001	0.42	-0.0001	0.0001	-1.32	-0.0001*	0.0001	-1.88
	PAA	0.0001***	0.0001	2.94	0.0001***	0.0001	5.68	-0.0001***	0.0001	-3.66	-0.0001***	0.0001	-4.72
	NU	0.1303***	0.0474	2.75	0.0709*	0.0392	1.81	0.0029	0.0278	0.11	-0.0015	0.0355	-0.04
	NCI	-0.0042	0.0104	-0.40	0.0003	0.0086	0.04	-0.0016	0.0061	-0.26	-0.0020	0.0078	-0.26
	Lag_1	0.7655***	0.0134	56.95	0.8558***	0.0120	71.07	0.7911***	0.0127	62.24	0.8493***	0.0118	71.71
	sigma_sq	12.8742	0.3805		8.8001	0.2601		4.4502	0.1315		7.2739	0.2150	
	LR chi2	2,104.33**			3,013.06***			2,405.56***			2,989.23***		
25–29	Intercept	5.8613***	0.3488	16.81	7.1857***	0.3791	18.95	8.0925***	0.3976	20.35	10.3837***	0.4523	22.96
	GRDP	0.0001***	0.0001	3.93	0.0001***	0.0001	2.77	-0.0001*	0.0001	-1.83	-0.0001***	0.0001	-2.81
	PAA	0.0001	0.0001	-0.97	0.0001	0.0001	-1.09	-0.0001***	0.0001	-5.53	-0.0001***	0.0001	-5.12
	NU	0.0478	0.0450	1.06	0.0147	0.0466	0.32	0.0305	0.0365	0.84	-0.0244	0.0408	-0.60
	NCI	-0.0133	0.0099	-1.34	-0.0072	0.0103	-0.69	-0.0077	0.0081	-0.95	-0.0057	0.0090	-0.63
	Lag_1	0.7665***	0.0133	57.59	0.7169***	0.0143	50.09	0.7242***	0.0132	55.07	0.6436***	0.0151	42.72
	sigma_sq	11.6487	0.3443		12.5203	0.3700		7.6813	0.2270		9.5817	0.2832	
	LR chi2	2,292.38***			1,811.94***			2,218.99***			1,569.84***		

*Note: *** $p < .01$, ** $p < .05$, * $p < .1$*

Table 3: Results of Tobit Model: Individuals Aged 30–39

		Male in-migration rate			Female in-migration rate			Male out-migration rate			Female out-migration rate		
Age	**Variable**	**Coef.**	**SE**	**t**	**Coef.**	**SE**	**t**	**Coef.**	**SE**	**t**	**Coef.**	**SE**	**t**
30–34	Intercept	7.1164***	0.3656	19.46	8.1188***	0.3901	20.81	8.9695***	0.4034	22.24	9.0189***	0.4041	22.32
	GRDP	0.0001**	0.0001	2.42	0.0001	0.0001	1.06	0.0001	0.0001	1.56	0.0001	0.0001	-0.19
	PAA	0.0001	0.0001	0.66	0.0001	0.0001	0.32	0.0001***	0.0001	4.72	0.0001***	0.0001	6.60
	NKCF	0.0011***	0.0004	2.57	0.0004	0.0005	0.85	-0.0006*	0.0003	-1.90	-0.0010***	0.0003	-2.84
	NCI	-0.0099	0.0102	-0.97	0.0019	0.0112	0.17	-0.0032	0.0075	-0.43	0.0037	0.0081	0.45
	Lag_1	0.6832***	0.0151	45.31	0.6350***	0.0160	39.61	0.6367***	0.0159	40.14	0.6143***	0.0163	37.64
	sigma_sq	12.2216	0.3612		14.7608	0.4362		6.6605	0.1968		7.6173	0.2251	
	LR chi2	1,701.63***			1,244.05***			1,382.09***			1,323.75***		
35–39	Intercept	5.9987***	0.3031	19.79	5.9717***	0.3040	19.64	5.6352***	0.2891	19.49	5.4492***	0.2930	18.60
	GRDP	0.0001	0.0001	0.76	0.0001	0.0001	-0.84	0.0001	0.0001	1.04	0.0001	0.0001	-1.18
	PAA	0.0001	0.0001	1.07	0.0001	0.0001	0.30	0.0001***	0.0001	8.11	0.0001***	0.0001	5.81
	NKCF	0.0003	0.0004	0.82	-0.0006	0.0004	-1.56	-0.0003	0.0003	-0.96	-0.0009***	0.0003	-3.02
	NCI	0.0057	0.0094	0.61	0.0195**	0.0098	2.00	0.0006	0.0064	0.10	0.0055	0.0069	0.80
	Lag_1	0.6574***	0.0158	41.63	0.6511***	0.0158	41.13	0.6785***	0.0157	43.18	0.6868***	0.0156	43.90
	sigma_sq	10.3202	0.3050		11.1078	0.3283		4.8081	0.1421		5.5891	0.1652	
	LR chi2	1,363.50***			1,306.38***			1,823.86***			1,662.04***		

*Note: *** $p < .01$, ** $p < .05$, * $p < .1$*

Table 4: Results of Tobit Model: Individuals Aged 40–49

		Male in-migration rate			Female in-migration rate			Male out-migration rate			Female out-migration rate		
Age	**Variable**	**Coef.**	**SE**	**t**	**Coef.**	**SE**	**t**	**Coef.**	**SE**	**t**	**Coef.**	**SE**	**t**
40–44	Intercept	4.0133***	0.2242	17.90	4.0666***	0.2296	17.71	3.6767***	0.2099	17.52	3.6883***	0.2149	17.16
	GRDP	0.0001	0.0001	0.58	0.0001	0.0001	-0.20	0.0001	0.0001	0.55	0.0001	0.0001	-0.55
	PAA	0.0001	0.0001	0.19	0.0001	0.0001	-0.29	0.0001***	0.0001	6.26	0.0001***	0.0001	4.43
	NKCF	-0.0003	0.0004	-0.61	-0.0009	0.0005	-1.93	-0.0001	0.0003	-0.18	-0.0006*	0.0003	-1.87
	NPAI	0.0001	0.0003	0.19	0.0001	0.0003	0.27	-0.0001	0.0002	-0.48	-0.0001	0.0002	-0.34
	Lag_1	0.7126***	0.0146	48.87	0.7090***	0.0147	48.20	0.7238***	0.0146	49.70	0.7254***	0.0146	49.81
	sigma_sq	5.9399	0.1755		6.4950	0.1919		3.0581	0.0903		3.3971	0.1004	
	LR chi2	1,661.04***			1,669.86***			2,008.48***			1,896.07***		
45–49	Intercept	2.9494***	0.1878	15.70	3.1920***	0.1996	15.99	2.1284***	0.1552	13.72	2.8218***	0.176	16.03
	GRDP	0.0001	0.0001	0.65	0.0001	0.0001	0.19	0.0001	0.0001	0.14	0.0001	0.0001	-0.27
	PAA	0.0001	0.0001	1.01	0.0001	0.0001	0.21	0.0001***	0.0001	4.90	0.0001***	0.0001	4.59
	NPAI	-0.0002	0.0002	-1.47	-0.0005***	0.0002	-2.69	-0.0001	0.0001	-0.32	-0.0001	0.0001	-1.05
	NCI	0.0041	0.0056	0.73	0.0033	0.0062	0.53	0.0013	0.0042	0.30	0.0015	0.0046	0.33
	Lag_1	0.7467***	0.0142	52.53	0.7333***	0.0147	49.74	0.7985***	0.0131	60.82	0.7368***	0.0148	49.74
	sigma_sq	3.7656	0.1113		4.5568	0.1347		2.0738	0.0613		2.5526	0.0754	
	LR chi2	1,853.71***			1,730.90***			8,645.00***			1,879.80***		

*Note: *** $p < .01$, ** $p < .05$, * $p < .1$*

Discussion

Cohort-specific determinants and patterns of rural migration

Forecasts of the net migration rate for rural areas can be calculated as the difference between the in-migration and out-migration rates. Figure 1 presents a geographic overview of South Korea's top-level administrative divisions, which provides context for the regional disparities in migration patterns discussed below. From a national perspective, regions proximate to the Seoul metropolitan area exhibit higher rates of in-migration. In contrast, regions farther from Seoul, excluding those near regional hub cities, exhibit more pronounced out-migration. This pattern indicates that migration flows tend to move from peripheral areas, such as rural regions, toward urban centers. It is consistent with Ravenstein's (1889) "laws of migration", which posit that proximity to major centers is associated with higher in-migration.

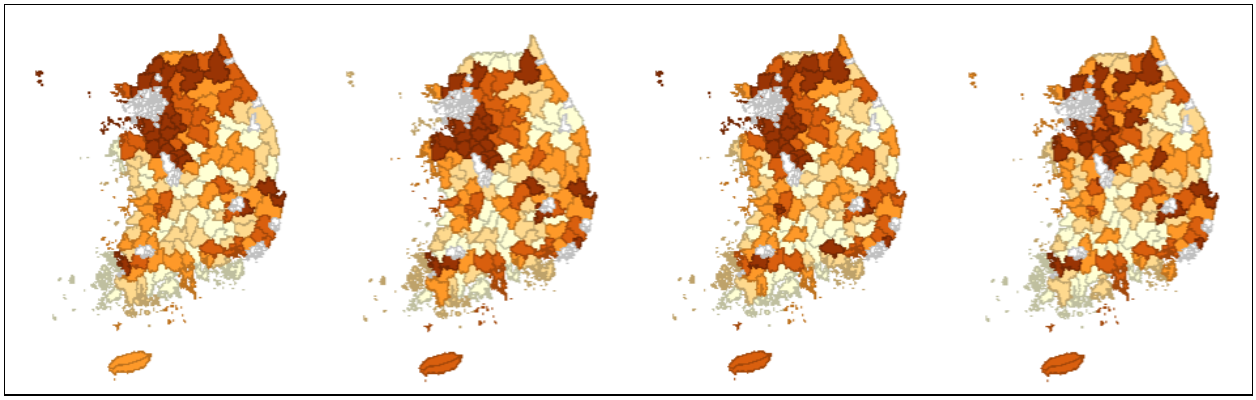
Figure 1: The Map of South Korea and Top-Level Administrative Divisions

Top-level administrative divisions of South Korea	
Metropolitan Cities	**Provinces (known as "Do" in Korean)**
Seoul	Gyeonggi-do
Busan	Chungcheongbuk-do (North Chungcheong)
Daegu	South Chungcheong (Chungcheongnam-do)
Incheon	Jeollabuk-do (North Jeolla)
Gwangju	Jeollanam-do (South Jeolla)
Daejeon	Gyeongsangbuk-do (North Gyeongsang)
Ulsan	Gyeongsangnam-do (South Gyeongsang)
Special Self-Governing City	**Special Self-Governing Province**
Sejong	Gangwon
	Jeju

Note: The names indicated in white represent a higher-level administrative division that includes cities and counties, corresponding to the concept of a province, while the names indicated in black represent metropolitan cities, which have administrative status equivalent to that of a province.

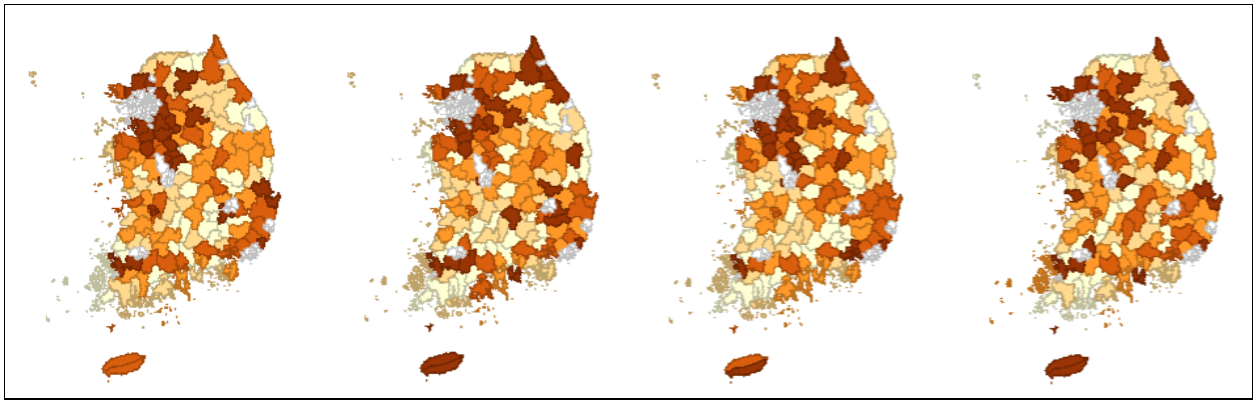
In contrast, regions farther from these centers tend to experience net out-migration. Figures 2–4 use color intensity to visualize net migration rates by region, with darker colors indicating greater population movement. These visualizations allow for a spatial understanding of regional imbalances, with higher in-migration concentrated around the capital area, including Seoul and Gyeonggi-do, and out-migration more prominent in remote rural regions.

Figure 2: Predictive Value of Net Migration Rates for 20s in Rural Areas



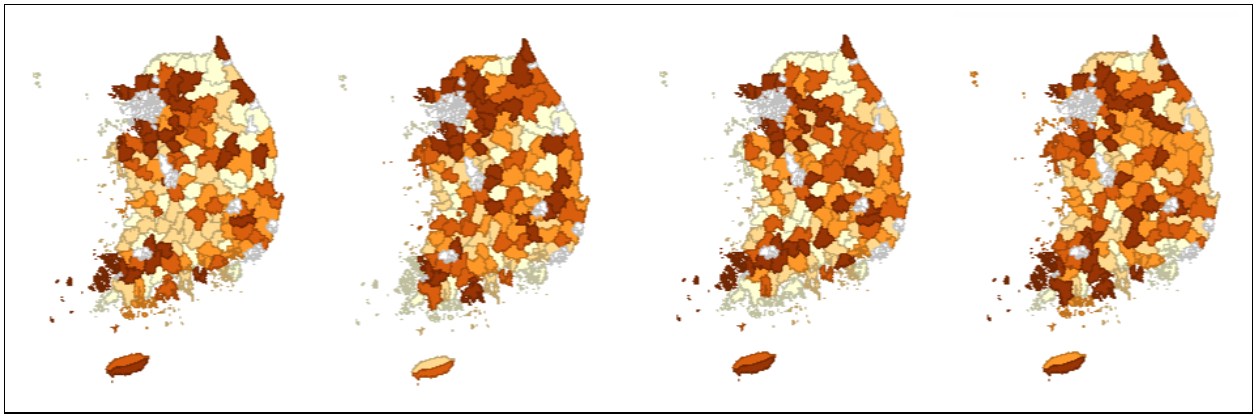
Note: From left to right: men and women aged 20–24, followed by men and women aged 25–29.

Figure 3: Predictive Value of Net Migration Rates for 30s in Rural Areas



Note: From left to right: men and women aged 30–34, followed by men and women aged 35–39.

Figure 4: Predictive Value of Net Migration Rates for 40s in Rural Areas



Note: From left to right: men and women aged 40–44, followed by men and women aged 45–49.

Regarding gender, the net migration rate for men is -1.51%, and for women, -1.81%, indicating substantial out-migration for both genders. Although the out-migration rate is higher for women, there is no significant difference in net migration rates between men and women. However, women exhibit a higher rate of in-migration to regional hubs and surrounding areas than men.

Examining by age group, the net migration rate for people in their 20s in rural areas is -4.75%, for those in their 30s it is -0.84%, and for those in their 40s it is 0.61%. This indicates that in rural areas, the younger the age group, the more prominent the out-migration. Among the younger population, a high out-migration rate is observed in the southern region (particularly in some areas of Jeollanam-do and Gyeongsangnam-do), followed by a high rate in the eastern region, particularly in parts of Gangwon Special Self-Governing Province and Gyeongsangbuk-do. In contrast, among the older population, out-migration from the southern region is minimal, with in- and out-migration rates relatively evenly distributed across regions.

According to the push-pull theory, the lack of educational and cultural infrastructure in rural areas constitutes a push factor influencing migration. The results of this study demonstrate that out-migration from rural areas among individuals in their twenties is significantly higher than that of other age groups. Accordingly, policy efforts should focus on expanding access to higher education and job opportunities in rural or regional hub areas. From a cultural perspective, enhancing the attractiveness of rural areas for young adults is also necessary. Among individuals in their 30s and early 40s, the availability of kindergartens and childcare facilities is a strong determinant of migration decisions. Therefore, expanding child-rearing support services in rural regions is essential and can be a key factor in enhancing willingness to settle there.

In light of these considerations, when formulating policies for rural areas, it is important to focus not on uniform application but on how these age-specific characteristics inform strategies for regional economic revitalization and population policy. The spatial disparities revealed by the figures' predictive values for net migration call for differentiated strategies. In remote rural areas experiencing severe population decline, it is necessary to mitigate push factors by expanding essential infrastructure such as educational and cultural facilities. Insofar as demographic revitalization is set as a policy objective, remote rural areas experiencing more severe population decline than capital-adjacent regions may require relatively greater per capita investment to maintain basic services and improve living conditions. The cohort- and region-specific migration patterns identified in this study illustrate how rural migration can both reflect and intensify demographic and economic restructuring. Building on these empirical findings, the impacts of migration on rural areas and their broader policy implications are discussed.

Impacts of migration on rural areas

The negative impacts of migration on rural areas primarily manifest through population decline, population aging, and labor shortages. Population decline weakens the fundamental vitality and economic activity of rural communities, and the out-migration of young and working-age individuals has become a serious concern. As a result, economic dynamism and labor supply in rural regions continue to decline, adversely affecting not only agriculture but also a wide range of local industries. Labor shortages further threaten the sustainability of rural economies, potentially reducing agricultural productivity and leading to broader economic stagnation.

However, migration can also have specific positive effects on rural areas. In particular, the in-migration of younger generations can revitalize rural communities and positively affect demographic restructuring. The influx of younger cohorts may contribute to economic

regeneration and the revitalization of local industries, while also enhancing the attractiveness of rural areas as residential environments. Furthermore, improvements in infrastructure and services can expand economic opportunities in rural communities.

To address these negative impacts and maximize the positive effects of migration, targeted policy interventions are required. Policies should focus on improving employment opportunities, enhancing social services, and incentivizing younger individuals and families to settle in rural areas. Investing in education, economic infrastructure, and childcare services is essential to foster sustainable rural development and reduce the adverse impacts of migration.

Policy implications and strategic directions

Given that migration can also be viewed as a rational decision, policies may balance efforts to revitalize rural areas with measures that facilitate mobility to regions offering better opportunities. Such a balanced approach addresses the regional need for population sustainability and individuals' pursuit of improved living conditions. In the Korean context, where parents place strong emphasis on their children's education, disparities in the quality and accessibility of educational and childcare services between rural and urban areas are likely to be an important mechanism shaping migration patterns. Therefore, it is crucial to recognize that migration to urban areas may represent a rational choice for some households seeking a better life. At the same time, rural population policies should focus on narrowing these educational and childcare gaps.

Although this study primarily discusses policies aimed at revitalizing rural areas under rapid fertility decline, policies that accept and manage rural depopulation can also serve as an alternative strategic approach. While efforts to suppress out-migration across all regions face practical limitations, administrative consolidation of small, sparsely populated areas or broader regional restructuring may offer efficiency gains. From this perspective, the age- and gender-specific migration patterns identified in this study can inform strategies for regional consolidation and restructuring. Specifically, these patterns provide valuable evidence for distinguishing between areas where investments in public services and infrastructure—such as education, childcare, and cultural facilities—are likely to support long-term demographic sustainability, and regions where strategic consolidation may be a more realistic policy option.

Korea is experiencing a rapid decline in fertility, and its total population is projected to fall to roughly 70% of its current size over the next 50 years (Statistics Korea, 2024), making it difficult to reverse the overall demographic contraction. However, passively observing continued population decline risks exacerbating out-migration pressures, which, in turn, would pose serious obstacles to the long-term sustainability of rural communities. In this context, the cohort-specific insights and policy responses proposed in this study offer important implications. Policies that improve access to education and employment for younger cohorts and strengthen childcare and residential stability for middle-aged cohorts can help slow the erosion of rural human capital, mitigate widening regional disparities, and support a more orderly adaptation to long-term population decline.

Conclusion

Currently, South Korea is experiencing rapid changes in its rural population. However, specific data on rural demographics are not published regularly, making it difficult to predict and respond effectively to these changes. Consequently, this study estimated in-migration and out-migration rates in rural areas to examine the effects of factors that influence fluctuations in the rural population. Cohort-specific forecasts of net migration rates were generated from the estimates, and the spatial distribution of migration rates was analyzed. Furthermore, the study examined rural mobility patterns in detail by calculating interregional gender- and age-specific migration rates through a disaggregated analysis, a method not previously explored in rural population models. Understanding the framework of rural migration and gaining detailed insights into inter-regional population movements are considered crucial. It can significantly contribute to forecasting regional populations and proposing practical solutions to address regional population decline.

This study used educational, cultural, and economic variables to predict rural migration rates, but it did not include additional regional factors that influence rural migration. For example, variables such as housing prices, transportation accessibility, and social networks, which can significantly affect population movement, were not incorporated into the present dataset, which represents a limitation of this study. Another limitation is that the population data used in the analysis excluded older adults. This group was excluded from the analysis because migration rates among older adults are very low in practice, and data collection is challenging. However, including older cohorts and their interregional migration patterns may further improve forecast accuracy. Further data collection and analysis are necessary to advance research on rural migration rates. In future studies, accurate forecasts and projections of rural population trends are expected to be achieved based on the analysis results.

Despite these limitations, this study remains significant for its contribution to the growing literature on rural migration by offering age- and gender-specific insights into the socio-demographic drivers of population movements in Korea. By employing a two-limit Tobit model with fine-grained regional data, this study provides estimates that better capture the censored nature of migration rates, distinguishing them from previous research.

These findings also indicate that discussions of rural population policy should shift from aggregate measures to cohort- and spatial-level microstructures. The development of educational infrastructure and services can effectively alleviate demographic imbalances in rural areas, while cultural infrastructure may also play a complementary role. This implication can be generalized to other Asian regions facing rural population decline. Future studies could build on this framework by incorporating individual-level longitudinal data or examining the role of migration motivations through qualitative approaches.

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