

Determinants of Interregional Migration Flows in Korea by Age Groups, 1995-2014

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Despite the growing importance of interregional migration at the local level in rapidly aging society, past literature overlooked the relationship between these two demographic phenomena. To better understand the determinants of interregional migration and its implications for population aging, this study estimated fixed-effects models derived from the gravity model of migration using population registration data. Contrary to theoretical expectation, economic determinants of migration showed similar patterns across three age groups. Other than the effect of crude marriage rate for young age group, life course variables showed inconsistent effects on migration. Trends in migration flows by geographical regions indicated that some provinces are in double jeopardy because their elderly population is increasing while the young population decreases. Visual inspection of migration systems drawn from social network analysis suggested that migration streams between Seoul and Gyeonggi overwhelms all other regions and that Ulsan and Jeju are isolated throughout the periods.

Keywords: interregional migration, gravity model, fixed-effects model, panel data analysis

Introduction

With its extremely low fertility levels, Korean society is currently undergoing population aging at an unprecedented rate in human history. Accordingly, one of the most hotly debated topics amongst academics and the general public is strategies to reverse, or at least slow down, this shift. Though the problem of population aging is a global trend and not limited to Korea (United Nations 2013), unlike western European countries that experienced the same phenomenon earlier than Korea, it is caused by rapid decline of fertility in three decades rather than a decline of mortality over prolonged periods of time. For Western countries, it took, on average, 40 to 100 years to experience the transition from aging society (i.e., a society in which the proportion of those aged 65 and over is between 7% and 14%) to aged society (i.e., a society in which the proportion of those aged 65 and over is between 14% and 20%), but Korea experienced it only within 18 years (Park 2008). More disturbing is that population aging in Korea is worsening before the social safety net for the elderly is fully established. Perhaps the world's highest level of suicide among Korean elderly is associated with this lack of a social safety net.

Although, at the national level, rapidly declining fertility is undoubtedly responsible for population aging, at the local level, population migration, especially among those at working age, can have a substantial influence on the rate of aging. Nevertheless, the relationship between migration and population aging occurring at the local level is vastly understudied. Furthermore, only a few past studies (e.g., Choi and Lee 2013; Hong and Yu 2012) examined the determinants of interregional migration by age groups despite the substantial differences in propensity for relocation by age (Rogers 1988). Past studies on interregional migration flows are also limited in that they tend to use cross-sectional data or examine the migration from only one side of the flow: either from destination (i.e., inflows) or from origin (i.e., outflows).

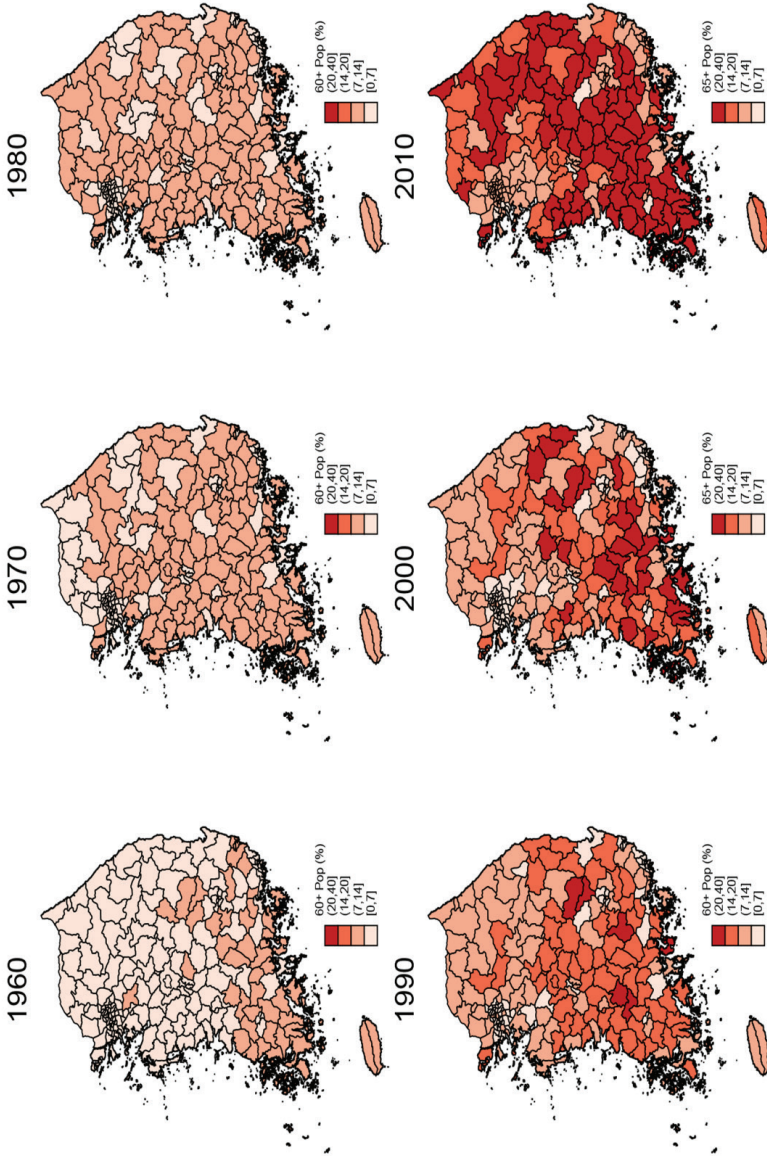
To fill in the gap in our knowledge on the determinants of interregional migration in Korea and its implications for population aging, the current study, drawing data from annual migration flows between 1995 and 2014 by 5-year age groups in the KOSIS and various governmental and municipal database, estimates fixed-effects models in order to control for unobserved time-invariant characteristics between origin and destination regions. In addition, the present research investigates the determinants of the inflows

and outflows simultaneously.

Literature Review

The effects of internal migration on population aging can be inferred from the historical trends in regional distribution of the elderly that has developed over the past five decades in Korea. Results from the Census in 1960 indicated that aging first started in some areas in Gyeongbuk province, such as Namhae-, Hadong-, Geoje-gun, and Jeonnam province, such as Gurye-, Gokseong-, and Damyang-gun. The early onset of aging in these areas appears to be related to the significant loss of young people when they migrated to big cities as industrialization started in the 1960s, rather than an increase in the number of elderly population (Kim 1996). However, a more fundamental cause might be that, during these periods, the central government invested heavily in the development of regions through the Seoul-Busan line. As a result, young population in Honam and Gyeongbuk, away from the rapidly developing regions, experienced difficulties finding jobs in their hometown and had few alternatives other than moving to burgeoning cities like Seoul and Busan. A similar pattern continued throughout the 1970s and 1990s. Furthermore, super-aged society (in which the proportion of those aged 65 and older reaches more than 20%) began to emerge in the 2000s among these areas. This implies that differential economic development across regions may result in unequal distribution of industrial infrastructure, educational institutes, or political hegemony, which, in turn, may have a substantial impact on population migration and aging.

There are many theoretical hypotheses and models concerning the determinants of migration. In the framework of neoclassical economics (Massey et al. 1993; Ranis and Fei 1961; Todaro 1980), migration is the result of the sum of individual cost-benefit calculations undertaken to maximize expected income through relocation. According to this theory, interregional migration is caused by differences in the supply of, and demand for, labor. Regions with a limited supply of labor relative to labor demands are characterized by high market wages, whereas, regions with a large supply of labor relative to capital are characterized by low market wages. These wage differences cause workers to move from low wage to high wage regions. As time progresses, the supply of labor in the receiving region rises and wages fall, leading to an equilibrium in which migration ceases. Furthermore, the decision to migrate is made by comparing expected income in the region of



NOTE.—Adapted from Kim K. (2015).

FIG. 1.—Trends in distribution of aged population in Korea, 1960-2010

origin and the destination; and a key assumption underlying the neoclassical economic framework is that individuals make rational economic decisions on the basis of complete or perfect knowledge. When calculated over some period of time and added to the costs of movement, what results is the expected net gain from movement. Only if the net gain is positive do individuals migrate. However, it should be noted that wage variables are not always found to be significant in predicting migration; rather, it sometimes appears that employment and unemployment have explanatory primacy (Massey et al. 1993).

Much of the discussion on the determinants of interregional migration in Korea has relied on neoclassical economic theory. Kim and Jang (1997) stated that the benefit of migration is a function of expected income, local public goods, and amenities of living environment, while the cost is comprised of housing expenses and local taxes. Empirical work by Lee (2001) examined the effect of individual and locational characteristics simultaneously. His model included the number of medical doctors, the proportion of farmers, and the acreage under cultivation as local environmental conditions. For local administration factors he included fiscal self-reliance ratio of the local government and the number of government employees. Hong and Yu (2012) argued that the living environment should include even average temperature, air pollution, and traffic congestion. Porell (1982) even asserted that the power of economic determinants of migration would become negligible over the long run because wage differentials by geographical regions would disappear through migration. According to him, quality of life factors, such as climate, would prevail in the end.

Though the empirical evidence generally supports the fundamental proposition of wage differentials and finds a significant positive effect for expected income (Massey and Espinosa 1997), this effect does not necessarily explain most of the variation in migration between regions. There are large numbers of cases where wage differentials have not been sufficient to attract migrants. The pull effect of high wages may mean little to a population located outside of labor market, such as the elderly retirees or the permanently unemployed. In the U.S., Chen and Rosenthal (2008) found that, regardless of educational attainment, couples near retirement tended to move away from places with favorable business environments while the young and highly educated population move in the exactly opposite direction. Using large Danish data, Hansen and Gottschalk (2006) also found that changes in life stages rather than economic motivations, such as the loss of a spouse or deteriorating health, exert the strongest influence on old

people's residential mobility. In the case of Korea, Hong and Yu (2012) reported that the migration of the elderly population depends more on the percentage of welfare spending by the local government than expected income at the destination.

Similarly, a single factor can have a different impact on the likelihood of migration for people in different stages of life. For instance, young and single people may be more attracted to large cities than married people as cities might provide more opportunities to meet potential mates. Costa and Kahn (2000) found that power couples, defined as cases when both husband and wife have at least a college education, are far more likely to reside in large metropolitan areas than other couples. They argued that the reason is associated not only with the fact that the large cities provide professional jobs for the highly educated population, but also with that those cities are functioning as marriage markets for them.

Obsession with education in Korea affects virtually every aspects of life, and Korean parents feel strongly that it is their responsibility to provide a proper education for their children (Anderson and Kohler 2013). It follows that Korean parents with school-aged children, who are likely in their 40s and 50s given that the mean age at first birth is approximately 30.5 as of 2012 in Korea (Lee 2014), would prefer to move to a region with a greater number of private cram schools, all other things being equal. Nevertheless, empirical evidence for the effect of private cram schools on the propensity for residential mobility is somewhat weak. For example, Hong and Yu (2012) and Choi (2008) did not find a significant impact from the number of cram schools on the likelihood of migration. This weak evidence might be associated with methodological limitation, such as not accounting for unobserved factors that could affect migration, and it should be subject to empirical test.

Data and Method

Data and Measures

The current study draws data from various sources. The descriptive statistics and data source is presented in Table 1. Interregional migration flows by origin and destination regions were drawn from the internal migration statistics provided by the KOSIS. The number of interregional migrants by sex and 5-year age groups are also available. In the current study, the

TABLE 1
DESCRIPTIVE STATISTICS AND DATA SOURCE FOR INDEPENDENT VARIABLES USED
IN ANALYSES

Variable	Mean	SD	Source
Population	3,028,858.00	2,815,987.00	Mid-Year Population Based on Population Registration (KOSIS)
GDP per capita	19,831.00	9,627.40	Gross Regional Domestic Product (KOSIS)
Standard land price	272,639.00	667,958.60	Ministry of Land, Infrastructure and Transport
Welfare spending	17.42	8.82	Percent of Welfare Spending by Regions at the Ministry of Interior
Employment rate	59.30	3.12	Economically Active Population Survey (KOSIS)
Corporations	87,593.55	93,645.79	Statistics Database at the Ministry of Employment and Labor
Childcare facilities	1,778.87	2,097.07	Ministry of Health and Welfare Database
Crude marriage rate	15.49	2.50	KOSIS
Private cram schools	4,114.04	3,743.86	Korean Educational Statistics Service
Elderly care facilities	91.18	169.71	Ministry of Health and Welfare Database
<i>N</i>	3,988		

determinant of interregional migration among three age groups—20 to 39, 40 to 59, and 60 and older—were examined. The youngest age group, 0 to 19 years old, were excluded because they tend to depend on their parents and the decision to migrate to other region would not be theirs. The old age population is defined as those aged 60 and over in order to reflect the average age at retirement in Korea. Past literature found that interregional migration sharply increases around retirement ages due to life adjustments (Chevan and Fischer 1979). Also, Chang and Ho's (2002) life table estimates suggested that average retirement age in Korea would be approximately 60.9.

Mid-year population is also drawn from the KOSIS and it refers to the annual figures for the registered population at the province and six

metropolitan cities. Results indicated that there were, on average, roughly 3 million residents in each region over the periods under consideration. Information about regional GDP (Gross Domestic Product) per capita is also provided by the KOSIS. Over the periods, the overall mean of the GDP per capita was 19,831 won—though there were significant variations across regions. Standard land price was taken from the statistical yearbook of the Ministry of Land, Infrastructure and Transport (MLIT). Annually, the MLIT samples lands from each administrative area and determines the standard price of the land in that area. It should be noted that the standard land price is not identical with real sales price since it is the mean value in the MLIT sample. Nonetheless, the standard land price may represent the general housing cost in the region, and higher values might hamper in-migration into the region. Welfare spending means the percentage of spending on all sorts of welfare in the local government's annual budget. Employment rate, drawn from the Economically Active Population Survey conducted by the KOSIS, represent the economic opportunity in the region. Since there was little variations in the unemployment rate across regions, employment rate was used. In a similar vein, to measure economic opportunity in the region, the number of corporations in each year by regions was also taken from the Statistics Database at the Ministry of Employment and Labor. Over the periods, on average, 87,593 corporations were registered in Korea, and the vast majority of them hired less than five employees.

Analyses

In order to estimate the determinants of interregional migration flows, the present study relies on the gravity model of migration. Gravity models were initially based on Newton's gravity law, and researchers have used the gravity model to explain flows such as commuting between cities (Zipf 1946), international trade (Bergstrand 1989; Porojan 2001), and internal and international migrations (Isserman et al. 1985; Karemera, Oguledo, and Davis 2000; Mayda 2010). These models have been widely used in the empirical analysis of migration due to their relatively good forecasting performance (e.g., DeWaard, Kim, and Raymer 2012; Kim and Cohen 2010; Schmidt and Fertig 2000).

The gravity model views migration as determined by the size of the populations of destination and origin and the distance between origin and destination:

$$M_{ij} = k \cdot \frac{p_i \cdot p_j}{d_{ij}}, i \neq j$$

where M_{ij} denotes the number of migrants from origin i to destination j , p_i and p_j denotes population of i and j , respectively, d_{ij} refers to distance between i and j , and k is a constant.

After the relevant log transformations, the above equation can be transformed to a linear model. More specifically, the following empirical model was estimated:

$$\text{Log}(M_{ijt}) = \beta_0 + \sum_{k=1}^k \beta_k \text{Log}(X_{it}) + \sum_{n=1}^n \beta_n \text{Log}(X_{jt}) + \varepsilon_{ijt}$$

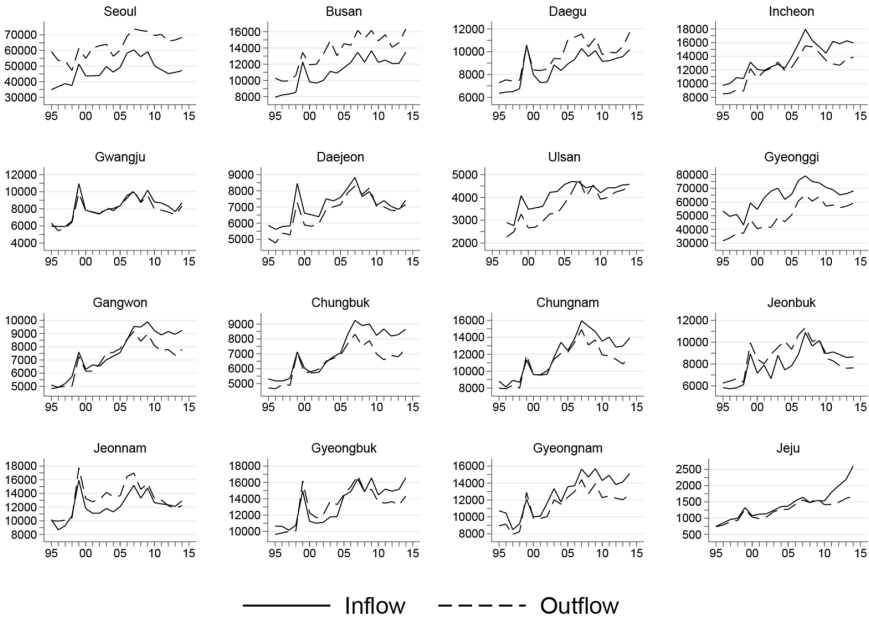
where $\varepsilon_{ijt} = \alpha_{ij} + \gamma_{it} + \lambda_{jt} + \nu_{ijt}$. This modified form of gravity model (DeWaard et al. 2012; Greenwood 2005; Kim and Cohen 2010) states that migration flows are directly related to the characteristics of the origin and destination places.¹ I address the variation over time within region pairs, by introducing fixed effects (FE) for each combination of origin and destination regions.² These region-pairs fixed effects allow to control for time-invariant and unobserved features of the pairs, such as historical development of migration networks between regions (e.g., see Figure 4 and 5). One drawback of the fixed-effects models is that they cannot be used to investigate time-invariant causes of the dependent variables. However, all independent variables in the current study varies over time, and the FE models could be estimated.

Results

Before moving onto multivariate results, some descriptive analyses were conducted. Trends of interregional migration flows for two age groups, elderly population (65 and over) and young population (20-39), are presented

¹ After the logarithm transformation, the initial equation becomes $\ln(M_{ij}) = \ln(p_i) + \ln(p_j) - \ln(d_{ij})$, and the first two entities in the right hand side of the equation can be considered pull factors while the last part (i.e., distance) can be thought as the push factor. As such, the gravity model can be converged to the conventional push-pull factor model of migration (Kim and Cohen 2010).

² In order to decide whether a fixed effects model is preferred over random effects model, Hausman tests were conducted for all models in Table 2. Hausman test statistics for all models suggested that fixed effects models are strongly preferred over random effects ($p < 0.000$), implying that the residuals specific to the region pairs might be correlated with the regressors.



NOTE.—Sejong Special Self-Governing City, which was established in 2012, is not presented, but it is included in the calculation of inflows and outflows in 2012 onward.

FIG. 2.—Inflow and outflow of aged 60 and over by regions in Korea, 1995-2014

in Figure 2 and Figure 3, respectively, which can illuminate which area gained or lost what sort of population through interregional migration over the past two decades. Results in Figure 2 indicated that Seoul is losing its old aged population while Gyeonggi is gaining members of this group over the periods under analysis. For instance, in 1995, the out-migration among those aged 65 and over from Seoul (to all regions in Korea) was roughly 60,000 while in-migrants of the same age was about 35,000, resulting in a deficit of 25,000. This pattern of negative net migration of the aged 65 and over continued until the late 2000s. In the most recent periods (2010-2014), however, while the number of out-migrants from Seoul remained more or less the same, the number of in-migrants began to decline. As a result, the gap between the two flows are growing in recent periods. On the other hand, about 30,000 persons aged 65 and over moved out of Gyeonggi province in 1995 while roughly 55,000 of the same age group moved in. Consequently, there were about 25,000 net gains of the elderly population in that province. Although the net gains of elderly population decreased during the late 1990s, when the

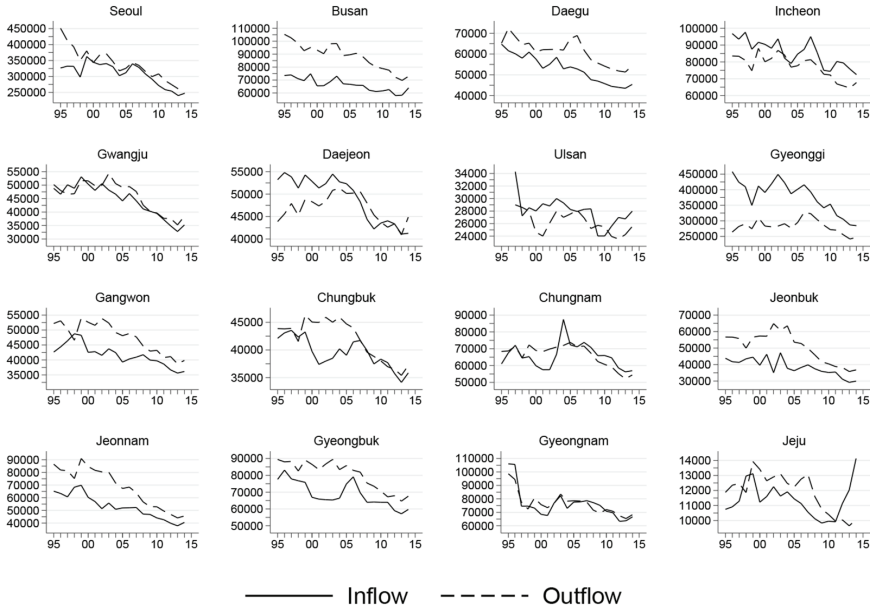
financial crisis hit Korea and other Asian countries, it recuperated during the early 2000s and Gyeonggi province gained approximately 20,000 elderly persons annually through population migration during the mid-2000s. In more recent periods, it is gaining roughly 10,000 persons aged 65 and over annually. As Kim C. (2015) suggested, it is likely that a large fraction of the net gain in Gyeonggi province would come from Seoul.

As observed in Seoul, Busan and Daegu experienced a similar loss in their elderly population over the past two decades, except during the late 1990s in Daegu when the net migration of the aged 65 and older approached zero. In recent years, Busan and Daegu are losing roughly 3,000 and 1,000 persons aged over 65 each year. Paralleling the relationship between Seoul and Gyeonggi, it appears that the elderly population in Busan moves to Gyeongnam province. Kim and Yang (2013) found that Seoul, Busan, and Daegu are losing populations of all age groups over the last decade. Hence, results from the present study confirm their findings and shows in addition that these large cities in the country continue to lose their elderly population as well as their working-age population.

Interestingly, all other regions have gained elderly persons over the periods under analysis. In particular, Gangwon, Chungbuk, Chungnam, and Jeonbuk experienced a considerable net gain in their elderly population through migration. Since this net gain of elderly population in these regions is occurring along with constant loss of the working-age population, it might have important implications for the regional differences in age structure and population aging in the near future.

Inflows and outflows of population aged 25 to 39 by region is presented in Figure 3.³ As found in the older population, the number of out-migrants from Seoul, Busan, and Daegu was greater than the number of in-migrants into these regions throughout the periods. However, contrary to the patterns of the elderly population, Gangwon, Jeonbuk, Jeonnam, and Gyeongbuk have constantly lost a significant number of persons aged 25 to 39 although the negative net gain is declining in the early 2010s in those regions. As noted above, these regions are also experiencing positive net gains from migration

³ These age groups are characterized as “demographically dense” periods in one’s life course (Rindfuss 1991): a period in which a large percentage of people experience a large percentage of key life-course events. Those in these age categories tend to have the highest rate of migration compared to all other age groups (Rogers 1988), and thus their migration patterns were presented here in order to highlight the difference with older age groups. However, the next age group, 40-59, was included in multivariate analyses in order to compare the determinants of migration for the middle aged population.



NOTE.—Sejong Special Self-Governing City, which was established in 2012, is not presented, but it is included in the calculation of inflows and outflows in 2012 onward.

FIG. 3.—Inflow and outflow of aged 20 to 39 by regions in Korea, 1995-2014

of those aged 65 and over during the same periods. Hence, these regions may double jeopardy with respect to population aging. In other words, in the calculation of the old age dependency ratio, the numerator is increasing while the denominator is shrinking. These pattern would accelerate the rate of population aging in these regions, which are already vulnerable (see Figure 1).

On the other hand, Gyeonggi province is gaining a significant number of people aged 20 to 39 throughout the periods. During the early 2000s, it gained roughly 200,000 persons aged 20 to 39 per annum. As Kim C. (2015) found, the influx of young population into the Gyeonggi province may be associated with high housing and living costs in Seoul that the young people cannot afford. In addition, Chungbuk and Chungnam have seen more incoming young people than those moving out over the periods. It appears to be related to relocation of the central government’s offices and research institutes into those regions. Finally, the inflows into Jeju is skyrocketed from 2010, and it is perhaps related to recent real estate booms in the island.

So far, trends in migration flows have been examined within a particular

region. The information about the number of migrants from one region to another would be best arranged in the form of a matrix. However, interpreting a 16×16 matrix would be cumbersome. Hence, social network analysis (SNA) is conducted in order to visualize the system of relations among regions, and the results from the aged 60 and older and aged 20 to 39 are presented in Figure 4 and 5, respectively. It should be noted that the width of the lines is proportional to the number of migrants. Also, in the case of interregional migration, the actors are regions and, at this level, migration flows usually exist between most regions, which would result in a picture with too many lines to show structure. To reduce the density of the network, a threshold level was selected, and values below it were suppressed.

The first impression is that, in all periods, exchange of migrants aged 60 and older between Seoul and Gyeonggi province overwhelms those among all other regions, with flows from Seoul to Gyeonggi stronger. This is not surprising given the fact that roughly half of the entire population of Korea lives in Seoul or Gyeonggi province. There are also strong connection between Incheon and Seoul as well as between Incheon and Gyeonggi province. This triad – Seoul, Gyeonggi province, and Incheon — dominates migration flows of the elderly in other regions throughout the periods. During 2000-2004 period, the number of links among regions increases while it decreases afterwards, and it suggests that movement of the elderly population across regions was more frequent in the early 2000s than other periods.

More interesting is that although several provinces, such as Gangwon, Chungbuk, and Chungnam, exchange elderly migrants with Seoul and Gyeonggi province, core local cities, such as Busan, Daegu, and Gwangju, only do so with provinces where the city is located. For instance, old person in Busan moves to Gyeongnam province, but not to Seoul or Gyeonggi province. Indeed, the Busan-Gyeongnam pair is isolated from the migration network system in all periods, except in 2000-2004. In addition, Ulsan, the sixth largest city in Korea, is not connected to migration networks in all periods, and the substantial concentration of heavy industries, which requires a skilled young labor force, might be related to the trivial number of migrants exchanged with other regions.

Migration networks for those aged 20 to 39 closely parallels those for the elderly. The number of migrants between Seoul and Gyeonggi province dwarfs those among all other regions. However, the number of links among regions are slightly greater compared to what was seen in the case of the old aged group. When combined with the results from Figure 3, Gangwon,

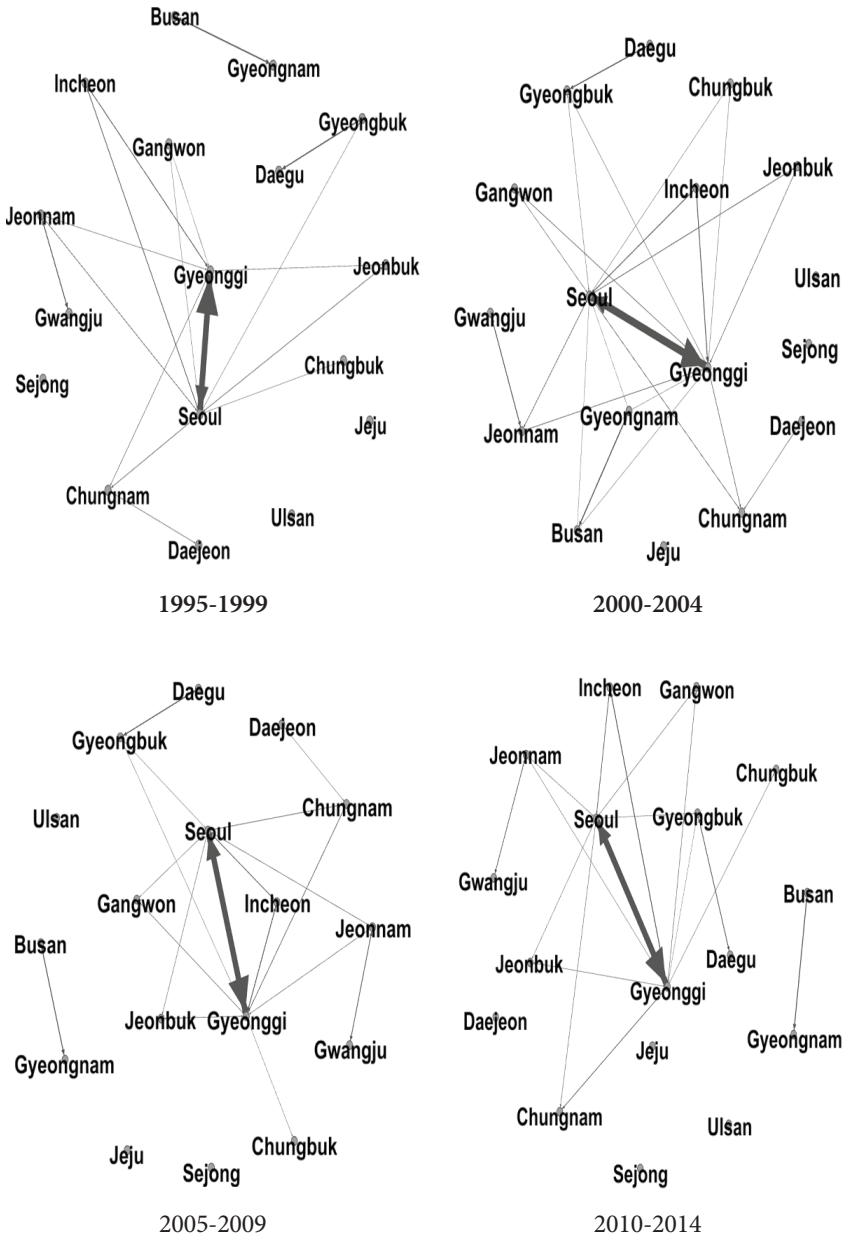


FIG. 4.—Migration network of aged 60 and over by periods in Korea

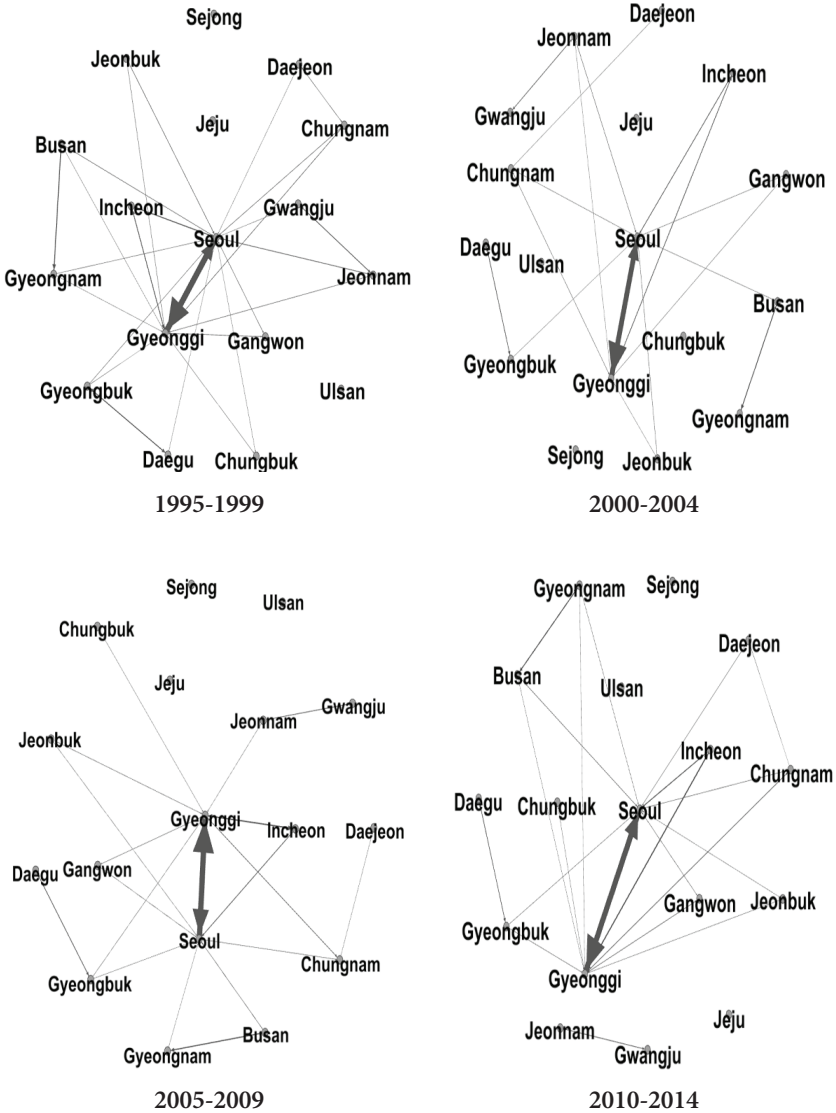


FIG. 5.—Migration network of aged 25 to 39 by periods in Korea

Chungbuk, and Jeonbuk appear to be losing young adult persons to Seoul and Gyeonggi province. As found in the elderly population, Ulsan and Jeju was not connected to the migration networks of the younger population throughout the periods.

Results from the fixed-effects regression analysis are presented in Table 2. Wooldridge (2009) suggested that, if this model is expressed in double-log form, the interpretation of the coefficient should be that a 1% increase in origin or in destination characteristic is associated with a 1% increase in migration from i to j . The results for the total population in Table 2 indicated that 1% increase in the number of population in the region of origin is associated with 1.36% increase in the migration flow. Likewise, a 1% increase in the number of population in the region of destination raises migration flows by 0.93%. This result provides a strong support for the basic tenet of the gravity model of migration. Also, consistent with the theoretical prediction, a 1% increase in GDP per capita in the origin reduces migration by 0.13% whereas the same amount of increase in GDP in the destination elevates migration flows by 0.28%. Results suggested that increase in the land price of the destination region significantly diminish interregional migration flows. In accordance with the neoclassical economics theory of migration, the greater number of corporations in the place of origin, which indicates the size of the economy and employment opportunities in the region, reduces migration while the number of corporations in the destination has the opposite effect. In a similar vein, the direct measure of employment rate in the place of origin had the same effect although it failed to reach statistical significance in the destination. Somewhat unexpectedly, the percentage of welfare spending by the local government both in origin and destination reduces migration flows. The sign of the coefficient for welfare spending in origin is line with theoretical expectation: 1% increase in welfare spending in origin is associated with 0.027% decrease in migration flows. However, greater percentage of welfare spending in the destination is also associated with reduced migration. This might be related to the fact that young population, who comprises more than 60% of all migrants in a given year, seems to move to metropolitan areas that can provide job opportunities and, at the same time, often spend a smaller portion of their budget on welfare.

The model for population aged 20 to 39 added the number of childcare institutions and crude marriage rate (CMR) to reflect two of the most important life course events – raising young children and marriage. Hong and Yu (2012) found that the effect of the CMR on migration is significant, and a 1% increase in the CMR is associated with a 0.17% increase in the number of migrants aged 23 to 27. Based on the result, they suggested that higher CMR may represent higher probability of marriage and, thus, young unmarried people may migrate to a region with higher CMR. The present study provides a strong support for their hypothesis. That is, results indicated

TABLE 2
REGRESSION COEFFICIENTS FROM FIXED-EFFECT MODELS FOR INTERREGIONAL MIGRATION FLOWS IN KOREA, 1995-2014

	Total population		Aged 20-39		Aged 40-59		Aged 60 & over	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Population (origin)	1.361***	(0.062)	1.220***	(0.069)	1.154***	(0.069)	1.097***	(0.090)
Population (destination)	0.930***	(0.062)	0.987***	(0.069)	0.850***	(0.074)	0.792***	(0.090)
GDP per capita (origin)	-0.131***	(0.029)	-0.271***	(0.034)	0.193***	(0.074)	0.253***	(0.044)
GDP per capita (destination)	0.284***	(0.029)	0.220***	(0.034)	0.585***	(0.035)	0.522***	(0.044)
Standard land price (origin)	0.052*	(0.031)	0.016	(0.034)	0.057	(0.035)	0.081*	(0.047)
Standard land price (destination)	-0.487***	(0.031)	-0.473***	(0.034)	-0.543***	(0.037)	-0.303***	(0.047)
Welfare spending (origin)	-0.027***	(0.004)	-0.005	(0.005)	-0.027***	(0.007)	0.007	(0.007)
Welfare spending (destination)	-0.014***	(0.004)	-0.014***	(0.005)	-0.023***	(0.005)	0.008	(0.007)
Employment rate (origin)	-0.207**	(0.103)	0.267**	(0.114)	-0.581***	(0.005)	-1.017***	(0.154)
Employment rate (destination)	0.124	(0.103)	0.502***	(0.114)	-0.431***	(0.123)	-0.678***	(0.154)
Corporations (origin)	-0.398***	(0.035)	-0.491***	(0.038)	-0.150***	(0.123)	-0.303***	(0.052)
Corporations (destination)	0.071**	(0.035)	-0.087**	(0.038)	0.236***	(0.041)	-0.003	(0.052)
Childcare institutions (origin)			0.162***	(0.022)				
Childcare institutions (destination)			0.000	(0.022)				
Crude marriage rate (origin)			-0.185***	(0.048)				
Crude marriage rate (destination)			0.338***	(0.048)				
Private cram schools (origin)					0.142***			
Private cram schools (destination)					0.003	(0.028)		
Elderly care facilities (origin)						(0.028)	0.003	(0.008)
Elderly care facilities (destination)						(1.167)	-0.067***	(0.008)
Constant	-17.778***	(0.989)	-17.298***	(1.046)	-22.809***		-16.539***	(1.506)
Observations	3,988		3,988		3,988		3,988	
R ²	0.267		0.402		0.753		0.443	

NOTE.—Standard errors in parentheses. All independent variables in the models were transformed to natural logarithms.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

that, net of all socioeconomic factors, a 1% increase in the CMR in destination raises migration flows by 0.34% while the same increase in origin deters migration by 0.18%. Also, both coefficients were statistically significant. However, people aged 20 to 39 may not be attracted to the number of childcare institutions in a destination. Moreover, a greater number of childcare institutions in the origin increases migration flows of young people rather than decreases it. This unexpected result may stem from the young population migrating from small cities or provinces to metropolitan areas when the former has, on average, more childcare facilities than the latter.

In the case of the middle-age population (aged 40 to 59), they appear more sensitive to land price in destination compared with other age groups. Results suggested that a 1% increase in the standard land price in destination reduces migration of middle-aged population by 0.54%. In general, during this age interval in one's life course, individual need to prepare financially for life after retirement. Hence, people in this age interval may avoid migrating to regions with high land and house prices.

Contrary to theoretical predictions, the elderly population (60 and older) is influenced by economic conditions in origin and destination as strongly as younger age groups. For instance, a 1% increase in employment rate in origin diminishes migration by 1.02% while the same amount of increase in the number of corporations is associated with a 0.3% decrease. This might be associated with the highest level of labor force participation rate in the world among Korean elderly population aged 64 to 75 (Park 2008). Owing to insufficient social security measures, old people in Korea might not be able to leave the labor market completely, and they consider economic opportunities seriously if they have to relocate. However, the number of elderly care facilities did not have a significant effect for migration flows. Rather, the number of care facilities for the elderly in destinations deterred migration by 0.07%. Nonetheless, Hong and Yu's (2012) study also did not find a significant effect of the number of elderly care institutions on migration of those aged 81 and over. In the current study, the number of care facilities for the elderly is positively associated with the population size of the region in which those facilities are located.

Discussion and Conclusion

Despite the growing importance of interregional migration at the local level

in rapidly aging society, past research has tended to pay little attention to the relationship between these two demographic phenomena. The handful of previous studies on this issue have generally been based on cross-sectional data or examined migration flows in only one direction. Moreover, the determinants of interregional migration are vastly understudied. In order to better understand the determinants of interregional migration and its implications for population aging, the current study estimated a fixed-effects models derived from the gravity model of migration by using population registration data. The present study also explored trends in the number of inflows and outflows over the last two decades by geographical regions. Furthermore, social network analysis method was applied to visualize the migration system and its trends over this period.

The results of this study provide important evidence about the trends in inflows and outflows within a region. In accordance with past literature (e.g., Kim C. 2015; Lee and Noh 2010), the three largest cities in Korea, Seoul, Busan, and Daegu, are constantly losing not only young and working-age population (i.e., 20 to 39), but also those over 60. On the other hand, Gyeonggi province's population has risen, young and old, through migration more than any other regions in Korea over the same periods. Specifically, its average annual net migration during the mid-2000s was roughly 20,000 and 200,000 of the 60 and older group and the 20 to 39 group, respectively. More importantly, some areas, such as Gangwon, Chungbuk, and Jeonbuk province, experienced a considerable net gain in their elderly population through migration while constantly losing their working-age population. This pattern accelerates the rate of population aging in these regions—regions which, compared with other regions in Korea, already have high old age dependency ratios and encounter more aging-related problems and issues including labor force shortage and fiscal burdens due to welfare measures supporting the elderly.

In order to examine the development of the spatial structure of migration in the past two decades in Korea, SNA of migration networks by periods was performed. Visual inspection of the network indicated that the most important source and destination regions for migration are Seoul and Gyeonggi province, both of which dominate the migration flows in other regions. Although slightly more regions are involved in the migration of population aged 20 to 39 than those aged 60 and older throughout the periods, there were few differences in the overall pattern of important migration streams between the two age groups. Other than moving toward Seoul and Gyeonggi, dominant form of migration flow tend to occur between

core local metropolitan areas, such as Busan, Daegu, or Gwangju, and small cities or counties in which the big local cities are located. This pattern of migration networks changed little over the periods. Finally, some areas, such as Ulsan and Jeju, remained isolated from the migration network throughout the periods.

Results from the fixed-effects regression based on the gravity model suggested that the size of population in origin and destination have more or less similar influences on interregional migration flows across three different age groups. This result provides strong support for the basic tenet of the gravity model: migration flows are positively associated with population size in origin and destination. The impact of economic determinants showed similar patterns among the three age groups, even after accounting for group specific life course variables. For instance, high GDP per capita in destination significantly attracted migrants at all age groups. In a similar vein, a high standard price of land in destination, which represents high living costs, significantly reduces interregional migration streams at all ages. However, variables that represent important life-course tasks specific to young, middle, and old age groups showed somewhat inconsistent effects. While the CMR in destination was significantly and positively associated with migration flows of the aged 20 to 39, the number of cram schools and the number of elderly care facilities failed to reach statistical significance. Hong and Yu (2012) also documented that the percentage of welfare spending and the number of elderly care institutions are not correlated with migration flows, though their classification of the age groups are considerably different from this study. These results suggest that the fundamental driver of interregional migration is an individual's economic motivation, which stems from the desire to maximize his or her well-being (Greenwood 2005; Isserman et al. 1985; Kim and Cohen 2010; Massey et al. 1993).

In spite of these novel and important findings, this study has several limitations. First, due to data limitation, the current study examined migration flows aggregated at the metropolitan cities and provinces. The use of migration data based on smaller spatial units, such as county (i.e., *gun*) or ward (*dong*), would make more detailed analyses possible and might generate some new insights on the determinants of interregional migration. Second, although some prior research (e.g., Kim C. 2015) used individual-level migration data and investigated the effects of socioeconomic status on the propensity of residential mobility, Kim only looked at migration flows between Seoul and Gyeonggi province. Hence, an important avenue for future research would be to investigate the influence of an individual's

socioeconomic conditions on the likelihood of geographical relocation over time.

With the ultra-low level of fertility that is highly unlikely to increase in the near future in Korea (McDonald 2009), population growth through natural increase (i.e., difference between number of births and deaths in a year) will be increasingly difficult to achieve at the local level. Rather, the movement of people across geographical regions will play more important roles in the changes in population composition and economic growth than ever before, and it has become an important issue not only for local governments interested in attracting more constituents and obtaining larger budgets, but also for the central government as it seeks balanced development between regions. A deeper understanding of the determinants of migration and the way they differ across age groups may lead to a more accurate population projections at the local level (DeWaard et al. 2012; Kim and Cohen 2010). Ultimately, these may help lawmakers and government officials to implement social policies that improve people's well-being.

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