High-speed rail developments and spatial restructuring
A case study of the Capital region in South Korea

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The main purpose of this paper is to examine how high-speed rail developments between Seoul and Pusan may affect changes in spatial structures in the Capital region in South Korea. To this end, a range of coefficients and indices such as Gini, Wright, mean center, standard distance and density function were used as analytical tools in order to examine spatial structures. The changes in spatial patterns over time and space in the region were observed by using population and employment data derived from 64 zones. In order to forecast the changing spatial structure of the region after the opening of the high-speed rail link, two scenarios were designed based upon the possible occurrence of low or high growth. The results of this research indicate that spatial structures relating to population (density and total numbers) showed a trend of continual concentration towards Seoul and its fringe, whereas spatial structures relating to employment revealed a trend towards greater dispersion over time. The results of the scenario modeling reveal that the low- and high-growth scenarios suggest similar types of changes in population and employment distribution over time, although the degree of change in Scenario Two is clearly more pronounced than that in Scenario One. A higher rate of growth will produce changes over a wider area, magnifying trends observed in a low-growth scenario.

Keywords: High-speed rail, Spatial structure, Scenario modeling

Introduction
In South Korea, approximately 70% of economic and industrial activity is focused along a corridor running from Seoul through Chunan, Daejon, Taegu, to Pusan in the south-east. Because of this focusing of activity, increasing traffic congestion has meant that the movement of both freight and people along this corridor has become increasingly problematic. These difficult traffic conditions have dictated a need for improved rail links. It is the construction and subsequent spatial impact of such a link that this paper is to examine.

The first stage of a new high-speed rail service connecting Seoul and Pusan is expected to come into service in the year 2001; a second stage will operate from 2010. The link will have a total length of 412 km and pass through six major stations including two in the Seoul metropolitan area, Chunan, Daejon, Taegu and Pusan (see Fig. 1). It is estimated that the...
maximum operational speed of the rail line will be 300 km h\(^{-1}\) with an average of 240 km h\(^{-1}\) being achieved during normal service (KHRC, 1998). Eventually, the minimum train headway will have a duration of 3 min overall, but it is expected that a 7 min headway will be achieved when the first stage opens. The rolling stock of each train will carry 1000 persons.

The principal function of the new rail link is to provide a transport service for passengers, whilst existing rail services will provide for passengers and freight with priority given to container traffic. On achieving full capacity, the rail link will transport up to a maximum of 520,000 passengers daily roughly 2.6 times more than the existing rail service. Once the link is completed, a reduction in transport congestion should occur while a diffusion of economic activity throughout the neighboring Seoul–Pusan corridor, and, more specifically, the Capital region, should bring clear economic benefits.

Land-use effects of high-speed rail developments have been examined since the 1980s. It is possible to draw on experience gained from Shinkansen in Japan and the TGV (Train à Grande Vitesse) in France. The experience of the Shinkansen has demonstrated that a high-speed rail service can have a major impact on urban centers (see Kamada, 1980; Hirota, 1984; Nakamura and Ueda, 1989). Taniguchi et al (1995) reported that new development may cluster around rail line terminals and major nodes, resulting in significant increases in commercial and business activity. Sato (1995) found that significant changes in accessibility as a result of the Shinkansen have occurred in smaller rather than in larger metropolitan areas. It is interesting to note that his findings are consistent with the results suggested by a European case study. Allport and Brown (1993) suggested that the relative impact of high-speed rail is more likely to occur in smaller cities than in the large metropolitan areas. An interpretation is that smaller cities are less well served by air with infrequent flights, whereas the travel time to high-speed rail stations is relatively low.

The case of the TGV has also demonstrated that high-speed rail travel can affect economic activity and employment in several ways (see SNCF, 1986;
Mathieu, 1990; Brotchi, 1991). A study by Gimpel (1993) found that the TGV network offered the opportunity for a transportation system to play an important role in changing the socio-economic and spatial patterns in the regions. Thompson (1994) indicated that the TGV provided greater opportunity and competitiveness for peripheral areas previously disadvantaged by distance from the core areas. Arduin (1995) and Bonnafous (1995) also observed that new high-speed rail stations in France (e.g., Lyon) provided a boost for local economies, encouraging a range of new development in commercial, business, tourist and other service sectors.

Gibb et al. (1990) examined the effects of the Channel Tunnel on peripheral regions in the UK, focusing on the implications for the port and tourist industries in Devon and Cornwall. Rohr and Williams (1994) also conducted a study to evaluate the impacts of the Channel Tunnel on the economic development of regions within the European Community. Goodenough and Page (1994) evaluated the economic impact of the Channel Tunnel high-speed rail link. Bruyelle and Thomas (1994) studied the impact of the Channel Tunnel on a French-side region, i.e., Nord-Pas de Calais. In summary, these studies indicate that the opening of the Channel Tunnel will contribute to future regional economic developments. These range of experiences are a guide for the scenario modeling in this paper.

The Korea Transport Institute has carried out a traffic impact assessment examining a range of impacts likely to be introduced by the high-speed rail link (KOTI, 1993). The Institute has also explored the possible macro economic effects of the rail link at the national level (KOTI, 1995). At the same time, The Korea Research Institute for Human Settlements and the Korea Planners Association have collaborated on a study aimed at deriving an appropriate strategy for balanced regional development in the context of the rail development (KRIHS and KPA, 1995). Overall, the purpose of these broadly focused studies was to ensure that the Seoul–Pusan rail link was fully integrated into the context of national transport policy. To date, insufficient micro-level research has focused on the effect that the new rail link may have on changing spatial structures in the Capital region in the longer term.

This paper examines how high-speed rail developments between Seoul and Pusan may affect changes in spatial structures in the Capital region. To this end, a range of coefficients and indices such as Gini, Wright, mean center, standard distance and density function are used as analytical tools in order to examine spatial structures. The changes in spatial patterns over time and space in the region are observed by using population and employment data derived from 64 zones. In order to forecast the changing spatial structure of the region after the opening of the high-speed rail link, two scenarios are designed based upon the possible occurrence of low or high growth. The first part of this paper briefly examines the ways in which spatial structure may be measured, whilst the second part traces the changes occurring in population and employment distribution in the Capital region. The measures are used to analyze changing patterns of population and employment after the opening of the first stage of the rail link in 2001 and further changes occurring after 2011. The term “Capital region” in this paper is used to refer to an area comprising Seoul, Inchon and Kyonggi province (see Fig. 1). The Capital region comprises an area extending some 60 km from the center of Seoul and accommodates approximately 21.4 million inhabitants in the area of 11 754 km² as of 1997. Seoul and Inchon are the core areas of the region, accounting for 60% of the population.

Measures of spatial structure

The Gini coefficient

The Gini coefficient measures the degree of deviation, represented by a Lorenz curve, from observed distributions plotted against a 45° baseline. The curve is used to depict graphically the degree to which a spatial distribution of a certain attribute differs from a uniform distribution. In order to generate the curve, zones covering a larger area are first rank-ordered by attribute (e.g., percentage or proportion of population or employment opportunities found in a particular zone); these percentages are used to produce cumulative percentages that are plotted against the baseline to give the final Lorenz curve (Darden and Tabachneck, 1980). This curve will deviate below the baseline, or line of uniform distribution, which represents a theoretical situation where all zones have identical attribute densities. The greater the deviation, the larger the attribute concentration in particular zones.

Gini coefficients may range from 0.0 to 1.0, where 0.0 indicates a uniform distribution of density and 1.0 indicates the total concentration of an attribute in a single zone. It should be noted that the Gini coefficient is relatively complicated to understand and compute (Allison, 1978; Greene, 1980). It does make use of all information with respect to the attribute distribution and is defined for all distributions. However, its interpretability is questionable, because any of its discrete data can reach its upper bound only in an infinite distribution. Another criticism of the coefficient is that different distributions can create Lorenz curves that deviate to the same extent from the line of uniform distribution. A Gini coefficient will compute the same value for both of them. Despite the fact that the Gini coefficient has some weaknesses, it certainly has intuitive appeal derived from its property that a change of the coefficient over time can clearly describe whether or not an attribute distribution is becoming concentrated or dispersed.
The Wright coefficient

The Wright coefficient is a measure of the symmetry of the Lorenz curve and is calculated by dividing the Lorenz curve into two discrete segments (Kim, 1985, 1995; Gordon et al, 1986). These segments are depicted by plotting a straight line perpendicular to the baseline through the 45° tangent. Here, the coefficient varies between 1.0 and 1.0. A positive Wright coefficient indicates that the distribution is skewed in favor of particular high-concentration zones. However, a negative coefficient implies a lesser degree of attribute concentration and more areas are characterized by low density. A Wright coefficient of 0.0 indicates a symmetry in the segments beneath the Lorenz baseline. One of the advantages of the Wright coefficient is the ease of interpreting the relative population or employment distribution over time. However, like the Gini coefficient, the Wright coefficient has several weaknesses such as sensitivity to the shape and size of areal units, and exaggerated sensitivity to dispersion near the mean of the attribute distribution.

The mean center and standard distance

The mean center is comparable to the arithmetic mean employed in univariate statistics. Here, the mean center is derived from the arithmetic means of centroid points on a Cartesian grid. Despite its sensitivity to extreme data points, the mean center is attractive since it is computationally simple. The standard distance is a measure of spatial dispersion, indicating whether an attribute (e.g., population) is widely dispersed with a high standard distance or concentrated. This measure is comparable to the standard deviation in univariate statistics, and may be portrayed graphically in the form of a circle around the mean center with a radius representing the standard distance. By calculating standard distance, it is possible to describe both mathematically and diagrammatically the real dispersion of an attribute, model changes over time, and compare its dispersion with that observed in other attributes (Bachi, 1973; Coccossis, 1980). Because the standard distance gages dispersion around the mean center, it is more sensitive to extreme cases. For this reason, it is an appropriate tool for describing dispersion patterns where only minor changes are occurring at the periphery of a particular area.

The density function

The density function measure was originally formulated by Clark (1951), subsequently modified and applied by numerous empirical studies (for example, Newling, 1966; Mills, 1970; Zielinski, 1979; Gordon et al, 1986; Parr and O’Neill, 1989; Batty and Kim, 1992). Clark demonstrated that if zones in a given area are arrayed by distance from the city center, plotting their density against distance will produce a negative exponential curve that fits the resulting scatter of points. Essentially, this curve depicts changes in attribute density over time. A high value indicates a compact city and a low value a spread-out city. The significant problem with the negative exponential model is that it assumes that the shape of urban distribution is circular. Certainly this condition does not apply to real places without considerable variation. A solution to the problem is to divide the study area into sectors, and calibrate the model separately for each sector. Despite certain acknowledged deficiencies, the negative exponential model was found to be useful to depict the overall shape of population distributions in a monocentric region, which is the case of the Korean Capital region (Kim, 1985, 1995).

Spatial changes in the structure of the Capital region over time

The study area and data

For the purposes of this study the Capital region was divided into 64 zones, covering the areas of Seoul, Inchon and Kyonggi province. These divisions replicated local government administrative boundaries. The centroid of each zone was arbitrarily designated and plotted on a map indicating relevant Cartesian coordinates. Data regarding population and employment in each zone were obtained from local censuses conducted by each authority. Population data were available for 1970, 1975, 1980, 1985, 1990 and 1992, and employment data for 1981, 1986 and 1991. Clearly, because of these time differences, data are not directly comparable although they highlight general trend changes over time. The employment data sets used in this paper relate to place of work (of employees) rather than place of residence.

Models of low and high growth

Two possible scenarios of low or high growth relating to changes in population and employment were devised as a means of forecasting changes in spatial structure in the study region after the opening of the high-speed rail link. The rail link represents a significant transport investment and is likely to become an important component in shaping regional spatial structure and promoting economic development. Certain assumptions need to be outlined before forecasting the possible structural changes emerging in the wake of the new development, particularly relating to the location of rail link stations. Clearly, changing patterns and levels of accessibility should attract new development around stations.

The first scenario (Scenario One) is concerned with a narrow spatial sphere of direct influence by the three high-speed rail stations including Chunan station, located close to the boundary of the Capital region. It assumes that each station’s spatial influence, or catchment area, will cover an area of 10 km radius.\(^3\) It should be noted that the 10 km distance

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\(^3\)The choice of 10 km distance threshold is derived from a KOTI forecast done in connection with the proposed Seoul–Pusan quality rail service.
threshold is arbitrarily defined but derived from a study of high-speed rail development (Kim and Choi, 1998). It further assumes that growth rates in terms of employment and population in these areas will be equivalent to the average rate for urban areas in the Capital region (comprising 19 minor cities in 1992) excluding Seoul and Inchon. Over the last two decades the growth rates of population and employment in urban areas in the region ranged from 4.2 to 9.3% a year (Kim, 1995). These figures indicate that the growth rates in the urban area are higher than those in the Capital region as a whole. Since rail stations on the high-speed rail line and their adjacent area will attract population and employment, higher growth rates were applied for the forecasts for 2001 and 2011. The zonal growth rates and population–employment ratios were calculated by using simple predictive models. The predictive models include the linear or exponential growth models, depending on the zonal trends of population and employment, taking into account zonal land-use plans for the study period. Scenario Two uses comparable assumptions to those applied in the first scenario although it is applied with higher population and employment growth rates around rail stations and their fringe, taking into account the zonal growth rates for the urban areas within the Capital region. It should be noted that the predictive techniques are limited in their ability to address land-use and infrastructure policies in the forecasting process.

Changing patterns in population and employment over time

Population. Data presented in Table 1 indicate that the absolute values for the Gini coefficient range from 0.752 to 0.821. These indices are relatively high and can be interpreted as a sign of population concentration in the Capital region. The calculated Gini coefficients also demonstrate that population distribution in the region is becoming more concentrated. This is partly due to a significant inward migration of people from rural areas into Seoul before the 1970s and into the surrounding area thereafter. Although the rate of population growth in Seoul has declined since the 1980s, annual growth rates around the suburban fringe remain high, ranging from 5.5% to 6.4% between 1980 and 1992. In contrast, population levels have fallen in all peripheral areas (30 to 60 km away from the center of Seoul) at an annual rate of −1.8% between 1980 and 1992 (Kim, 1995). There is a general tendency for the Wright coefficient values to fall over time. When they are positive, they are marginally skewed in favor of high-density zones. However, decreasing Wright coefficients between 1970 and 1985 indicate a population distribution where the skewness changes from being positive to negative from 1990 onwards, indicating a new concentration in favor of lower-density zones.

The mean center of population, representing the center of gravity, moved south-westwards between 1970 and 1992 (see Fig. 2). This is mainly due to the “pull” exerted by existing cities expanding to the south and west of Seoul and to the development of new towns situated just outside the city. The standard distance away from the mean center and measuring dispersion declined from 44.6 in 1970 to 37.0 in 1992, indicating greater population concentration (see Table 1). Diagrammatically, this concentration is shown in Fig. 2, where circles representing these standard distances have become progressively smaller over time. Over the last three decades, central government has pursued a series of restrictive policies, controlling the influx of population into the Capital region and encouraging the relocation of industries away from Seoul. However, coefficients and indices generated from this analysis reveal that government policies have not been wholly successful in terms of addressing the problem of overpopulation in the region.

Figures contained in Table 1 show that population distribution in the Capital region has become denser over time. Similarly, the density functions display

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gini</td>
<td>0.752</td>
<td>0.769</td>
<td>0.787</td>
<td>0.802</td>
<td>0.818</td>
<td>0.821</td>
</tr>
<tr>
<td>Wright</td>
<td>0.209</td>
<td>0.155</td>
<td>0.073</td>
<td>0.121</td>
<td>−0.039</td>
<td>−0.051</td>
</tr>
<tr>
<td>Mean center</td>
<td>X</td>
<td>120.9</td>
<td>120.1</td>
<td>119.7</td>
<td>119.3</td>
<td>118.2</td>
</tr>
<tr>
<td>Y</td>
<td>117.4</td>
<td>116.1</td>
<td>115.0</td>
<td>114.0</td>
<td>113.8</td>
<td>113.2</td>
</tr>
<tr>
<td>Standard distance</td>
<td></td>
<td>44.6</td>
<td>42.4</td>
<td>40.1</td>
<td>38.3</td>
<td>37.2</td>
</tr>
<tr>
<td>Density function $D_b$</td>
<td>5927</td>
<td>9168</td>
<td>14464</td>
<td>19730</td>
<td>23961</td>
<td>26122</td>
</tr>
<tr>
<td>$b$</td>
<td>−0.371</td>
<td>−0.403</td>
<td>−0.450</td>
<td>−0.481</td>
<td>−0.501</td>
<td>−0.508</td>
</tr>
</tbody>
</table>

$D_b$ – central density in persons per km$^2$; $b$ – density parameter.

The interpretation of the differences in Gini coefficient on the third decimal place is due to the considerable size and fairly high density profiles of both population and employment across the Capital region.
more pronounced absolute negative values, indicating that exponential curves have become steeper and pointing to a denser population distribution over time. In effect, most of the coefficients and indices measured here demonstrate that the pattern of population distribution in the Capital region displays a more concentrated spatial structure over time. It is also clear that the center of gravity relating to population distribution has moved progressively south-westwards. This reorientation has also been characterized by a lower density of population distribution from 1990 onwards.

Employment. The Gini coefficients pertaining to employment, shown in Table 2, are reasonably high, ranging from 0.884 to 0.856. However, the tabulated data also reveal that absolute coefficient values declined over the decade 1981 to 1991; this indicates a more recent trend of employment dispersion. In earlier years, employment distribution displayed a greater degree of concentration than that of population. However, as time passed, the employment distribution has become less concentrated than that of population. This might be partially explained by the tendency of certain industries (mostly pollution-generating), previously located in Seoul, to move to newly constructed industrial parks on the Capital region’s west coast (Kim and Gallent, 1997). Similarly, many new business and commercial activities have recently located in Inchon and in other cities situated in the southern and south-western areas away from Seoul. In terms of the generated Wright coef-

Table 2 Coefficients and indices in employment

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Date</th>
<th>1981</th>
<th>1986</th>
<th>1991</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gini</td>
<td></td>
<td>0.884</td>
<td>0.864</td>
<td>0.856</td>
</tr>
<tr>
<td>Wright</td>
<td></td>
<td>−0.157</td>
<td>−0.161</td>
<td>−0.102</td>
</tr>
<tr>
<td>Mean center X</td>
<td></td>
<td>117.2</td>
<td>117.0</td>
<td>116.8</td>
</tr>
<tr>
<td>Mean center Y</td>
<td></td>
<td>116.5</td>
<td>114.0</td>
<td>112.6</td>
</tr>
<tr>
<td>Standard distance</td>
<td>D₀</td>
<td>30.5</td>
<td>32.8</td>
<td>33.8</td>
</tr>
<tr>
<td>Density function</td>
<td>D₀</td>
<td>3657</td>
<td>5456</td>
<td>7553</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>−0.540</td>
<td>−0.540</td>
<td>−0.545</td>
</tr>
</tbody>
</table>

*D₀ – central density in persons per km²; b – density parameter.
Coefficients, negative values suggest a regional dispersion of employment. During the first five-year period, coefficients indicate an increasing level of dispersion; this pattern is followed by less dispersion over the next five years. These small variations over time, however, do not conceal an overall pattern of employment dispersion in favor of lower-density zones.

Like the distribution of population, the mean center for employment has shifted south-westwards during the last decade (see Fig. 3). This movement has been largely driven by the extensive development of new industrial parks located in the west-coast area in and around Inchon. At the same time, standard distances have increased, suggesting a more pronounced pattern of employment dispersion. These patterns are shown in Fig. 3, which indicates both the direction of movement and increasing dispersion that is a function of circle size. During the 1980s, patterns of employment distribution across the entire region became increasingly dense; as a consequence density functions remained largely unchanged. The slope of the negative exponential curves is relatively steep compared with that of population, which means a greater density in the employment distribution over that of population. In summary, most of the coefficients and indices calculated in these analyses suggest a history of concentrated employment distribution in the region. In contrast, comparable indices for more recent years show increasing levels of employment dispersion.

Changes in the spatial structure of the Capital region introduced by the high-speed rail link

Scenario One. It is explained above that two distinct scenarios were used to examine projected spatial changes occurring in the Capital region after the opening of the high-speed rail link. Scenario One is based upon the assumption that each high-speed rail station will have a narrow spatial influence and an average growth rate equivalent to that of the surrounding minor cities. The rationale behind Scenario Two is essentially the same, but it assumes that the station nodes will have a more extensive spatial influence and higher population and employment growth rates.

Table 3 presents data relating to the projected distribution of population and employment after the opening of the high-speed link. The Gini coefficients indicate that the region’s population will become increasingly concentrated in the run-up to 2001. After this date, the trend will be towards marginally greater dispersion. In terms of employment distribution, the coefficients suggest that there will be progressively more dispersion over the entire study period (ie, 1991 to 2011). Negative Wright coefficients (pertaining to both population and employment) imply increasing regional dispersion and the greater prominence of low-density zones.

Based upon the extrapolation of past trends, the

Figure 3  Employment mean centers and standard distances over time
Table 3 Changing population and employment patterns (Scenario One)

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Population</th>
<th></th>
<th>Employment</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gini</td>
<td>0.821</td>
<td>0.827</td>
<td>0.825</td>
<td>0.856</td>
</tr>
<tr>
<td>Wright</td>
<td>-0.051</td>
<td>-0.074</td>
<td>-0.058</td>
<td>-0.102</td>
</tr>
<tr>
<td>Mean center</td>
<td>X</td>
<td>117.6</td>
<td>116.8</td>
<td>116.3</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>113.2</td>
<td>112.0</td>
<td>110.3</td>
</tr>
<tr>
<td>Standard distance</td>
<td>D_0</td>
<td>37.0</td>
<td>36.9</td>
<td>37.7</td>
</tr>
<tr>
<td>Density function a</td>
<td>b</td>
<td>-0.508</td>
<td>-0.520</td>
<td>-0.522</td>
</tr>
</tbody>
</table>

*aD_0 – central density in persons per km^2; b – density parameter.*

population mean center will continue to move south-westwards (see Fig. 4). The pattern of changing standard distances (again depicted in Fig. 4) indicates that the increasing population concentration currently being experienced will not be sustained after the rail link is opened in 2001. Rather, population dispersion may be observed and will be further accelerated after 2011. The employment mean centers and standard distances also suggest a continuing south-westerly movement and a similar pattern of spatial dispersion (see Fig. 5). These results are perhaps not surprising given the propensity of stations in the link corridor to attract economic activity, which is likely to be associated with overall growth. It is predicted that population and employment density will increase at pace, although the rates of increase will begin to decelerate after 2001 (see Table 3). At this time, the density of population will begin to increase marginally as a function of distance away from the regional center (ie, the negative density function becomes steeper). In contrast, employment density will reduce nearer the center (ie, the density function becomes flatter) and a process of decentralization will take effect. Clearly, this can be explained by a new clustering of jobs around stations situated away from the center, to the south of the Capital region.

Scenario Two. Applying the second scenario, figures in Table 4 reveal that the overall distributions of population and employment following the opening of the rail link may be similar to those produced in Scenario One with some slight variations. For example,
Table 4  Changing population and employment patterns (Scenario Two)

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Population</th>
<th></th>
<th>Employment</th>
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</thead>
<tbody>
<tr>
<td>Gini</td>
<td>0.821</td>
<td>0.827</td>
<td>0.824</td>
<td>0.856</td>
</tr>
<tr>
<td>Wright</td>
<td>-0.051</td>
<td>-0.078</td>
<td>-0.071</td>
<td>-0.102</td>
</tr>
<tr>
<td>Mean center</td>
<td>X</td>
<td>117.6</td>
<td>116.7</td>
<td>115.9</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>113.2</td>
<td>111.5</td>
<td>108.4</td>
</tr>
<tr>
<td>Standard distance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density functiona</td>
<td>$D_0$</td>
<td>26 122</td>
<td>29 501</td>
<td>31 269</td>
</tr>
<tr>
<td></td>
<td>$b$</td>
<td>-0.508</td>
<td>-0.516</td>
<td>-0.513</td>
</tr>
</tbody>
</table>

$D_0$ – central density in persons per km$^2$; $b$ – density parameter.

the Gini coefficients relating to population in both scenarios suggest approximately the same degree of concentration. However, Gini coefficients in Scenario Two suggest a higher population concentration in 2011 than suggested in Scenario One, mainly because the second scenario considers the possibility of greater employment growth within a wider area of influence surrounding the stations. Wright coefficients relating to both population and employment imply a pattern of continual regional dispersion with increasing emphasis on lower-density zones. Figs 6 and 7 show the mean centers of population and employment continuing to move south-westwards after 2001, with increasing standard distances indicative of greater regional dispersion. Following the same trend, a more marked dispersion of population and employment will be observed by 2011. These changing spatial patterns might be interpreted as responses to the rail link development, affecting the relocation of employment to sites adjoining rail stations, and producing a decentralization and therefore more dispersed pattern of residential space.

In this scenario, the density of the population and employment distribution will continue to grow, although at a reduced pace after 2001. The changing density functions suggest that population density will increase marginally between 1992 and 2001. In the new millennium, however, population density will begin to decrease gradually away from the regional center. In contrast, employment density will continue to decrease as a function of distance away from the center during the first time period. As in Scenario
Figure 6  Population mean centers and standard distances in Scenario Two

Figure 7  Employment mean centers and standard distances in Scenario Two
Conclusion

This paper has considered how the development of a high-speed rail link between Seoul and Pusan may impact upon the demography and economy (ie, patterns of employment opportunities) of the Capital region. A range of measures was engaged as means of gaging and analyzing changing spatial patterns over both time and space. A comprehensive examination of past trends was used as a platform from which to extrapolate future patterns on the bases of projected low- or high-growth scenarios. These analyses have a number of clear implications.

The various coefficients and indices produced in the course of these analyses underscore the fact that population distribution in the Capital region has a past history of concentration and high spatial density. The population center of gravity has migrated gradually south-westwards over time and shown an increasingly concentrated pattern. The employment distribution in the region also showed a pronounced level of concentration, although a trend towards greater dispersion became established between 1981 and 1991. Like population, the employment center of gravity also shifted towards the south-west, but unlike population, the trend was towards increasing regional dispersion and a more even distribution of employment opportunities filtering into lower-density zones.

The central hypothesis is that the development of the high-speed link between Seoul and Pusan will impact upon patterns of population and employment distribution at the micro level, producing new patterns of employment around development nodes and producing a shock wave of change with important repercussions across the entire region. The scenario modelling employed in this analysis indicates that the population distribution in the region will become increasingly concentrated prior to 2001. After this time, this trend towards greater concentration will continue but at a reduced pace until 2011. In contrast, employment distribution will display greater spatial dispersion over time as more job opportunities are created away from the center of the capital region, particularly in the new development corridor. Overall, the low- and high-growth scenarios suggest similar types of changes in population and employment distribution over time, although the degree of change in Scenario Two is clearly more pronounced than that in Scenario One. A higher rate of growth will produce changes over a wider area, magnifying trends observed in a low-growth scenario.

In simplified terms, whilst population patterns will become more focused around Seoul and its fringe resulting in a greater density of residential space, employment opportunities and economic activity will develop along a path of greater decentralization producing a dispersed geography of economic space. Whilst population concentration will meet inevitable barriers and slow down after the opening of the first stage of the rail link in 2001, the trend towards a greater dispersion of employment will continue. These two elements of urban development look set to follow diverging paths, at least into the foreseeable future.

References

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