Housing abandonment and socio-spatial inequalities: experience from a shrinking inner-city area of Incheon, South Korea

Youngmee Jeon & Saehoon Kim

To cite this article: Youngmee Jeon & Saehoon Kim (2023): Housing abandonment and socio-spatial inequalities: experience from a shrinking inner-city area of Incheon, South Korea, Housing Studies, DOI: 10.1080/02673037.2023.2236965

To link to this article: https://doi.org/10.1080/02673037.2023.2236965

Published online: 21 Jul 2023.

Submit your article to this journal

View related articles

View Crossmark data
Housing abandonment and socio-spatial inequalities: experience from a shrinking inner-city area of Incheon, South Korea

Youngmee Jeon and Saehoon Kim

ABSTRACT

Housing abandonment is one of the most distinct characteristics of urban shrinkage. Previous research has investigated the extent and process of abandonment in the United States and Europe’s former industrialized centers. However, little is known about its features in places that have recently seen rapid urbanization. The study examines the relationship between vacant houses and a variety of urban factors, further expanding it to the perspective of spatial inequality. The multilevel logistic regression model was applied after constructing a new parcel-level dataset of vacant houses in Incheon, South Korea. The findings showed that spatially selective patterns of housing abandonment occurred at the intra-downtown level. Older, smaller, and less-accessible residential buildings were more vulnerable to abandonment. Failed large-scale redevelopment attempts fueled the emergence of vacant housing clusters. Vacant houses were associated not only with the collapse of industrial and commercial activities, but also with an unsustainable population structure. The results suggest the necessity for vacant house management plans tailored to neighborhood characteristics, especially for vacant house clusters, and a greater emphasis on socio-demographic dynamics such as age and generation in relation to urban shrinkage.

1. Introduction

Shrinkage has emerged as one of the most striking urban phenomena for many cities around the world. Shrinkage-related problems such as local economic collapse, unemployment, aging, poverty concentration, and housing dilapidation have arisen not only in deindustrialized cities of the West, but also in East Asia, including Japan, South Korea, and China, where shrinkage was uncommon during the rapid
urbanization phase just a few decades ago (Joo & Seo, 2018; Kim, 2019). Housing abandonment, the most severe and evident spatial manifestation of shrinkage, has a detrimental impact on the neighborhood’s environment and can lead to social stigmatization (Jeon & Kim, 2020). In 2021, the number of vacant houses in South Korea reached 1.4 million, accounting for 7.4% of the total housing stock, owing to a considerable increase in the elder population, the world’s lowest birth rate, and poor economic growth since the 2000s.

The creation of an abandoned housing cluster highlights the negative consequences of urban shrinkage, demonstrating the socio-spatial inequalities between a metropolitan city’s inner-city areas and its newly developed suburbs (Xie et al., 2018). Spatial imbalance is described as spatially unequal development and resource distribution at the global, national, and urban levels, including infrastructure, household income, healthcare, and educational services. As spatial fragmentation aligns with political and institutional tensions between different areas, inequality intensifies, jeopardizing social and economic stability (Kanbur & Venables, 2005). Deindustrialization of a city’s core and middle-class out-migration to the suburbs are known to exacerbate spatial inequality (Accordino & Johnson, 2000; Martinez-Fernandez et al., 2016; Wilson et al., 1994).

South Korea, where declining inner cities and newly developed suburbs are closely juxtaposed, is witnessing spatial polarization. The resultant uneven distribution of vacant houses between the two areas reflects policy imbalance and indiscriminate development practice. Since the 1980s, state-led developments of built-up areas on the periphery of major cities have persisted, whereas older inner cities have experienced long-lasting urban decline (Jeon & Kim, 2020). Many local governments facing the decline of inner-city areas have designated an excessive number of ‘redevelopment districts’ to stimulate the urban economy in the short term during the 2000s. However, redevelopment projects have been delayed or canceled since the 2010s due to little investment in aged housing and social conflicts among residents. Vacant houses are encroaching on inner-city areas that have been deprived of population and facilities by newly constructed suburbs. Moreover, policymakers have paid little attention to shrinking neighborhoods in large cities due to the whole city’s growth tendency, as opposed to dramatically shrinking small cities and rural areas.

Housing abandonment is closely connected with rises in spatial disparity in Incheon, South Korea’s third most populous city. The study aims to identify the built-environmental and socio-economic characteristics of residential buildings in the inner-city areas that are vulnerable to abandonment through empirical research on Incheon. The influence of urban redevelopment districts, which have been pointed out as a leading trigger of vacant housing clusters in South Korea’s major cities, is scrutinized.

2. Literature review

2.1. Shrinking cities and intra-urban inequalities

Urban shrinkage can be interpreted as the process of a city’s socio-spatial restructuring into an undesirable direction. Shrinkage generates the dynamics of spatial
inequalities because it evolves in a spatially selective manner, affecting particular areas of the city more than others (Grossmann et al., 2013; Mallach, 2015; Silverman, 2020; Silverman et al., 2013). Socio-spatial inequalities, common in growing cities, become more polarized and permanent with no influx of new populations or resources in shrinking cities, forming a self-aggravating spiral. (Silverman, 2020).

Urban shrinkage is accompanied by a selective movement of the primary urban functions and the most qualified people from inner-city areas to new suburbs. Public facilities such as government offices, schools, universities, hospitals, and transportation hubs are relocated from the former to the latter to provide a more pleasant environment and accommodate increased demand (Jeon & Kim, 2020). The mobility gap between middle-class households with a wide range of residential options and less privileged groups with restricted access to the housing market exacerbates socio-spatial divides. While the younger and better-educated prefer gated communities in the suburbs or gentrified neighborhoods, the older and vulnerable are trapped in the inner city’s most devalued areas, leading to a concentration of poverty (Fol, 2012; Kilroy, 2009). Vacant houses, the main cause and result of urban shrinkage, appear in particular areas with distinct characteristics, illustrating the spatial selectiveness of housing abandonment. Furthermore, inadequate policy responses to urban shrinkage, including short-term urban regeneration programs and indiscriminately designated redevelopment districts, contribute to enhanced spatial segregation (Grossmann et al., 2013; Kim, 2019).

The geographical selectiveness of inequality is particularly significant since it extends to small-scale spatial units ranging from urban-rural and inter-urban to intra-urban, neighborhood, and even block and street levels (Grossmann et al., 2013). The ‘peripheral dual city’, defined by Silverman (2020), described the growing spatial inequality and social polarization between the revitalized areas of the urban core, expressed by ‘urban enclaves’, and the rest of the declining inner city, represented by ‘internal colonies’, within shrinking cities (Silverman, 2020). Mallach (2015) indicated that downtown revitalization does not confer citywide benefits within shrinking industrial cities in the United States, instead concentrating jobs, resources, and wealth in a smaller section of the city and leaving the rest worse off than before. He further argued that prolonged bipolarity transforms a large portion of each of these shrinking cities into places with little sales activity except occasional investment or speculation, as well as widespread abandoned lots and buildings.

2.2. Bi-polarization of shrinking cities in South Korea

In East Asian countries, strong growth-oriented policies under the developmental state prompted rapid economic development, changes in industrial structure, and urbanization, bringing significant issues associated with fast urban shrinkage (Joo & Park, 2017). Shrinkage-related problems have been aggravated by the addition of demographic shift, such as population aging at an unprecedented rate and extremely low birth rates.

Since the 1980s, the Korean central and local governments have directly led the development of extensive new urban areas under the growth agenda, accompanied by the inevitable relocation of major public institutions out of inner-city areas (Jeon
& Kim, 2020). Additionally, numerous new built-up areas, smaller than new towns, have been built adjacent to the existing inner-city areas in most cities, both small towns and metropolitan cities (Kim, 2010). Middle-class households, main public institutions, and employment opportunities have moved to more livable new built-up areas, creating a chronic structural gap with old inner-city areas densely populated with low-income groups, the elderly, and vacant houses. According to Yuh & Cho (2008), the majority of certified secondary or tertiary hospitals and educational institutions were distributed in new towns, and their price per pyeong (approximately $3.3 \text{ m}^2$) of apartments, Korea's typical dwelling type, was significantly higher than in old towns. Residents of Ilsan and Bundang Newtowns, representative large-scale new towns in Korea's metropolitan area, strongly requested spatial segregation and the elevation of status to independent cities because of vast cultural and emotional differences with the existing inner-city areas and tax leakage to them.

Indiscriminate urban redevelopment projects in most inner-city areas and their ultimate failures have deepened inequalities with newly built-up areas, particularly in South Korea. Some malfunctioning redevelopment processes—excessive designation, delay, and cancellation—deviating from their original purpose of improving the residential environment and instead being used as a means of economic stimulus have aggravated the quantitative and qualitative conditions of vacant houses within inner cities (Jeon & Kim, 2020). In the first stage, local governments unduly assigned planned redevelopment districts under their growth-oriented public policies, following the implementation of redevelopment-related law and the relaxation of district designation requirements in the 2000s. During the real estate boom, residents' expectations for development profits were also heightened. However, those districts that already had inferior physical conditions enough to meet the specified requirements became susceptible to a gradual decline due to legal restrictions on any development activities like new constructions and major repairs after the designation. In the second stage, numerous projects were postponed indefinitely as a result of the 2010s recession and the limitations of profit-oriented redevelopment, and the sharp physical and economic decline forced residents to move to other places, with their homes sold or abandoned. In the last stage, only collapsed communities, marginalized residents, and vacant housing clusters were left without proper follow-up measures, when projects were canceled because of loss of profitability and conflicting interests among residents.

Incheon Metropolitan City is one of the cities that exhibits the aforementioned bi-polarization between the newly built-up suburbs growing and the existing inner-city areas shrinking. The inner-city areas suffering from manufacturing decline, population decrease and aging, deterioration of urban facilities, and most notably housing abandonment expose two faces of Incheon (Cho, 2015). Incheon’s dichotomized spatial pattern reflects multiple pairs of opposing traits.

First, Incheon’s geographical location demonstrates both centrality and marginality. Incheon, a coastal metropolis west of Seoul in the capital area, acts as a gateway to South Korea through Incheon International Airport. Incheon acquired the locational advantages of easy accessibility to Seoul through the completion of the Gyeongin (Seoul-Incheon) Railroad in 1899, Korea’s first modern infrastructure, and the opening of the Gyeongin Expressway in 1968, Korea’s first highway. However,
the proximity and connectivity of these two cities rather turned Incheon into a passage point to Seoul. Second, Incheon made its early mark as a historical, cultural, and industrial city, but it is currently striving to transfigure itself into a global metropolis. Massive industrial complexes were created in Incheon’s inner city based on the state-led export-oriented economic development policies in the 1960–70s. The continued decline of manufacturing after rapid industrialization and metropolitanization, however, has left inner-city areas with deteriorated factories, desolate landscapes, and stigmatized images. Since the 2000s, Incheon has been rebranding itself with the designation of the Free Economic Zone and the construction of skyscrapers in the International Business District. Third, the contradiction between the desperate need for redevelopment projects in the decaying inner city and the low profitability and feasibility of such projects caused the cancellation of numerous redevelopment plans. In the 2000s, the local government's political scheme for balanced urban development and residents' soaring expectations for development gains were matched, along with the central government's policy direction to maintain the economic upswing. Citizens and officials utilized the over-planned redevelopment projects as economic and political ladders. Resultingly, the real estate market downturn, residents' limited economic capacity for the allotted redevelopment charges, and community conflicts thwarted the projects in the 2010s, leading to the redevelopment districts’ demise as the most damaged in the inner city just a few years after designation (Cho, 2015).

Incheon is presently divided into two urban zones: the old inner city, with the three administrative districts of Jung-gu, Dong-gu, and Nam-gu experiencing urban shrinkage; and the newly built-up five gu's surrounding it (Figure 1). The total population of Incheon increased by 25.2% between 1995 and 2015, while the population of the inner city decreased by 9.6% except for Yeongjong-do. Especially, it is a significant issue that vacant houses have been gradually eroding the inner city. Although Incheon does not have the highest vacancy rate in South Korea, it best exemplifies the characteristics of urban shrinkage in large cities, the concerns of long-term vacancy in deteriorated low-rise houses, and the related spatial segregation. As of 2017, Incheon's detached housing vacancy rate was 5.4%, according to the Korea National Statistical Office's data. This figure was quite high compared to Seoul's 1.0% and Gyeonggi-do's 2.8%. Within Incheon, the aforementioned rate recorded 5.2% (1,936 vacant among 37,163 units) in the inner city, while 0.9% (330 vacant among 37,970 units) in the suburbs. Furthermore, according to local government data, more than 1,600 vacant houses were located in Incheon as of July 2017, with 73.6% distributed in the old inner city, about three times the 26.4% of the new suburbs.

3. Setting and methods

3.1. Data

The original data on vacant houses in Incheon's three inner-city districts—Jung-gu, Dong-gu, and Nam-gu—in 2017 was obtained from their gu offices, which had been collected through field surveys by dong (an administrative subdivision of gu). The
Incheon Nam-gu’s relevant ordinance defines a vacant house as a building that is uninhabited or no longer used because the occupants have relocated, along with the Vacant Housing Act specifying that specific categories such as unsold homes and temporary residences are excluded. In the data above, vacant houses were classified into two groups according to whether they were located within redevelopment districts, implying that vacant houses in Incheon’s inner city are mostly composed of structures in substandard condition requiring major repairs or demolition beyond simply buildings without residents.

This parcel-based data, or VHD (Vacant House Data of three gus), provided detailed building information, including parcel ID, location, type of use and structure, number of floors, and total floor area. VHD’s missing information like the year of construction was supplemented by the building register data. The data on buildings and urban characteristics for all parcels of Incheon’s inner city was gathered through the National Spatial Data Infrastructure portal. This external data was combined with VHD based on the parcel number information using Excel software. The dong-level data was acquired from the Korean Statistical Information System portal to uncover the socio-demographic and economic factors of neighborhoods.
connected to housing abandonment. However, the above data and VHD were classed as administrative and legal dong, respectively, according to different dong classification criteria. Therefore, the two data sets were linked based on a total of 22 dong by integrating and adjusting some dongs.

Some missing information in the integrated data, such as the number of floors, was filled through on-site observations and aerial photographs (Figure 2). Among the housing types, apartments were excluded from the data since some of the units remained temporarily unoccupied. Observations omitting essential information related to the abandonment decision, e.g., building structure, total floor area, and construction year, were eliminated. The majority of the removed observations were unregistered buildings constructed between the post-Korean War era of the 1950s and the rapid urbanization period of the 1970s. Consequently, the final data set for

Figure 2. Data construction and processing for statistical analysis.
statistical analysis, here referred to as HADS (Housing Abandonment Data Set), consisted of 30,593 inner-city housings, of which the number of vacant houses changed from the original 1,201 to 560 units due to the removed observations. The final data was georeferenced in ArcGIS, and then matched with multiple explanatory variables based on each building's location.

3.2. Measures

Table 1 shows the definitions and descriptive statistics of the key variables. The dependent variable (VACANT) was dichotomous: 1 if the house was vacant, 0 if occupied in 2017. Vacant houses accounted for approximately 1.8% of total housing units. The data structure of sixteen explanatory variables was multilevel, with clustering of 30,593 parcels (level-1) in 22 dongs (level-2). All of the variables were examined for multicollinearity using the Variance Inflation Factor (VIF) test based on the threshold 10.

3.2.1. Built-environmental characteristics (level-1 variables)

The time-varying built environment, i.e. the intensified obsolescence of buildings, leads to a drop in investment and maintenance, and eventually to the physical abandonment of structures (Sternlieb et al., 1974). Ryan (2012) noted that Flint’s small-scale, wooden single-family houses, which had been swiftly developed at low cost, quickly deteriorated and were abandoned.

The construction year (YEAR) was categorized into three phases, each with its own set of urban development strategies and prevalent building types: (1) before 1980; (2) 1980–1999; and (3) 2000–2017. Residential areas were mainly created through land readjustment projects prior to the 1980s, and numerous small-scale multi-household houses were built to address the housing shortage in the 1980–1990s. The building structure (STRUCT) was divided into three categories according to the main building materials: (1) wood; (2) cement-brick, block, and stone; and (3) reinforced concrete and steel. The number of floors (FLOOR), limited to four stories under legal standards of multi-household housing, was included to investigate the effect of building scale on abandonment.

The total floor area (TFA) was classified into two groups depending on the government's criterion of 85 m$^2$ national housing. The land parcel area (LPA) had two classifications based on the extremely small parcel (90 m$^2$) criterion, which is one of the prerequisites for judging dilapidated dwellings under Incheon’s related ordinance.

The land slopes (SLOPE) considered that many substandard buildings were constructed on the hills in the inner city after an initial period of urbanization. The parcel shape (SHAPE) was defined by whether or not it was rectangular, whose ‘non-rectangular’ category comprised parcels with triangular, inverted triangular, and irregular shapes. The access road (ROAD) had two sections depending on whether each building was vehicle accessible. Moreover, whether a house was situated within the urban redevelopment district (REDEV), additionally including thirteen districts canceled in the last two years as of 2017, evaluated the impact of the failed—delayed
or canceled—redevelopment projects and vacant houses concentrated inside those districts. The natural logarithm of individual land price per square meter (PRICE) was calculated, taking into account that the neighborhood’s overall real estate market downturn discourages residents from maintaining specific buildings with a limited

Table 1. Descriptive statistics of key variables.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Categories or units</th>
<th>Mean (Min/ Max)</th>
<th>Std. Dev.</th>
<th>Hypothesized relationships with dependent variable</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent Variable</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VACANT</td>
<td>Whether the house is vacant or not</td>
<td>1: vacant 0: occupied</td>
<td>0.018 0.134</td>
<td></td>
</tr>
<tr>
<td><strong>Level-1 (Parcel-level) Variables (N=30,593)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>YEAR</td>
<td>Construction year</td>
<td>(1) before 1980 (2) 1980–1999 (3) 2000–2017</td>
<td>1.747 0.677</td>
<td>older/vacant†</td>
</tr>
<tr>
<td>STRUCT</td>
<td>Building structure</td>
<td>(1) wood (2) cement-brick, block, stone (3) reinforced concrete, steel</td>
<td>2.266 0.539</td>
<td>wooden/vacant†</td>
</tr>
<tr>
<td>FLOOR</td>
<td>Number of floors x ≤ 4</td>
<td>1.906 0.898</td>
<td>2.681</td>
<td>single-storied/vacant†</td>
</tr>
<tr>
<td>TFA</td>
<td>Total floor area x ≤ 85 m² 0: x &gt; 85 m²</td>
<td>0.354 0.478</td>
<td>15.868</td>
<td>small scale/vacant†</td>
</tr>
<tr>
<td>LPA</td>
<td>Land parcel area x ≤ 90 m² 0: x &gt; 90 m²</td>
<td>0.191 0.393</td>
<td>21.287</td>
<td>small scale/vacant†</td>
</tr>
<tr>
<td>SLOPE</td>
<td>Land slope 1: slope 0: flat</td>
<td>0.224 0.417</td>
<td>7.112</td>
<td>slope/vacant†</td>
</tr>
<tr>
<td>SHAPE</td>
<td>Parcel shape 1: non-rectangular 0: rectangular</td>
<td>0.162 0.368</td>
<td>7.242</td>
<td>non-rectangular/vacant†</td>
</tr>
<tr>
<td>ROAD</td>
<td>Access road 1: no vehicles allowed 0: accessible by vehicles</td>
<td>0.209 0.407</td>
<td>4.596</td>
<td>inaccessible/vacant†</td>
</tr>
<tr>
<td>REDEV</td>
<td>Urban redevelopment (including the canceled districts) district 1: designated 0: no designated</td>
<td>0.295 0.456</td>
<td>2.681</td>
<td>in district/vacant†</td>
</tr>
<tr>
<td>PRICE</td>
<td>Ln of individual land price per square meter Ln of KRW</td>
<td>13.900 0.334</td>
<td>8.018</td>
<td>lower/vacant†</td>
</tr>
<tr>
<td><strong>Level-2 (Dong-level) Variables (N=22)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BASIC</td>
<td>Ratio of households receiving the national basic livelihood benefits % of dong (2.84/14.62)</td>
<td>6.188 2.681</td>
<td>4.596</td>
<td>ratio†/vacant†</td>
</tr>
<tr>
<td>MANUF</td>
<td>Rate of change in the number of manufacturing companies % of dong (−21.05/104.76)</td>
<td>9.179 15.868</td>
<td>7.112</td>
<td>rate of change†/vacant†</td>
</tr>
<tr>
<td>RETAIL</td>
<td>Rate of change in the number of retail businesses % of dong (−21.11/146.52)</td>
<td>2.915 21.287</td>
<td>7.242</td>
<td>rate of change†/vacant†</td>
</tr>
<tr>
<td>POP</td>
<td>Rate of change in the total number of population % of dong (−11.86/29.84)</td>
<td>−0.769 7.112</td>
<td>4.596</td>
<td>rate of change†/vacant†</td>
</tr>
<tr>
<td>ELDER</td>
<td>Rate of change in the number of the elderly (≥ 65 years old) % of dongs (12.31/46.88)</td>
<td>24.399 7.242</td>
<td>4.596</td>
<td>rate of change†/vacant†</td>
</tr>
<tr>
<td>EDU</td>
<td>Ratio of persons 20+ years old not having a high school diploma % of dong (9.68/35.19)</td>
<td>20.992 4.596</td>
<td>4.596</td>
<td>ratio†/vacant†</td>
</tr>
</tbody>
</table>


chance of recovering (Lee, 2018; Silverman et al., 2013; Sternlieb et al., 1974; Xie et al., 2018).

### 3.2.2. Economic and socio-demographic factors (level-2 variables)

The concentration of underprivileged groups, including the impoverished and the elderly, in the inner-city areas forms a vicious circle with poor neighborhood environments, such as dilapidated yet affordable housing, fostering the spatial heterogeneity of urban shrinkage (Bassett et al., 2006; Silverman et al., 2013; Xie et al., 2018).

The ratio of households receiving the national basic livelihood benefits (BASIC) was added considering the lack of community capacity to improve substandard houses in economically depressed areas. Each rate of change in the number of manufacturing companies (MANUF) and retail businesses (RETAIL) between 2010 and 2015 was examined, given that changes in industrial structure and commercial districts have a substantial impact on population inflow and outflow (Bassett et al., 2006; Xie et al., 2018). Furthermore, the rates of change in the number of the total population (POP) and the elderly aged 65 and older (ELDER) between 2010 and 2015 were selected as representative variables related to the rapid socio-demographic shift that has become the leading driver of urban shrinkage and housing abandonment in East Asian countries (Bassett et al., 2006; Lee, 2018; Silverman et al., 2013). Lastly, the ratio of persons 20 and above not having a high school diploma measured the influence of educational inequality, including renowned school districts, concentrated highly educated people, and decent facilities, which plays an important role in determining not only the image of an area but also whether or not residents with school-aged children leave the area (Batchis, 2010; Xie et al., 2018).

### 3.3. Modeling

The multilevel structure of the dataset, whereby level-1 units (parcels) cluster within level-2 units (dongs), poses an analytical challenge in estimating the probability of vacant housing (Kim et al., 2014). Because of the similar built-environmental and socio-economic characteristics that exist in each dong, spatial dependence between parcels from the same dong is greater than that for parcels from different dongs. The within-cluster dependency can lead to invalid statistical analysis results, by violating the ordinary regression-model assumption that individual observations are conditionally independent of each other (Kim et al., 2014). Multilevel modeling addresses the spatial autocorrelation issue by incorporating explanatory variables at different levels and a random intercept. Particularly, since the dependent variable of HADS is a dichotomy of 1 or 0, we applied Multilevel logistic regression model using the STATA program as follows:

\[
\text{Logit} \left( P_{ij} \right) = \beta_0 + \beta_1 X_{ij} + \beta_2 X_j + u_j
\]

\[u_j \sim N \left( 0, \sigma_u^2 \right)\]
Where $p_i$ is the probability of a building $i$ being vacant in a dong $j$; $X_i$ and $X_j$ are the level-1 (parcel-level) and level-2 (dong-level) variables, respectively; $u_j$ represents the level-2 (residual) variance.

4. Results

4.1. Shrinking inner city’s vacant houses

According to the findings, 1,201 of the total 1,631 vacant houses in Incheon (73.6%) were found in the inner-city areas—Jung-gu, Dong-gu, and Nam-gu. Given that the three gus (excluding Yeongjong-do) accounted for 13.2% of the city’s total area and 19.3% of the population, a remarkable imbalance was observed between the inner city and the periphery. Additionally, as of 2017, nearly 28.3% of the entire population aged 65 and up belonged to the inner city (including Yeongjong-do). In 2015, the old town of Jung-gu contained 10.4% of the population under the age of 15 and 18.5% of the population aged 65 and older among the total population, while its new town covered 19.8% and 9.1%, respectively; the new town had about twice the youth and half the seniors as the old town, in terms of percentage. Yeongjong-do, the new town of Jung-gu, had no vacant houses.

Microscale inspections revealed that vacant houses were concentrated in a few specific areas of the inner city, especially in the former redevelopment districts (Figure 3). As of July 2017, there were five planned redevelopment districts in Jung-gu, 14 in Dong-gu, and as many as 27 in Nam-gu except for apartment reconstructions. Of the above 1,201 vacant houses in the inner-city areas, 761 units (64.4%) were clustered in these districts.

4.2. The spatial selectiveness of housing abandonment

The results of multilevel logistic regression with HADS verified the spatially selective occurrence of vacant houses in Incheon’s inner city (Table 2). The final model’s Intraclass Correlation Coefficient (ICC) of 0.146, which declined stepwise from the null model, was statistically significant, justifying the adoption of this multilevel logistic model rather than an ordinary least-square model. The dong-level Pseudo R-squared value indicated that between-dong residual variance decreased by 78.4% from the null without independent variables to the final model. $-2LL$, AIC, and BIC goodness-of-fit statistics also dropped with the addition of successful predictors.

In terms of the built environment, low-cost, low-quality buildings influenced residents to regard their investment in and maintenance of these structures as unproductive and to consider easily abandoning them. Although some well-maintained houses are also abandoned, most are quickly repaired or repurposed by owners or municipalities before becoming long-term vacant houses. The variables YEAR and STRUCT indicated that relatively older buildings built of fragile materials may be more vulnerable to being converted into vacant houses. Buildings constructed before 1980 accounted for 38.2% of occupied houses, but 70.7% of vacant houses. 4.1% of the former were made of wood, while the latter constituted 39.8%. Prior to the
rapid increase of single and multi-family brick houses in the 1980s, most buildings in South Korea were made of wood requiring steady upkeep to prevent their relatively fast obsolescence. The variables $TFA$ and $LPA$ showed a high possibility of buildings being abandoned when their respective areas were less than $85\text{m}^2$ and $90\text{m}^2$; also, the $FLOOR$ variable had a negative correlation with the dependent variable, suggesting that structures of smaller scale were more likely to be abandoned. Particularly in Incheon’s inner city, urban blocks with extremely small houses that could not even satisfy the minimum standard of living space were observed, revealing that its average and minimum total floor area of vacant houses were $64.7\text{m}^2$ and $9.4\text{m}^2$, respectively. Poorly-maintained and overly-crowded buildings
in shrinking areas with ever-dwindling populations could not meet the upward needs of the remaining residents, and impeded essential redevelopment projects due to the difficulty in securing the existing floor area ratio and promoting projects with owners of tiny lands (Jeon & Kim, 2016; Kwon et al., 2014).

All three variables of SLOPE, SHAPE, and ROAD indicating physical inaccessibility presented a positive association with housing abandonment. Parcels with very small entranceways restricting pedestrian movement, e.g. inverted triangular shapes, or parcels facing narrow roads that did not allow vehicles, especially located on slopes,
increased the risk of getting abandoned. Buildings positioned inside blocks or at the ends of alleyways on the hills deterred residents from maintaining their houses because of inadequate security and sanitation, as well as plummeting property values. Difficult-to-reach buildings, after being transformed into vacant houses, decayed unnoticed by people. The **REDEV** variable correlated positively with the dependent variable, confirming the forementioned hypothesized relationship. As of 2017, 46 planned redevelopment districts were located in Jung-gu, Dong-gu, and Nam-gu, encompassing 2.6 km² or approximately 5.6% of Incheon’s inner city except for Yeongjong-do. Large-scale redevelopment projects that were postponed or canceled after the indiscriminate district designation have had critical impacts on the decline of the inner city, distinctively incurring clusters of vacant houses (Jeon & Kim, 2016; Jeon & Kim, 2020; Silverman, 2020). The **PRICE** variable had no significant effect on the likelihood of abandonment, which can be interpreted as a result of the overall dropping inner-city land values. For example, the nation’s five regions with the lowest average annual rate of change in individual land prices included Jung-gu, Dong-gu, and Nam-gu in 2012, Jung-gu in 2013 and 2014, and Dong-gu in 2017.

In terms of economic and socio-demographic attributes, the dysfunctional manufacturing industry and commercial districts, as well as socially disadvantaged areas contributed to reduced local economic vitality and stigmatized neighborhood images, spurring housing abandonment. The **MANUF** variable associated positively with the occurrence of vacant houses, while the **RETAIL** variable correlated negatively. Incheon’s industrial structure has been centered on low-value-added manufacturing despite the country’s overall trend toward deindustrialization. Manufacturers in the inner city became worse off and smaller in size, indicating that the areas where they were concentrated did not function as pleasant residential districts. As of 2017, 80.1% of all businesses in Incheon had fewer than five employees; and manufacturing workers ranked first, accounting for 24.7% of the total workforce. Moreover, traditional marketplaces and retailers around the Gyeongin Railroad Line in the inner city have been declining for decades as new commercial centers were created in the suburbs. The decreasing vigor of major commercial districts prompted a population outflow from neighboring residential areas, encouraging residents to leave their depreciated houses. Meanwhile, the **BASIC** variable did not appear to be a significant determinant of housing abandonment.

The **POP** variable had a statistically-significant inverse relationship with the probability of abandoned houses. Between 2010 and 2015, 15 of the inner city’s 22 adjusted **dongs** witnessed population declines, with a peak of −11.9%; the area (dong) with the highest population growth rate of 29.8% was part of Yeongjong-do with new towns under Jung-gu, one of the inner-city districts. This suggested that, even within the inner city, population distribution and vacant house density may differ depending on various development plans including the construction of new apartment complexes. The **ELDER** variable was not significant with a negative coefficient, unlike the above hypothesized relationship. This finding was consistent with some previous studies that found an inverse association between the proportion of the elderly and the incidence of vacant houses (Park & Oh, 2018). This unexpected result can be attributed to the substantial increase in the elderly in almost all areas
of Incheon’s inner city. During the past five years, all 22 dongs were afflicted by a precipitously rising aging population, up to 46.9%. This shift has considerable relevance to the issue of South Korea having the highest poverty and suicide rates of the elderly among OECD countries, eventually incurring socially unsustainable cities (OECD, 2019). The EDU variable had a positive correlation with the dependent variable as expected, but it was not statistically significant. This finding can be inferred to be a result of the generally high percentage of people who did not graduate from high school in the inner-city dongs, with an average of 21.0%, higher than Incheon’s overall average of 15.4%, and with a maximum of 35.2%.

5. Discussion

A spatially selective pattern of vacant houses, a manifestation of growing spatial polarization, was observed even within the inner-city areas. Based on the foregoing findings, the following three issues can be further explored: (1) spatial inequalities were evident within smaller spatial units, such as intra-urban, intra-downtown, neighborhood, and even urban block scales; (2) delayed or canceled redevelopment districts within the inner city established enclaves of vacant houses; and (3) the skewed demographic structure exacerbated spatial polarization threatening social sustainability in addition to the well-known economic disparities and accompanying residential segregation.

Spatial unevenness has taken on multiple scales and patterns in accordance with the central and local governments’ development policies (Kilroy, 2009). As with other fast-growing cities in developing countries, urbanization and industrialization, based on South Korea’s rapid economic development since the 1960s, have resulted in greater regional imbalances between urban and rural areas. Then, numerous municipalities, including Incheon, have developed new suburbs outside the existing inner city and relocated major institutions since the 1980s. Inner-city districts with deteriorated detached and multi-family houses were in stark contrast to newly created suburbs with up-to-date apartment complexes. Incheon’s inner city held about three-quarters of the total vacant houses despite its much smaller area and population than the new suburbs. Furthermore, the majority of inner-city regeneration initiatives concentrated on revitalizing subway station areas or central commercial districts, thereby excluding general residential neighborhoods from the development plan’s benefits. Canceled inner-city redevelopment projects because of the economic downturn and low profitability devastated already-declining neighborhoods, producing vacant housing clusters. Several older neighborhoods in major cities’ inner cities were redeveloped into luxurious gated communities of large apartment complexes for the upper middle class, accentuating the obvious physical and economic disparities at small urban spatial scales.

The redevelopment districts were typical of the most vulnerable areas even inside Incheon’s shrinking inner city, with almost two-thirds of its total vacant houses (Jeon & Kim, 2020). Many inner cities in South Korea have witnessed the rise of clustered vacant houses because of the cruel process of redevelopment failure. Ironically, contrary to some shrinking cities in Japan and Europe, where the value of abandoned properties dropped to nearly zero, strong resident expectations for
future redevelopment kept vacant house prices in Korea from plummeting. However, as many residents who had left their houses persistently retained ownership for the above reason, local governments were unable to promote maintenance, culminating in devastated urban islands full of vacant houses.

The socially underprivileged groups were concentrated in physically deteriorated areas, exacerbating the spatial disparity. Based on the Hoyt sector model describing residential segregation by economic classes, the filtering process led the middle class to relocate to the new suburbs while the economically disadvantaged stayed in Incheon’s inner city. However, long-term persistent and spreading shrinkage has highlighted the importance of social determinants in spatial differentiation beyond economic factors. In South Korea, which entered an aged society with an elderly population ratio surpassing 14% in 2018, the young population has moved to new suburbs to enjoy pleasant and convenient residential spaces, well-established educational environments, and trendy cultural and commercial facilities, while the elderly population with physical and economic inability to move has remained in inner cities. The decline of inner cities has accelerated, along with an increase in vacant houses, because of the elderly having little capacity to improve the residential environment and the young’s amenities leached away to the suburbs. Inner cities were labeled as inconvenient and unattractive places for highly educated young people, illustrating a severe spatial confrontation between generations.

6. Conclusion

The uneven distribution of vacant houses and related influencing factors, derived from the multilevel logistic regression model including the valuable parcel-level dataset, provide some planning and policy implications for resolving the issues of urban shrinkage and spatial inequality.

First, regular inspections on vacant houses at the micro-spatial level are required, and relevant management plans tailored to neighborhood and community characteristics should be developed for sustainable regeneration. Second, to cope with the possibility of vacant house clusters, it is necessary to clearly define an area with a high concentration of vacant houses and devise a management system distinct from simply maintaining individually scattered vacant houses. Third, an in-depth comprehension of the inner city’s shifting demographic structure, such as the soaring elderly population, is crucial for breaking the vicious cycle between housing abandonment, urban shrinkage, and spatial inequality. Buildings at risk of being converted to vacant houses, including dilapidated houses owned by elderly people living alone, can be managed separately to enable proactive responses to long-term vacant houses. Lastly, further elaboration of vacant house data, establishment of time-series data, and acquisition of owner information may provide the means for a multidimensional analysis of the characteristics of housing abandonment.

However, the most fundamental aspect is that decisions on associated policies, such as how to utilize vacant houses, must be in the hands of the residents left in the declining neighborhoods. Therefore, future research should focus on investigating residents’ perceptions of urban shrinkage and housing abandonment, as well as formulating measures to improve their quality of life.
Notes
1. South Korea’s capital area refers to Seoul and its environs, Gyeonggi Province and Incheon Metropolitan City.
2. Although Yeongjong-do (island) is under the jurisdiction of Jung-gu, which is classified as one of the old inner-city districts, it is exceptional in terms of their typical shrinkage pattern. Yeongjong-do has grown in tandem with the development of Incheon International Airport and new towns since the 2000s.
3. Administrative dong is a unit of the administrative district established for administrative convenience, whereas legal dong is an administrative district unit designated by law. Administrative dongs are often founded or abolished according to the increase or decrease in the number of residents, as opposed to legal dongs, which have little change based on unique place names passed down from ancient times.

Disclosure statement
No potential conflict of interest was reported by the authors.

Funding
This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) (2020R1A2C4002751).

References
Joo, Y. & Seo, B. (2018) Dual policy to fight urban shrinkage: Daegu, South Korea, Cities, 73, pp. 128–137.


