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Decoding Socio-Economic Demographic Trends: The Power of Spatial Econometrics and Geographic Analysis

Evgenia Anastasiou

Department of Planning and Regional Development, University of Thessaly, 38334 Volos, Greece; evanastasiou@uth.gr

Abstract: Greece is experiencing a steady population decline caused by the declining migratory and natural balance. This research investigates the spatial impact of socio-economic and demographic factors on the natural population balance in Greece for the spatial zoning of municipal administrative units. Using geographically weighted regression (GWR) on data from the 2011 Greek census, the research explores the local impacts of factors like housing repair permits, vacant housing, employment rates, population inflows, distance from regional centers, aging, gender ratios, and education levels. An initial ordinary least squares (OLS) regression was conducted, revealing significant spatial variation and emphasizing the necessity of spatial econometric methods. The GWR model proved to be more effective in accounting for the variance in the data, removing spatial autocorrelation and revealing high local variation. Results show the high negative impact of the aging index in Western Greece and the Ionian islands, the counterintuitive positive effect of the gender ratio in urban areas, and the positive influence of population inflows in high-migration regions like Northern Greece and Crete. The results of this study underline the need to utilize spatial econometric methods for a precise and detailed understanding of demographic trends and provide valuable insights for localized strategies to address demographic challenges.

Keywords: spatial econometrics; spatial modeling; geographically weighted regression (GWR); demographic trends; spatial analysis; local variation; spatial patterns; population; natural balance

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1. Introduction

The review of demographic and economic analysis of social aspects influencing population balance represents a distinct research area within the European Union. This is particularly genuine in regions with declining birth rates, an increasingly elderly population, and migrant pressures, all of which are present to varying extents across EU countries. Methodological and conceptual concerns aside, a clear understanding of demographic processes is crucial for effective regional planning and policy provision.

For Southern European countries such as Italy and Spain, many demographic issues are mirrored (aging populations, low birth rates, and migration). The high aging rates and decreasing birth rates are not just statistics; they are urgent problems that put pressure on social systems and reduce economic growth [1]. Demographic trends are occurring in France that point to the continuous population aging as an effect of enhanced life expectancy and a fall in birth rates. While the stagnation of births and the effects of economic insecurity are imposing constraints, it is essential to note that international migratory flow continues to play a significant role in fueling population growth [2]. The demographic changes in Germany are complex and multifaceted. The aging of households is not only due to the recent high life expectancy but also one of the lowest fertility rates across Europe. Although migration is still the leading cause of population growth, there is little more than a slight positive net demographic increase. For the central part, births are not affected or at least less significantly affected where children increasingly put their parents' lives to the test economically and socially by overloading childcare facilities, increasing parental

leave or extending working hours, and continuously widening expectations regarding availability in firms during family-friendly career promotion [3]. Furthermore, the demographic challenges in Central and Eastern Europe, particularly Poland and Hungary, are pressing. Implementing effective policies in these countries, such as increased childcare support, incentives for larger families, and occasional tax relief, is paramount [4]. However, the outcomes are still limited by economic disparities and the allure of Western labor markets [5].

Turning to Greece, the birth rate has declined, and the age-specific fertility rate is above 1.3 live births per woman [6]. Life expectancy is on the rise, and the migration balance remains negative, leading to further population decline. These changes are the result of complex socio-economic and cultural factors. Greece also faced severe economic problems in the late 2000s, with high levels of unemployment and bleak prospects for those considering having children or expanding their families [7]. Another factor contributing to the population decline is the increase in emigration, particularly of young and educated individuals seeking better opportunities elsewhere [8].

Meanwhile, the trend of an aging population due to better life expectancy and decreased birthrates has placed more significant pressure on social services and economic sustainability [9]. Additionally, internal migration has experienced a shift from rural areas to urban regions, reinforcing demographic challenges for the sparsely populated regions [10,11]. In order to effectively alleviate these deleterious effects on the Greek economic and social landscape, it is equally necessary to conduct in-depth examination of those spatial dimensions characterizing demographic transformations and to construct policy interventions targeted at providing solutions. Such demographic shifts carry with them broad socio-economic implications and should be thoroughly examined.

The present study used the geographically weighted regression method to analyze spatially dependent demographic, social and economic background characteristics related to Greece's natural population balance. Drawing on 2011 census data and including a suite of explanatory variables such as housing repair permits, vacant percentages, local employment rates, population inflows, distance from regional centers, aging indexes, gender ratios, and education levels, the aim was to shed light on the spatial implications of these factors at the municipal level, providing a fine-grained view of demographic space.

Unlike traditional econometric models, where the possibility of spatial dependencies and heterogeneities is not accounted for, spatial econometrics gives a solid foundation to study sparsity on data related directly or indirectly to evolving areas [12]. Geographically weighted regression (GWR) is a valuable tool in spatial econometrics for conducting localized analysis. It helps to identify how demographic variables vary from region to region, providing detailed insights into each municipality or geographic entity [13]. Previous research has underscored the importance of spatial analysis in understanding demographic phenomena, demonstrating that the spatial patterns inherent in population data can reveal crucial local differences that are often obscured by generic summaries [14]. Additionally, as Reibel [15] noted, spatial regression models make a significant contribution to demography by allowing us to explicitly consider the geographic context of demographic processes.

While the widespread dissemination of detailed data through the 2011 Greek census has encouraged research, many recent contributions have been limited to descriptive results. There has been a lack of research in Greece using advanced spatial econometric methods to analyze local demographic and socio-economic trends. This study aimed to address this gap by examining these trends at the smallest spatial level in Greece (municipal units) and across the entire country, allowing for a nuanced understanding of regional and localized demographic and socio-economic patterns and contributing valuable insights into underexplored urban and regional variations.

The paper is structured as follows: Section 2 overviews the study. The Data and Methods (Section 3) Section outlines the data sources and the methodology, including OLS-based model followed by GWR. The results of the empirical analysis are presented in Section 4. Finally, Section 5 concludes by summarizing the implications of our findings for

regional planning and policymaking, discussing their relationship to previous work, and suggesting potential areas for future research.

2. Materials and Methods

This study aimed to examine the spatial variation in determinants such as demographic, economic, and social factors that affect the natural population balance in Greece, which refers to the equilibrium between births and deaths in a given population (Figure 1). It also aimed to reveal the dynamic effects of other socioeconomic variables on the birth-to-death ratio at the municipal administration level through geographically weighted regression (GWR). Therefore, this research addresses the following main hypotheses to fulfill its objective in a practical setting:

Hypothesis 1. *Socio-Demographic Determinants of Population Balance.*

The natural population balance is positively associated with greater housing availability (vacant dwellings) and negatively influenced by higher aging indexes, indicating an older population. Numerous empty dwellings are likely to create a favorable natural population balance, as housing availability in these areas tends to attract new residents [16]. Conversely, an increased life expectancy reduces population balance and indicates lower fertility rates and higher dependency ratios that culminate in demographic incidence [1]. This hypothesis is grounded in demographic transition theories that link housing dynamics and population aging to regional demographic outcomes. Housing and population aging dynamics are related to regional demographic patterns, providing the context where an area could benefit from additional theoretical development.

Hypothesis 2. *Impact of Accessibility on Population Balance.*

The closer a location is to urban centers, the more advantageous its effects on natural population balance. These centers play a crucial role in providing myriad opportunities, including jobs, services, and educational opportunities. Inversely, locations that are more remote from these centers are anticipated to negatively affect population stability as barriers to accessibility diminish, leading to outmigration and lower fertility and household growth [17].

Hypothesis 3. *Spatial Variation in Local Determinants.*

Socio-demographic variables like migration inflows and local employment rates have different spatial impacts across Greek regions. Specifically, areas experiencing higher inflows of younger migrants will demonstrate more favorable natural population balances due to the demographic characteristics associated with these populations, including higher birth rates and a lower aging index. On the contrary, areas with lesser levels of migration tend to experience stagnation or decline due to aging populations, population growth, and low fertility. This hypothesis shows the necessity of considering how local socio-economic contexts mediate demographic dynamics, as different impacts of demographic determinants may produce divergent fertility-balancing outcomes across municipalities [13].

Hypothesis 4. *Effectiveness of GWR in Modeling Local Determinants of Population Balance.*

GWR can help to build a less biased model of the local determinants driving natural population-balance enhancement compared with traditional OLS regression models. If GWR can effectively capture spatial heterogeneity, we expect it to outperform the traditional OLS model in revealing its local predictors on natural population balance. The contrast between OLS, which assumes the effects of variables are the same across space, thus neglecting local contexts, and GWR, which considers that the coefficients vary spatially and provides richer results on how demographic and economic factors affect population

dynamics for municipal units, is a key aspect of our research. This unique ability of GWR to explain more local and regionally complex patterns that classical models might miss [13,18] offers a more detailed picture of how demography affects various regions.

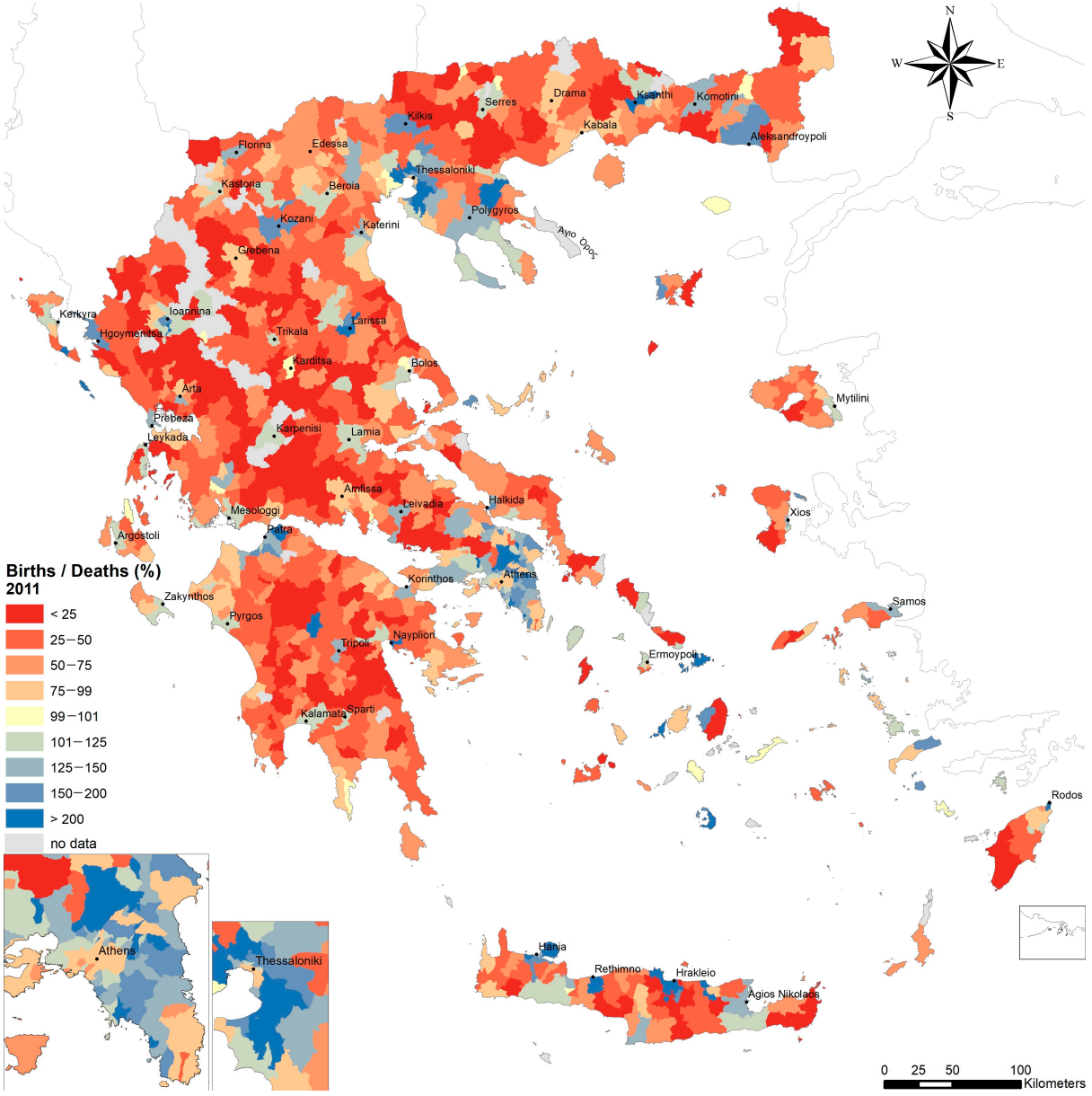

Figure 1. Spatial Distribution of the Natural Population Balance in Greek Municipalities (2011).

2.1. Study Area, Spatial Scale, and Data

This paper is based on a comprehensive study in Greece that analyses municipalities' demographic and socio-economic factors. The analysis covered the spatial scale of municipalities, specifically the Kapodistrian Municipalities as defined by 2011 administrative regions (LAU1). Fine spatial granularity allowed for detailed examination of localized variations, providing a comprehensive view of regional demographic trends. The data for this study were obtained from the 2011 Population Census conducted by the Hellenic Statistical Authority (Table 1).

Table 1. Definitions and Descriptions of Explanatory Variables.

Dependent Variable	
Natural Population Balance	The ratio of births to deaths in each municipality
Explanatory Variables	
Housing repair permits	The percentage of permits issued for housing repairs and renovations relative to the total building permits issued
Vacant housing	The percentage of vacant housing units in each municipality
Local employment rate	The percentage of the population employed within the same municipality
Population inflows	The percentage of the population that has moved into the municipality from other areas
Distance from regional center	The distance of each municipality's centroid from the administrative center of the respective regional unit
Aging index	The ratio of individuals aged 65 and above to those aged 0–14, indicating the aging population.
Gender ratio	The percentage of males to females in each municipality
Education level	The percentage of employed individuals with education up to primary school level

2.2. Methods

The analysis first estimated an ordinary least squares (OLS) regression model to determine the initial relationships between our dependent and explanatory variables. The OLS model is defined as follows:

$$y_i = \beta_0 + \sum_{k=1}^{p} \beta_k x_{ik} + \varepsilon_i$$

where y_i is the natural population balance at location i, β_0 is the intercept term, β_k are regression coefficients for k-th explanatory variable, and ε_i is error term. This model gives a hypothesis of the global relationships when we treat all study area as equal.

The GWR model used in this work is a linear-type, which as such applies for variable of the ratio of births over deaths (natural population balance). GWR is a type of local regression that captures locally linear relationships between dependent and independent variables, thus allowing study of how these relationships evolve across different geographic areas. Where the local system must be defined in linear form, the GWR model is given as follows:

$$y_i = \beta_0(u_i, v_i) + \sum_{k=1}^{p} \beta_k(u_i, v_i) x_{ik} + \varepsilon_i$$

where y_i represents the population balance, (u_i, v_i) are local coordinates at location i with respect to relevant explanatory variables k, and ε_i represents error term.

The GWR model was based on the 2011 Hellenic Statistical Authority (ELSTAT) population census data, a comprehensive and reliable source of demographic and socio-economic information. This dataset includes housing repair permits (%), vacant housing percentages (%), local employment rates (%), population inflows (%), distance from regional centers (km), aging indexes (ratio of individuals aged 65 years old or more to those at up to age 14 years old), gender ratios (% male/female ratio), and employed individuals by education level up to primary school (%). The dataset is geocoded to the centroids of the Kapodistrian municipalities. All variables are standardized to have a mean of 0 and a standard deviation of 1 for comparison and estimation purposes.

The calibration process was carried out using the versatile GWR tool in ArcGIS. We input the spatial coordinates of each municipality centroid to capture proximity relationships. The GWR tool's adaptability is demonstrated in the selection of a bandwidth that determines the size of each local regression in terms of support. This bandwidth was chosen using an adaptive method, which guarantees a minimum number per estimation. The optimal bandwidth was then determined using the minimum Akaike Information Crite-

rion (AIC). The GWR tool subsequently calculates local regression coefficients for every municipality, which shows the changes in the effect of each explanatory variable from one location to another.

Various statistical measures were employed to evaluate the performance and goodness-of-fit of the GWR model. The R-squared (R^2) value is the proportion of variance in natural population balance explained by explanatory variables. A higher value of R^2 suggests that the model better fits the data. The Akaike Information Criterion (AIC) for model fit was employed and adjusted for the number of estimated parameters; small values of AIC indicate better-fitting models. The Moran's I statistic is a valuable tool in determining the residuals from the GWR model. The absence of strong spatial autocorrelation in the residuals not only validates our findings but also assures that no further, pertinent geographical structures need to be described.

3. Results

The descriptive statistics of the initial analysis show extensive suppression of demographic trends at more minor scales within Greek municipalities (Table 2). High variety levels in housing repair permits and local employment rates demonstrate various economic conditions and infrastructure requirements among regions. Population inflows and the aging index also differ, indicating diverse effects on demographic composition, especially regarding birth rates and age structure. In addition, the large disparity in distance to regional centers also creates potential inequality within access to services, which could affect demographic movement. Policy adjustments must consider the unique regional variations when tackling demographic challenges in Greek municipalities.

Table 2. Descriptive statistics of Explanatory variables.

Variables	Median	Mean	Std. Dev.	CV (%)
Housing repair permits	50.8	73.3	86.4	117.9
Vacant housing	22.6	23.4	9.1	38.9
Local employment rate	3.6	5.4	6.0	111.1
Population inflows	68.3	64.3	19.5	30.3
Distance from regional center	13.0	18.2	29.6	162.6
Aging index	29.2	34.1	26.7	78.3
Gender ratio	186.6	231.1	163.0	70.5
Education level	100.5	101.5	9.2	9.1
Housing repair permits	27.7	28.2	13.8	48.9

3.1. Ordinary Least Squares (OLS) Regression Results

The initial analysis involved estimating an Ordinary Least Squares (OLS) regression model to identify the relationships between the natural population balance and the selected explanatory variables. The OLS model provided a global assessment, assuming homogeneity across the entire study area (Table 3).

Table 3. OLS Model Summary.

Measure	Value
R^2	0.321
Adjusted R^2	0.304
AIC	10,927.2602
F	47.8

The regression coefficients, along with their statistical significance, were calculated for each variable (Table 4).

Table 4. OLS Regression Results.

Variable	Coefficient (β)	Std. Error	t-Value	*p*-Value	Tolerance	VIF
Intercept	168,936	29,922	5.646	0.000		
Housing repair permits (%)	−635	225	−2.152	0.005	0.849	1.178
Vacant housing (%)	1381	453	2.872	0.002	0.728	1.374
Local employment rates (%)	−471	196	−2.923	0.016	0.619	1614
Population inflows (%)	284	234	3.136	0.226	0.854	1.172
Distance from regional centers	−152	73	−1.446	0.038	0.778	1.285
Aging index	−131	18	−7.380	0.000	0.731	1.368
Gender ratio (%)	59	218	0.206	0.787	0.889	1.125
Education levels (%)	−1186	243	−5.021	0.000	0.577	1.733

However, the residuals of the OLS model showed a notable pattern of spatial clustering, as highlighted by Moran's I statistic (Figure 2). This indicates that the OLS model may not fully reflect the spatial diversity within the data. To overcome this issue, a geographically weighted regression (GWR) model was introduced to better capture the local variations in the relationships between the dependent and independent variables.

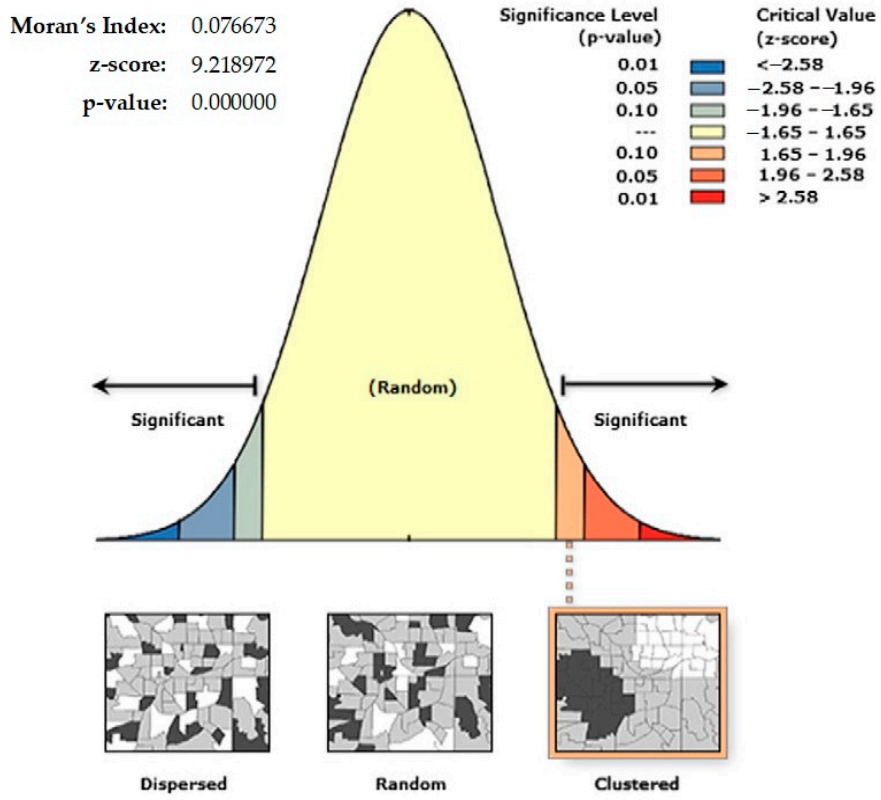

Figure 2. Moran's I Spatial Autocorrelation Analysis (OLS).

3.2. Geographically Weighted Regression (GWR) Results

To better address the spatial differences in the data, a geographically weighted regression (GWR) model was employed. This approach allowed us to capture local variations in the regression coefficients, offering deeper insights into how the various explanatory variables influence the natural population balance across different municipalities.

The GWR model demonstrated a significant improvement in explanatory power, accounting for 43.5% of the variance in the natural population balance. Although the AIC value

of 90,279,791 is higher than that of the OLS model, this is expected given the GWR model's added complexity, which accommodates local variations and offers a more nuanced understanding of spatial relationships. Local R^2 values differed across municipalities, with a median value of 0.609, underscoring the considerable spatial variability present in the data. The GWR results are detailed in Figure 3 and Table 5.

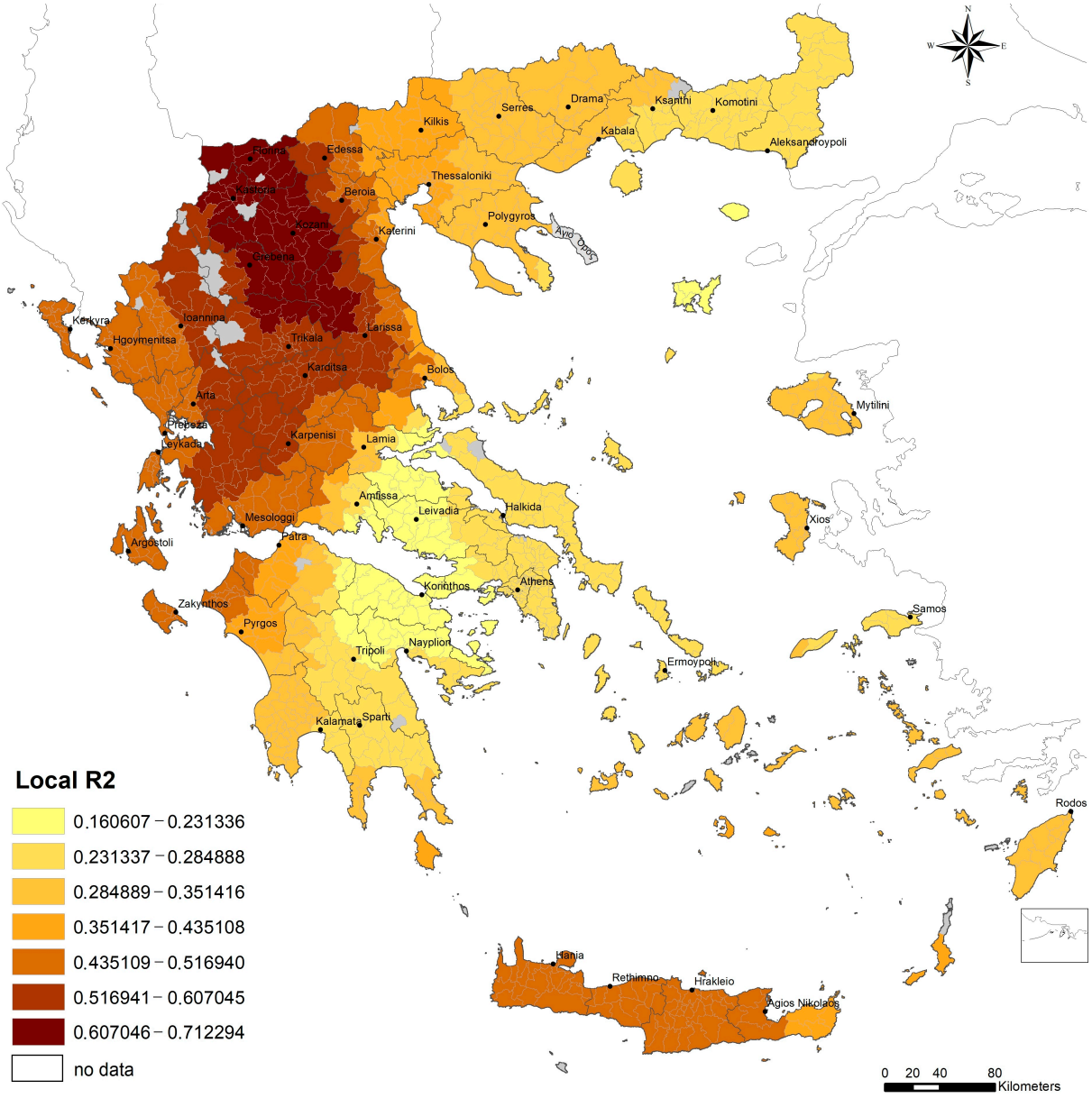

Figure 3. Spatial Distribution of Local R^2 Values from the GWR Model across Greek Municipalities.

Table 5. GWR Model Summary.

Measure	Value
R^2	0.487
Adjusted R	0.435
AIC	90,279,791
Local R^2 (Median)	0.609

The residuals from the GWR model for spatial autocorrelation using Moran's I statistic were checked (Figure 4). The fact that there was no significant spatial autocorrelation

in the residuals suggests that the GWR model successfully captured the spatial patterns within the data.

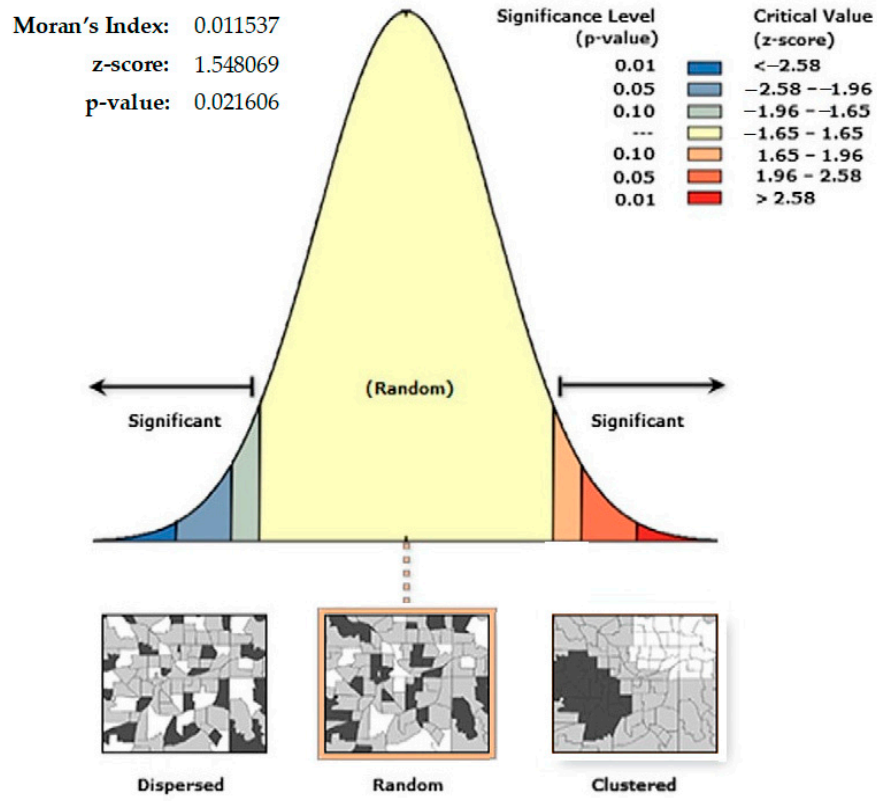

Figure 4. Moran's I Spatial Autocorrelation Analysis (GWR).

The GWR model results, with their marked spatial non-stationarities in the effect of explanatory variables on natural population balance within different Greek LAU-1 municipalities, underscore the importance of our study (Figure 5). This study revealed the crucial role of local context in demographic dynamics, a nuance that an OLS model failed to capture.

The negative effect of housing repair permits (%) on the natural population balance in various municipalities, particularly along southern Pelion and central and northern Evia, suggests that areas with more housing repairs could experience demographic declines. This fact could manifest as outmigration or an aging population choosing to invest in property upkeep rather than new builds or starting families.

Vacant housing (%) exhibited a strong positive correlation to the natural population balance in Epirus, western Macedonia, and Crete, followed by the Aegean islands. So, the paradoxical result could be that places with a high proportion of housing units awaiting occupants are providing magnets for new residents, possibly because they have more affordable housing or greater availability of houses for newcomers and thus build up their populations through natural increase (the number by which births exceed deaths).

The effect of local employment rates (%) on the natural population balance was region-specific, with different magnitudes. The analysis found a negative effect of high local employment rates on the natural population balance in urban areas. This result is likely because the urban workforce has lower fertility, possibly due to career-centered lifestyles or the high cost of living. Conversely, in some rural regions, such as Thessaly and Crete, higher local employment rates positively affect the natural population equilibrium. This effect is likely from more financial stability in rural areas, which could lead to family expansion and less outmigration.

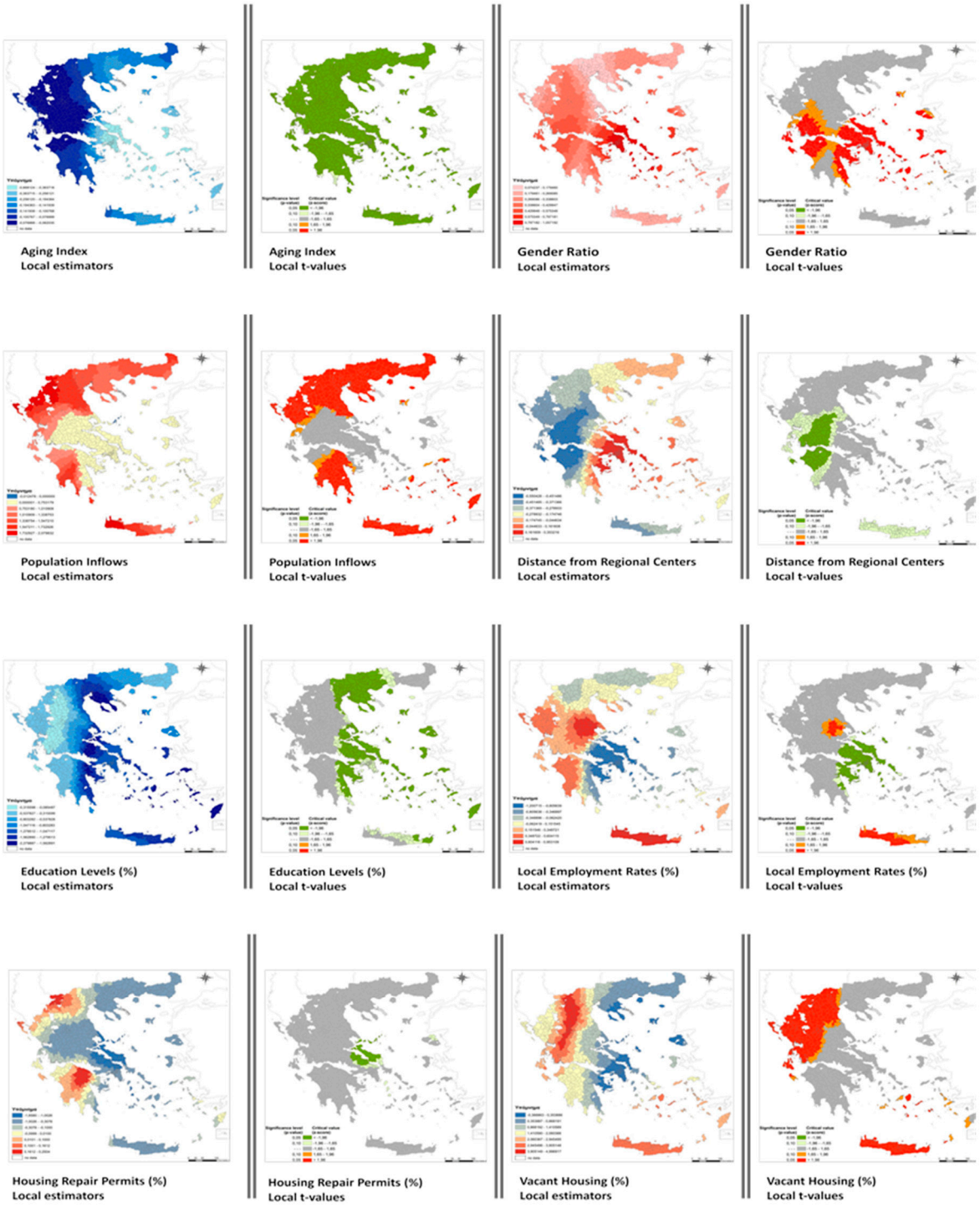

Figure 5. Spatial Distribution of Explanatory Variables and Their Significance in the GWR Model across Greek Municipalities.

Education levels (%) negatively impacted natural population balance, especially in municipalities where the percentage of educated, employed people up to the primary level was high. Lower educational attainment goes hand in hand with population decline because residents whose opportunities and income appear stunted by the area might either start fewer families or leave.

Distance from regional centers hurts the natural population balance of the more distant municipalities. Farther distances from regional centers, which are often significant

employment and service nodes, mean the population decreases, and there needs to be more access to jobs and education.

The aging index had a robustly negative coefficient for all municipalities, especially in Western Greece and the Ionian Islands. This is consistent with what demographic theory would predict—larger elderly shares cause fewer births and more deaths in a population, which, taken together, results in an overall natural decrease. Understanding these quantities and the spatial differences in them is key. It allows us to see that aging populations can either exacerbate or alleviate the sensitivity of these variables locally, thereby amplifying the depopulation caused by population age structure. This also presents an opportunity for positive change, as it highlights the potential for specific policy measures to be directed to areas where older populations represent a large share, thereby mitigating the effects of depopulation.

The spatial variation of this variable and its sensitivity suggest that areas with a high proportion of elderly population are particularly affected by aging populations, necessitating specific policy interventions to counteract demographic decline.

Population inflows (%) were positively associated with the natural population balance in regions displaying migration attraction, which refers to areas that attract many migrants due to employment or living conditions, especially in Northern Greece and Crete. Areas that attract a large population for employment or living conditions have the most stable and growing populations. Contrary to theoretical expectations, the gender ratio (%) unexpectedly positively affects the natural population balance in urban areas.

The spatial analysis from the GWR model highlights the significant variations in demographic trends across different regions of Greece. These results stress the need for policy measures that are carefully customized to fit the specific demographic and socio-economic realities of each municipality. The fact that the GWR model offers more explanatory power than the OLS model highlights just how crucial spatial econometric techniques are in gaining a more precise and detailed understanding of demographic trends.

4. Discussion

This study used geographically weighted regression (GWR) to reveal the spatial dynamics of demographic and socio-economic determinants affecting the natural population balance in Greece. GWR enhanced the explanatory power of this model by capturing spatial heterogeneity and offering a better understanding of local demographic dynamics.

The analysis showed significant local variation in the explanatory variables, such as housing repair permits and vacant housing, which can affect population balance in different municipal units. This emphasizes the need for demographers and policymakers to acknowledge these specific regional factors and tailor their interventions accordingly.

Housing repair permits have a negative effect on the natural population balance, with municipalities of southern Pelion and central and northern Evia revealing significant findings. The demographic shifts caused by these permits, where people are still maintaining their homes, have begun to lose population—people leaving the state or simply growing older and refraining from building new structures (or expanding families) at the expense of property maintenance—underscoring the urgent need for housing policy to focus on fostering new development rather than maintenance and repair. The urgency of this need cannot be overstated, as attractive regions may experience population decline or aging if younger citizens move, seeking more plentiful prospects in genuinely new development areas [16]. High housing prices due to constraints in supply can cause an exodus out of more expensive areas, moving towards cheaper locations, leading to changes in demographics and worsening the aging problem [19].

The share of vacant housing exhibited a strong positive linear correlation with the natural population balance rate in regions such as Epirus, Western Macedonia, and Crete, where this latter is negative, but also the Aegean Islands. In other words, perhaps areas with the most vacant housing are, in fact, drawing new residents to them—possibly because of cheaper housing pricing or due to empty properties that newcomers can pur-

chase [20]. Indeed, the previous literature has proven that converting void properties can help alleviate socio-economic pressures by increasing affordable housing and stimulating local economies [21]. Furthermore, strategically reusing and adapting vacant buildings can enhance available occupancy rates and foster urban regeneration [22]. These findings underscore the potential of well-managed vacant housing to attract new residents and contribute productively to community growth, which should inspire optimism among policymakers.

According to the analysis, there was no clear pattern of an impact on regional employment rates due to local trends. However, the results from this study confirm the central role of economic opportunities in determining population flows. This underscores the weight of decisions made by policymakers, as higher employment rates reduced the natural population balance, possibly as fewer children were born among an urban workforce. On the other hand, since higher local employment rates also had a significant positive effect on natural population balances in rural regions—Thessaly and Crete—it could be claimed that they ensure family increases instead of individual decreases, suppressing outmigration from these. Indeed, this conclusion is supported by research that considers economic stability and employment opportunities as the major driving forces to change demographic trends both in urban [23] and rural settings [24].

The natural population balance is negative [25] due to higher living costs in urban locations— where people are employed more frequently but live career-focused lifestyles with suppressed fertility. These factors play a vital role in contemporary fertility as urbanization leads to lowered birth rates, associated with more economically driven lifestyles [26], while employment within the city stimulates lower childbearing because it is often linked to higher quality of living and career-minded behavior [27]. Urban areas have lower fertility rates due to constraints on the economic conditions of families and reproductive freedom, all leading to reduced natural population maintenance. In contrast, rural areas profit from higher local employment rates that underpin economic stability and foster family formation, resulting in higher birth rates than outmigration [28]. A way to stabilize the demographic trends is by setting up economic structures in rural areas and retaining parts of each region's population so that even young people with families can be attracted [29].

There is a positive relationship between where the people are moving and whether or not they have a natural rate balance of population growth, likely due to economic pull factors/sources or factors related to healthcare and favorable living conditions. Some of this might be the same effort along different lines, as recent research shows regions with more economic and living conditions attracting immigrants while matching or increasing the net center population [30,31]. In this way, the demographic structure depends on economic growth and job availability, drawing more migrants, which leads to an increase in birth rates and a decrease in mortality. This statement follows the general view that economic circumstances and opportunities are some of the primary factors in determining demographic trends, particularly for places with a solid appeal to migrants.

In the more distant municipalities, in contrast, an adverse effect would be observed concerning changes referring to natural population balance. This finding indicates that the further a territory is from regional centers where economic activities and services are typically concentrated, the more demographic decline occurs, as these regions need access to employment opportunities, educational facilities, or healthcare. The location of places such as municipalities underlines the importance of more tailored policies in order to improve connectivity and accessibility, especially when emphasis is placed on how certain areas are still considered pockets found within geographic gaps [32]. Recent research findings concur with this by pointing to the importance of urban-central location for demographic stability and growth. Previous research has found that depopulation is concentrated in areas with poor service and social infrastructure but also follows the same negative trend regarding economic opportunities. According to a study of the influence of highway transportation infrastructure on flow and population aging, better highways linking periphery regions into the core city could attract more people immigrating, while economic levels rebalance developmental patterns [33].

Moreover, the study of urban and rural spillovers also shows that connectedness to urban activities and spatial proximity for rural territories can contribute significantly to accessing a more comprehensive range of economic opportunities and services available in cities. This has positive effects in terms of stabilization of demographics through the reduction of outmigration and is conducive to a higher birth rate, ultimately benefiting population growth [34]. Urban land expansion has also been a focus of the literature, highlighting administrative and economic hubs as critical determinants of city growth. It means that the closeness of these centers to the intensity and direction of urban growth is highly dependent on population distribution. Regenerated areas closer to regional centers have more balanced population dynamics because they enable better access to resources and opportunities [35].

This fits in the broader sense with our knowledge that being isolated geographically reduces the chances of having a certain level or type of service and, again, in demographic terms, extinguishes remote communities fast. Improving connectivity and public service availability in these areas is critical to developing effective policies that ensure demographic stability and growth. Improved transportation networks and technology structures give thousands of people the same opportunities as those near too-large cities [36].

Most municipalities displayed strong negative associations linked to the aging index, identified from Western Greece and the Ionian Islands regions. The more significant the elderly population, the more likely that lower birth rates or high death tolls translate into the retention of a negative natural balance. These results are consistent with demographic aging theories [37] such as the Demographic Transition Theory, which posits the increasing complexity of supporting older populations. Aging populations have several implications, including increased healthcare costs, higher dependency ratios, and more policies to support elderly care. Apart from the number of inhabitants in regions with a relatively high proportion of older people, demographic decline is likely to affect low fertility and largely heterogeneous mortality [38]. This demographic transition pressures public resources and will necessitate substantial shifts in social and economic policy if a balanced population is to be maintained [1]. In addressing such challenges, effective policy interventions are needed to improve healthcare services for the elderly population and promote active aging while providing an environment that supports older individuals [39].

Surprisingly, the gender ratio positively affected urban regions, suggesting that socio-economic factors (for example job opportunities or greater access to health services for women) may influence fertility and mortality rates, as previously suggested. New research delves deeper into this by showing that marriage and child-rearing patterns relate to how demographic realities play out across larger urban spaces [40]; for many women seeking career advancement, urban areas—with greater access to job opportunities and education for themselves or their children—naturally become appealing.

Lower educational attainment negatively impacts the natural population balance. Limited economic opportunities and low income hinder family development while increasing the desire for migration. Higher education levels are associated with better job prospects, higher incomes, and more excellent job stability, all of which support family growth and help retain populations. Additionally, improved health outcomes and increased civic participation linked to higher education contribute to lower mortality rates and a more stable population. Therefore, enhancing access to quality education is crucial for promoting economic and demographic stability [29].

The findings from this study underscore the need for localized policy measures tailored to each municipality's specific demographic and socio-economic conditions. Policies to support economic stability, improve access to services in remote areas, and leverage vacant housing to attract new residents could mitigate demographic decline. Additionally, addressing the needs of aging populations and enhancing educational opportunities are crucial for promoting sustainable demographic growth.

5. Conclusions

The research details the contributions of spatial econometric methods, specifically geographically weighted regression (GWR), to explaining demographic trends in Greece. The socio-economic and demographic aspects of population balance were analyzed and observed, and wide local differences in these aspects that reflect localized policies are herein disclosed. Places with high housing repair rates, such as urban areas, are experiencing population shrinkage. However, the research also highlights that strategic management of vacant dwellings could attract newcomers to areas like Epirus and Crete, offering a potential solution and fostering optimism among policymakers. The study also suggests disparate economic impacts, with rural areas seeing more significant employment rate benefits associated with them. The results reflect a call for improved care and access in rural areas, where the populations may be aged. Finally, the research points to a need for policy that recognizes local variation and is sensitive to demographic change.

Building further on this study, overlapping subjective restrictions in using 2021 Greek census data is crucial. Detailed data at a low spatial scale have yet to be released, and as such, they act as an additional constraint to the analysis. Granular data are significant for advancing accuracy and capturing more detailed local demographic dynamics in spatial econometric models. Longitudinal investigation using data drawn from multiple time points may also reveal trends over more extended periods and the effect of policy interventions on demographic change in a longer-term perspective. The analysis would still enriched if the explanatory variables were diversified to incorporate economic development initiatives, infrastructure projects, and social service changes, thus informing a more comprehensive policy response.

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