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From South Asia to Southern Europe: a comparative analysis of Sri Lankans' residential segregation in the main Italian cities using high-resolution data on regular lattice geographies

Francesca Bitonti[1*], Federico Benassi[2], Angelo Mazza[1*] and Salvatore Strozza[2]

*Correspondence:
francesca.bitonti@unict.it;
a.mazza@unict.it

[1] Department of Economics and Business, University of Catania, Catania, Italy
[2] Department of Political Sciences, University of Naples Federico II, Naples, Italy

Abstract

The present work proposes a spatial analysis of the residential segregation and settlement models of Sri Lankans in the eight main Italian municipalities. Hosting more than half of the total Sri Lankan population residing in Italy, the selected urban areas allow Sri Lankans' residential model to be globally framed across the country. The purpose of this work is threefold. First, it provides a general assessment of the allocation pattern of a foreign community that has seldom been studied and yet is characterized by peculiar settlement choices. Second, it attempts to compare the settlement patterns of Sri Lankans across different urban contexts. Third, it aims to detect the possible spatial polarization of Sri Lankans in specific neighbourhoods and to verify its spatial correlation with other key variables that constitute proxies of urban neighbourhoods' socioeconomic inequalities. The study runs multiple aspatial linear models to assess the global variation in concentrations of Sri Lankans related to several socioeconomic predictors. Furthermore, it implements geographically weighted regressions to explicitly model the spatial dependence between Sri Lankans' location quotients and several predictors. It refers all the considered variables to a single geographic reference grid, enabling the homogenization of different areal unit arrangements and comparisons across space. Except for Milan and Rome, the findings suggest that Sri Lankans tend to reside in central neighbourhoods characterized by a high foreign presence and a decreased trend of Italian population. Conversely, the impact of the cost of living and the state of the built environment is heterogeneous across space, with a sort of centre-periphery duality in Southern cities and more fragmented situations in the other urban contexts. This evidence proves the relevance of local scale analysis and the need to build up urban observatories on spatial inequalities and segregation processes.

Keywords: Italy, Sri Lankans, Urban segregation, Local-scale analysis, Divided cities

Introduction

Today, the issue of urban socioeconomic segregation and inequality is a global concern and attracts significant attention from researchers and policymakers (van Ham et al., 2021). Migration plays a crucial role in this regard. It shapes the socio-spatial structures of contemporary urban and metropolitan contexts, affects urban spaces and influences host societies' demographic structures (Benassi et al., 2020a; Portes, 2000; Strozza et al., 2016). Recent decades have seen a significant increase in immigration flows towards Europe, particularly in its southern regions (Martori & Madariaga, 2023; Strozza, 2010). This trend, boosted by the 2008 financial and economic crisis and the ongoing COVID-19 pandemic, has contributed to the consolidation of social, economic and residential segregation in European cities (Allen et al., 2004; Musterd et al., 2017; Tammaru et al., 2016). This issue is particularly pronounced in Italian metropolitan areas, which are characterized by densely populated urban cores surrounded by less populated belts. These areas have experienced significant demographic changes and real estate speculations, which have fuelled gentrification and have accelerated the suburbanization of poverty and class segregation (Hochstenbach & Musterd, 2018). Overall, the dynamics of migration, socioeconomic inequality and urban segregation are complex and multifaceted. Addressing them requires a holistic and interdisciplinary approach from policymakers and researchers alike. To date, the problems relating to socioeconomic segregation and inequality within urban areas have gained international relevance. The Organisation for Economic Co-operation and Development (OECD) has published an entire report focusing on the so-called divided cities (OECD, 2018): cities where economic and social divisions generate exclusivity of the spaces. Location choice is not random, especially for migrants, who are affected even more than the native population by network effects, housing conditions and a starting position of disadvantage. Assessing the causes of residential segregation is particularly important when segregation has negative social or economic consequences, whether for the residents of minority enclaves or for society as a whole (Boustan, 2013). Inequality, particularly the socioeconomic heterogeneities that exist within cities, hinders the integration of migrant populations within the host society.

Recent studies have contributed to the body of knowledge on residential segregation in Europe. They have found that urban segregation in the South of Europe has increased in recent years, narrowing the gap with the North, where higher levels of inequality and segregation have traditionally been observed (Arapoglou, 2012; Benassi et al., 2020a, 2023b; Panori et al., 2019). Other studies have focussed on specific territorial partitions, such as the analysis of Southern Europe by Arbaci (2008) and the comparison of different main Spanish and Italian cities by Benassi et al. (2020b), as well as the studies conducted by Ciommi et al. (2022), Di Feliciantonio and Salvati (2015), Rontos et al. (2016), Salvati et al. (2016) and Zambon et al. (2017) examining residential segregation in urban European contexts. Moreover, individual studies have addressed the residential segregation of foreign populations within specific southern European countries. It is worth mentioning the contributions by Arapoglou (2006), Arapoglou and Sayas (2009), Maloutas and Arapoglou (2016), Maloutas et al. (2019) and Kandylis et al. (2012) for Greece, and those by Benassi and Iglesias-Pascual (2023), Gastón-Guiu and Bayona-i-Carrasco (2023), Iglesias-Pascual (2019), López-Gay et al. (2020) and Martori and Madariaga

Table 1 Sri Lankan citizens residing in the top eight Italian cities according to their numerosity at the beginning of 2012 and 2021 (absolute values in thousands and percentages; the bold values indicate the peculiarities of the Sri Lankans' settlement model in Italy, as described in the following section)

Municipality (2012)	A.V. (000)	%	Cum. %	% of foreigners	Municipality (2021)	A.V. (000)	%	Cum. %	% of foreigners
Milan	11.1	15.5	15.5	6.3	Milan	16.1	14.8	14.8	6.3
Naples	7.2	10.1	25.6	**22.9**	Naples	15.3	14.1	28.9	**26.3**
Verona	5.2	7.3	32.9	17.3	Rome	9.1	8.4	37.3	2.7
Rome	4.9	6.8	39.7	2.2	Verona	7.4	6.8	44.1	20.1
Messina	3.6	5.0	44.7	**32.4**	Messina	3.8	3.5	47.6	**32.2**
Palermo	3.3	4.6	49.3	**16.7**	Palermo	3.1	2.9	50.5	**13.1**
Florence	1.6	2.2	51.5	3.7	Catania	2.4	2.2	52.7	**18.3**
Catania	1.4	2.0	**53.5**	**20.1**	Florence	2.1	1.9	**54.6**	4.2
Others	33.3	46.5	100.0	1.0	Others	49.3	45.4	100.0	1.2
Total	71.6	100.0		1.8	Total	108.6	100.0		2.2

Source: own elaboration on Istat data (Demographic Census and Municipal Population Registers)

(2023) for Spain. Studies focusing on Italy are fewer than those concerning the realities of other European countries. Nevertheless, they are constantly growing in number and highlight a North–South duality in which the North exhibits a higher proportion of foreigners but manages to maintain lower levels of inequality than those generally recorded in the South (Benassi et al., 2019, 2020b; Busetta et al., 2015; Mazza & Punzo, 2016; Mazza et al., 2018; Petsimeris & Rimoldi, 2015; Rimoldi & Terzera, 2017). Even so, studies comparing different Italian urban contexts remain very scarce.

The existing literature dealing with Sri Lankans settled in Europe is still limited and includes both group-specific analyses (Aspinall, 2019; Dharmadasa & Herath, 2020) and comparisons between Sri Lankans and other foreign communities (Benassi et al., 2019; Maloutas & Arapoglou, 2016). Even fewer contributions analyse the settlement geographies of Sri Lankans in Italy, one of their main European destination countries together with the United Kingdom, Cyprus, Greece and Ireland (Dharmadasa & Herath, 2020). This is quite surprising, because this community shows a peculiar residential distribution across Italy (Benassi et al., 2022, 2023a).

Based on these premises, this paper proposes the spatial analysis of residential segregation and settlement models of Sri Lankans. The empirical application focuses on the eight Italian municipalities hosting the largest numbers (see Table 1) of this foreign community: Milan and Verona in the North, Florence and Rome in the Centre, and Naples, Palermo, Messina, and Catania in the South. This work makes several contributions to the existing literature. First, it advances the analysis of Sri Lankans' allocation model in Italy with respect to a previous study conducted by the authors (Benassi et al., 2023b). In particular, the present study extends the context of analysis from solely the main southern Italian municipalities analysed in the previous work, to a set of municipalities covering the entire geographical territory of Italy. In so doing, it allows us to assess the spatial distribution of Sri Lankans in association with extremely heterogeneous socioeconomic and urban conditions. It is well-known that Italy's northern and central areas are generally more developed and economically advanced than its southern regions. In this respect, the findings emerging from the current analysis enable us to draw more comprehensive conclusions on Sri

Lankans' allocation model in Italy. Second, the work exploits exclusive census data, which soon will no longer be available at the same territorial level, given the sampling approach used for the future Italian censuses (Istat, 2014). In addition, the investigated urban areas host almost 55% of the Sri Lankans residing in Italy in 2021, a share that allows broader insights to be made into the residential allocation of this population across the territory and represents a further element of exclusivity in the data. Overall, given the concentration of Sri Lankans in the selected municipalities, the analysis provides a general understanding of the allocation of this foreign community across the entire country. Such a community-specific picture encompassing all the Italian macro-regions is the first of its kind. Furthermore, the peculiarities of the Sri Lankans' settlement pattern in Italy (namely, their being concentrated in a few big urban areas and their preference for the southern Italian contexts) make Sri Lankans a unique and curious subject of investigation. Third, the present study stands out in its use of Italian Revenue Agency data to analyze the economic conditions of different urban areas, this being an uncommon data source for analogous demographic research despite the quality and free availability of such data. Fourth, the work also employs a distinctive methodological approach. On one hand, it harmonizes and spatially processes data collected from different sources to create a uniform spatial grid of 100 by 100-m cells, facilitating comparative analyses between different urban areas. This contrasts with typical demographic applications that use census tracts, which can vary significantly in size and geometry. The regular shape of the cells used in this work allows for more accurate and uniform comparisons between urban areas. On the other hand, the high level of spatial resolution achieved in this study enables local-specific contextualization. This means that the study can identify and analyze socioeconomic conditions at a very local level, providing a fine-grained picture of disparities and their spatial distribution.

The remainder of this article is organized as follows: Sect. "Sri Lankans in Italy" presents a summary of Sri Lankan immigration to Italy; Sect. "Data and methods" describes the data and the methodology implemented; Sect. "Results" illustrates and discusses the main findings of the empirical application; finally, Sect. "Discussion" draws the general conclusions of the work. Appendix A reports the results of the local regressions in detail.

Sri Lankans in Italy

Sri Lankans have been present in Italy since the 1970s. The first Sri Lankans immigrating to Italy were mainly Catholic women who were recruited to work as caregivers in elderly people's homes. Thereafter, Italy's easier admission possibilities compared to other European countries, its simplified procedure for family reunifications and its use of so-called nominative calls (formal requests made by an Italian employer guaranteeing a job to a foreigner) attracted a large number of Sri Lankan men, balancing the proportions between genders (Henayaka-Lochbihler & Lambusta, 2004). As mentioned above, Sri Lankans' spatial distribution across Italy is characterized by a twofold specificity[1] (Benassi et al., 2023a). First, Sri Lankans prefer to settle in large cities,[2] particularly those listed

[1] The data on Sri Lankans analyzed in the present work were made available within the scope of the 'Caratteristiche, comportamenti e condizioni di vita degli immigrati di prima e di seconda generazione secondo le principali fonti disponibili' research agreement between the Italian National Institute for Statistics (Istat), the National Research Centre (CNR) and six Italian universities.

[2] In the present work, the nouns 'city' and 'municipality' are treated as synonyms referring to the same geographic unit: the local administrative unit (LAU), as defined according to Eurostat's Nomenclature of Territorial Units for Statistics and delineated in the official database '8000census' (http://ottomilacensus.istat.it/) released by Istat.

in Table 1, which were home to almost 55% of the total number of Sri Lankans residing in Italy at the beginning of 2021 (as indicated by the bold numbers in the fourth and ninth columns of Table 1). Second, Sri Lankans tend to concentrate in the southern cities (Naples, Messina, Palermo, and Catania), which are rarely among the main Italian settlement municipalities for other foreign communities (see the bold figures in the two "% of foreigners" columns in Table 1). This restricted pattern of international migration shows the significance of social networks in channelling future flows (Pathirage & Collyer, 2011).

Sri Lankans exhibit a strong work specialization in the domestic sector, with their most common jobs being domestic assistance, housekeeping and cleaning services (Benassi et al., 2023a; Mazza & Punzo, 2016; Mazza et al., 2018). In particular, many live in the house in which they work (Henayaka-Lochbihler & Lambusta, 2004).

Data and methods

In this work, we consider the eight Italian municipalities reported in Table 1. Our analyses are based on areal data referring to specific reporting zones, such as census tracts and *Osservatorio del Mercato Immobiliare* (OMI) zones (see Table 2). The arbitrary nature of such reporting zones immediately leads to difficulties known as the modifiable areal unit problem (MAUP) (Openshaw, 1984; Openshaw & Taylor, 1979), that is, the dependence of spatial analysis results on both the scales and the methods used to create areal units. Indeed, the levels of segregation and the conclusions drawn on the spatial distribution of a population can vary depending on the type of areal unit considered (Östh et al., 2015). The comparison of segregation levels across cities is a popular topic in applied social research. Typically, such comparisons involve calculating a set of segregation indices for multiple cities at a specific time and then ranking the values. However, the question of whether these differences are statistically significant is often overlooked (Rey et al., 2021). Various segregation indices have been proposed and used in research, each reflecting different underlying urban attributes. These attributes can include the city's overall demographic mix, urban development density (especially for spatial

Table 2 Indicators (correlates) and dimensions used in the study

Dimensions	Indicators	Sources
Demographics	– Mean growth rates for Italian and foreign residents between 2001 and 2011 – Proportion of foreign residents over the total resident population in 2001 – Proportion of large families (more than 5 members) over the total number of families in 2011	Istat, General Population and Housing Census
Tenure status	– Proportion of renter families over the total number of families in 2011	Istat, General Population and Housing Census
Labour and education	– Unemployment rate in 2011 – Proportion of individuals with lower secondary education or less in 2011	Istat, General Population and Housing Census
Real estate	– Mean rent cost for residential properties in 2011	Italian Revenue Agency *Osservatorio del Mercato Immobiliare* (OMI)—Real Estate Market Observatory
Building environments	– Proportion of buildings in very poor condition in 2011	Istat, General Population and Housing Census

segregation indices), administrative unit sizes and configurations, and the total size of the city in terms of population or geography. It is challenging to compare racial (or ethnic) segregation among cities because it can be unclear how these underlying urban attributes combine into a single measure and which attributes have a stronger or weaker influence on the differences observed. Segregation indices are known to be affected by factors such as the number, sizes, shapes, and arrangement of enumeration units used as well as the spatial extent of the community being studied (Clark & Östh, 2018; Jakubs, 1981; Lee et al., 2008; Massey, 1978; Wong, 2003). In addition, commonly used segregation measures can be sensitive to the overall composition of minority groups within a city (Allen et al., 2015). A smaller minority population is more likely to be unevenly distributed compared to a larger minority population, assuming all other factors are equal. Furthermore, the presence of small enumeration units can magnify the impact of minority composition on segregation indices, adding another layer of complexity to the analysis. Moreover, the forces that generate and maintain segregation—as well as tangible and intangible consequences—differ across scales (Kaplan & Holloway, 2001). For these reasons, issues of scale are potentially important not only in describing patterns of segregation, but also in understanding both its causes and its consequences (Reardon et al., 2008). The multi-scalar nature of segregation was first recognized by Duncan et al. (1961) and has since been explored by other scholars (Fischer et al., 2004; Johnston et al., 2003; Parisi et al., 2011; Reardon et al., 2000; Voas & Williamson, 2000). Several studies have empirically shown the multi-scalar dimension of segregation, proposing different methodologies to capture the phenomenon. Tranmer and Steel (2001) have found that if urban residential segregation varies across scales, then neglecting one of those scales in the analysis can lead to an overestimation of segregation at smaller geographic levels. Johnston et al. (2016) have demonstrated the variation in changes in segregation levels in London at different geographic levels. Focusing on South Seattle, Fowler et al. (2016) have argued that segregation is multi-scalar and continuous and can be experienced at several scales simultaneously. Nevertheless, in spite of growing attention to the multi-scalar dimension of segregation, more needs to be done to examine the causes and consequences of segregation at different scales.

In order to integrate data referred to different geographic units, namely, census tracts referring to two different population censuses (2001 and 2011) and OMI sections (for real estate data), we performed areal weighted interpolation (Prener & Revord, 2019). Specifically, the procedure allowed to homogenize data and urban contexts over space and through time by referring all the data at hand to a uniform spatial grid with 100 by 100-m cells. A similar type of grid was exploited at the European level in the Data Challenge on Integration of Migrants in Cities (D4I), which aimed precisely at making comparisons among different urban areas of eight European Union member states (Natale et al., 2019).

Data on the resident population, both Italian and Sri Lankan, come from the 2011 Italian General Population Census. The main dependent variable is the location quotient (LQ) (Haig, 1926) for Sri Lankans in 2011. The LQ is a local index varying from 0 to ∞ that can detect, where a particular population group (i.e., Sri Lankans in our case) is over- ($LQ > 1$) or under-represented ($LQ < 1$). Its formulation is given by

$$\mathrm{LQ}_i = \frac{x_i/w_i}{X/W}$$

where the numerator represents the proportion of Sri Lankans (x_i) compared to the total resident population (w_i) in cell i, while the denominator represents the global proportion of Sri Lankans (X) over the total resident population (W) at the urban level. The use of LQs is prevalent across different research fields: for example, epidemiologists use them to examine the spatial distribution of diseases (Clayton & Hills, 1993; Saravanabavan et al., 2019), while criminologists often use them to understand peculiarities in reported crimes in different neighbourhoods (Block et al., 2012; O'Connor, 2017). LQs have also been applied in studies dealing with residential segregation with the aim of rising attention to the local dimension of urban segregation (Brown & Chung, 2006; Iglesias-Pascual et al., 2019). Reviewing the LQ maps in Fig. 1, a difference between the cities of the Centre and the North (Milan, Florence, and Rome) compared to those of the South and the islands (Naples, Palermo, Messina, and Catania) emerges. Whereas the highest concentration cells in the North are scattered throughout the urban areas, Sri Lankans appear more localized in the most central neighbourhoods in southern cities. The only exception is Verona, which shows an arrangement similar to that characterizing the southern urban areas.

As correlates of the concentration of Sri Lankans, we considered several predictors referring to five explanatory dimensions (Table 2). The data exploited come from the 2001 and 2011 General Population and Housing Census, with the exception of the mean rent cost per square metre for residential property, which we retrieved from the OMI database of the Italian Revenue Agency and refers to 2011.[3] The selected dimensions and covariates address the two sources of spatial clustering: spatial inhomogeneity or apparent contagion, which concerns variations in socioeconomic conditions such as the cost of residential property; and spatial attraction or true contagion, which refers to the preference for living near people sharing the same culture and identity (Schelling, 1971).

With a specific focus on the exogenous factors potentially driving allocation choices, Meen and Meen (2003) have suggested that to comprehend the processes of residential segregation, it is crucial to examine the dynamics of local real estate markets and how they can affect the structure of neighbourhoods. This is achieved through a filtering process first described by Hoyt (1939). According to Hoyt, affluent households tend to migrate towards newer real estate developments, primarily located in the suburbs of cities. Consequently, lower income residents gradually occupy older neighbourhoods. Furthermore, as a consequence of price movements or changes in the state of buildings' maintenance, according to Royuela and Varga (2010) some neighbourhoods polarize, changing from a mixed composition to one with inhabitants belonging to just one socioeconomic or ethnic group.

[3] The Italian Revenue Agency publishes minimum and maximum values for rent prices, referring to the first and second semesters of each year. The mean rent cost in 2011 was computed by averaging the minimum and maximum values of both these semesters in 2011.

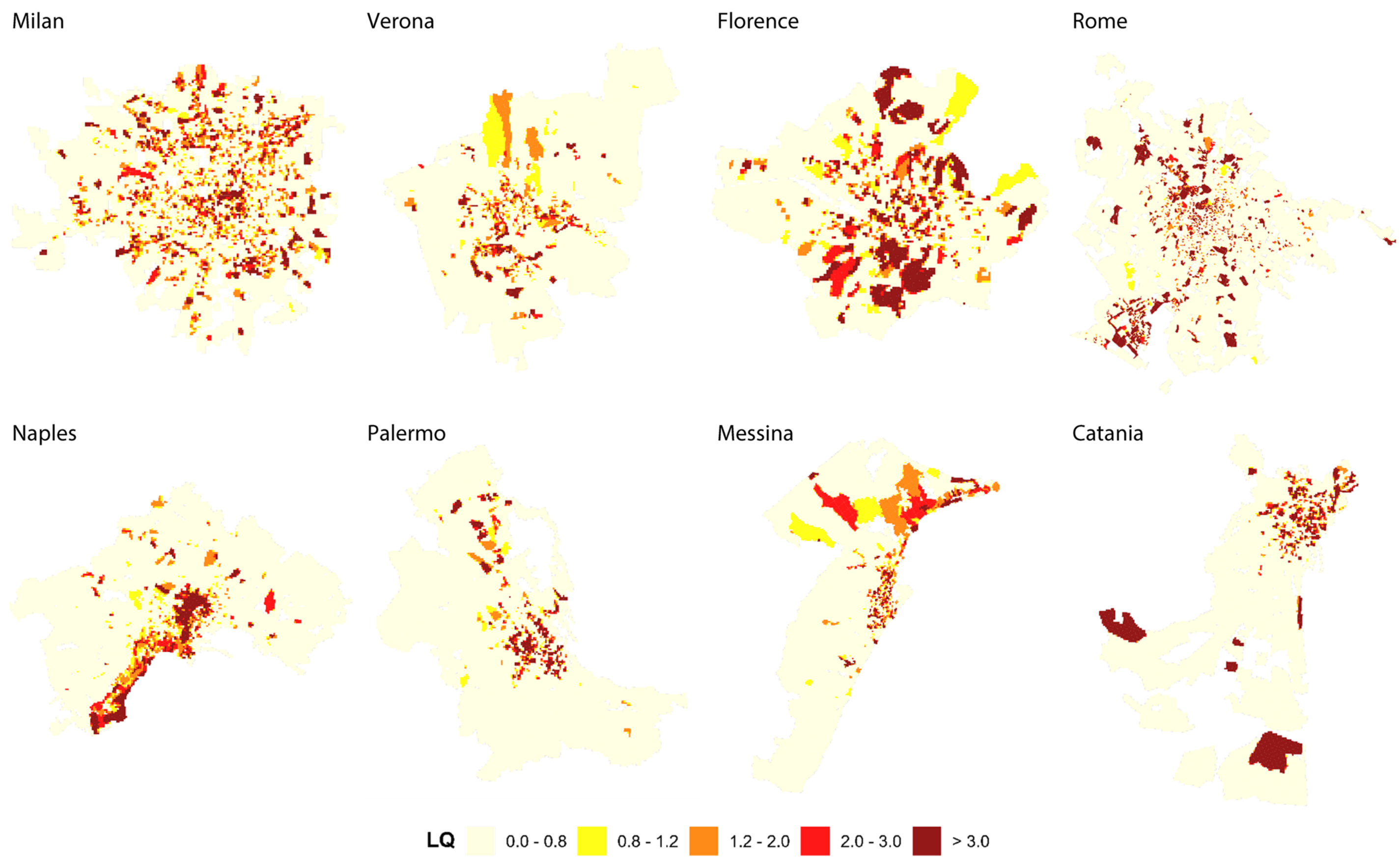

Fig. 1 Location quotients of Sri Lankans (ref. group: total resident population). The eight Italian municipalities hosting the majority of Sri Lankans, 2011. Spatial grid with 100 × 100 m cells. Source: own elaboration on Istat data (2011 General Population and Housing Census)

The spatial distribution of some of the independent variables is reported in Fig. 6 (Appendix A). All the covariates exhibit a great spatial variability in each of the municipalities illustrated. A centre-periphery dynamics emerges for the low educational attainment in Florence and for the proportion of foreigners in 2011 in Naples, with the highest values registered in the periphery for the first city and the lowest for the latter. More complex patterns appear in the case of Verona and Messina. The distribution of the omitted variables also shows a clear spatial gradient, which departs from a configuration of random allocation.[4]

To globally and preliminarily analyse the settlement model of Sri Lankans, we performed a multiple linear regression (OLS) for each city. To adequately represent detailed local variations in the data and explicitly model spatial dependence in Sri Lankans' spatial distribution, we carried out geographically weighted regressions (GWRs) (Fotheringham et al., 2002). GWR techniques represent a powerful tool for analyzing spatially heterogeneous data and can provide valuable insights into the local relationships between dependent and independent variables (Brunsdon et al., 1998, 1999; Fotheringham et al., 2002). In traditional regression analysis (OLS), a single model is fitted to the entire data set, assuming that the relationships between variables are the same across all spatial units. However, this assumption may not hold in many real-world scenarios, especially when the observations are geographically dispersed. GWR methodologies address this issue by estimating a separate regression model for each observation, taking into account its local spatial context (i.e., the bandwidth). This allows for the detection of spatially varying relationships between variables, and the identification of local patterns and trends that may not be apparent in a global analysis. For each location, the GWR model employed in this paper fits a single linear regression equation of the form:

$$y_i = \beta_0(u_i, v_i) + \sum\nolimits_k \beta_k(u_i, v_i)x_{ik} + \varepsilon_i$$

where y_i denotes the response variable at cell $i = 1, \ldots, N$, x_{ik} the kth independent variable measured at cell i, (u_i, v_i) the coordinates (longitude and latitude) of the centroid of the ith cell, $\beta_k(u_i, v_i)$ the parameter associated with the kth variable in the ith cell, and ε_i the error term (Fotheringham et al., 2002). Each regression equation (one for each square cell composing the grid of each municipality) is calibrated using an adaptive Gaussian kernel, where the bandwidth corresponds to the number of nearest neighbours. The best-fitting model is selected by minimizing the Akaike information criterion (AIC).

To compare the fit and the performance of the OLSs and the GWRs, we first compared their AIC. In addition, we evaluated the spatial stationarity in the residuals of both models by conducting a Moran's I test for residual spatial autocorrelation (Moran, 1950).

Results

The OLS coefficients for the different covariates are almost always significant at the 5% level (Table 3). Some covariates, such as renting households, proportion of foreigners (2001) and foreigners' mean growth rate, positively influence the presence

[4] For the sake of brevity, we do not show all the maps illustrating the spatial distribution of the covariates for each city. Apart from the description and visualization of the data analyzed, the main purpose of these maps is to show the presence of heterogeneity in the spatial arrangement of the covariates within the cities. However, all the maps are available upon reasonable request to the authors.

Table 3 OLS results

Covariates	Verona	Milan	Florence	Rome	Naples	Messina	Palermo	Catania
(Intercept)	0.147**	0.330***	4.407***	3.072***	− 1.435***	1.672***	− 0.080	0.601**
Unemployment rate	− 0.023***	− 0.013*	− 0.031	− 0.097***	− 0.040***	− 0.018***	− 0.022***	− 0.011
Large households	0.005**	− 0.044***	− 0.014	− 0.024***	− 0.042***	− 0.036***	− 0.052***	− 0.023*
Households (rent)	0.020***	0.005***	0.050***	0.003*	0.002	0.025***	0.049***	0.012***
Low Educ. Attain	− 0.006***	− 0.012***	− 0.155***	− 0.067***	0.045***	− 0.027***	0.006	− 0.030***
Foreign. prop. (2011)	3.937***	7.108***	4.589***	13.950***	2.759***	13.404***	2.043***	40.312***
Buildings (poor cond.)	− 0.003***	0.019***	− 0.045***	− 0.017***	0.004***	− 0.006***	− 0.004***	0.009***
Mean rent cost	− 0.004	− 0.011*	− 0.069***	− 0.079***	0.196***	− 0.098***	− 0.022*	0.106***
Ita. growth rate	− 0.002***	− 0.005***	− 0.003***	− 0.021***	− 0.001*	− 0.003***	0.001	− 0.004***
Foreign. growth rate	0.002***	0.005***	0.003***	0.011***	0.001***	0.003***	0.001***	0.003***
No. of cells	14,637	11,556	7478	59,889	7245	8912	8065	3098
Adj. R^2	0.175	0.126	0.010	0.078	0.166	0.237	0.081	0.220

*p value < 0.05; **p value < 0.01; ***p value < 0.001

of Sri Lankans. Other covariates, namely, unemployment rate, proportion of large households, low education, and Italians' mean growth rate, are associated with lower LQ values across all the cities. Finally, proportion of buildings in a bad state of maintenance and mean rent cost have different effects on the distribution Sri Lankans, depending on the urban context. Variables related to the cost of living and the built environment aside, the OLS models show that static dynamics are similar in all the cities. However, OLS models do not capture the whole data variability; indeed, the adjusted R-squared values are very low for all cities. For this reason, we tested the performances of local versus global regressions by computing their AIC, whose values are reported in Table 4 (Appendix A). The AIC is lower for GWR models in all cases, indicating that local analyses consistently outperform global ones. Moreover, the results of the Moran's I test on the residuals of the models reported in Table 5 (Appendix A) suggest that generally, for both OLSs and GWRs and considering a structure of 30 or 50 neighbouring cells, we cannot reject the null hypothesis of an absence of spatial autocorrelation at the level of significance considered. Nevertheless, while the Moran's I values exhibit high levels of positive spatial autocorrelation in the case of OLS models, GWRs' residual autocorrelation is very close to zero. In some cases, the local regressions are consistent with the random allocation, and hence, the null hypothesis of an absence of spatial non-stationarity in the residuals can be accepted. Overall, the GWRs seem to capture better the variability of the phenomenon compared to the global models.

The goodness of fit of the GWRs is indeed quite high for all the municipalities considered, as illustrated in the maps of Fig. 7 in Appendix A. Very high values of the local

R-squared are recorded for almost all the urban areas. Some small pockets, mainly converging in the central parts of the cities, cause a decrease in the value of the local R-squared. Although marginal, this loss in the models' performance could be attributed to some omitted variables or a relationship between dependent and independent variables other than linear.

The results from the GWRs show that the associations between Sri Lankans' LQ and its correlates in the eight municipalities are geographically heterogeneous, being positive in some areas and negative or not statistically significant in others. Moreover, while some covariates influence the dependent variable across cities similarly, others configure urban-specific dynamics.[5]

Figures 2, 3, 4 and 5 plot the local parameter estimates for some selected covariates that are significant at the 5% level. Figures 2 and 3 highlight that the distributions of the coefficients for the variables buildings in poor condition and mean rent cost show considerable variability across cities. In the cases of Verona, Palermo, and Catania, a sort of centre–periphery dichotomy emerges, whereas in the other contexts, the situation is highly mixed and should be the cause of specific evaluations. Looking jointly at the coefficients of Italians' and foreigners' mean growth rates between 2001 and 2011, we notice that in all cities, Sri Lankans tend to reside in central areas, where the proportion of foreigners in general has grown, whereas the proportion of Italians has decreased over time. This phenomenon may imply a sort of spatial segregation between foreigners and, hence, Sri Lankans on the one side and Italians on the other, which prevails over local urban specificities. For the sake of brevity, the visualization of the coefficient estimates for the remaining covariates is not shown but is available upon request to the authors.

Discussion

Cities are our greatest invention and one of the main causes of wealth and progress (Glaeser, 2011). Nevertheless, cities are also contexts in which spatial inequality phenomena such as residential segregation, poverty and the marginalization of certain population groups are particularly prevalent (Florida, 2017; Van Ham et al., 2021). Measuring these processes at the local scale is, therefore, fundamental to the provision of effective and territorially calibrated active intervention policies (de Castro, 2007).

The different findings emerging from this empirical application highlight considerable variability in the spatial arrangement of Sri Lankans across Italy and in its plausible influencing factors. Therefore, any attempt to convey an overarching understanding of Sri Lankans' allocation model risks providing only a misleading or partial interpretation of the phenomenon. Starting from these premises, it is possible to draw two main general considerations which summarize the residential configurations characterizing the different cities analysed.

First, the results of the local regression analyses do not clearly show a centre–periphery dynamic, according to which Sri Lankans are segregated in the outskirts,

[5] The complete summary statistics of the GWR results for each city are reported in Appendix A.

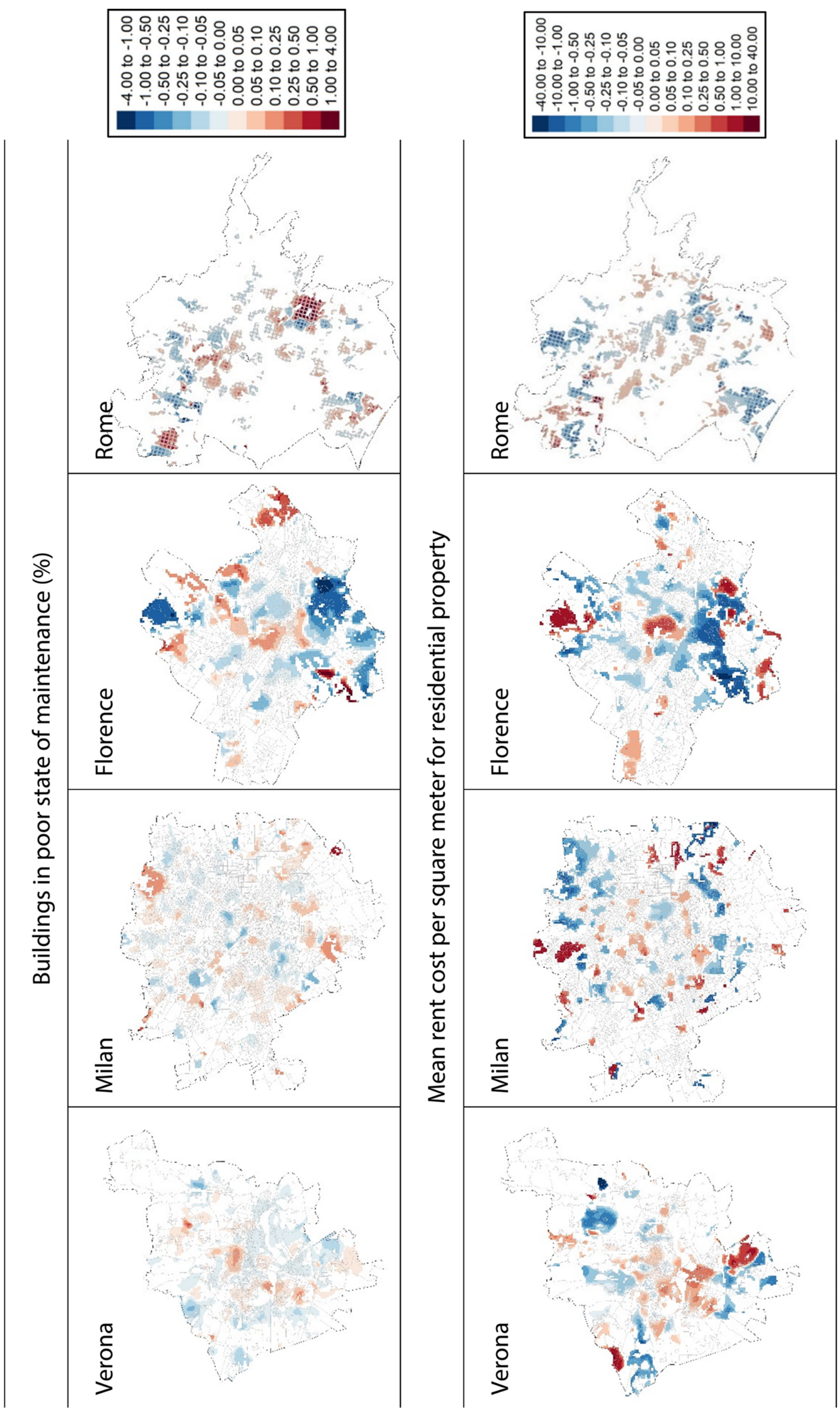

Fig. 2 Results from geographically weighted regressions: significant local parameter estimates for buildings in poor state of maintenance and mean rent cost per square meter for residential property in the four municipalities of North and Central Italy (significance level: 5%; not comparable geographical scales)

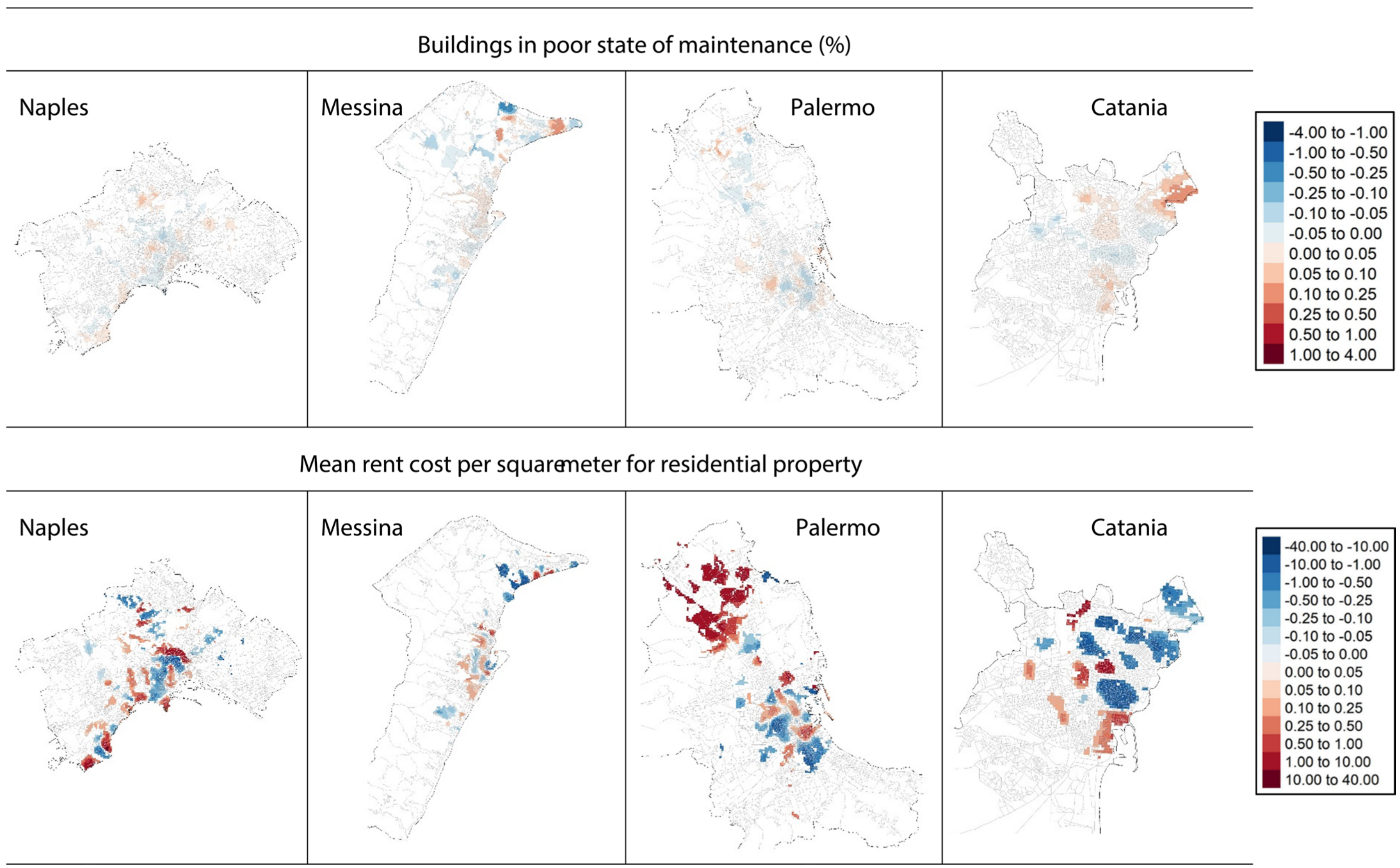

Fig. 3 Results from geographically weighted regressions: significant local parameter estimates for buildings in poor state of maintenance and mean rent cost per square meter for residential property in the four municipalities of the South of Italy and Islands (significance level: 5%; not comparable geographical scales)

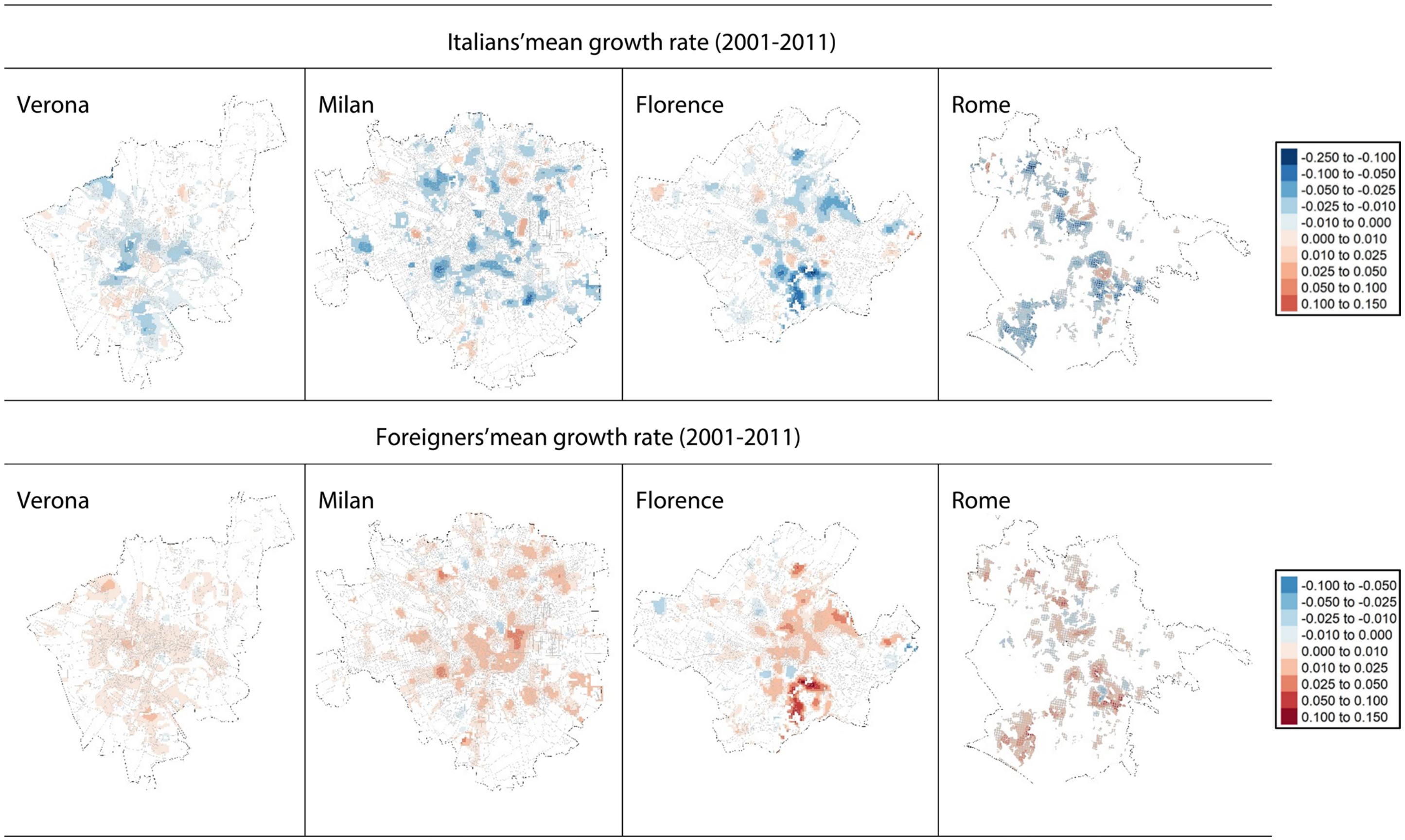

Fig. 4 Results from geographically weighted regressions: significant local parameter estimates for Italians' and foreigners' mean growth rate between 2001 and 2011 in the four municipalities of North and Central Italy (significance level: 5%; not comparable geographical scales)

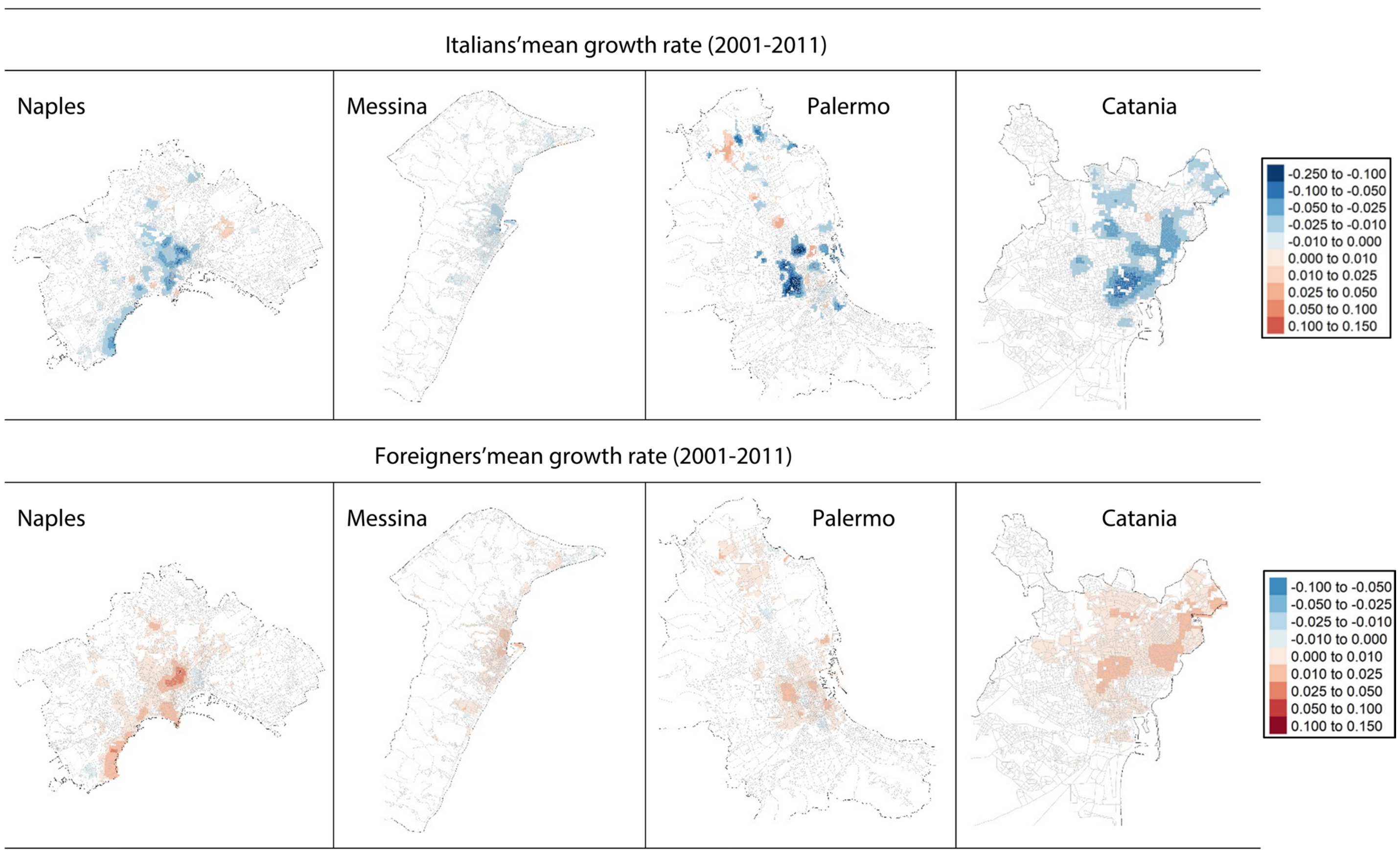

Fig. 5 Results from geographically weighted regressions: significant local parameter estimates for Italians' and foreigners' mean growth rate between 2001 and 2011 in the four municipalities of the South of Italy and Islands (significance level: 5%; not comparable geographical scales)

while Italians converge in the core areas. Thus, the analysis cannot confirm the presence of this type of intra-urban duality, which has been detected in other cities in the Global North (Hochstenbach & Musterd, 2018; Hochstenbach & Van Gent, 2015; van Ham et al., 2020). According to several studies, the root causes of the social separation between migrant and host populations might be ascribed to the increasing globalization and individualization of society and to the progressive demolition of the institutional and cultural structures of the welfare state (Musterd et al., 2017; Secchi, 2013).

Second, Sri Lankans' residential model emerging here departs from the North–South differential detected for other foreign minorities living in Italy and, more generally, for many demographic and social processes (Asso, 2021; Costa et al., 2003; Mocetti & Porello, 2010; Reynaud et al., 2020). In our application, each urban context is characterized by a specific configuration resulting from the interplay of different local contextual factors. In particular, a fragmented history of urbanization in Italy has brought about great heterogeneity in the development of different cities (Accetturo & Mocetti, 2019; Barbagli & Pisati, 2012), which in turn has determined the emergence of specific socioeconomic configurations for each of the urban areas considered.

These conceptual implications also entail political and policy reasoning. On one hand, the identification of a context-specific spatial arrangement, at least for Sri Lankans, should strongly be taken into consideration for the implementation of effective social spatial urban policies (de Castro, 2007; Secchi, 2013). Differences in immigrant–native spatial integration and socioeconomic inequalities should be addressed through a set of locally focussed interventions rather than standardized ones in order to improve the living conditions of Sri Lankans effectively and to prevent the squandering of public financial resources. On the other hand, adequate data collection and permanent monitoring activities at the urban level should be carefully implemented to achieve and inform the planning and implementation of effective tailored policies.

Conclusions

In recent years, technological advancements in geographic information systems (GIS) and computational capacity, the development of models and theories of spatial analysis and the availability of spatial data have all provided sophisticated ways of explaining current demographic issues. In addition, the newly generated information allowed the implementation of spatially targeted public policies (De Castro, 2007; Gu et al., 2020; Matthews, 2020). In the present case, exploiting a unique regular reference grid allowed us to integrate data from different sources and refer to specific geographic units. Furthermore, it facilitated comparison across several urban configurations. In addition, our use of uncommon statistical information at the sub-urban level, including OMI data, which are rarely exploited in Italian studies, allowed us to frame processes of residential segregation within the broader framework of socioeconomic inequalities.

We applied global OLS and GWR analyses to explore the relationships between Sri Lankan segregation patterns and population and contextual variables. As a result of this study, several conclusions may be advanced. First, the OLS results globally showed that all the municipalities are characterized by similar dynamics, except for the covariates referring to the cost of living and the built environment. Nevertheless, the fit of the global regressions proved to be poor and worse than that of the GWRs, as emerged from the Moran's I test, which detected high levels of spatial autocorrelation in the residuals for the OLS models. Second, implementing the local analyses improved the goodness of fit to the data and yielded high values for the local R-squared for each city. Indeed, when studying demographic behaviours, as the individual residential choices, spatial modelling is advisable when there are reasons to believe that the influence of neighbouring contexts is important (Vitali & Billari, 2017). The preliminary findings of the GWRs suggest that urban specificities and macro-level dynamics shape Sri Lankans' residential settlement models. In particular, in all the cities analysed, the associations between Sri Lankans' LQ and Italians' and foreigners' mean growth rates suggest that Sri Lankans generally reside in the same neighbourhoods as other foreign groups, which correspond to areas that Italians have left over time. These areas are usually located in city centres, with the exception of Milan and Rome, which exhibit a more scattered configuration. This finding confirms the global assessment yielded by the OLS analyses, albeit with some peculiarities in the local variations of the covariates within cities. Conversely, the coefficient estimates for the independent variables relating to the cost of living and the state of the built environment show substantial spatial heterogeneity across municipalities. In particular, the southern cities are characterized by a sort of centre–periphery duality, whereas more complex and fragmented situations emerge in the northern and central urban contexts. Although the GWR models successfully identified important spatial non-stationarity in the relationships, interpreting such non-stationarity requires additional contextual and 'city-specific' information. In particular, while some macro-level dynamics influence the distribution of Sri Lankans across Italy in a similar manner, other distinctive contextual and socioeconomic factors intervene at the local level, resulting in differences among cities. Indeed, individuals shape and are shaped by the context in which they live, and contexts and spatial effects are embedded in individual residential decisions.

Despite the great potential of the GWR methodology, we acknowledge that inferences based on this type of local analysis suffer from certain limitations. The choice of the spatial kernel and bandwidth can influence the local coefficients estimated (Farber & Paez, 2007), while multicollinearity between predictors can determine the spatial patterns detected by the model (Wheeler & Tiefelsdorf, 2005). In addition, residual spatial autocorrelation can yield biased estimates (Leung et al., 2000). Finally, a multiscale approach to assess possible geographic variations in the association between dependent and independent variables could be a feasible future extension of the present analysis.

This paper contributes to the demographic literature on the residential segregation and settlement model of foreign minorities by comparatively evaluating the urban distribution of Sri Lankans in eight Italian municipalities. Although our analysis was exploratory, it allowed us to bring space (in terms of spatial statistical methodologies and techniques, including the geographical dimension of the processes analysed) back into the demographic realm, by incorporating geographic proximity and implementing local regression analyses. Indeed, in recent years, several demographic studies (e.g.Balabdaoui et al., 2001; Campisi et al., 2020; Fowler et al., 2016; Rogers & Raymer, 2001; Santos & Noronha, 2001; Shelton et al., 2006; Tolnay, 1995; Voss, 2007) have emphasized that space is a crucial element of demographic matters because individuals interact and are embedded in the place, where they live. Residential segregation is strictly intertwined with other demographic processes and can have various consequences throughout the life course. The economic, physical, social and environmental context of neighbourhoods may be shaped by segregation (Acevedo-Garcia et al., 2003; Diez-Roux, 2003; Kawachi & Berkman, 2003; Kramer & Hogue, 2009; Williams & Collins, 2001). Furthermore, it has emerged as an important determinant of health outcomes because it might put individuals 'at risk of risk' (White & Borrell, 2011). Neighbourhood disparities in healthcare quality, environmental exposures and the built environment serve as key mediators between segregation and health disparities (Landrine & Corral, 2009), ultimately influencing morbidity and mortality differentials across space and population groups. Moreover, unequal exposure to neighbourhood stressors can affect health behaviours, such as poor dietary habits and smoking. As an illustration, neighbourhoods with limited access to affordable healthy foods and where tobacco advertising is targeted can significantly shape individuals' dietary habits and increase their propensity to smoke (White & Borrell, 2011). Residential segregation can also affect fertility rates within different population groups cross-sectionally as well as over the life course. Segregated neighbourhoods may have varying cultural or social norms regarding family size and childbearing, which can influence fertility preferences and behaviours. Wilson and Kuha (2018) have investigated how cultural factors in segregated neighbourhoods may influence individuals' perceptions and goals relating to early childbearing, the sequencing of marriage and fertility and completed fertility. Focusing on England and Wales, they have shown that first- and second-generation immigrants' fertility is closer to the natives' one if they grow up in areas, where they are more likely to be exposed to native norms. Furthermore, they found that immigrants living in more segregated areas as children are significantly more likely to have higher completed fertility than is typical of the native population.

Given the mixed results yielded by the present application in terms of macro- and micro-level dynamics in Sri Lankans' allocation and considering the demographic and socioeconomic implications deriving from the spatial arrangement of minority groups, we can draw two relevant messages for policymakers. First, enhancing the synergy between local development initiatives and policies addressing segregation-induced disparities can foster a well-balanced population structure in metropolitan regions. Such integration can also promote social cohesion by encouraging class diversification and guiding spatial transformations, ultimately reducing economic polarization and income inequalities (Lamonica et al., 2022). Second, local administrators should assess and monitor whether those Sri Lankans living in segregated areas have proper and easy access to healthcare facilities, means of transportation, high quality schools and the like. In fact, while it is important to acknowledge that ethnic segregation can have negative consequences, there are some potential positive spillovers relating to the creation of social support networks (Bolt et al., 2010). Indeed, residential segregation can foster the formation of tight-knit social networks within ethnic communities. These networks can provide individuals with emotional support, a sense of belonging and access to resources and services specific to their cultural needs. Such social support can enhance the well-being and resilience of individuals within these communities. For these reasons, ad hoc interventions (e.g., the creation of urban observatories on residential segregation and spatial inequalities) identifying and addressing the most deprived neighbourhoods could mitigate negative consequences of segregation on the well-being of both current and future Sri Lankan generations as well as that of other minority groups.

Appendix A: GWR validation and results

See Figs. 6 and 7.

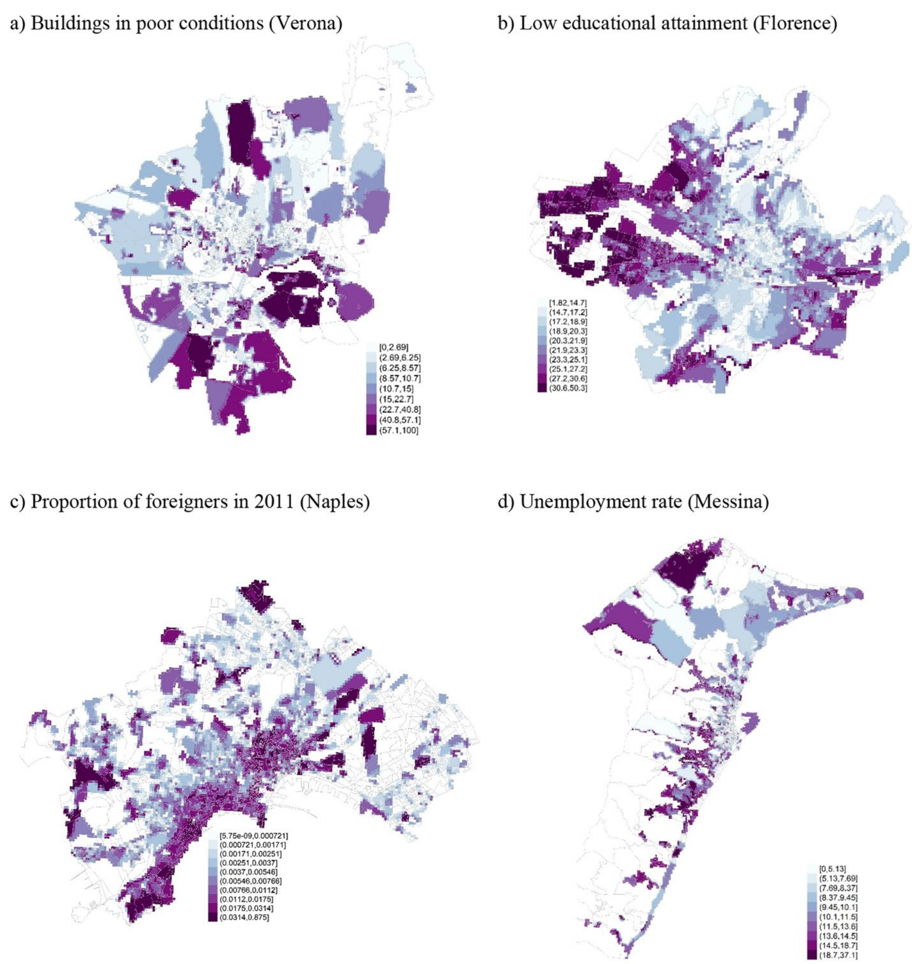

Fig. 6 Spatial distribution of selected covariates for the cities of Verona (**a**), Florence (**b**), Naples (**c**), and Messina (**d**) on a regular reference grid. Breaks are defined considering the deciles of the distributions. Different geographical scales. Source: authors' elaboration

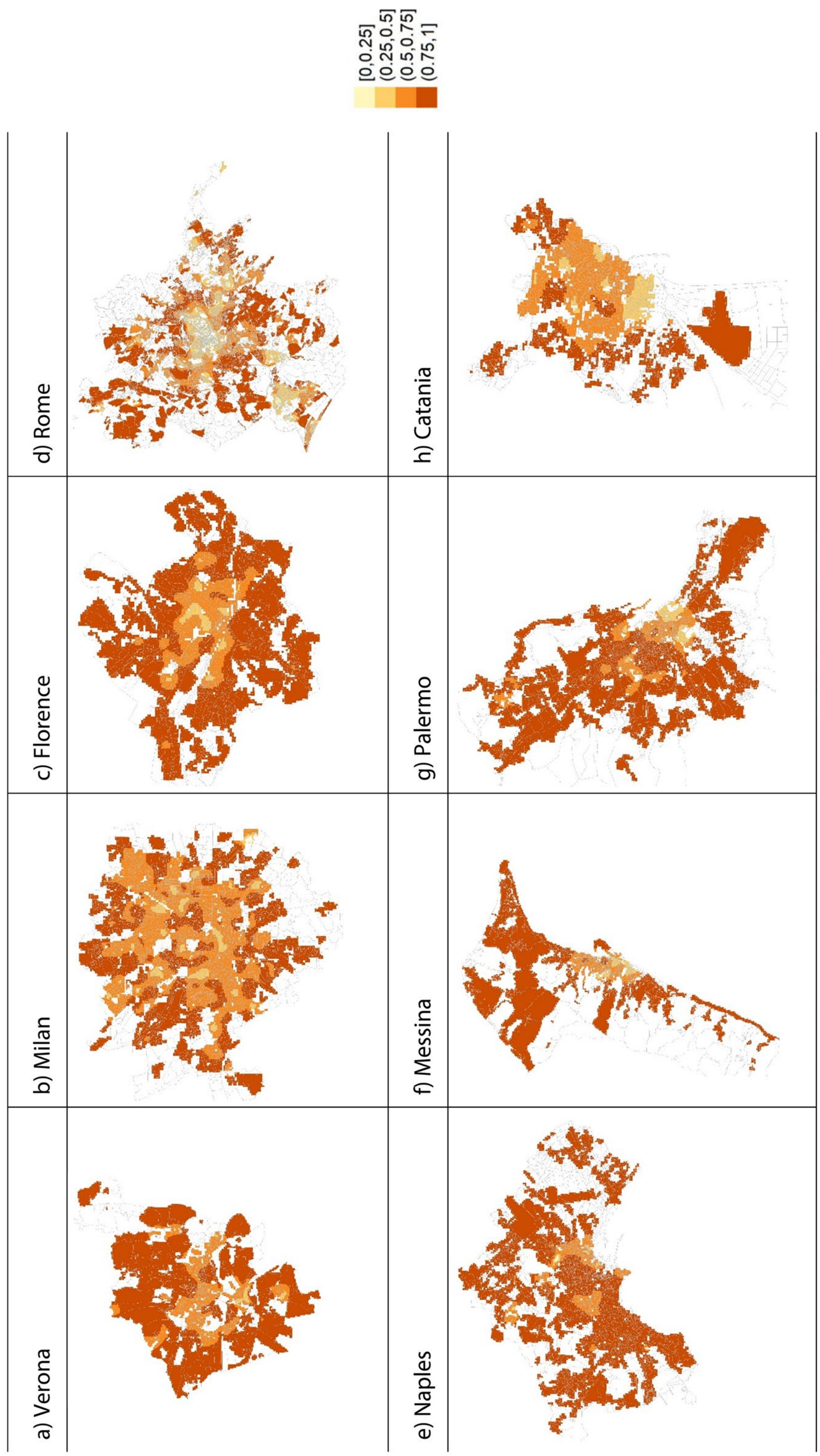

Fig. 7 Local R^2 in the eight Italian municipalities considered (not comparable geographical scales)

GWR results

See Tables 4, 5, 6.

Table 4 AIC comparison between OLS and GWR procedures

AIC		
Municipality	**OLS**	**GWR**
Rome	384,934.40	271,567.10
Verona	40,024.76	11,706.33
Florence	40,264.63	18,872.44
Milan	46,183.81	27,158.26
Naples	26,963.18	11,733.55
Messina	27,146.90	12,223.42
Palermo	32,794.74	18,824.14
Catania	14,178.24	11,692.50

Table 5 Moran's I test for residual spatial autocorrelation in OLS and GWR models

Municipality	N° of neighboring cells			
	30		50	
	OLS	GWR	OLS	GWR
Verona	0.50***	0.05***	0.40***	0.02***
Milan	0.35***	− 0.0004	0.25***	− 0.01***
Florence	0.57***	0.002	0.50***	− 0.01***
Rome	0.67***	0.17***	0.61***	0.01***
Naples	0.58***	0.018***	0.52***	0.004**
Messina	0.41***	0.015***	0.36***	0.002
Palermo	0.35***	− 0.005	0.28***	− 0.01***
Catania	0.15***	0.009**	0.1***	− 0.004

**p* value < 0.05; ***p* value < 0.01; ****p* value < 0.001

Table 6 Summary of GWR coefficient estimates in the eight municipalities

Verona					
Covariate	**Min**	**1st Qu**	**Median**	**3rd Qu**	**Max**
(Intercept)	− 4.1008e+01	− 1.8419e+00	− 2.9390e−01	4.2975e−01	1.0256e+02
Unemployment rate	− 3.9972e+01	− 6.1537e−02	− 2.0550e−03	7.2522e−02	3.3742e+00
Large households	− 5.2346e+00	− 3.2511e−02	5.3658e−03	5.8659e−02	3.8224e+00
Households (rent)	− 4.3546e+00	− 4.9988e−03	9.9835e−03	3.7477e−02	2.0806e+01
Low Educ. Attain	− 2.8319e+00	− 1.8293e−02	7.6159e−03	6.1415e−02	1.4898e+00
Foreign. prop. (2011)	− 1.0902e+02	− 2.7840e−01	2.4644e+00	8.3366e+00	1.0557e+02
Buildings (poor cond.)	− 1.5754e+00	− 1.5472e−02	− 2.3350e−03	8.2220e−03	2.2539e+00
Mean rent cost	− 1.9450e+185	− 7.6159e−02	− 1.2082e−04	5.0566e−02	1.9814e+188
Ita. growth rate	− 3.9808e−02	− 2.1921e−03	− 1.8645e−04	1.5467e−04	1.8800e−02
Foreign. growth rate	− 4.5462e−03	2.6576e−09	3.2983e−04	1.7502e−03	2.2900e−02

Table 6 (continued)

Milan					
Covariate	**Min**	**1st Qu**	**Median**	**3rd Qu**	**Max**
(Intercept)	− 8.7135e+02	− 1.3586e+00	− 4.4878e−02	1.0704e+00	1.2984e+02
Unemployment rate	− 3.4496e+00	− 9.4166e−02	− 1.6878e−02	5.8630e−02	8.2311e+00
Large households	− 3.0840e+00	− 1.1248e−01	− 2.3112e−02	6.2232e−02	1.0858e+01
Households (rent)	− 1.0967e+00	− 8.0181e−03	3.7334e−03	1.9951e−02	6.7760e−01
Low Educ. Attain	− 1.5375e+00	− 4.5146e−02	− 1.0819e−03	4.4575e−02	1.0578e+00
Foreign. prop. (2011)	− 2.3085e+02	2.1621e+00	7.7542e+00	1.4914e+01	1.7401e+02
Buildings (poor cond.)	− 5.2837e−01	− 1.4937e−02	1.0218e−03	1.8554e−02	4.3306e+00
Mean rent cost	− 2.4446e+39	− 1.1369e−01	− 1.0102e−02	7.6609e−02	1.0973e+54
Ita. growth rate	− 7.1394e−02	− 9.7377e−03	− 3.9463e−03	2.0865e−05	4.4300e−02
Foreign. growth rate	− 1.7336e−02	9.2939e−04	3.5838e−03	7.4467e−03	4.1600e−02
Florence					
Covariate	**Min**	**1st Qu**	**Median**	**3rd Qu**	**Max**
(Intercept)	− 1.1995e+02	− 1.1478e+00	9.0084e−01	3.8037e+00	6.6384e+01
Unemployment rate	− 4.1199e+00	− 1.5908e−01	− 1.5805e−03	1.4236e−01	5.2959e+00
Large households	− 6.3926e+00	− 2.3650e−01	− 5.4833e−02	4.5830e−02	3.6253e+00
Households (rent)	− 1.1517e+00	− 1.8276e−02	7.7231e−03	7.2018e−02	2.4785e+00
Low Educ. Attain	− 3.3059e+00	− 1.6040e−01	− 2.0117e−02	5.5490e−02	3.1640e+00
Foreign. prop. (2011)	1.0178e+02	− 4.4176e−01	3.9870e+00	1.6097e+01	1.7183e+02
Buildings (poor cond.)	− 3.5191e+00	− 6.0787e−02	− 8.0708e−03	2.1985e−02	1.2904e+00
Mean rent cost	− 6.8002e+23	− 1.4515e−01	− 2.9218e−02	4.6040e−02	5.5546e+18
Ita. growth rate	− 1.1071e−01	− 5.8269e−03	− 1.1285e−03	3.5562e−04	5.3500e−02
Foreign. growth rate	− 5.3488e−02	− 9.1101e−06	1.4239e−03	6.3840e−03	1.1460e−01
Rome					
Covariate	**Min**	**1st Qu**	**Median**	**3rd Qu**	**Max**
(Intercept)	− 5.1573e+01	− 7.1509e−01	1.6492e−01	2.0594e+00	335.8890
Unemployment rate	− 1.7711e+01	− 7.5611e−02	1.8776e−03	9.3853e−02	4.3745
Large households	− 5.5878e+00	− 8.5975e−02	− 1.5961e−08	9.4045e−02	14.3060
Households (rent)	− 5.2205e+00	− 2.1107e−02	− 2.2319e−04	1.4189e−02	6.4187
Low Educ. Attain	− 1.2754e+01	− 7.3707e−02	− 5.1259e−03	3.8600e−02	4.4210
Foreign. prop. (2011)	− 1.5470e+03	9.4214e−03	4.5479e+00	2.2929e+01	518.2287
Buildings (poor cond.)	− 3.7955e+00	− 1.4251e−02	− 5.9296e−04	1.6427e−02	12.1587
Mean rent cost	− 5.4857e+00	− 7.1989e−02	− 2.6105e−04	4.1600e−02	35.6451
Ita. growth rate	− 1.1610e−01	− 8.5073e−03	− 1.4845e−03	1.6607e−04	0.1177
Foreign. growth rate	− 5.7375e−02	− 4.6067e−06	1.2553e−03	5.5685e−03	0.0912
Naples					
Covariate	**Min**	**1st Qu**	**Median**	**3rd Qu**	**Max**
(Intercept)	− 3.2117e+02	− 9.5536e−01	5.7344e−02	7.5311e−01	22.1351
Unemployment rate	− 5.4222e−01	− 4.4647e−02	− 4.5177e−03	2.6893e−03	0.5508
Large households	− 7.8110e−01	− 7.2972e−03	1.7308e−03	3.5471e−02	0.4162
Households (rent)	− 3.2951e−01	− 6.3278e−03	− 2.1506e−05	3.0437e−03	0.1637
Low Educ. Attain	− 3.5795e−01	− 1.1491e−02	4.6304e−05	2.1811e−02	0.7788
Foreign. prop. (2011)	− 2.1516e+02	− 5.9749e−01	3.0821e+00	4.9965e+01	370.3511
Buildings (poor cond.)	− 6.1167e−02	− 1.8128e−03	1.8264e−06	2.7936e−03	0.0687

Table 6 (continued)

Naples

Covariate	Min	1st Qu	Median	3rd Qu	Max
Mean rent cost	− 3.3105e+00	− 8.4691e−02	− 8.8386e−04	6.1402e−02	21.7909
Ita. growth rate	− 8.3631e−02	− 4.0345e−03	− 4.8971e−04	3.4316e−05	0.0212
Foreign. growth rate	− 5.8711e−03	6.3925e−06	3.7239e−04	1.9900e−03	0.0526

Messina

Covariate	Min	1st Qu	Median	3rd Qu	Max
(Intercept)	− 2.2678e+01	− 1.2869e+00	5.0959e−01	3.4549e+00	64.3421
Unemployment rate	− 8.0829e−01	− 5.2655e−02	8.7045e−03	8.0771e−02	0.9215
Large households	− 3.8479e+00	− 1.1054e−01	− 1.5248e−02	8.4828e−02	5.2466
Households (rent)	− 7.8988e+00	− 1.0961e−02	2.8083e−02	1.5130e−01	2.2626
Low Educ. Attain	− 2.1831e+00	− 1.0365e−01	− 1.2293e−02	3.5095e−02	1.0518
Foreign. prop. (2011)	− 3.3846e+02	− 9.2159e−05	1.9800e−01	1.2024e+01	440.2252
Buildings (poor cond.)	− 7.1578e−01	− 2.0872e−02	− 2.7900e−03	7.1316e−03	0.5122
Mean rent cost	− 5.5807e+00	− 1.4949e−02	− 4.2109e−08	2.5522e−03	1.1330
Ita. growth rate	− 2.6376e−02	− 1.1034e−03	− 4.8573e−05	− 2.1151e−15	0.0088
Foreign. growth rate	− 6.5197e−03	− 1.4880e−10	1.2536e−05	7.8882e−04	0.0186

Palermo

Covariate	Min	1st Qu	Median	3rd Qu	Max
(Intercept)	− 2.9801e+01	− 1.0155e+00	− 2.5658e−03	1.7416e−01	3.1823e+01
Unemployment rate	− 6.8459e−01	− 3.3067e−02	2.7356e−13	2.8763e−02	9.8870e−01
Large households	− 6.3481e−01	− 2.3183e−02	− 9.8685e−07	3.2735e−02	1.3015e+00
Households (rent)	− 2.9160e−01	− 3.1697e−03	6.8043e−05	1.9352e−02	3.7020e−01
Low Educ. Attain	− 4.1222e−01	− 1.0136e−02	2.3356e−06	2.7603e−02	4.5080e−01
Foreign. prop. (2011)	− 2.5263e+02	− 5.3549e−04	3.5380e+00	4.6594e+01	3.1079e+02
Buildings (poor cond.)	− 1.1688e−01	− 5.3659e−03	4.7072e−12	3.6506e−03	1.1460e−01
Mean rent cost	− 2.1591e+01	− 5.1117e−02	2.6349e−02	5.2477e−01	1.2989e+11
Ita. growth rate	− 2.2201e−01	− 3.6756e−03	− 1.1361e−05	1.3195e−04	4.8600e−02
Foreign. growth rate	− 1.1783e−02	1.4163e−09	2.1126e−04	1.5384e−03	2.0300e−02

Catania

Covariate	Min	1st Qu	Median	3rd Qu	Max
(Intercept)	− 1.6275e+01	− 1.0949e+00	1.4972e−04	1.5548e+00	30.5074
Unemployment rate	− 4.8244e−01	− 7.7501e−02	− 2.7420e−03	1.1891e−02	0.3292
Large households	− 5.3180e−01	− 1.0223e−01	− 4.1820e−03	1.0669e−02	0.6018
Households (rent)	− 8.4894e−02	− 8.2579e−04	7.8963e−03	7.9235e−02	0.2974
Low Educ. Attain	− 4.0763e−01	− 3.4425e−02	2.5940e−06	2.5323e−02	0.2493
Foreign. prop. (2011)	− 1.3155e+01	1.2119e−01	2.1361e+01	7.4160e+01	176.4775
Buildings (poor cond.)	− 8.2941e−02	− 4.6128e−03	2.0022e−05	9.7242e−03	0.2212
Mean rent cost	− 8.5575e+00	− 3.7424e−01	− 5.9811e−03	5.1024e−02	2.2150
Ita. growth rate	− 7.1144e−02	− 1.1109e−02	− 1.0719e−03	2.5930e−11	0.0171
Foreign. growth rate	− 1.1098e−03	1.4747e−04	1.6520e−03	6.5634e−03	0.0169

Results from GWRs (see Table 6) highlight the local variations in the associations between dependent and independent variables. The local analyses show that Sri Lankans' allocation model did not involve all the urban areas equally (see also Figs. 3, 4, 5, 7). In general, extreme maximum values were recorded in the northern and central cities. The sole exceptions are the covariates concerning the Italians' and foreigners' mean growth rate, which are always characterized by lower values and moderate min–max ranges. Moreover, while the median value for the first is positive, for the second is negative in each municipality, confirming the general situation detected by the OLS. A large variation is recorded instead for the foreigners' proportion in 2011 and for the mean rent cost. The first covariate presents very high coefficient values in the southern cities and in Rome, while the cost of renting shows a strong variability especially in the North and Center.

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Author contributions
Writing—review and editing, investigation, conceptualization, validation: FrB, FeB, AM, and SS; writing—original draft, methodology: FrB; supervision: FeB, AM, and SS.

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Availability of data and materials
The population data (source: 2011 Population Census) used in the study are not releasable for privacy reasons. They were made available by the Italian National Institute for Statistics (Istat) as part of the "Caratteristiche, comportamenti e condizioni di vita degli immigrati di prima e di seconda generazione secondo le principali fonti disponibili" research agreement between Istat, the National Research Centre (CNR), and six Italian universities. Data on the real estate market (source OMI) are freely downloadable from the website https://www.agenziaentrate.gov.it/portale/schede/fabbricati terreni/omi/banche-dati/quotazioni-immobiliari. In both cases, the original data were re-estimated on regular grids using a specific statistical procedure. Estimates are available from the authors upon reasonable request.

Declarations

Competing interests
The authors declare that they have no competing interests.

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