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Analyzing spatial vulnerability in cities by combining the analytic hierarchy process and geographic information systems: the case of Vitoria-Gasteiz, Spain

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Abstract

Vulnerability in urban areas has been on the rise following the global political and economic restructuring processes that have taken place since the 1980s. This increase in vulnerability has sparked a growing awareness of the need to understand the impact of these processes on the most vulnerable neighborhoods and areas of cities so as to develop effective policy responses. Although this vulnerability has become more evident in larger cities, this casuistry can also be seen in medium-sized cities. This paper examines the level of vulnerability of different neighborhoods in the medium-sized European city of Vitoria-Gasteiz (Basque Country, Spain), using a methodological approach which combines the analytic hierarchy process and geographic information systems, based on a number of indicators for different economic, demographic and migratory status-related dimensions. The results reveal a synthetic map of the vulnerability of neighborhoods in Vitoria-Gasteiz that shows an uneven impact of structural processes and policy initiatives implemented over decades. The paper concludes that synthetic maps of vulnerability make it possible to show the different realities in the urban framework and can contribute to defining public interventions tailored to these specific problems.

Keywords: Spatial Vulnerability; Analytic Hierarchy Process; Geographic Information Systems; Vitoria-Gasteiz

Introduction

Having weathered the economic crisis of the 1970s, by implementing neoliberal sectoral restructuring processes on a global scale, cities became the true strategic centers of the advancement of these processes. As a result, the management and advanced services functions of multinational companies began to concentrate in large cities around the world, leading to an increase in social polarization. Whilst the most qualified and better-paid workers have settled in the metropolises, there is a parallel demand for low-skilled workers to provide services to consumers (Sassen, 1991). The transformations in the labor markets –strong deregulation by governments, increase in jobs in the informal economy, increase in employment in the service sector ranging from jobs in the advanced tertiary sector to low paid consumer services, increase in wage inequality, etc.– (Koch, 2017; Bentolila et al., 2019; Martínez et al., 2022), together with a significant reduction in the provision of services by the welfare states of numerous countries, especially in Europe (Spain, Portugal, Greece, Italy, United Kingdom, France, Holland, Sweden, etc.), which had to implement austerity and public spending control policies (Pavolini et al., 2015; Hassenteufel & Palier, 2016; Farnsworth, 2021), have contributed to an increase in the vulnerability of urban areas (Ranci et al., 2014).

This increase in vulnerability has sparked a growing interest in the study of this concept, and in recent years it has started being used to explain the ability of an individual, population group or place to cope with various hazards and their effects (Christmann & Ibert, 2012). Despite the fact that significant efforts have been made to develop and improve the concept in different contexts, vulnerability lacks a standardized definition

in the field of social sciences, and there are a number of different interpretations of the same concept (Cutter et al., 2000; Miller et al., 2010; Piñeira-Mantiñán et al., 2020). In our research context, spatial vulnerability refers to geographical places or spaces whose population may be affected by various threats (social, cultural, economic, demographics, political or institutional) and find themselves at risk and/or in a fragile situation and with a lower ability to respond to and recover from these threats (Spielman et al., 2020). Therefore, a more in-depth analysis of the current state of spatial vulnerability in cities could help identify the corrective measures needed to determine their future directions. However, our knowledge about vulnerability levels in urban areas remains limited, especially in the case of small and medium-sized cities.

We have taken a step towards covering this gap by studying vulnerability levels within urban space of a medium-sized European city, Vitoria-Gasteiz (Basque Country, Spain), by combining the analytical hierarchy process (hereinafter referred to as AHP) with geographic information systems (hereinafter referred to as GIS). This combined methodological approach has hardly been used in the field of urban analysis.

We have focused on this methodological approach for the following reasons. Firstly, because this methodological approach allows us to create a synthetic vulnerability index for a city, at different scales or spatial units of analysis, through the weighted combination of various indicators relating to a range of mainly socio-economic and demographic variables or dimensions. Secondly, because this methodological approach allows us to translate these values to a synthetic map that reflects the spatial vulnerability of that city. This is a critical issue that may provide better understanding of the spatial vulnerability in cities and appropriate information for authorities and

stakeholders to consider in their decision making. Thirdly, because this methodological approach allows us to include indicators measured at different scales or spatial units of analysis, so that we can create a synthetic index for the spatial unit of our choice, depending on the availability of data. Finally, this methodological approach allows us to make comparisons at different points in time and between different locations.

In this paper, we chose the city of Vitoria-Gasteiz as an empirical case study, since it allows us to bring a focus on small and medium-sized cities in Europe, moving away from much existing scholarly attention on larger urban metropolises. In our research context, we analyzed, measured and mapped the level of vulnerability of the various neighborhoods of Vitoria-Gasteiz, based on a number of indicators relating to different demographic and economic dimensions and those related to migratory status, through the combined use of AHP and GIS, thereby obtaining a synthetic map of the city's vulnerability by neighborhood. This synthetic map shows a clear differentiation between a neighborhood in the north, two neighborhoods in the south-east and some central neighborhoods, where vulnerability is concentrated, and the south-west area of the city, where there is a spatial clustering of neighborhoods with low and medium-low levels of vulnerability. These patterns of vulnerability in the city are a result of structural processes and policy initiatives implemented over decades. More specifically, this research is aimed at responding to two research questions: (1) By analyzing levels of vulnerability, what impact may the neoliberal expansive urban growth model have had on the city's various neighborhoods? and (2) What insights can be drawn for policymakers and, more generally, for debates on urban affairs/urban studies?
The response to these questions could provide some guidance to both scholars and practitioners.

The remainder of the paper is structured as follows. In the following section we present the literature review, aimed at understanding how the neoliberal governance of recent decades has generated alarming levels of vulnerability in numerous cities (from large metropolises to small and medium-sized cities). We then present the study area and provide a map of the situation of the neighborhoods in Vitoria-Gasteiz, explaining their evolution. Subsequently, we explain the methodology, including the sources used and the variables selected. Then, in the fifth section, we present our findings. Finally, we discuss our findings and present the main conclusions derived from our research.

Literature review

Over the past forty years, there has been a renewed debate on the increasing vulnerability of cities associated with the aftermath of Fordism and global economic and political changes. In general, the factors that have contributed most to the increase in spatial vulnerability in cities in recent decades are twofold. Firstly, the global processes of economic and political restructuring, following the crisis of the 1970s, resulted in unequal incomes and social and spatial polarization in numerous cities around the world, which can be seen particularly in what are known as global cities (Sassen, 1991; Marcuse, 1997; Marcuse & Van Kempen, 2000; Musterd, 2005; Musterd et al., 2017; Van Ham et al., 2020; Méndez, 2023). Secondly, the emphatic turn towards neoliberalism in political and economic actions through different processes, such as deregulation, labor market restructuring, privatization, housing market segmentation, new urban policy, and restructuring and weakening of welfare states with cuts in various public services (education, health, transportation, housing, etc.) (Marcuse & Van Kempen, 2000; Moulaert et al., 2003; Arbaci, 2007; Tammaru et al., 2020; Hamnett, 2021; Joy & Vogel, 2021; Van Ham et al., 2021; Joy & Vogel, 2022).

In Europe, it is necessary to highlight the studies carried out by Arbaci (2007), Van Kempen & Murie (2009), Lennert et al., (2010), Ranci et al. (2014), Tammaru et al. (2016), Arbaci (2019) and Rimoldi et al. (2020), among others, warning about the alarming levels of vulnerability that were being reached in many cities (from the large metropolises to small and medium-sized cities), after the processes of economic and political restructuring and several decades of neoliberal governance. However, the way in which this dynamic unfolds and takes place is multifaceted and provides for variegated outcomes (Ballas et al., 2017; Fainstein & Fainstein, 2018; Van Ham et al., 2020).

For example, Lennert et al. (2010) showed in their study that social polarization has increased in almost all the European cities they examined in recent decades, although they noted that the level of polarization in a city depends on the one hand, on the national context and, on the other, on the degree of insertion into the global economy and the new forms of economic growth associated with the knowledge-based economy. Lastly, they pointed out that the main drivers of these social polarization processes in the cities analyzed were related to economic dynamics, particularly labor markets in terms of qualifications, socio-demographic development, the evolution of real estate markets, and the public policies of both the state and the city itself. More recently, in their study, Tammaru et al. (2016) analyzed 13 European cities (Amsterdam, Athens, Budapest, London, Milan, Madrid, Oslo, Prague, Riga, Stockholm, Tallinn, Vienna and Vilnius), based on four underlying universal structural factors (welfare regimes, housing systems, social inequalities, global connectivity and changing economic structures) and on certain unique characteristics of the individual cities, showing that the spatial gap

between the rich and the poor is widening in European capital cities, and is threatening to damage the social stability of cities in Europe.

Along the same lines, Rimoldi et al. (2020) measured the vulnerability levels of municipalities in Italy through the creation of various synthetic indices, showing that the underlying socio-economic structure of the country is reflected in the north-south "well-being gradient". Meanwhile, Scarpa (2016) carried out an in-depth analysis of the growing income inequality in the three largest Swedish metropolitan areas (Stockholm, Gothenburg and Malmö) and its contribution to the increase in the spatial gap, and found that the compensatory effect that the welfare state used to provide has been significantly reduced, particularly in relation to the unemployed population, regardless of their origin or nationality.

Finally, Ranci et al. (2014) pointed out that there is a strong connection between the degree of economic competitiveness of cities and the degree of social cohesion. According to these authors, the reliability of this relationship depends on the following three factors: (1) the extent to which the welfare state is able to create a network of social and economic organizations, (2) the importance that citizens attach to social solidarity and equality, and (3) the support of local governments for local solidarity initiatives aimed at helping people in vulnerable situations.

In the case of Spain, it is also possible to identify similar dynamics in a number of studies carried out in recent years (Méndez et al., 2015; Romero et al., 2015; González Pérez et al., 2016; Leal & Sorando, 2016; Piñeira-Mantiñán et al., 2018; Sorando et al., 2021). More specifically, the neoliberal urban growth model has followed market rules

and has promoted the construction of public infrastructures and facilities, as well as large residential projects. However, weakening links between economic growth, employment, and social progress have pushed a part of the population out of the labor market or toward low-skilled and low-wage service sector jobs. An increase in income disparities and social polarization have been analyzed in different studies, showing how the economic dynamics themselves, acting through the instruments of the real estate market, have spatially fragmented numerous cities into rich and poor neighborhoods. Moreover, the latter tend to be increasingly isolated and suffer from a concentration of vulnerability in terms of poor housing, unemployment, low-quality education and difficulty in accessing certain services (transport, health, ICT) (Subirats & Martí-Costa, 2014; Hernández-Aja, Córdoba Hernández et al., 2018; Nel·lo, 2021).

Therefore, several studies have focused on vulnerable or disadvantaged neighborhoods (Alguacil Gómez et al., 2014; Blanco & Nel·lo, 2018; Pitarch-Garrido et al., 2018). In this regard, the pioneering study led by Hernández-Aja (Hernández-Aja, 1996) resulted in a catalogue of vulnerable neighborhoods in the main Spanish cities. The evolutionary analysis of the catalog of vulnerable neighborhoods derived from that research led to the conclusion that, in the period 1991-2011, there was a gradual increase in internal imbalances in Spanish cities, with an increasing concentration of the vulnerable population in cities (Hernández-Aja, Rodríguez Alonso et al., 2018; Rodríguez-Suárez et al., 2021). Along these lines, in a very recent study, Iglesias-Pascual et al. (2023) compared the level of vulnerability in Madrid and Barcelona, showing that vulnerability in both cities is concentrated in the peripheral areas, compared to less vulnerable areas in the center, although a higher percentage of Madrid's population lives in areas of high vulnerability. More recently, these tendencies have been exacerbated as a result of the

impact of the financial crisis and austerity policies on the most vulnerable populations and neighborhoods.

In this vein, in the city of Valencia, new urban projects such as the one that was intended to be developed in the Cabanyal neighborhood, which were part of the global marketing strategy related to neoliberal urban policy, generated strong citizen resistance. The social reaction and uncertainty generated by public action led to a reduction in private investment, which contributed to exacerbating the vulnerability of the neighborhood (Ilisei & Salom-Carrasco, 2018).

Martín-Legendre et al. (2021) carried out a comparative analysis of 40 Spanish cities (A Coruña, Alcobendas, Badalona, Burgos, Granada, Las Palmas de Gran Canaria, among others), which revealed that, since the last economic crisis, there has been an increase in income concentration in the wealthier neighborhoods of these cities, reducing their dependence on labor income.

In Bilbao, intensifying the social and spatial division of the city has been an integral part of a process of uneven redevelopment that has reinforced differences between an affluent center and the working class and lower-income periphery neighborhoods (Esteban, 2000; Vicario & Martínez, 2003; Gainza, 2017; Martínez et al., 2022).

In the case of the city of Vitoria-Gasteiz, neighborhoods's vulnerability has been largely eclipsed by a powerful discourse of ecological regeneration success and best practice. However, the uneven distribution of vulnerability between its neighborhoods has been an integral part of its project of development has tended to follow the rationale of

neoliberal city-making, especially exacerbated since 2001 (Arriola, 1986, 1991; Zárate-Martín, 1989; Aguado et al., 2013; Hernández-Aja, Córdoba Hernández et al., 2018; Neidig et al., 2022).

In sum, in recent decades, many cities have experienced an intensification of spatial vulnerability related to the simultaneous changes in the economic, demographic, political, cultural and social environment. Therefore, identifying the relative influence of different factors at a neighborhood level - economic factors such as the income levels of its population, unemployment and poverty levels, demographic factors such as the aging of its population, education levels, etc., and factors related to migration status - is essential when it comes to understanding the greater or lesser resilience of a city's neighborhoods and reshaping internal differences and urban divides. Below, we examine in greater detail the case of the city of Vitoria-Gasteiz.

Study area

Vitoria-Gasteiz, a mid-sized city with a population of 250,106 inhabitants (Eustat, 2022), is the administrative capital of the autonomous region of the Basque Country and is also the capital of the province of Araba, in Spain. Its flat orography and the high availability of land have favored urban development with densities much lower than those of other Basque capitals (897.95 inhabitants/km^2 compared to 2,979.81 inhabitants/km^2 in Donostia-San Sebastian and 8,387.65 inhabitants/km^2 in Bilbao) (Eustat, 2022). The municipality is divided into 28 neighborhoods and a surrounding rural area that contains 62 smaller local entities belonging to the municipality (Figure 1).

[insert Figure 1]

The city has a radius-concentric plan that is arranged around the medieval town, its foundational nucleus. Until the middle of the 20th century, Vitoria-Gasteiz was a small town with a population of 40,000 inhabitants driven by the agricultural sector, without great contrasts, in a sparsely populated province. However, throughout the 19th century the upper and upper-middle classes had been settling in the town's expanded area (Ensanche), fleeing from the overcrowding and deterioration of the Historical Center (Casco Viejo) and the first spatial divisions were beginning to be seen. The construction of the Ciudad-Jardín housing in 1924 probably marked the first step towards a divided city because, although they made use of the Law of Cheap Houses and the financial aid that came from that law for their construction, they were really aimed at the bourgeois classes of the town (Arriola, 1986).

From the second half of the 20th century, urban development in Vitoria-Gasteiz can be described as a centralized, planned growth trajectory marked by a shift in the 1950s from a small agricultural town towards an industrialized city. Its geostrategic position as a transport node connecting Madrid (the centralized political and economic engine of Spain) with France, its geographically easily accessible and flat terrain, and –in contrast to its Basque urban counterparts, Bilbao and Donostia-San Sebastian – a rather supportive economic and religious elite to the Franco regime helped the city receive subsidies and tax incentives from the Franco administration to push an industrial transition forward. By the 1960s this transition became complete as many factories, especially from the automotive sector, had moved their production from other parts of the Basque Country to Vitoria-Gasteiz. The new economic sector encouraged labor

immigration from rural Spain, with primarily rural farmers moving North looking for better living conditions. In just two decades, the city's population nearly quadrupled, and by 1960 almost 60% of workers were employed in industrial work, compared to only a third a decade earlier (Ruiz Urrestarazu & Areitio, 2004).

This rapid industrialization demanded a quick response to meet new demands for the housing, mobility, and social life of the working class. To accommodate a part of this working class, in the 1960-1970s a number of new urban enclaves, far from the city and with few facilities, were built on the periphery: San Prudencio in Armentia, Errekaleor, and the colony for the workers at the Imosa Factory in Ali, Abetxuko and Bustaldea. The distance from the urban center, the low level of urbanization, poor access to basic services and the low quality and small size of the houses meant that these areas were characterized by a very marked marginality (Arriola, 1986). Within addition to this, new working-class neighborhoods were also created that connected the city center with the industrial estates in the North and the South-East. These new residential areas were characterized by high density and relatively affordable but low-quality housing close to the new factories and polluted areas. Finally, in 1971, a decree approved the construction of a large new neighborhood in the city, the neighborhood of Lakua, as part of the Urgent Urban Planning Actions (ACTUR) planning instrument, which allowed this area of the city to be urbanized. ACTUR was a planning instrument created in Spain by Decree-Law in 1970, inspired by European models of the time, such as British 'new towns' and Parisian 'villes nouvelles', which were aimed at providing urban land at a reasonable price to meet the need for social housing in large urban concentrations, particularly in Madrid and Barcelona. However, the Decree-Law itself provided for its use in other cities in Spain, subject to prior declaration of the need for it

by Decree. As a result, in Vitoria-Gasteiz, after the ACTUR Decree was passed in 1971, a large new neighborhood was designed and developed in the Lakua area during the 1970s and 1980s, separate from the consolidated city, inspired by functionalist urban planning with the construction of blocks of flats, mostly of a medium density and limited in height (4 or 5 floors on average), thereby contributing to the further expansion of the city and causing it to lose the compact nature that had characterized it (López de Lucio, 1992). By the end of the Francoist dictatorship in the mid-1970s, the city had grown to 190,000 residents.

In the period when the Spanish political system was restructured after the death of Franco in 1975, which marked a long phase of transition from dictatorship to democracy, there was a change of direction in the municipal policy of Vitoria-Gasteiz, which resulted in a more progressive urban policy from the 1980s onwards (Zárate-Martín, 1989). In addition, the new progressive municipal policy also launched the long-term greening of the city in these years by integrating nature into the urban network (Neidig et al., 2022).

Since the start of the 21st century, there has been a change of direction in terms of municipal policy and, following the approval of the new general urban development plan in 2001, a large part of the city's land has been allowed to be redeveloped, benefiting the real estate development of almost 100,000 new inhabitants. In that year, the city had a population of 215,000 inhabitants with a projected population growth of only 0.5-1% per year, so it soon became clear that the proposed pace and scale of urban development went far beyond the actual demand. Thus began a new period of expansion of the city with the construction of two large new neighborhoods: Zabalgana and

Salburua, on the western and eastern periphery, respectively (Ruiz Urrestarazu & Areitio, 2004). Moreover, since 2001, the project of greening the city began to be integrated into local urban planning.

Finally, Goikolarra is the latest new neighborhood to be built in Vitoria-Gasteiz, in the south of the city. The first houses in this new neighborhood were built about a decade ago. The neighborhood is located on one of the city's former peripheral enclaves (Bustaldea), which emerged in the 1960s, and also takes in two small rural centers close to the city, the small local communities of Aretxabaleta and Gardelegi. Although its development was also included in the 2001 General Urban Development Plan, where land for development was classified for the construction of the two large new neighborhoods of Zabalgana and Salburua, the development of Goikolarra has been much slower and features a much more diversified housing mix.

Land in the Goikolarra area was in the hands of a few landowners (Barroso et al., 2005), who have, to a large extent, dictated the construction and development of the neighborhood. Consequently, it was only when house prices began to recover after the property bubble burst that there was a strong boost in construction in this area, which experienced strong development during the COVID-19 lockdown. In this neighborhood there is a clear differentiation between the urban planning in the area adjacent to the city, where the services (shopping center, supermarkets, schools, restaurants) are concentrated along with the higher quality and more expensive housing, and the urban planning in the area of the neighborhood furthest from the city where the social housing is located, which also had to circumvent a steep slope because this area is very close to the natural area of the Vitoria-Gasteiz Mountains. This means that the Goikolarra neighborhood is home to public housing developments on the outskirts, but in the area

closest to the city center, in the neighborhood of Mendizorrotza, which it borders, there is a predominance of private developments of detached houses and enclosed residential areas of high standing with private community facilities such as gyms, gardens, paddle tennis courts, etc.

Below, we will look in more detail at how neoliberal urban processes have had an impact on the different neighborhoods of Vitoria-Gasteiz by analyzing the level of vulnerability. To do this, we use indicators based on available data from recent years.

Materials and method

This research measures, maps and analyses the level of vulnerability in the various neighborhoods in Vitoria-Gasteiz, through the combined use of the analytical hierarchy process (AHP) and geographic information systems (GIS), after decades of significant urban sprawl.

As with other complex and multidimensional concepts, such as well-being or quality of life, in the case of vulnerability we follow the view of Quadrado et al. (2001) that it is preferable to analyse it by estimating composite indices that weight and take into account the interrelationship between various indicators, rather than using a single indicator. The construction of a synthetic index from a large number of indicators provides value mainly because of the composite picture it provides, rather than because of the reality that each indicator provides independently. Moreover, this combined view mitigates some of the high statistical uncertainty that can be linked to using a single indicator to analyse a small spatial unit (Spielman & Singleton, 2015). For this reason,

we have expanded the number of indicators used by Hernández-Aja, Rodríguez Alonso et al. (2018) in the Atlas of Urban Vulnerability in Spain to build our synthetic index, in order to provide more information to the study on the vulnerability of the neighborhoods of Vitoria-Gasteiz.

Unit of analysis

A crucial step in these studies is selecting the spatial level of analysis, which must be congruent with the purpose of the assessment (Fekete et al., 2010). Different divisions in the study area can lead to different statistical results and we could come up against what is known as the Modifiable Areal Unit Problem, as both the shape and scale of the aggregation unit can be affected (Fotheringham & Wong, 1991).
Based on the fact that a large part of municipal policies in Vitoria-Gasteiz are carried out at a neighborhood level, we have selected the 28 neighborhoods in the city as the unit of analysis. Neighborhoods are easily identifiable administrative boundaries and are also the administrative units of reference for providing public facilities and services in the city. There is even a participatory budget that allows residents and neighborhood associations in each neighborhood to decide on the actions to be prioritized, so we decided that this was the most appropriate approach for implementing municipal policies aimed at reducing vulnerability.

We could have opted to carry out the study on a smaller scale or unit of analysis, such as the census section (using between 1,000 and 2,500 inhabitants), a statistical unit from which a wide variety of information can be obtained. This lower scale of analysis would have allowed us to obtain greater detail of the internal patterns of vulnerability in the

larger neighborhoods, which have many census sections, meaning that internal vulnerability patterns may be somewhat blurred when the study is carried out at a neighbourhood scale. However, since our aim is to provide a useful diagnosis for implementing municipal policies, we chose to use neighborhoods as the unit of analysis. A second reason for our choice was the fact that many of the indicators at a census section level in Spain are obtained through surveys and, frequently, the sample volume used in such small units does not make it possible to achieve a sufficient level of confidence (Piñeira-Martiñán et al., 2018).

Data and sources of information

The study uses information from the latest statistical sources published by both the Basque Institute of Statistics (Eustat) for 2021 and 2022 and the Basque Employment Service (Lanbide) for the year 2021 by neighbourhood. We contacted the Basque Employment Service (Lanbide) to obtain information on the number of recipients of Guaranteed Income (GI). This is a minimum income that households with no or very low income can apply for. We used this variable in our study as a proxy variable for the poverty level in neighborhoods. The selection of indicators is contingent on the availability of data on a neighborhood scale, but is consistent with indicators frequently used in research on neighborhoods (Ilisei & Salom-Carrasco, 2018; Piñeira-Martiñán et al., 2018; Martínez at al., 2022).

Consequently, the study defines 8 indicators related to the 3 dimensions of interest: economic, demographic and migratory status, and we have built a database that includes information related to the 8 indicators that allow us to measure these 3 dimensions for

the 28 neighborhoods in Vitoria-Gasteiz. Having built the database of indicators, we used the linear normalization technique to standardize them and have them in the same order of magnitude, an essential step before going on to add the variables. Table 1 shows the dimensions and indicators and their sources.

[insert Table 1]

The Analytical Hierarchy Process (AHP)

The AHP is a multi-criteria evaluation method developed by the mathematician Thomas Saaty (1990), which provides a rational and comprehensive framework for hierarchically structuring information related to a problem to be solved (a decision to be made or a goal to be achieved). This method has been used in a wide range of fields such as the environment, industry and health, but it has scarcely been used in the field of urban studies. More specifically, the AHP is carried out in three stages. The first stage consists of formulating the problem to be solved by structuring all the information in a hierarchical manner by identifying its key components: the problem to be solved, the criteria and sub-criteria for resolving it and the existing alternatives or scenarios.

After building the hierarchical structure of the problem, the second stage of the AHP consists of evaluating the components of the hierarchy and assigning a value to them. To do this, the relative importance of each criterion or sub-criterion is compared pairwise using a rating scale that ranges from a minimum value of 1/9 (of least importance) to 9 (of greatest importance) (Saaty, 1990). The result of these comparisons

is a positive, reciprocal, square comparison matrix, which is used to calculate the relative weight of each of the criteria or sub-criteria.

In the third stage, the weighting of each criterion or sub-criterion is calculated to give them their relative importance in terms of solving the problem being evaluated. These weightings must include the sign for each criterion or sub-criterion, according to their positive or negative contribution to the object of evaluation.

Procedure followed in our study through the combination of Analytical Hierarchy Process (AHP) and Geographic Information Systems (GIS)

The procedure of combining AHP and GIS in our research was as follows: Firstly, we formulated the hierarchical structure by identifying: a) the problem to be solved (the construction of a synthetic vulnerability index for Vitoria-Gasteiz by neighborhood, b) the criteria (economic, demographic and migratory status dimensions), c) the sub-criteria (the eight indicators selected: income level, unemployment rate, beneficiaries of guaranteed income, aging rate, activity rate, primary education, higher education and foreign population) and d) the different alternatives (levels of vulnerability for the neighborhoods considered in Vitoria-Gasteiz: high, medium-high, medium, medium-low, low).

Secondly, we compared all the selected indicators in pairs to assess the relative importance of each indicator based on the rating scale proposed by Saaty (1990). Each of the three researchers distributed the scores independently for each pair of indicators according to their contribution to the vulnerability of the neighborhoods in Vitoria

Gasteiz, based on the knowledge acquired through different research funded by the Spanish Government (Ministry of Economy and Competitiveness) related to urban studies. If these scores did not match for any pair of indicators, the researchers discussed the evaluation given until a single comparison matrix was reached by consensus. This matrix fulfills the properties of reciprocity (if aij=x, then aji=1/x), homogeneity (if i and j are equally important, aij=aji=1, and furthermore, aii= 1 for each i), and consistency (the matrix must not contain contradictions in the evaluation performed).

Thirdly, we obtained the weightings of the indicators from the matrix of comparisons. The weight of each indicator was calculated from this matrix of comparisons. To do this, the first step was to normalize the matrix of consensual comparisons by dividing each element in column j by the sum of all the elements in that column. Secondly, we calculated the average of each row in the normalized matrix, thereby obtaining the weight to be assigned to each indicator. Table 2 shows the normalized pairwise comparison weighting matrix and the final weighting of the indicators.

[insert Table 2]

Stages 4, 5 and 6 related to the GIS development phase of our methodology, where we worked on the indicators in cartographic form using ARCGIS 10.5 software. We downloaded the base-map layers from GeoEuskadi (the geoportal of the Basque Government that contains the spatial data infrastructure of Euskadi).

Fourthly, we incorporated each indicator into the GIS as a vector layer and thereby transformed them into a raster layer, in order to represent the indicators in a uniform and

continuous manner, regardless of their original form of representation (continuous or discrete), thus allowing the overlapping of layers.

Fifthly, using the weighted linear sum tool, we carried out the weighted linear sum of all the raster layers, thereby obtaining a synthetic vulnerability index expressed in a continuous form. The technique of weighted linear sum of the factors is expressed by the equation:

$$r_i = \sum_{j=1}^{n} w_j x_{ij}$$

where

r_i is the suitability capacity of alternative i, w_j is the weight of criterion j and x_{ij} is the weighted value of alternative i in criterion j (Saaty, 1990).

In the sixth stage, we reversed step 4 and transformed the raster layer representing the synthetic vulnerability index into a vector layer, the output map of which represents the synthetic vulnerability index at the selected scale of analysis, which, in our case, was neighborhoods, but which could have been projected to another territorial scale of our choice. Figure 2 shows a summary of the methodological procedure.

[insert Figure 2]

The analytical hierarchy process (AHP) in combination with geographic information systems (GIS) offers analytical advantages over other methods, making it possible to create synthetic indexes that are more suited to achieving the objectives of this study. The most important thing is that no information on the indicators used to build the index

is lost with the analytical hierarchy process (AHP), as the indicators themselves are weighted. With other methods, such as multiple factor analysis (MFA) or principal component analysis (PCA), the synthetic indices obtained only include part of the information provided by the original indicators, as dummy variables (factors or principal components) are weighted instead of the original variables, which only explain part of the total variance, meaning that important information for analyzing the multidimensionality of vulnerability is lost. However, we are not interested in simplifying the existing reality, but rather in knowing all the nuances of vulnerability in the different neighborhoods in Vitoria Gasteiz.

Results

In this section, firstly we will individually present each of the selected indicators by means of maps. We have classified them into intervals constructed using mean and standard deviation, which makes it easier to see the mean values and extremes than other types of grouping (Figure 3). Then, we will show the resulting vulnerability map of the neighborhoods in Vitoria-Gasteiz (Figure 4).

Starting with economic indicators, a clear spatial differentiation can be seen in Vitoria-Gasteiz, with the highest income levels concentrated in the south-west of the city, in the Mendizorrotza neighborhood in particular, although the new Goikolarra neighborhood, which is still under construction, also has relatively high income levels. Meanwhile, the lowest income levels are located mainly in peripheral neighborhoods such as Abetxuko, Sansomendi, Adurtza, Aranbizkarra, Arana and San Cristóbal, as well as in the more central neighborhoods such as Casco Viejo, Coronación, El Pilar and Zaramaga,

neighborhoods that were developed in the 1950-60s to accommodate the working class population

[insert Figure 3]

As far as the unemployment ratio indicator is concerned, two neighborhoods stand out with highly negative values: Zaramaga and Casco Viejo. The residents of these two neighborhoods have a profile of high labor vulnerability. Other neighborhoods with values close to the above are Arana, El Pilar, Coronación, Abetxuko and Adurtza, and these also have low income levels. At the opposite extreme is the new neighborhood of Goikolarra, where single-family homes and private housing developments with enclosed collective spaces predominate, attracting young families with both high incomes and qualifications, which could explain the low levels of unemployment in the neighborhood.

The last indicator considered within the economic sphere is the number of recipients of the Guaranteed Income. This indicator serves as a proxy variable for the level of poverty, given that it is a minimum income provided to economically precarious cohabitation units. In this case, the neighborhoods with the greatest precariousness are Casco Viejo and Coronación, closely followed by Zaramaga, and Abetxuko. Moreover, the residential fabric in all these neighborhoods is old and of low constructive quality. By contrast, the neighborhoods of Mendizorrotza and Goikolarra have very low percentages of GI recipients.

In terms of demographic factors, the map representing the elderly ratio clearly reflects that younger people are concentrated in newly built neighborhoods such as Zabalgana,

Goikolarra, and Salburua. Meanwhile, the neighborhood with the most aged demographic structure is Gazalbide, followed by many of the neighborhoods whose construction dates back to the 50s, 60s, 70s and even the 80s, such as the neighborhoods of Santa Lucía and Arantzabela, where most of their dwellings were built at that time. Nevertheless, some central neighborhoods that a decade ago were very old, such as Coronación, Lovaina, Ensanche, Desamparadas or El Anglo, now have intermediate values, and even the neighborhood of Casco Viejo has a relatively low elderly ratio. This shows that a rejuvenation of these neighborhoods is taking place. In some cases such as Casco Viejo and Coronación, this is thanks to the arrival of an immigrant population with lower age structures than the native population, but in other cases such as Lovaina, San Martín, Ensanche or Desamparadas, this is due to the settlement of young local families.

As far as the active population indicator is concerned, the map of the active population should, in a certain sense, be the opposite of the map of the elderly ratio, given that the correlation coefficient between both variables is highly negative ($r = -0.963$), which indicates that the higher the activity ratio, the lower the elderly ratio (Table 3). This is the case of the most recently built large neighborhoods, where this relationship can clearly be seen. We also found that some neighborhoods, such as Mendizorrotza, which has a medium elderly ratio (it would rank 18th out of 31 if we put the elderly ratio in order from lowest to highest), has a low activity ratio (it would rank 29^{th} out of 31). The neighborhoods of San Martín, Coronación, and Santa Lucía, on the other hand, also presented relatively important discordances between both variables, although to a lesser degree than in the case of Mendizorrotza.

[insert Table 3]

As for educational level, given that the educational levels of the Spanish population have increased over time, we would expect that the older neighborhoods would have lower educational levels. However, this is not the case, which is also corroborated by the correlation coefficient for these variables, which is positive, although with a very low value ($r = 0.188$). Moreover, lower educational levels have a positive correlation with the unemployment ratio variable ($r = 0.747$) and a strong negative correlation ($r = - 0.809$) with disposable average income. By contrast, the neighborhoods with the highest levels of the population that have completed higher education are the south-western neighborhoods (Mendizorrotza, Goikolarra, San Martín, Lovaina, Ensanche, and Desamparadas), which are characterized by high or medium-high income levels. These neighborhoods also showed low or medium-low percentages of population with primary education levels or lower. By contrast, El Pilar, Zaramaga, Arana, and Abetxuko are the neighborhoods with the lowest percentages of the population who have completed higher education. These neighborhoods have a marked working-class nature, since they accommodated a large part of the population from other Spanish provinces that arrived in Vitoria-Gasteiz in the 1960s and 1970s to work in the new factories that began to crop up around the city.

In terms of migratory status, Casco Viejo and Coronación have the highest percentage of foreign population, while the new neighborhood of Goikolarra has the lowest percentage of foreign population. Furthermore, if we compare the map with the percentages of SSI recipients against the map with the percentages of foreign population, the image provided by both maps is practically the same, given that only the

neighborhoods of Mendizorrotza and Ali-Gobeo are not the same. To a certain extent, this reflects the strong interrelation between the foreign population and SSI recipients, as is also corroborated by the correlation coefficient, which has a high value (r = 0.860). This high correlation is also observed between the foreign population variable and the unemployment ratio variable, which also shows a high positive correlation (r = 0.857). However, the correlations with the rest of the variables are not as high, which indicates that there is not such a direct relationship between foreign population and educational level, demographic structure of the neighborhood or personal income level. This allows us to intuit that there may be a high degree of vulnerability among some foreign population groups leading to a spatial concentration of these groups within specific neighborhoods.

Secondly, after incorporating the selected indicators as cartographic layers and applying the weighted overlay technique, we obtained the resulting map that reflects the level of vulnerability of the neighborhoods of Vitoria-Gasteiz, where these are classified into five levels of vulnerability: low, medium-low, medium, medium-high and high. Figure 4 shows the different levels of vulnerability of the neighborhoods of Vitoria-Gasteiz.

[insert Figure 4]

Figure 4 clearly shows a contrast between the neighborhoods of Mendizorrotza and Goikolarra, which have the lowest levels of vulnerability, and the neighborhoods of Casco Viejo, Zaramaga, and Coronación, which are the neighborhoods with the highest levels of vulnerability. Nevertheless, a significant number of the neighborhoods of Vitoria-Gasteiz (39.3%) are in medium levels of vulnerability, while 21.4% have

medium-low or low levels of vulnerability and the other 39.3% of the neighborhoods have high or medium-high levels of vulnerability. As far as the population is concerned, the two neighborhoods with very low levels of vulnerability account for only 2.75% of the population, while the three neighborhoods with very high levels of vulnerability account for almost 20% of the population of Vitoria-Gasteiz. However, there are significant differences between the surface area occupied by these neighborhoods, given that the neighborhoods of Mendizorrotza and Goikolarra occupy 15.3% of the surface area while Casco Viejo, Zaramaga and Coronación, despite being home to 47,594 inhabitants (Eustat, 2022), only occupy 4.7% of the total surface area of the neighborhoods. These data show the high spatial concentration of vulnerability in Vitoria-Gasteiz.

The degree of vulnerability presents a clear differentiation between some central neighborhoods, the neighborhood of Abetxuko in the north and the neighborhoods of Adurtza and San Cristóbal in the south-east, where vulnerability is concentrated, and the south-west area of the city, where there is a spatial grouping of neighborhoods with low and medium-low levels of vulnerability (Mendizorrotza, Goikolarra, San Martín, Ensanche, Lovaina, and, Gazalbide, slightly to the north). These patterns of vulnerability in the city are a result of structural processes and policy initiatives implemented over decades.

The neighborhoods that emerged during the industrial development close to the industrial estates of Uritiasolo and Campo de los Palacios (San Cristóbal and Adurtza) and the Betoño-Gamarra industrial estate (Abetxuko, El Pilar, Zaramaga, and Arana, and more recently, Aranbizkarra) present high or medium-high levels of vulnerability,

whereas most of the large new neighborhoods such as Zabalgana, Salburua and also Lakua-Arriaga present medium levels of vulnerability. However, Goikolarra, the most recently built neighborhood in Vitoria-Gasteiz, which is still being built, reflects a different socio-economic profile from that of the other new neighborhoods. Goikolarra may be regarded as an extension of the Mendizorrotza neighborhood, both in terms of housing typology, due to its abundance of single-family homes, and in terms of the housing regime (free or subsidized), as it contains a lower percentage of subsidized houses than in the Zabalgana and Salburua neighborhoods.

We cannot state that the age of the dwellings correlates with the level of vulnerability of the neighborhood, as can be seen in Table 4, which, by contrast, shows a clear correlation between the level of vulnerability and the average surface area of the dwellings. Accordingly, the least vulnerable neighborhoods have an average surface area of 135.5 m2, a surface area that decreases as the vulnerability of the neighborhood increases, with the most vulnerable neighborhoods having an average surface area of 77.4 m2.

[insert Table 4]

Furthermore, if we analyze the results obtained after applying a principal component analysis (PCA) (Figure 5), we can see that there is a strong interrelation between the level of income and the highest level of education, with both variables positioned very close to each other on the factorial axis and showing a highly negative coordinate in component 1. Likewise, there is a high interrelation between the percentage of

foreigners, lower level of education, beneficiaries of guaranteed income (SSI recipients) and unemployment rate variables, which, in this case, have a highly positive coordinate.

Based on this analysis and bearing in mind that the conditions for validity have been met (the Kaiser-Meyer-Olkin measure is high and the significance associated with Barlett's test of sphericity is 0.0000), we can conclude that the first component, which has an eigenvalue of 4.74 and explains 59.27% of the variance, reflects the vulnerability of the neighborhoods. Together with component 2, they accumulate 83.57% of the variance explained, which means that these two components adequately reduce the multidimensionality of the factors considered.

Component 2 is mainly used to explain the vulnerability of neighborhoods according to their age structure, comparing the variables of the aging rate versus the activity rate, given that this issue is not well covered in component 1.

As far as the location of the neighborhoods in the factorial plane made up of these two components is concerned, it can be seen that component 1 orders the neighborhoods based on their degree of economic vulnerability, mainly locating the neighborhoods with higher income levels at its negative end, while at its positive end it includes the neighborhoods that reflect higher levels of vulnerability due to economic reasons. By contrast, component 2 reflects the diversity of demographic situations in terms of the level of aging of the neighborhoods and contrasts the newly built neighborhoods (Zabalgana, Salburua and Goikolarra) with neighborhoods with very old demographic profiles such as Gazalbide and Txagorritxu.

[insert Figure 5]

Despite the interpretation given to the first main component, if we observe the average income for each level of vulnerability, neighborhoods with high vulnerability do not present a great difference compared to neighborhoods with medium-high vulnerability. However, neighborhoods with low vulnerability present a wide difference in the average personal income variable with neighborhoods with medium-low vulnerability. This appears to show that, in the case of the most vulnerable neighborhoods, not only is income a differentiating factor, but also other factors such as variables related to the labor market or the higher concentration of foreign immigration. However, income is the reason why Mendizorrotza and Goikolarra are grouped together alone, as for the rest of the variables they present similar characteristics to the neighborhoods of Ensanche, Gazalbide, Lovaina and San Martín.

To conclude this section of the results, the following is a summary of the features of the neighborhoods according to their level of vulnerability:

(1) The neighborhoods with a high level of vulnerability (Casco Viejo, Coronación, and Zaramaga) have high percentages of foreign population along with the highest unemployment ratios. They are also characterized by having the highest percentages of SSI beneficiaries along with the Abetxuko neighborhood. Average personal income levels are also among the lowest in the city. In terms of demographic structure, Zaramaga and Coronación show higher elderly ratios than the city average, while Casco Viejo has an elderly ratio ten points lower than the city average. These differences also transfer to the level of education, since, although Casco Viejo has average values in terms of both the percentage of population with primary education or lower and the percentage of population with higher education, Coronación and

Zaramaga, by contrast, show levels of education lower than the average for the city.

(2) The neighborhoods with a medium-high level of vulnerability (Abetxuko, Adurtza, Arana, Aranbizkarra, El Anglo, El Pilar, Judimendi, and San Cristóbal), generally have percentages of foreign population above the city average (10.4%), except for Abetxuko, which has a percentage of 8.6% of foreign population, and Aranbizkarra, with 10.4% of foreign population. All the neighborhoods, except for Abetxuko, which has a lower than average elderly ratio, exceed the average elderly ratio for the city. In addition, all the neighborhoods, and especially Abetxuko, have higher percentages of SSI recipients than the city average. The unemployment ratio is also above average, while the average personal income is below average. These are neighborhoods with a high percentage of population with primary education or lower, and except for El Anglo, which has values close to the average, these are neighborhoods that do not have a high percentage of population with higher education.

(3) The neighborhoods with a medium level of vulnerability (Ali-Gobeo, Arantzabela, Ariznabarra, Arriaga-Lakua, Desamparados, Salburua, Sansomendi, Santa Lucía, Santiago, Txagorritxu, and Zabalgana) is the largest group in terms of the number of neighborhoods it groups together and, to an even greater extent, in terms of population (44.9%). This means that they also present a greater diversity from the point of view of the variables analyzed. Overall, they have an average income of 18,574 euros. It includes neighborhoods of recent construction, which means that the average age of the dwellings is around 27 (almost nine years less than the city average).

However, we found wide differences between these neighborhoods, for example, in ages ranging from 52.4 years old in the Desamparadas neighborhood to an average age of the dwellings of 10.3 in the Zabalgana neighborhood. However, the percentage of residents with primary education or lower is closer to that of the city, although the neighborhoods of Arantzabela and Ali-Gobeo are far from that average, with higher percentages of population with low levels of education. By contrast, the percentages of population who have completed higher education are close to the city average in most neighborhoods, although the neighborhoods of Sansomendi, Arantzabela and Ali-Gobeo are far from this average.

(4) The neighborhoods with a medium-low level of vulnerability (Ensanche, Gazalbide, Lovaina, and San Martín) show medium-high income levels and low percentages of SSI recipients, especially in the cases of Gazalbide and San Martín. They are home to a population with high levels of education, as can be deduced from the low percentages of population with primary or lower education levels and the high percentages of population with higher education levels. Unemployment ratios are low, while activity ratios, except in Gazalbide, which has an older demographic structure, are close to the average for the city. Meanwhile, they have average personal income levels above the average, but nowhere near the Mendizorrotza neighborhood, so the principle difference between this group of neighborhoods and those with lower levels of vulnerability is the level of income.

(5) The neighborhoods with a low level of vulnerability (Goikolarra and Mendizorrotza) are fundamentally different from the rest in their high income level and the high percentage of population with higher education levels. Their

average income is more than double the income of the most vulnerable neighborhoods (32,696 euros compared to 14,685 euros per capita) and they have the lowest unemployment ratios in the city and the lowest percentage of SSI recipients. They also stand out, together with the San Martín neighborhood, for having the lowest percentages of foreign population. In terms of demographic structure, there is a clear divergence between them. While Goikolarra is characterized by a high active population and a low elderly ratio, Mendizorrotza presents a more aged demographic structure, although nowhere near neighborhoods such as Gazalbide, El Pilar and Txagorritxu in terms of elderly ratio.

To sum up, by applying a combination of AHP and GIS, we have created a synthetic map that allows us to see the different levels of vulnerability in the neighborhoods of Vitoria-Gasteiz according to the selected variables, and which reflects the structures that can currently be found in the municipality, which could, in turn, be used as a basis for implementing urban policies that are more in line with reality.

Furthermore, the analysis of the vulnerability of neighborhoods based on a set of variables or dimensions can be enhanced by adding new variables that can be analyzed in different formats and on different scales, as they can later be transformed and all the variables can be converted to the same format in the GIS environment.

Lastly, the AHP also makes it possible to incorporate the perception of the level of vulnerability of the neighborhoods by different actors (neighbors, economic and social agents, politicians and technicians, academics, etc.) and to introduce this perception through weightings agreed upon by representatives of each group in a joint preparation of the matrix for comparing the criteria and sub-criteria.

Discussion

In this section, we examine how the neoliberal approach to city building adopted in the medium-sized European city of Vitoria-Gasteiz has had an impact on its neighborhoods, resulting in different levels of vulnerability representing the strong internal differences that exist, in order to understand the varying levels of resilience of the neighborhoods and the reconfiguration of urban divides.

The application of the AHP and GIS to the case of Vitoria-Gasteiz has allowed us to draw up a synthetic map that allows us to view the levels of vulnerability of the city's neighborhoods. This synthetic map (Figure 4) reveals a clear differentiation between some central neighborhoods (Casco Viejo, Coronación, Zaramaga, El Pilar, Aranbizkarra, El Anglo, Judimendi and Arana), the neighborhood of Abetxuko in the north and the neighborhoods of Adurtza and San Cristóbal in the south-east, where vulnerability is concentrated, and the south-west area of the city, where there is a spatial grouping of neighborhoods with low and medium-low levels of vulnerability (Mendizorrotza, Goikolarra, San Martín, Ensanche, Lovaina, and, Gazalbide, slightly to the north).

This diagnosis is consistent with previous diagnoses of the city, which were less visual and carried out in the late 1980s and early 1990s, using simple statistical techniques and qualitative analysis (Zárate-Martín, 1988; Leonardo & Lavía, 1990; Arriola, 1991). However, although these studies were prior to the expansion that the city experienced in the first decade of the 21st century, they already highlighted a concentration of high incomes and higher levels of well-being in the Mendizorrotza neighborhood as opposed to the lower levels of income and well-being in the Casco Viejo neighborhood and in

the working class neighborhoods. The latter neighborhoods have been showing high levels of vulnerability for a long time, which is why the so-called vicious circle of economic marginality and residential segregation could be taking place. This vicious circle causes people's places of residence to have an impact on their life opportunities, leading to a continuous increase in vulnerability, in a process that feeds back and is inherited from one generation to the next (Ranci et al., 2014; Musterd, et al., 2017; Nel·lo, 2021).

All this highlights how cities have historically been the stage for developing capitalist societies, but also a trigger for the capitalist process itself, which has been particularly visible in recent years, as urban space has become a product and an object of change. Therefore, income from urban land, which is the foundation of all activity and is subject to ownership, is very much taken into account when producing a city. Consequently, land production becomes a complex process that is not only of interest to public authorities seeking to ensure that there is enough land available to ensure the perpetuity of a neoliberal city, but also to private agents, as it becomes a source of rentier or capitalist income (Harvey, 1985; Tammaru, et al., 2020; Van Ham et al., 2020; Hamnett, 2021; Méndez, 2023). In short, our study shows that the current situation of the city of Vitoria-Gasteiz, which has a strong economic, functional, social, environmental and cultural division of space, is the result of urban planning applied over the last seven decades in response to a realistic and global strategy, initially to develop an industrialized and capitalist city, and later, since the 1970s and 1980s, to expand it and green it, respectively.

The complex ways in which neoliberal urban strategies interact are sensitive to pre-existing land uses, institutional configurations and socio-political power constellations (Joy & Vogel, 2021; Méndez, 2023). Over the last few decades, Vitoria-Gasteiz City Council has carried out direct urban development work through various mechanisms, but mainly through an active land acquisition policy. Despite acting as a producer of residential land, the city council never coerced private interests, but agreed on a distribution of areas of action with them. Consequently, areas with greater accessibility, connectivity and better landscaping conditions were left in private hands, while the municipality developed the less profitable areas (Arriola, 1991). All of this occurred with the urban development of the large Lakua neighborhood in the 1970s and 1980s (where in the distribution of the industrial estates, in the areas furthest from the city center, such as the Sansomendi area, social housing was concentrated –higher buildings with fewer facilities– and the Roma population living in the area was rehoused in order to avoid shanty towns). The same thing has taken place more recently too, since the start of the 2000s, and in a more accentuated way, with the approval of the construction of the two large new neighborhoods of Zabalgana and Salburua and the current construction of the new neighborhood of Goikolarra.

Moreover, at the same time as these latter large urban developments were taking place, something that became very common in many Spanish cities during the real estate boom of the 1990s and the first decade of the 2000s (Esteban & Altuzarra, 2016), the process of urban greening started to come to the fore. Urban greening was considered to be a social and environmental good during the 1980s and 1990s, and from 2001 onwards was gradually incorporated into urban agendas of neoliberal city expansion through the selective integration of environmental objectives into urban planning. But it happened

in such a way that decision-makers started to focus only on those environmental objectives that were compatible with business and economic growth strategies (Long, 2016, Angelo, 2019; Winter & Le, 2020; Neidig et al., 2022). However, as the greening of cities has become more integrated into neoliberal urban agendas, it has also risked undermining the social and spatial dimensions of sustainability in terms of equity and inclusion (Affolderbach y Schulz, 2017; Kotsila et al., 2021).

This focus of municipal urban policies on large urbanization projects in Vitoria-Gasteiz has resulted, on the one hand, in a significant increase in the maintenance costs of an expanded city, and, on the other, in lower investment in the city's most vulnerable neighborhoods with persistent structural deficiencies resulting from the policy initiatives applied for decades, strongly supported by growth-oriented perspectives (i.e. aging housing without elevators and/or heating, lack of facilities and support services or having a large number of inaccessible spaces, aging populations with low income and educational levels and/or high unemployment rates and/or high densities of a generally excluded immigrant population). Although, it should also be noted that during the 80s and 90s a progressive urban policy was applied that took the form, firstly, of greater investment in social policies and the provision of infrastructures and services in many of the city's neighborhoods, with the construction of civic centers in a number of neighborhoods that offered cultural, educational, sporting and other services to citizens, and, secondly, the restoration of the historic center and the pedestrianization of the city center (Zárate-Martín, 1989). In addition, this progressive municipal policy also launched the long-term greening of the city in these years by integrating nature into the urban network, which was an innovative solution to local environmental problems by the political and technical leaders of the time (Neidig et al., 2022).

Consequently, neoliberal urban planning has led to an asymmetrical vulnerability among the neighborhoods of Vitoria-Gasteiz, and the urban regeneration actions undertaken have been sporadic and aimed at physical renovation and developing infrastructures, without undertaking comprehensive actions aimed at tackling the vulnerability of the most disadvantaged neighborhoods. This has meant that even though initiatives were implemented early on (from the 1980s on) to regenerate the Casco Viejo (Old Town) neighborhood, these initiatives (pedestrianization of the area, restoration of the historical heritage, improvement of infrastructures, commercial revitalization and construction of new public housing that was later privatized) have not had any effect on the social fabric (health, education, employment, social integration, etc.) of the neighborhood, and have not contributed to reducing its level of vulnerability. In addition to this, in recent years, speculative pressures have been identified, meaning that the neighborhood will not be able to avoid tourist gentrification processes in the very near future.

Similarly, the Coronación and Zaramaga neighborhoods, which are centrally located and adjacent to the Casco Viejo neighborhood and to each other, are also highly vulnerable. These neighborhoods were built as a matter of urgency in the 60s and 70s to accommodate the population from rural Spain that came to the city attracted by the industrial development that was taking place there. Right now, these two neighborhoods are disadvantaged and are home to an aging population and a growing immigrant population. Between 2017 and 2022, the SmartEnCity project was operational in the Coronación neighborhood, financed mainly with funds from the European Union, under the Horizon 2020 Program. The objective of this project was to carry out the energy refurbishment of more than 1,300 dwellings, mainly dealing with issues related to

changing the building envelope and connecting them to a biomass-based heat network (Hernández-Aja, Córdoba Hernández et al., 2018). Therefore, the actions were focused on physically renovating the area, without considering other social policies or providing comprehensive solutions for the neighborhood. Meanwhile, the Zaramaga neighborhood was declared a Degraded Area in 2019 by the Basque Government based on a diagnosis on urban renewal needs carried out in 2011, but twelve years since the diagnosis, the physical rehabilitation work in the neighborhood has still not even begun.

The Abetxuko neighborhood, which has a medium-high level of vulnerability, is also a working-class neighborhood, which emerged with the industrial development of the 1960s and 1970s, and is some way away from the city center and separated from it by the River Zadorra that runs through it. Today, it is a disadvantaged neighborhood that is somewhat better connected to the center, but it continues to have above-average levels of conflict, although significantly lower than in the 1980s, when it was hit very hard. In 2019, a good part of the neighborhood was declared a Degraded Area by the Basque Government, based on a socio-economic diagnosis carried out in 2017. Although the diagnosis specified the actions that needed to be undertaken (focused on improving the area's connection with the rest of the city, rehabilitating residential buildings and providing the area with more facilities and green infrastructure), it did not specify a specific time frame for starting them, as a result of which, six years later, they have still not been started.

Adurtza and San Cristóbal are others working-class neighborhoods that were built during the industrialization of the city in the 1960s and 1970s and are characterized by medium-high level of vulnerability. Between 2019 and 2022, actions were carried out in

the neighborhoods aimed at rehabilitating 160 homes by improving their energy efficiency and accessibility. These homes were built prior to 1980 and had serious deficiencies in their insulation and accessibility. These actions were also financed mainly with funds from the European Union through the European AGREE project (Aggregation and improved Governance for untapping Residential Energy Efficiency potential in the Basque Country), as part of the Horizon 2020 Program. It should also be noted that the Adurtza neighborhood has undergone a significant transformation in the last decade, with the dismantling of part of the declining industry that had settled in the area and a change in land use with the reclassification of industrial land. The latter decision is not without contention and controversy. It has meant the construction of new public and private housing in the area.

In short, after decades of neoliberalism, there are still very serious gaps between the multiple interrelated problems faced by the most vulnerable neighborhoods in Vitoria-Gasteiz and a number of medium-sized cities in the 21st century (growing poverty, high unemployment and insecure employment, low income and education levels, aging population, deteriorating infrastructure and social exclusion) and the solutions proposed, which are often small-scale, one-off and unsustainable. Further research is needed in this field.

Conclusions

In this article, we have examined how the expansive neoliberal urban growth model followed in the medium-sized European city of Vitoria-Gasteiz has had an impact on the city's different neighborhoods, by analyzing their levels of vulnerability. Using the

latest statistical data published on a neighborhood scale by the Basque Institute of Statistics (Eustat) and the Basque Employment Service (Lanbide) and a methodological approach that combines the analytic hierarchy process and geographic information systems, we have obtained a synthetic vulnerability map for the neighborhoods of Vitoria-Gasteiz, based on a set of variables related to different dimensions (economic, demographic and related to migratory status) that describe various aspects of differences between neighborhoods. This methodology, which is seldom used in urban studies, consists firstly of structuring and organizing a hierarchy for the set of variables that contribute to the vulnerability of the city's neighborhoods through the analytic hierarchy process, and then reflecting all this information by building a synthetic index resulting from the weighted combination of these variables. Secondly, we map the variables and the synthetic index using geographic information systems.

The first thing our study revealed was a synthetic map of the vulnerability of the neighborhoods in Vitoria-Gasteiz, where three of the neighborhoods (Casco Viejo, Coronación and Zaramaga) had the highest level of vulnerability. They had the worst indicators in terms of unemployment rate and income, together with a growing proportion of immigrant population and the highest percentages of recipients of guaranteed income support. All three neighborhoods are in central areas of the city, although Casco Viejo differs from the others in that it has a less aged and better educated population as a whole and has recently witnessed speculative pressures aimed at tourist gentrification. These are followed by eight neighborhoods (Abetxuko, Adurtza, Arana, Aranbizkarra, El Anglo, El Pilar, Judimendi and San Cristóbal) that share a medium-high level of vulnerability, with poor conditions in most of the economic, labor, demographic and housing quality indicators. Some of these

neighborhoods are located on the outskirts of the city, such as Abetxuko and Adurtza. Eleven neighborhoods (Ali-Gobeo, Arantzabela, Ariznabarra, Arriaga-Lakua, Desamparados, Salburua, Sansomendi, Santa Lucia, Santiago, Txagorritxu and Zabalgana) showed a medium level of vulnerability, and this is the largest group, made up of neighborhoods where, in general, intermediate conditions prevailed. Meanwhile, four neighborhoods had a medium-low vulnerability level (Ensanche, Gazalbide, Lovaina and San Martín), where they mainly shared good socioeconomic and demographic conditions, although they differed from the next two neighborhoods in that they had lower income levels. Finally, only two neighborhoods (Mendizorrotza and Goikolarra) achieved the lowest levels of vulnerability, sharing a very advantageous position in all of the dimensions studied.

Secondly, it should be noted that the current situation of asymmetric vulnerability in the neighborhoods of Vitoria-Gasteiz, which is reflected in a significant economic, functional, social, environmental and cultural division of space, is the result of the urban planning applied over the last seven decades, strongly underpinned by growth-oriented perspectives, in response to a realistic and global strategy initially to develop an industrialized and capitalist city, and subsequently to expand it (since the 1970s) and to green it (since the 1980s). However, it should also be noted that since 2001, when the last major urban developments in the city took place, the process of greening the city, which was understood as a social and environmental good during the 1980s and 1990s, was gradually incorporated into urban agendas of neoliberal city expansion through the selective integration of specific environmental objectives into urban planning.

Thirdly, we saw how the focus of municipal urban policies on large urbanization projects in Vitoria-Gasteiz has resulted, on the one hand, in a significant increase in the maintenance costs of an expanded city, and, on the other, in lower investment in the city's most vulnerable neighborhoods with persistent structural deficiencies resulting from the policy initiatives implemented, with the exception of the more progressive urban policy implemented in the 1980s and 1990s.

Fourthly, we analyzed the urban regeneration actions carried out in some of the city's most disadvantaged neighborhoods, which were characterized as being sporadic and aimed at physical renovation and developing infrastructures, without undertaking comprehensive actions aimed at tackling the vulnerability of these disadvantaged neighborhoods. This indicates that there is a need to focus on combating vulnerability as a planning strategy in the public debate, with specific emphasis on avoiding the growing gap in the spatial distribution of burdens of growth.

In sum, the analysis of Vitoria-Gasteiz revealed how the expansive neoliberal urban growth model implemented in the city has had an unequal impact on the different city's neighborhoods. Vitoria-Gasteiz is also an interesting case, because it is often presented as a pioneering example of a green city with international recognition (European Green Capital 2012 and Global Green City 2019 from the Global Forum on Human Settlements, backed by the UN) and, as a result, little attention has been paid to the spatial implications of urban planning. However, as our results indicate, the synthetic vulnerability map we produced helps to identify the most vulnerable neighborhoods in the city of Vitoria-Gasteiz, although we would like to point out that it is a snapshot of the city at a given moment in time. This case study on Vitoria-Gasteiz has sought to

contribute both methodologically and analytically to improving our understanding of how structural processes are influenced by local factors (political, institutional, cultural, environmental and planning), which, in part, determine how they actually come to fruition in terms of space. Moreover, this knowledge of the underlying urban structure, which we obtained by using a combined methodological approach, makes it possible to identify realities shared by territorial areas that are not part of the same administrative units or even in close proximity, but which are homogeneous from the point of view of a problem shared by clustered variables that behave in a similar way. It also makes it possible to clearly observe the vulnerability of neighborhoods located in intermediate positions that are otherwise difficult to characterize using traditional methods. In addition, it makes it possible to have a cross-cutting perspective when formulating and implementing urban policies in each of the dimensions studied. Likewise, it makes it possible to incorporate variables measured at different scales into the study by transforming the weighted sum of the variables within the GIS into a vector format and to incorporate the perception of the degree of vulnerability of the neighborhoods by different actors, and to make comparisons at different points in time and between different places. In short, this multi-dimensional analysis of vulnerability makes it possible to show the different realities in the urban framework and can contribute to defining public interventions tailored to these specific problems.

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