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Remaking Urban Divides: Shifting patterns of neighbourhood differentiation in Bilbao (Spain)

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Abstract:

Intensifying social and spatial divisions have been on the rise in cities since the 1980s. This trend has evolved in a context of increasing socioeconomic inequality and exacerbated by the effects of the last economic crisis and austerity policies. Understanding the differential impact of these processes on vulnerable social groups and urban areas is crucial for developing effective policy responses to the challenges of social exclusion and neighbourhood decline. This paper examines the spatial dimensions of rising socioeconomic inequality in Bilbao (Spain). Using Census Data and a multivariate approach, it analyses shifting patterns of socio-spatial differentiation in the city during two decades of intense urban restructuring and regeneration dynamics. The results present a characterization of Bilbao's neighbourhoods based on a set of variables that capture various aspects of neighbourhood differences, demographics, socioeconomic status and housing attributes, and their evolution, revealing a two-dimensional factorial structure. Neighbourhoods are grouped according to these two factorial axes that capture the structure of correlations among the variables. Subsequently, the analysis focuses on a selected number of "extreme" neighbourhoods to identify patterns of convergence/divergence and the driving factors behind them

including structural trends and policy initiatives implemented during the two decades considered.

Keywords: socio-spatial differentiation, neighbourhood inequality, Multiple Factorial Analysis (MFA), Bilbao.

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Introduction

Intensifying social and spatial divisions have been on the rise in cities throughout the world since the 1980s. This trend has evolved in a context of rising income and wealth inequality and exacerbated, in the last decade, by the effects of the financial and economic crisis and austerity policies (Piketty, 2014; Zwiers et al., 2016; Donald et al., 2014). Together with increasing social inequality, spatial inequality has also extended and deepened reinforcing existing patterns of segregation and bringing about new socio-spatial divisions (Marcuse & van Kempen, 2000, 2002; van Kempen & Murie, 2009; Musterd et al., 2016; van Ham et al., 2021). The link between social and spatial dimensions of inequality is undisputed but debate on the causes and effects of the underlying and mutually reinforcing factors behind socioeconomic segregation is inconclusive. Yet, understanding the differential impact of these processes on vulnerable social groups and urban areas is crucial for developing effective policy responses to the challenges of social exclusion and neighbourhood decline.

This paper examines the spatial dimensions of rising socioeconomic inequality in Bilbao (Spain). Using Census Data from 1991, 2001 and 2011, and multivariate techniques, Multiple Factor Analysis (MFA), it analyses shifting patterns of socio-spatial differentiation in the city during two decades of intense urban restructuring and regeneration strategies. The use of MFA allows to discriminate for the combined effects of different analytical dimensions of the variability of neighbourhoods and define the relative positions of the neighbourhoods on a synthetic map of socio-spatial stratification. This methodological approach, rarely used in the field of urban analysis (Altuzarra et al. 2018; Davino et al, 2021; Salazar-Llano et al., 2019), offers new possibilities for heightening our understanding of patterns of socio-spatial differentiation in cities.

The results of the research present a characterization of Bilbao's neighbourhoods based on a set of variables that capture various aspects of neighbourhood differences, demographics, socioeconomic status and housing attributes, and their evolution,

revealing a two-dimensional factorial structure. Neighbourhoods are grouped according to these two factorial axes that capture the structure of correlations among the differentiating variables. Subsequently, the analysis focuses on a selected number of further-apart neighbourhoods to identify changes in their relative positions and in convergence/divergence trends and the driving factors behind them, including structural dynamics and policy initiatives implemented during the two decades considered.

The paper starts with a review of current debates on the increasing social and spatial unevenness in cities. It follows with a discussion of urban restructuring and socio-spatial segregation dynamics in Bilbao between 1991 and 2011, including an explanation of data sources and methodology used for analysing socio-spatial stratification at the neighbourhood scale. The third section examines shifting patterns of differentiation and convergence/divergence trajectories among a selected number of neighbourhoods. The final section presents some concluding remarks.

Urban restructuring, rising inequality and changing socio-spatial divisions in the city

Since the 1980s, cities have been at the centre of the socio-economic restructuring processes that signalled the end of Fordism and the transition towards a new regime of globalized accumulation. In the emerging global competitive scenario, the sharp decline of traditional manufacturing industries and the expansion of services, especially advanced, finance and knowledge-intensive services, underpin the reorganization of the urban productive base and the economic functions of cities at different scales. These trends have been accompanied by radical changes in labour markets and in the occupational and income structure of urban economies, which lie at the heart of intensifying social and spatial divisions in cities throughout the world (Sassen, 1991, 1994; Mingione, 1996; Hamnett, 1994 and 2021; Marcuse & van Kempen, 2000, 2002; van Kempen & Murie, 2009; Musterd et al., 2016; van Ham et al., 2020).

In the aftermath of the crisis of Fordism, the links between increasing social class divisions in cities and global economic and labour markets restructuring were first interpreted by Cohen (1981), Friedmann & Wolff (1982), Friedmann (1986) and Sassen (1991), as an integral part of the changing national and international division of labour and the emergence of "global cities" as the control and command centres of the new globalised economy. Changes in social structure in these cities were seen as a direct effect of their evolving economic role and in the industrial and employment structure brought about by the decline and downgrading of their traditional manufacturing base and a shift towards advanced, highly specialized financial and business services. From this perspective, social polarisation reflects the growing occupational and income polarisation resulting from the reorganisation of work and the structure of employment in global cities and the associated and simultaneous growth of high-paid professional and managerial jobs, on the one hand, and low-wage consumer services, on the other, at the expense of a shrinking middle level occupations and income stratum (Sassen, 1991). Occupational polarisation has a spatial imprint in the form of growing social, residential and ethnic segregation linked to changes in housing markets and materialized in spatially separated concentrations of rich and poor, a pattern often described as "dual city" (Mollenkopf & Castells, 1991).

The social polarisation thesis has been criticized for its excessive simplification of the city's social structure and divisions and the need for both a wider focus on the changing occupational and income class structure of advanced capitalist societies, and a more detailed analysis of social stratification and income differentiation processes at a citywide level (Mollenkopf & Castells, 1991; Fainstein & Harloe,1992; Hamnett, 1994, 1996). Based on substantive empirical research regarding occupational change in London, Amsterdam and the Randstad and, more recently, on global cities across the world, Hamnett (1994 and 2021) has argued that while growing professionalisation within the labour force appears to be a common trend in most global cities, there is no evidence of a general pattern of polarisation; polarisation seems rather a contingent

outcome in particular cities at particular times. In many European cities, for example, the growth of income inequality does not result necessarily from occupational polarisation since the extension of a low-skilled, low-income consumer-service sector, identified by Sassen in global North American cities, is largely contained by lower immigration influx, greater regulation of labour markets and stronger welfare state regimes (see also Pratschke & Morlicchio, 2012; Vaattovaara & Kortteinen, 2003; Préteceille, 1995 and 2016). Recent studies on cities beyond the Global North also provide evidence of significant variation in urban social responses to globalisation and economic restructuring processes. Indeed, whereas there is considerable consensus that the changing industrial and occupational structure of employment and labour demand in all capitalist economies and cities is a key vector of production of socioeconomic inequality, the causes of the growth of income polarisation and the range of urban social outcomes is critically shaped by factors such as national differences in global embeddedness, the role and extent of welfare state regimes and modes of social regulation, housing systems and city-wide policies (Maloutas & Fujita, 2012; van Ham et al., 2021;Tammaru et al., 2020; Arbaci, 2007 and 2019; Moulaert et al., 2003; Tammaru et al., 2016).

Continuing debates on the causes and forms of growing socioeconomic inequality and the changing social structure of cities have been accompanied, in recent years, by a renovated interest in its spatial manifestations. There is little question that the growth of inequality has direct consequences for the spatial organisation of cities since income inequality is generally regarded as the key force for urban socioeconomic segregation, that is, the separation and concentration of different social groups across residential neighbourhoods of a city or an urban region based mainly on occupation, income and/or education. Income dictates largely the residential decisions of individuals and households according to their paying capabilities, with higher income groups having the greatest economic leverage in choosing their housing and neighbourhood of residence; this process of selective choice drives their increased concentration in certain

areas or neighbourhoods of cities which are then unavailable/unaffordable to the rest of the income groups (Harvey, 1985). Income differences intersect with other differentiating characteristics of residents, such as ethnicity or nationality, which often reinforce and perpetuate socio-spatial segregation (Marcuse & van Kempen, 2000; Kapezov, 2005).

Given the spatial imprint of income inequality in the form of urban socioeconomic segregation, it is hardly surprising that, alongside growing inequality, residential segregation between socioeconomic groups has also grown in urban regions throughout the world, in the last decades (Maloutas & Fujita, 2012; Tammaru et al., 2016; Musterd et al., 2016; Fainstein & Fainstein, 2018; Arbaci, 2019; van Ham et al., 2021). However, although increasing income inequality is the main cause driving the rising levels in residential segregation, the link between the two is not simple or univocal since it hinges on multiple and interacting factors (Musterd et al., 2016). Based on empirical evidence from European cities, Tammaru et al. (2016) link shifting patterns and levels of socioeconomic segregation to four key structural and general institutional factors: social inequalities, changing economic structures and global connectedness, welfare regimes and housing systems. But these structural factors overlap and interact over time and play out differently in different national and local settings as they are mediated by contextual factors, i.e., historically developed specific institutional and spatial contexts, where social divisions are translated in distinctive spatial patterns and may produce very different outcomes on the scale and form of socio-spatial divisions (see also Fujita & Maloutas, 2012; Musterd et al., 2016; Marcińczak et al., 2016; van Ham et al., 2021; Arbaci, 2019).

Combined with contextual embeddedness, the causal relationship between income inequality and socioeconomic segregation is also blurred by temporal effects, that is, by the fact that it takes time before a rise in income inequality materializes in higher levels of segregation. This time lag happens because this process depends on the occurrence of diverse mechanisms such as changes in population, selective residential

mobility and changes in housing stock, that signal changes in socio-spatial divisions (Tammaru et al., 2020).

In sum, the unrelentless growth of income inequality in advanced capitalist economies since the 1980s, has fuelled in recent years, a renovated interest in the links between social inequalities and socio-spatial divisions in cities in the light of intensified processes of economic globalisation, market liberalisation and welfare state retrenchment. Moving beyond simplified assumptions that spatial segregation mirrors social inequality, much of the debate has focused on the key structural and institutional factors driving changes in both social and spatial divisions and variations in degrees of correlation between the two. Research has also moved beyond the narrow focus on the changing and occupational structure and mechanistic notions of dual city associated with the social polarisation thesis by highlighting the critical mediating role of welfare regimes and housing systems in affecting levels of socioeconomic segregation. Moreover, evidence on lack of direct temporal and spatial correspondence between changing income inequality and urban segregation have also brought up the need to account for contextual embeddedness of socioeconomic segregation, drawing attention to the critical influence of historical trajectories and local contextual factors in shaping levels and patterns of segregation. To a large extent, better understanding of the complex, overlapping interdependencies between structural and contextual factors in accounting for socio-spatial divisions has resulted from a newfound emphasis on comparative research and a gradual turn towards examining the impact of rising inequality and changing patterns of segregation in "ordinary" cities.

A wealth of research in recent years provides empirical evidence of the changing socio-spatial segregation tendencies discussed above in a variety of urban contexts. As a whole, studies reveal that alongside rising income inequality cities throughout the advanced capitalist economies have become more unequal and divided but the way in which this dynamic unfolds and takes place is multifaceted and provides for variegated

outcomes (Fainstein & Fainstein, 2018; van Ham et al., 2020; Fujita & Maloutas 2016; Arbaci, 2019).

In European cities, the widening gap between rich and poor parallels increasing socio-spatial divisions although there are important differences in the levels and forms of segregation. In the Netherlands, a distinction is made between the reorganisation of the socio-economic positions of neighbourhoods, their changing levels of inequality and the joint increase or decrease in income levels that affect the whole urban area; each of these elements are of specific significance in explaining changing socio-spatial dynamics in different cities (Modai-Snair & van Ham, 2018 and 2019). Thus, although there is clearly a growing concentration of poverty in certain neighbourhoods (Zwiers et al., 2015 and 2017), policies aimed at the most depressed need to consider not only their relative position with respect to the rest of the city's neighbourhoods but also prioritise actions that affect the urban hierarchy of the region as a whole (Modai-Snir & van Ham 2019).

In Belgian cities, Costa and Valk (2018) have shown that segregation of non-European migrants strongly overlaps with socio-economic segregation. Concentration of non-European migrants and deprived conditions coincide as neighbourhoods with the highest proportion of non-European migrants are also those where employment and higher education are lowest, and the percentage of the population with low incomes is higher, as well as those who depend on social welfare. Similarly, variations in income inequality and variations in residential segregation between socio-economic groups have also been found to be closely related; after a certain time-lag, changes in residential segregation follow changes in income inequalities (Tammaru et al., 2020).

In the case of Spain, it is also possible to identify similar trends in different city studies carried out over the last decade (Méndez et al., 2015). In Madrid, Leal and Domínguez (2008) have pointed to the existence of greater social and economic distancing, even before the crisis, in a context marked by economic dynamism, which is mainly explained by a greater segregation of the classes best located both in the

peripheries and in the most central locations of the city. Since 2007, there has also been a significant fragmentation between different sectors of the city which translates, among others, into large differences in terms of unemployment and greater social and spatial segregation, partly explained by the increase in the privileges of the upper classes together with the greater impact of austerity policies on the population with the worst socio-economic conditions (Leal & Sorando, 2016). Moreover, the dynamics of the real estate market, aided by socially-regressive urban planning regulations, have also contributed to the attraction of higher income groups towards certain areas (central but also well to do peripheries), thus further intensifying socio-spatial fragmentation (Méndez & Prada, 2014). In Barcelona, there has also been an increase in urban segregation and socio-spatial segregation in the first decade of the 2000s reflected in the location of higher-income groups in very segregated affluent neighbourhoods (Donat et al., 2014; Rubiales et al., 2012) as well as in the city's most central locations (Rubiales, 2016). Likewise, studies carried out in Andalusian cities also confirm the link between changes in the socioeconomic structure and patterns of segregation in urban space as in the case of Malaga (Del Pino, 2001: 139) and Seville (Díaz Parra, 2010). In Bilbao, socio-spatial differentiation dynamics have been largely eclipsed by an overpowering discourse of urban regeneration success and best practice. But intensifying social and spatial inequality has been an integral part of a process of uneven redevelopment that has reinforced social-spatial divisions between an affluent centre and the working class and lower-income periphery neighbourhoods (Rodríguez et al., 2001; Vicario & Martínez, 2003; Vicario & Rodríguez, 2010; Antolín et al., 2010; Altuzarra et al., 2018). 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 neighbourhoods.

In sum, while socio-spatial differentiation has been since its inception an essential trait of capitalist urban development and redevelopment, in the last decades, the urban divide has deepened as a result of increasing socioeconomic inequality driven

by recurrent economic and financial crises and austerity policies and market-led neoliberal urban development strategies. Rising inequality and the uneven distribution of economic restructuring effects on different social groups are intensifying socio-spatial differentiation patterns and reshaping urban divides. However, these structural tendencies intersect with the particular character of neighbourhoods providing for distinct trajectories and outcomes which suggest a high degree of path-dependency (Zwiers et al., 2017). Identifying the relative influence of different factors - characteristics of the population such as income, education, occupation and professionalization levels, racial and immigration makeup, aging, concentration of vulnerable groups, etc., as well as the characteristics of the housing stock and the structure and dynamics of the real estate sector that condition access to and quality of housing, are determining variables for understanding the greater or lesser resilience of neighbourhoods and the reshaping of urban divides. In the following section, we analyse how these dynamic take place in Bilbao.

Urban restructuring, revitalization and socio-spatial segregation in Bilbao

With close to a million inhabitants, metropolitan Bilbao is one of the main urban agglomerations within Spain and the largest in the Basque Country. A traditional port city and heavy manufacturing centre, Bilbao suffered severely from industrial restructuring processes that accompanied the crisis of Fordism since the mid 1970s. For almost two decades, deindustrialization and productive reorganisation led the way to a shrinking productive base, rising unemployment, mounting social exclusion, environmental degradation and the critical loss of centrality functions, transforming Bilbao into an archetype of a declining industrial city (Rodríguez, 1995; Esteban, 2000; Rodríguez & Martínez, 2001).

The beginning of the 1990s marked a turning point in this trajectory as the city entered a new phase of urban regeneration. The core of this strategy aimed at reorganizing the material and functional base of the city through the reconversion of

derelict sites left behind by industrial firm closures or functional obsolescence of transport infrastructures into new centrality areas. This approach was outlined in the early draft of Bilbao's new Master Plan (PGOU) in 1989 and developed subsequently on Area Plans for each of the "opportunity" sites: Abandoibarra and Ametzola in 1995. Around the same time, a strategic planning process was also launched with resulted in the approval, in 1992, of a metropolitan scale strategic revitalization plan (see Figure 1 for a schematic view of Bilbao's urban regeneration timeline and milestones). However, following closely on the tracks of many cities' revitalization schemes across the world, Bilbao's model of regeneration was largely led by emblematic large-scale urban redevelopment projects. These mega-projects were predicated upon the maximization of redevelopment opportunities and entrepreneurial management supported strategically by massive direct public investment and governance (Rodríguez & Martínez, 2001; Rodríguez, 2002). Flagship projects and spectacular architectures contributed decisively to this strategy bolstering an intense urban marketing campaign —built around Gehry's iconic Guggenheim Museum— aimed at strengthening the city's capacity to attract investors and consumers (Plaza, 2006). Institutional innovation also played a key role in grounding a new urban governance capable of articulating contrasting interests at various scales in a context where coordinated and concerted action of various institutional actors was a necessary condition.

The turn to regeneration was accompanied by critical innovations in urban policy formulation and implementation including the development of new planning instruments and governance institutions such as Bilbao Ria 2000, a semi-public urban development corporation and the executive arm of the land redevelopment process, and Bilbao Metropoli 30, a public-private coalition charged with advancing the projects and initiatives defined in the Strategic Plan (Rodríguez, 1995; Esteban, 2000). Innovations were largely a response to shifting priorities, notably promoting urban competitiveness and growth. Besides, urban policy innovations were also precipitated by the continuing challenges to planning and the search for urban competitiveness. In the process,

regulatory procedures gave way to more active and targeted forms of intervention spearheading the emergence of a new mode of intervention in the city, a model was structured around three main axes of: a) urban and metropolitan territorial planning, b) urban strategic planning and c) large-scale urban projects. Figure 1 summarises the main milestones of urban regeneration in Bilbao in the two decades analysed: 1991-2011.

[insert Figure 1.]

As a result of these initiatives, in less than a decade, Bilbao moved rapidly away from being an archetype of a declining metropolis to become the new 'Mecca of urbanism' (Masboungi, 2001). Bilbao's 'miracle' regeneration has been marketed internationally as a success story, a unique example of 'best practice' and a model for other metropolis similarly affected by deindustrialization and urban decline. Yet, behind the undeniable achievements of the so-called "Bilbao effect" and the extensively publicized success story of Bilbao, this model exhibits important flaws and limitations. The highly focalized character of regeneration projects, the overwhelming physical bias, the concentration of renovation initiatives in the most central locations and, very particularly, the constraints imposed by the dominance of a short-term financial valorisation logic of redevelopment investments not only severely undermined the strategic potential of regeneration, particularly in relation to the diversification of the urban economic base, but also provided for critical negative effects in terms of increasing socio-spatial differentiation and intensifying gentrification tendencies in deprived but centrally located areas (Esteban, 2000; Rodríguez, 2002; Vicario & Martínez, 2003; Vicario & Rodríguez, 2010). The risks of two-speed regeneration are most ostensibly materialized in the continuing and even enlarging socio-spatial divisions in the city where a revitalized and recentralized urban core stands in striking

contrast with a stagnant and increasingly peripheralized deprived neighbourhoods (Rodríguez et al., 2001; Antolín et al., 2010).

However, while Bilbao's urban regeneration strategy was overwhelmingly focused on the reconversion of strategically located derelict sites and their transformation in new centrality areas, disadvantaged neighbourhoods received increasing attention during this period and a number of renovation initiatives were implemented in some of them addressing both physical dereliction as well as social exclusion and inadequate collective services and infrastructures. This is the case of Bilbao La Vieja and San Francisco, two severely deprived neighbourhoods located in the historic centre of the city that have been the focus of various rehabilitation and renovation plans since 1991, when they were defined as an Area of Integrated Regeneration (ARI). A series of planning instruments were drafted to manage the renovation process including a rehabilitation and a special area plan for Bilbao La Vieja (PERRI) in 1994. Regeneration initiatives continued during the following decade when the area became Bilbao La Vieja and San Francisco were labelled as a new opportunity area due to its strategic location and the existing land rent gap. An ambitious new Special plan (2005-2009) was launched to promote the redevelopment of this area into a new creative district through art, culture, leisure and tourist initiatives. The objective was to develop a new bohemian and multicultural hub aimed to enhance the attractiveness of Bilbao La Vieja and San Francisco for new residents and visitors. However, physical improvement and crucial infrastructure developments have only partly benefitted local residents as process of gentrification and intra-neighbourhood differentiation has also taken place (Vicario & Martínez, 2003; Rodríguez & Vicario, 2005; Vicario & Rodríguez, 2010).

Over time, these initiatives have moved from an urbanistic, housing renovation and infrastructure-oriented approach, towards more comprehensive plans integrating social and economic regeneration objectives and participative governance (Rodríguez, 2014). Still, the impact of these regeneration strategies has been mostly on the

physical dimensions of disadvantage, while the social and economic problems remain unsolved and even, in some ways, exacerbated by gentrification and displacement tensions. Otxarkoaga, another deprived but peripheral neighbourhood, has also been a target of various regeneration initiatives since the late 90s but more limited in its scope, resources and also its effects. These disadvantaged neighbourhoods are examined in more detail below when the socio-spatial differentiation dynamics in Bilbao in the period 1991-2001-2011 are analysed.

Measuring neighbourhood stratification in Bilbao: data and methodology

This research analyses the evolution of the socio-spatial differentiation of neighbourhoods in Bilbao during the period 1991-2001-2011, two decades of intense urban restructuring and regeneration. The study uses a multivariate approach, Multiple Factorial Analysis, to examine shifting patterns in the socio-spatial trajectories of a selected number of neighbourhoods focusing on evolving trends towards convergence/divergence among them during this period.

Data

The study uses census data published by the Spanish National Statistics Institute (INE) for the years 1991, 2001 and 2011. The selection of variables is conditioned by the availability of data at the neighbourhood scale but it is consistent with variables frequently used in neighbourhood research to examine socio-spatial attributes and patterns (Salom & Fajardo, 2017; Antolín et al., 2010; Donat et al., 2014). For each year, the study defines 12 census variables related to three areas of interest: demographics, socioeconomic conditions and housing. Therefore, we have a matrix of 39 individuals (neighbourhoods) and 36 variables grouped into 3 groups (census for 1991, 2001 and 2011). Table 1 presents the variables included in each group (census), and their basic descriptive values (mean, standard deviation and maximum and minimum values).

[insert Table 1]

Methodology

This research uses a multivariate approach, Multiple Factorial Analysis (MFA), to examine changing socio-spatial differentiation trajectories among neighbourhoods in Bilbao between 1991 and 2011. This technique is a useful tool for identifying neighbourhood attributes, determining which variables group together, and, more interestingly, identifying relative changes in the socio-spatial patterns occurred within the neighbourhoods over time.

MFA is a factorial method especially designed to the study of tables in which a group of individuals (neighbourhoods) is described by a set of variables structured in different groups (census years) (Pagès, 1998). Like any other factorial method, MFA analyses the connections between variables and, based on this analysis, examines the relationships that exist between individuals, both from the perspective of global analysis and from the perspective offered by each group of variables (partial analysis). More specifically, MFA is performed in two stages. In the first stage, a Principal Component Analysis (PCA) [1] is carried out for each group of variables separately (partial analysis). In the second stage, a new PCA is performed for the entire group of variables (global analysis) in which those that define each group are typified relative to the same group and weighted with the inverse root of the first eigenvalue obtained in the first PCA, a measure of how much of the variance of the observed variables a factor explains.

[1] Principal component analysis (PCA) is a technique for dealing with large data matrices it can be viewed as an exploratory technique that seeks to condense information into a small number of new variables that explain the maximum total variability in the data. PCA transforms a set of correlated variables into a new set of uncorrelated variables called principal components. These components are linear combinations derived in decreasing order of importance such that the largest component is the one that explains the greatest possible variability of the total variation contained in the original data. The second principal component is chosen so that it explains the largest possible amount of variation that remains unexplained by the first principal component, subject to the condition that it is uncorrelated with the first principal component. The third component is not correlated with neither the first nor the second and has the third largest variance, and so on (Dallas, 2000).

Based on the analysis of the connections between variables, the PCA reveals the relationships that exist between the individuals (neighbourhoods). This technique offers great flexibility in the processing of information allowing for the assembling of variables previously defined into different groups and, subsequently, weight each of these groups (Escofier & Pagès, 1990, 1994; Pagès, 1998; Abascal, Aguirre & Landaluce, 2001). The software used is SPAD 7.0.

Besides the weighting of variables, the MFA also generates a series of graphics that assist in the interpretation of results. On the one hand, it generates the graphical representation of the variables that allows observing the proximities between the variable points of the different tables. On the other hand, it obtains graphic representations of the cloud of individuals characterized by the variables of each group (partial individuals) and by the set of variables (average individual) on the same factorial plane. This projection makes it possible to identify the proximity between the individual points of the different tables and to detect differences.

The MFA has analytical advantages over other traditional regression techniques that make it more suitable for achieving the objectives of this study. The most relevant is that with MFA each variable is related to the others, so there is no a dependent variable and a set of independent variables. In traditional regression models, on the other hand, a dependent variable and a set of explanatory variables must be defined in advance. However, we are not interested in knowing the associations between a set of explanatory variables and a dependent variable, but in knowing the relationships between all the variables simultaneously, so that we can describe the same set of neighbourhoods through several groups of variables. That is, we are interested in examining the subjacent shifting patterns in the socio-spatial variables of a set of neighbourhoods.

Results

Based on the results of the MFA, and considering all the information contained in the three census years, the characterization of the districts of Bilbao reveals a two-dimensional factorial structure[2].More specifically, Table 2 presents the first three eigenvalues of the global analysis. The first two dimensions of MFA jointly account for 61% of the total variance: 43.20% for the first factor and 17.79% for the second. The third factor, in turn, explains 13,10% of the total variance. As noted, and accordingly with the literature, we take into account the first two factors since they have eigenvalues greater than unity (Kaiser, 1960; Boehmke & Greenwell, 2020) and explain a substantial proportion of the variance.

[insert Table 2]

Figure 2 shows the projection of the active variables on the first factorial plane allowing us to identify the variables that contribute most to the formation of the axes (dimensions) of the first factorial plane. For each census, the quality of housing (mean area per person and housing comfort index) and some characteristics of employment (percentage of high-medium skilled professions and employment rate) are the variables that contribute most to the formation of the first factor. The variables that contribute most to the second factor are total population and immigrant population (in terms of density and absolute numbers) (upper-half plane) and the housing ownership regime (lower-half plane). This general characterization is maintained in the three census decennial years considered, with minor variations that will be discussed below. Table 3 presents the coordinates of the variables to help in their interpretation.

[insert Figure 2]

[2] In this section we present the results of the global analysis obtained using MFA. The partial results for each group of variables can be found in Annex 1. The complete results are available upon request.

[insert Table 3]

Based on the distribution of the variables on the first factorial plane shown in Figure 2, the average individuals have been projected, showing the relative average position taking into account all variables and census years considered (Figure 3) To visualize them spatially, the neighbourhoods of Bilbao have been represented with the values of axes 1 and 2. The first axis describes the general ranking of neighbourhoods in terms of their socioeconomic situation and housing characteristics with Indautxu, Abando, San Pedro de Deustu and Castaños showing the highest values, and Iturrigorri-Peñascal, Otxarkoaga, Uretamendi, Altamira and Bilbao La Vieja, the lowest. The second axis provides information related to demographic features –total and immigrant population– and housing ownership regime, ranking neighbourhoods accordingly. In this case, San Francisco stands out as the neighbourhood with the highest values and density of immigrant population, a large part of whom is severely afflicted by social exclusion and irregular residence status[3].

[insert Figure 3]

Neighbourhood convergence and divergence dynamics in Bilbao (1991-2001-2011)

In this section, we examine the dynamics of socio-spatial convergence/divergence Bilbao's neighbourhoods during the intercensal period 1991-2001-2011. The analysis focuses on a number of selected neighbourhoods occupying the most extreme positions from the origin described in the values of axes 1 and 2 in Figure 3. It can be observed that Indautxu, Abando, San Pedro de Deustu and Castaños display the highest values, and Iturrigorri-Peñascal, Otxarkoaga, Uretamendi, Altamira

[3] For a detailed analysis of socio-spatial stratification in Bilbao's neighbourhoods, see Altuzarra *et al.*, 2018.

and Bilbao La Vieja the lowest values in the axis 1[4], whereas San Francisco shows the highest contribution to axis 2. Their trajectories are represented in Figure 4. The displacement of vectors outwards, away from the origin, suggests that a process of divergence has taken place in the neighbourhood in question; in contrast, an inwards movement is interpreted as a trajectory towards convergence.

[insert Figure 4]

The socio-spatial dynamics represented in Figure 4 reveal that, with the exception of San Francisco, the selected neighbourhoods followed a parallel evolution over the period 1991-2011: an improvement in their relative positions during the first decade and a relapse in the following one, an evolution that follows closely the dynamics of the economic cycle. These results, however, do not reflect an overall shift in their socioeconomic positions and/or a trend towards convergence or divergence among neighbourhoods occupying the most extreme positions. Rather, they show not only contrasting patterns regarding the convergence-divergence trajectories but also significant variability in the trajectories of different neighbourhoods over the two decades.

Abando and, particularly, Indautxu, the two most affluent neighbourhoods, improved their relative positions during the 1991-2001 decade. Some of the most disadvantaged neighbourhoods also followed a similar trend; this was the case of Bilbao la Vieja and, to a lesser extent, of Otxarkoaga, Iturrigorri-Peñascal and Uretamendi. In contrast, San Francisco moved further away from the average during this period, a trajectory which continued in the second phase. Thus, while in a general sense, the positive evolution of the more affluent neighbourhoods during the period 1991-2001 contributed to widen the gap between the highest- and lowest-income neighbourhoods,

[4] Altamira, a neighbourhood with one of the lowest values, has not been included in our selection because of its small surface area (0,15 km2) and population (less tan 2000 residents).

for some of the latter, improvement of their relative positions, during this period, contributed to a timid trend towards the average and convergence. These trends were reversed during the 2001-2011 decade, as the drop in the relative positions of the better-off neighbourhoods brought them closer to average values and convergence while, in the case of the less affluent ones, worsening of their relative positions neutralized the modest gains towards convergence of the previous phase.

Now, understanding the underlying logic behind shifting socio-spatial differentiation patterns in the city requires a more in-depth analysis of the sources of neighbourhood change both relative to the various neighbourhood characterization factors discussed, as well as in relation to the impact of urban policies and strategies implemented over the period considered. In this sense, the differing dynamics of the two most privileged neighbourhoods, Abando and Indautxu, in the 1990s are very pertinent. While Abando shows a moderate improvement in its relative position during that decade, Indautxu experiences a more intense dynamism breaking further away from the city's average, an evolution explained by a better performance in socioeconomic status variables (employment and increasing proportion of high-skilled occupation residents) as well as by housing quality index. However, during the period 2001-2011, Indautxu experienced a much greater fall in its relative position than Abando, an evolution that is related to a relative decrease of immigrant population in this area, as well as a rising share of housing ownership. The comparatively better performance of Abando during the second decade can also be interpreted in terms of the positive effects provided by substantial investments in the area associated to the regeneration of Abandoibarra, an old port and industrial enclave along the riverfront of Abando, redeveloped over the two decades considered (Rodríguez & Martínez, 2001).The concentration in this location of some of the most emblematic infrastructures and urban projects, including the Guggenheim Museum and the Euskalduna Congress and Music Hall, among others, have no doubt contributed to reinforce the centrality of this area (Rodríguez, 2002). At the same time, the building of almost 1.000 top-value housing units in Abandoibarra,

attracting new high-income residents to the neighbourhood, is also a relevant factor in explaining Abando's capacity to better resist the impact of the economic downturn. Paradoxically, the failure of the strategy to transform Abandoibarra into a new directional centre for advanced services and functions was prompted by an overwhelming focus on short-term land valorisation which rendered luxury real estate development the primary force in the area's regeneration. The result of this strategic turn was to produce a new centrality but not in the terms originally planned but rather reinforcing Abando's traditional urban centrality role in attracting high-income groups by providing new luxury housing and accessibility to new cultural and leisure infrastructures (Rodríguez & Abramo, 2012).

The neighbourhoods of San Francisco and Bilbao la Vieja, adjacent to one another also exhibit a contrasting evolution. Over the two decades, San Francisco diverged further away from the average on a dynamic of increasing socioeconomic peripheralization, particularly intense during the 2001-2011 decade. This trend is explained mostly by a loss of relative positions relative to the city's average of variables related to employment and quality of housing. Additionally, the growing proportion of immigrant population also contributed to reinforce this divergent path highlighting the extreme vulnerability of this area and the challenges of coping with the consequences of economic recession in the late 2000s. Bilbao la Vieja, in contrast, presents a rather different evolution. This neighbourhood shows a positive trend of convergence towards the city's average during the two decades analysed, but particularly during the 1990s. This evolution is explained by the positive performance of employment and housing indicators supported, partly, by urban revitalization initiatives implemented since the early 1990s till the mid 2000s targeting housing upgrading and collective infrastructure developments as well as employment and social integration initiatives. The neighbourhood's positive convergence trend, however, was thwarted during the 2001-2011 period as social problems, including rising unemployment and poverty, worsened following the financial and economic crisis. And,

while neighbourhood renovation programs and social housing developments contributed significantly to the area's overall improvement, a strong physical and urbanistic bias and the limited resources allocated to tackle socioeconomic conditions and exclusionary dynamics severely constrained the potential of regeneration efforts in this area (Rodríguez, 2014). In addition, the physical and functional improvement of Bilbao la Vieja has also contributed to intensify gentrification pressures in the neighbourhood (Vicario & Martínez, 2003), a dynamic that accounts for the declining proportion of immigrant population and the increase in the share of housing ownership tenure.

The socio-spatial differentiation dynamics for Otxarkoaga, Iturrigorri-Peñascal and Uretamendi, a cluster of disadvantaged neighbourhoods, are in tune with the trajectory followed by Bilbao La Vieja: a relative improvement in the 1991-2001 phase followed by a much greater fall over the following decade. Otxarkoaga, a neighbourhood located in the periphery of Bilbao, maintains its poor relative position with respect to the city average during the whole period as a result of the performance of variables related to employment and quality of housing. This evolution is of especial significance since Otxarkoaga has been categorized as a vulnerable area since the 1970s. Although neighbourhood regeneration initiatives have been implemented since the early 1990s, once again, they have been strongly geared toward physical renovation and infrastructure development. Nevertheless, renovation programs have contributed to improve its relative position during the 1991-2001 decade, a trend that was reverted during the following decade. From 2008 onwards, community development programs, targeting socioeconomic and exclusionary issues, have been implemented in this neighbourhood. Likewise, in Uretamendi and Iturrigorri-Peñascal the positive convergence trajectory of the 1990s, accounted for employment and quality of housing improvements, were thoroughly offset in the following decade. Worsening employment and poor housing conditions in these areas are largely responsible for this trend. But this process has also been supported by the relative increase in the proportion of immigrant population, a process related to the displacement effects of the

gentrification pressures in disadvantaged but centrally located neighbourhoods of San Francisco and Bilbao La Vieja (Altuzarra et al., 2018; Vicario & Martínez, 2003).

Conclusions

This paper has examined changing patterns of socio-spatial differentiation in Bilbao in the period 1991-2001-2011, two crucial decades of intense urban restructuring and rising inequality but also of widely acclaimed and purportedly successful revitalisation strategies in the city. Using Census Data and a multivariate methodological approach, it presents a characterization of Bilbao's neighbourhoods based on a set of variables -demographic, socioeconomic and housing attributes- that describe various aspects of neighbourhood differences, and the evolution of their relative positions. This statistical technique, rarely used in urban segregation studies, consists of performing a Principal Component Analysis for each group of identified variables separately and, subsequently, for the entire group of variables in order to identify the connections between them and the relationships between neighbourhoods. The results reveal a two-dimensional factorial structure that capture the correlations among the variables according to which neighbourhoods can be grouped. On the basis of these results, the analysis focuses on a selected group of "extreme" top- and bottom-ranked neighbourhoods to examine shifting patterns of convergence/divergence and the driving factors behind them including both structural and contextual and policy initiatives implemented during the two decades considered.

Our study reveals, on the hand, that patterns of socio-spatial differentiation among neighbourhoods in Bilbao have remained, for the most part, stable over the period 1991-2011, a phase of unequivocal intensifying socioeconomic inequalities in the city. Notably, research results show that, during these two decades, the relative positions of neighbourhoods farthest away from the average values of Bilbao's neighbourhoods have not significantly changed. Small variations in the relative

positions of the top-placed neighbourhoods -Abando and Indautxu- and one of the most disadvantaged -Bilbao La Vieja- provide for a timid move towards convergence over the two decades. This is mostly explained by modest improvements in employment and housing conditions in the latter, particularly during the first decade, and a parallel worsening of those same conditions in the more affluent areas, mostly during the following decade. Other disadvantaged areas, however, did not follow the same path. In some cases -Otxarkoaga, Uretamendi and Iturrigorri-Peñascal- advances registered during the 1991-2001 period were halted and offset in the following decade, while in the specific case of San Francisco, the most disadvantaged neighbourhood in the city, the inequality gap even widened as a result of worsening conditions throughout the two decades. Divergent paths among disadvantaged neighbourhoods in Bilbao can be partly explained as a result of inner-city gentrification processes driven by housing market and neighbourhood renovation effects. However, these effects take time to materialize and therefore variations in socioeconomic segregation trends might be overshadow but conjunctural dynamics and short-term effects. Nevertheless, these research results indicate, as many recent studies have suggested, that income inequalities do not translate directly into spatial inequalities and that the historical trajectories of neighbourhoods play an important role in determining varying urban outcomes.

On the other hand, research results also show that while levels and structures of socio-spatial differentiation within the city have remained stable, the pattern of socioeconomic segregation is gradually evolving. The traditional segregation pattern that divided the city into different fragments according to their relative distance from the centre, is slowly giving way to a more variegated socio-spatial structure with an urban centre and different types of peripheries ranked on the basis of changing demographic, socioeconomic and housing stock attributes. This tendency, however, does not refute the persistence of an overall centre-periphery pattern that, beyond the singular inner-city traits of Bilbao La Vieja and San Francisco, has characterised the urban divide in Bilbao for decades.

In sum, the analysis of Bilbao provides further evidence on the rich variation of outcomes resulting from increasing inequalities at the intra-urban, neighbourhood, scale. Bilbao is also an interesting case because it has been often upheld as a show-case of successful urban regeneration and, as a result, little attention has been paid to the consequences of the growth of income inequalities and socioeconomic segregation. Yet, as our results indicate, far from a monolithic view of success, different neighbourhoods have followed quite distinct paths and benefited to varying and contrasting degrees from the so-called "Bilbao effects". These differences reflect the multidimensional character of evolving socio-spatial trajectories also at the neighbourhood scale. In this sense, the case of Bilbao has aimed at contributing both methodologically and analytically to improve our understanding of how structural processes are mediated by local factors including institutional, cultural and planning histories and policies that partly determine how they actually materialize in space. And, understanding the contingent and multidimensional character of evolving socio-spatial trajectories is crucial for fine tuning urban strategies tackling inequality and neighbourhood disadvantage.

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Annex 1. Results of the first stage of the MFA.

The AFM is performed in two phases. In the first, a Principal Component Analysis (PCA) is performed for each of the groups of variables separately and the first eigenvalue of each of these partial analyses is reserved.

In the second phase, the same technique is used, but this time for the set of all variables and is called global analysis. For this second analysis, the variables in each group are typified with respect to the same group and weighted with the inverse of the root of the first eigenvalue. The objective is to balance the influence between the tables (Escofier and Pagès, 1990).

Results of the partial analysis (first stage)

Table A1 present the results of the first stage of the MFA, that is, the results for the PCA for each group of variables. It details, for each group of variables, the number of dimensions (variables) included in each group, the first three eigenvalues, the percentage of inertia and the accumulated percentage of inertia.

[insert Table A1]

The full results of the MFA including the partial analysis and the global analysis are available under request from the authors.

Table 1.
Descriptive statistics

		Mean			Standard deviation			Minimum			Maximum		
	Label	1991	2001	2011	1991	2001	2011	1991	2001	2011	1991	2001	2011
Demographics	Total population	9.732,6	9.209,8	8.846,5	8.545,2	7.716,1	7.501,4	511,0	446,0	423,0	39.330,0	34.316,0	32.968,0
	Total immigrant population	40,8	193,7	754,4	35,5	158,0	607,4	1,0	11,0	25,0	142,0	625,0	2.465,0
	Population density (hb/km^2)	25.624,9	28.882,8	23.556,5	16.727,1	35.510,8	13.922,5	721,9	1.484,8	592,0	75.509,6	221.553,9	50.326,0
	Immigrant population density (hb/km^2)	124,2	632,3	2.481,6	138,7	681,8	2.680,2	5,7	29,3	35,0	750,0	3.739,4	14.921,3
Socioeconomic	High-medium skilled professions (%)	38,8	47,3	45,8	15,7	16,6	14,1	6,5	17,0	16,6	69,7	80,6	72,8
	Unskilled professions (%)	28,7	10,7	5,5	14,9	4,3	1,7	10,1	4,4	2,2	67,1	20,2	8,7
	Employment rate (%)	46,4	56,5	58,9	4,1	3,8	3,7	38,4	47,8	48,6	53,1	66,6	65,9
	Mean personal income* (€)		11.430,8	17.478,3		3.251,8	5.245,5		7.232,0	9.794,0		20.623,0	32.572,0
Housing	Mean area per person (m^2)	38,3	41,8	31,3	7,1	6,5	4,8	26,6	29,8	22,3	57,2	59,8	44,2
	Housing comfort index (**)	62,1	67,4	68,0	4,4	5,8	6,4	54,3	51,5	49,8	70,0	76,9	81,0
	Owned homes (%)	80,9	85,5	78,2	15,1	7,5	2,7	20,2	64,9	70,2	94,2	94,6	83,2
	Rental homes (%)	4,1	9,0	9,9	3,7	6,3	2,7	1,6	3,2	4,9	24,6	29,0	16,6
	N	39	39	39	39	39	39	39	39	39	39	39	39

Note: Average values for 1991, 2001 and 2011.

(*) Data available only for 2001 and 2011

(**) Housing comfort index synthetically measures the existence or absence of facilities and services of the main family dwellings, so that its value allows to approximate the degree of comfort or welfare they may have (Eustat, n.d.: https://en.eustat.eus/documentos/elem_1757/definicion.html).

Table 2: Eigenvalues

Number	Eigenvalue	Percent	Cumul. percent
1	2,8769	43,2042	43,2042
2	1,1849	17,7937	60,9980
3	0,8724	13,1015	74,0994

Table 3: Coordinates and helps to the interpretation of the active variables

	Coordinates		Contributions		Squar.cosines	
Groups	axis 1	axis 2	axis 1	axis 2	axis 1	axis 2
Group 1 (NORMAL.PCA) (census 1991)						
Total population	0,5960	0,3997	2,7826	3,0375	0,3553	0,1597
Total foreign population	0,6032	0,6603	2,8500	8,2916	0,3639	0,4360
Population density (hb/km2)	0,0637	-0,1246	0,0318	0,2951	0,0041	0,0155
Foreign population density (hb/km2)	0,0414	0,7348	0,0135	10,2683	0,0017	0,5399
Housing comfort index	0,8565	-0,2255	5,7454	0,9671	0,7335	0,0509
Homes for rent (%)	0,1024	-0,0059	0,0821	0,0007	0,0105	0,0000
Average usable area per individual (m2)	0,6865	0,2528	3,6916	1,2155	0,4713	0,0639
Ownership regime (%)	0,1261	-0,3407	0,1245	2,2077	0,0159	0,1161
Employment rate (%)	0,8188	-0,2796	5,2515	1,4863	0,6705	0,0782
Higher and intermediate professions (%)	0,9284	-0,0059	6,7514	0,0007	0,8620	0,0000
Unqualified professions (%)	-0,8893	0,2468	6,1945	1,1581	0,7909	0,0609
			33,5188	28,9285	0,3891	0,1383
Group 2 (NORMAL.PCA) (census 2001)						
Total population	0,6325	0,3739	2,5871	2,1953	0,4001	0,1398
Total foreign population	0,5585	0,7262	2,0170	8,2796	0,3119	0,5273
Population density (hb/km2)	0,3162	0,7840	0,6464	9,6504	0,1000	0,6147
Foreign population density (hb/km2)	0,3903	0,5529	0,9849	4,7994	0,1523	0,3057
Housing comfort index	0,6813	-0,2704	3,0010	1,1480	0,4641	0,0731
Homes for rent (%)	-0,1312	0,5171	0,1113	4,1974	0,0172	0,2673
Average usable area per individual (m2)	0,7969	0,1411	4,1063	0,3128	0,6350	0,0199
Ownership regime (%)	0,0361	-0,5254	0,0084	4,3333	0,0013	0,2760
Average personal income	0,9374	-0,1069	5,6821	0,1795	0,8787	0,0114
Employment rate (%)	0,6961	-0,3850	3,1333	2,3277	0,4846	0,1483
Higher and intermediate professions (%)	0,9546	0,0215	5,8919	0,0073	0,9112	0,0005
Unqualified professions (%)	-0,9212	0,1466	5,4874	0,3373	0,8486	0,0215
			33,6571	37,7680	0,4338	0,2005

Group 3 (NORMAL.PCA) (census 2011)						
Total population	0,6379	0,4148	2,2956	2,3567	0,4069	0,1720
Total foreign population	0,4731	0,7838	1,2627	8,4160	0,2238	0,6143
Population density (hb/km2)	0,2701	0,4971	0,4116	3,3857	0,0730	0,2471
Foreign population density (hb/km2)	-0,0418	0,7441	0,0099	7,5859	0,0017	0,5537
Housing comfort index	0,6691	-0,1321	2,5262	0,2392	0,4477	0,0175
Homes for rent (%)	-0,7351	0,5121	3,0487	3,5929	0,5403	0,2623
Average usable area per individual (m2)	0,8232	-0,0338	3,8238	0,0156	0,6777	0,0011
Ownership regime (%)	0,5796	-0,5932	1,8953	4,8214	0,3359	0,3519
Average personal income	0,9315	-0,1164	4,8953	0,1856	0,8676	0,0136
Employment rate (%)	0,7501	-0,3860	3,1748	2,0416	0,5627	0,1490
Higher and intermediate professions (%)	0,9473	-0,0455	5,0629	0,0284	0,8973	0,0021
Unqualified professions (%)	-0,8848	0,2152	4,4175	0,6345	0,7829	0,0463
			32,8242	33,3035	0,4848	0,2026

Table A1. Summary of eigenvalues for partial analysis

			Eigenvalues			Percent of inertia			Accumulated percentage		
Group	Type	Dimension	axis 1	axis 2	axis 3	axis 1	axis 2	axis 3	axis 1	axis 2	axis 3
Group 1: Census 1991	NORMA. PCA ACT	12	4,4380	1,9557	1,6276	40,3451	17,7787	14,7962	40,3451	58,1238	72,9200
Group 2: Census 2001	NORMA. PCA ACT	12	5,3755	2,5717	1,8320	44,7958	21,4309	15,2663	44,7958	66,2267	81,4930
Group 3: Census 2011	NORMA. PCA ACT	12	6,1605	2,6507	1,1108	51,3375	22,0890	9,2567	51,3375	73,4264	82,6831

Figure 1. Location, demographic evolution and milestones of urban regeneration in Bilbao.

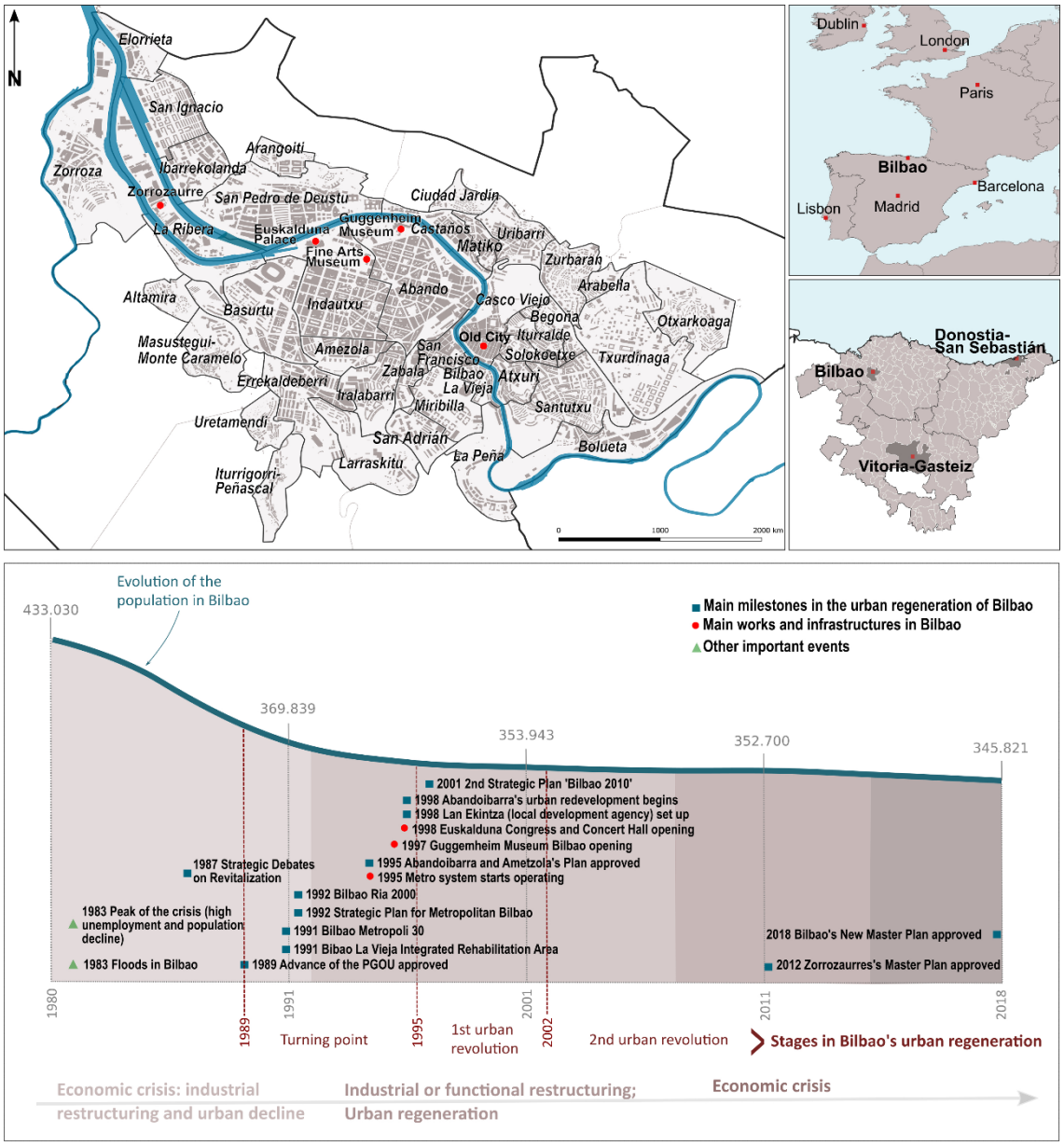

Figure 2. The projected points are component loadings average for all neighborhoods.

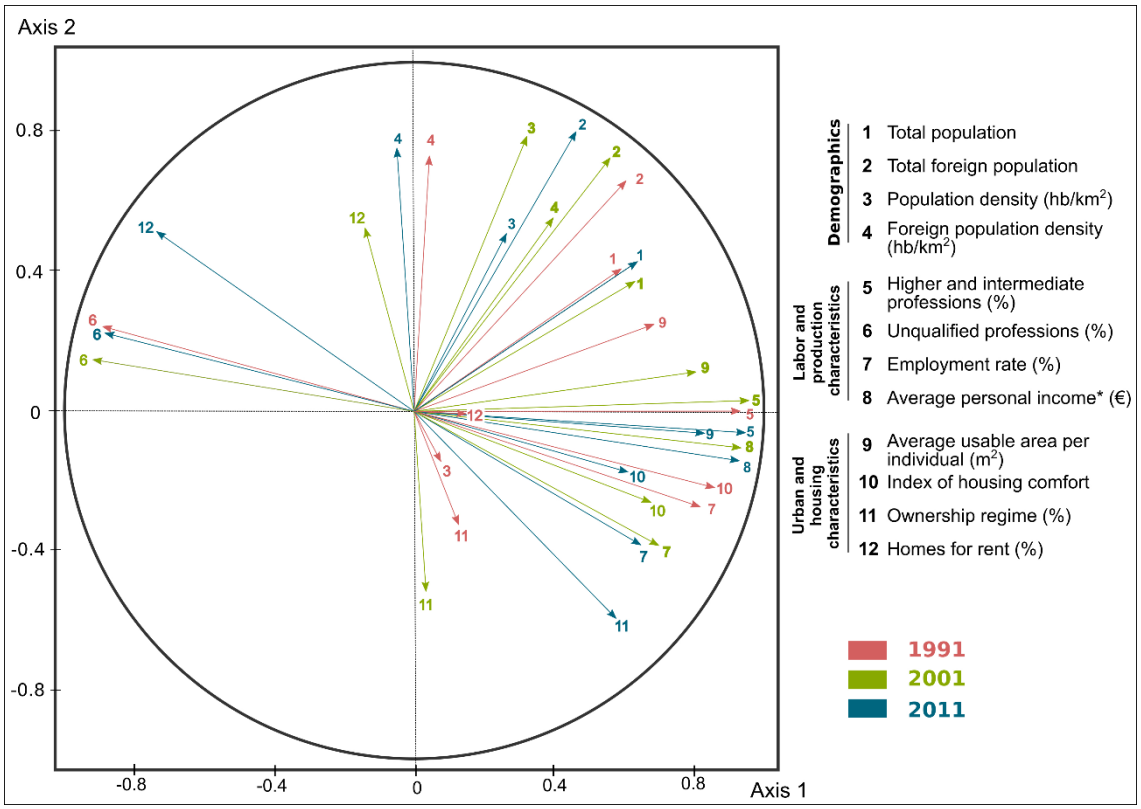

Figure 3.A) Projection of neighbourhoods on the first factorial plane showing their relative position based on socio-spatial characteristics. B) Choropleth map of the neighbourhoods with Axis 1 and Axis 2 values.

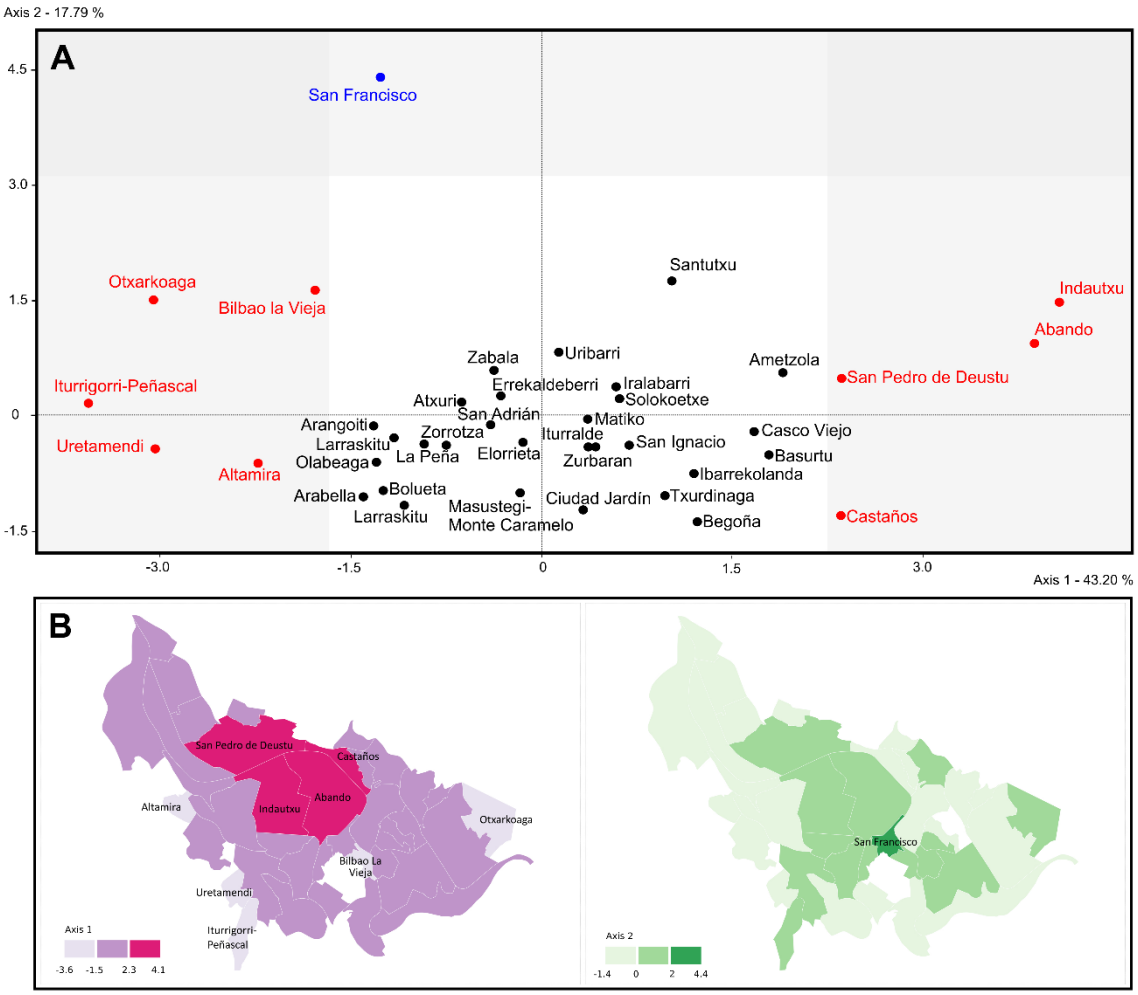

Figure 4. Projection of selected neighbourhoods on the first factorial plane (1991-2001-2011) indicating socio-spatial convergence-divergence trajectories.