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PAPER

Title: Assessing dynamic social landscapes in urban areas

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Abstract: Beyond the physical urban structure, that can be relatively easily observed, there are social landscapes defined by the socio-economic realities of the individuals, households and communities that live in this urban structure. The social landscapes are more dynamic than the urban structure, being influenced by relatively rapidly changing preferences and location choices. We develop a simple and well-defined methodology to assess the social landscapes in urban areas, allowing the evaluating of their dynamics over time. Using only detailed data about income and real-estate transactions, four different indexes related to land values, local average income, inequality and segregation are used to map the social landscapes in an urban area and its evolution over time. The results demonstrate that the social landscape dynamics are not simple, nor even always intuitive. Well-known urban processes, as gentrification, can be identified by social landscapes, but also unexpected processes are observable. The main goal of the suggested methodology is to describe the spatiotemporal dynamics of social landscapes without using contextual data: In other words, there is no need to know any specific characteristics of the urban area, excepting the data required for the indexes' calculation. Therefore, the suggested method is used to identify areas of interest and generate further questions about the social, geographical, economic, and historical drivers behind the observed social landscape dynamics. Doing so, it is a possible and valuable complement to urban sociological studies focused in advance on specific areas or population groups.

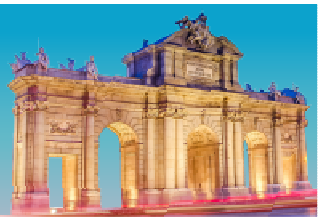
Keywords: *Social landscape, urban structure, land value, inequality, segregation*

JEL codes: *R23, R32, D63*

1. Introduction

The study of spatial urban dynamics is traditionally based on morphological approaches using land use data (Batty, Xie and Sun, 1999; Batty, 2005; Ramachandra, Aithal and Sanna, 2012). Whether based on elaborated theoretical models (Xie, 1996; Pumain and Reuillon, 2017) or in strict empirical observations (Li, Gong and Liang, 2015, 2015; Zhou *et al.*, 2018), these approaches focus on the most directly quantifiable urban measures, as spatial form, morphological typologies and built density. Therefore, the ability to map physical urban landscapes at large scales is increasingly accurate and sophisticated. But beneath the physical urban landscape there is a fluid and not easy to characterize additional layer, composed by the socio-economic realities of the individuals, households and communities living there. This layer may be called "the social landscape", and can include, beyond objective socio-economic data, also subjective perceptions and attitudes (Brown and Reed, 2012). It has been argued that the social landscape is difficult to apprehend since the required data is hard to collect (for example, attitudinal data) or potentially outdated (as is usually the case of census data). This could be one of the reasons why the study of the social landscape lags behind the developments regarding the physical urban landscapes (Ryan, 2011).

The emergence and dynamics of social landscapes in urban areas are intrinsically related to the fact that, in addition to economic capital (income and wealth), also socio-cultural lines traverse the different social classes (Anheier, Gerhards and Romo, 1995; Pret, Shaw and Drakopoulou Dodd, 2016). However, it seems that the influence of income on residential choice (and hence on the resulting social landscape) is strong (Bailey, 2012; Bailey, Gent and Musterd, 2017), while the spatial influence of socio-cultural traits is unclear compared with the former (van Gent, Das and Musterd, 2019). The increasing availability of spatial micro data related to population and income (Ruggles, 2014; Ruggles, Fitch and Roberts, 2018) suggests that through a proper use of rudimentary demographic and economic variables, the dynamic of social landscapes can be accurately depicted and described. Moreover, we argue that the analysis of the evolution of social landscapes in urban areas is a powerful tool for the identification of specific zones calling for further socio-economic inquires, and the definition of focused test cases aimed to test them.

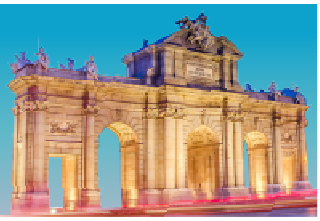


The goals of this paper are twofold: First, it develops a well-defined methodology to map and describe the spatiotemporal dynamics of social landscapes in urban areas. Aggregating individual level data about income at the level of neighborhoods, we calculate variables as relative average income, socio-economic segregation, and income inequality. In parallel, the economic, environmental, and locational features of the neighborhoods are assessed using land values obtained from observed real-estate transactions. This multidimensional set of variables calculated over time allows us to describe the changing spatial configuration of urban social landscapes. The second aim is to demonstrate how the different variables interact in the urban space over time, allowing for the identification of potential geographical and sociological areas of interests, without assuming previous knowledge of the city. The implemented bottom-up approach uses exclusively hard-data, having the potential to identify new urban phenomena, that may complement urban sociological studies focused in advance on specific areas or population groups.

The rest of the paper consists of 4 sections. Section 2 defines the concept of the social landscape and reviews the most potentially useful variables to measure it. The test case, the used data and the methodology are presented in section 3. In section 4 we present the results and Section 5 is devoted to discussing the results and their significance. Section 6 concludes while suggesting possible avenues for future work.

2. The assessment of social landscapes

Location choices are influenced by the quality of urban places and local amenities, but these are insufficient to characterize the spatial and social attachment of households to their place of residence (Lewicka, 2010). The geographical-sociological concept that best captures the attachment to place is the “neighborhood” (Brown, Perkins and Brown, 2003), defined as “a bundle of spatially based attributes associated with clusters of residences” (Galster, 2001). The concept of neighbourhood is usually operationalized by the definition of geographical areas with roughly homogeneous characteristics, generally in terms of housing markets or socio-economic variables (Clapp and Wang, 2006). A common approach to define neighbourhoods is to use census-based units as a proxy (Park and Rogers, 2015). Although this approach has its drawbacks, the large amount of data available over large periods of time makes the use of census tracks as a



surrogate of neighbourhoods a reliable choice (Mujahid *et al.*, 2007). Therefore, the neighbourhood level is the most appropriated scale for the study of social landscapes.

Changes in households' preferences are among the most powerful drivers of the socioeconomic changes observed in neighborhoods, as, for example, the renewed attraction of urban centers (Glaeser and Gottlieb, 2006). Changing preferences of wealthy households in the urban arena are at the heart of the burgeoning literature about gentrification, as, for example (Lees, 2000; Butler, 2007), to cite only a few influential papers. A large part of the change in the household's preferences is captured by the variation of land values over time. Land values reflect the perception of the quality of the environment in a certain location (De Groot *et al.*, 2015). In residential areas the dominant land use is for dwelling purposes, and the land value in these areas reflects the quality of the location regarding housing preferences, as the local amenities, the accessibility of the area, job opportunities located nearby, etc. Land valuation is performed daily by real estate appraisals (Davis and Heathcote, 2007; Davis *et al.*, 2021). The assessments pertain to specific properties, based on data about their physical characteristics, locations, and auxiliary data about the local real estate market (Glumac, Herrera Gomez and Licheron, 2018). This traditional approach to assess the land value of a specific real estate property assumes that it can be calculated from the difference between the market price of the property and its construction costs (Eurostat-O.E.C.D., 2015). Therefore, this method is useful for specific real estate properties, when both the market price of the entire structure (which can be a single house or an apartment building) and its construction cost are accurately known. However, this method can also be used for large scale regional assessment, provided that updated construction costs for each type of residence (such as private houses, detached houses or apartments located in different stories) are available (McAllister, Shepherd and Wyatt, 2018).

The most basic mechanism through which households modify the neighborhood system is inter and intra urban migration, that can be defined as a process of adjustment of households' needs and desires by means of spatial relocation (Brown and Moore, 1970). The decision to migrate adopted by a single household obviously impacts on both the original and the destination neighborhood (Bruch and Mare, 2012). The locational choices of households, therefore, modify physically the social composition of both

neighborhoods slightly changing their characteristics (Coulton, Theodos and Turner, 2012).

An additional aspect in which households' preferences strongly affect neighborhoods is "social homophily" (McPherson, Smith-Lovin and Cook, 2001), that may result in residential segregation. The seminal contribution of Thomas Schelling to the theory of spatial segregation (Schelling, 1969) contributed to attract urban scholars' attention, but related mainly on residential segregation by ethnicity, particularly in the USA (Van Valey and Roof, 1976). The economic implications of ethnic segregation were put back on the stake again during the early '90s, claiming that high segregation combined with persistent inequality tends to create spatially concentrated poverty (Massey and Denton, 1993). Economic segregation impacts on disadvantages groups, that are significantly worse off in segregated areas than in the mixed ones (Cutler and Glaeser, 1997). The link between inequality and segregation works also in the opposite direction since income inequality explains the rise of urban residential segregation in the USA during long periods of time (Watson, 2009). However, regardless its negative outcomes, recent analyses of long-term trends demonstrate that residential segregation by income is increasing both in the USA (Bischoff and Reardon, 2014) and in Europe (Musterd *et al.*, 2017). Although there are classical methods to measure residential segregation, the most widely used method is the dissimilarity index of unevenness which is relatively easy to compute and interpret (Massey and Denton, 1988). But the dissimilarity index can only be computed for two groups at a time (for example, segregation between "black" and "white"). A limitation of the residential segregation literature is its skews towards ethnic segregation. In comparison, analysis of socio-economic segregation in ethnically homogeneous locations are relatively scarce (Benenson, Hatna and Or, 2009; Bailey, van Gent and Musterd, 2017). Accordingly, there are few methods for the assessment of the segregation of multiple groups (as income deciles, for example, instead of dichotomous categories). An option is the use of the entropy index (Theil and Finizza, 1971) that can be expanded across two or more variables simultaneously. For example, the entropy index can be used with any division of the income distribution, as percentiles, deciles, quintiles, etc. (Fischer, 2003). However, a consistent methodology for the measurement and comparison of socio-economic segregation over time and space is a pending subject in this area.

Finally, the spatial dimension related to the changing structure of neighborhoods in general, and of social landscapes in particular, is, surprisingly, scarcely addressed. One interesting application was intended to delineate neighborhoods based on the resulting geographic footprint and the socioeconomic composition (Rey *et al.*, 2011). A similar approach was later used in combination to self-organizing maps in order to visualize information in a meaningful way (Arribas-Bel and Schmidt, 2013). Urban sociologists used spatial analyses of neighborhoods in studies about the distribution of crime and health outcomes in urban areas (Morenoff, 2003). However, spatial analyses at the level of neighborhoods explicitly intended to explain socio-economic change dynamics over time are relatively new (Tong and Kim, 2019).

3. Data and methods

3.1. Case study area

The study area is the Tel Aviv district, located in the central strip of Israel's coast. This is one of the most urbanized areas of the country, hosting 5 large municipalities with more than 100,000 inhabitants, 6 medium size municipalities and three small local authorities. The main city is Tel Aviv-Jaffa, considered as the most dynamic metropolis in Israel and its economic and cultural heart (Alfasi and Fenster, 2005). Overall, the area of the Tel Aviv district is approximately 176 square kilometres, and its population was around 1.45 million inhabitants in 2019 (CBS, 2020).

The Israeli Central Bureau of Statistics (CBS) determines statistical areas that are small and relatively homogeneous geographical units that usually holds 3,000 to 5,000 inhabitants. Therefore, large cities include many statistical areas, while towns under 10,000 inhabitants are usually represented by a single one (CBS, 2020). In this research, we analyse the 389 statistical areas for which we have consistent data along the whole research period. Figure 1 shows the location of the case study area in Israel with its main cities and the included statistical areas.

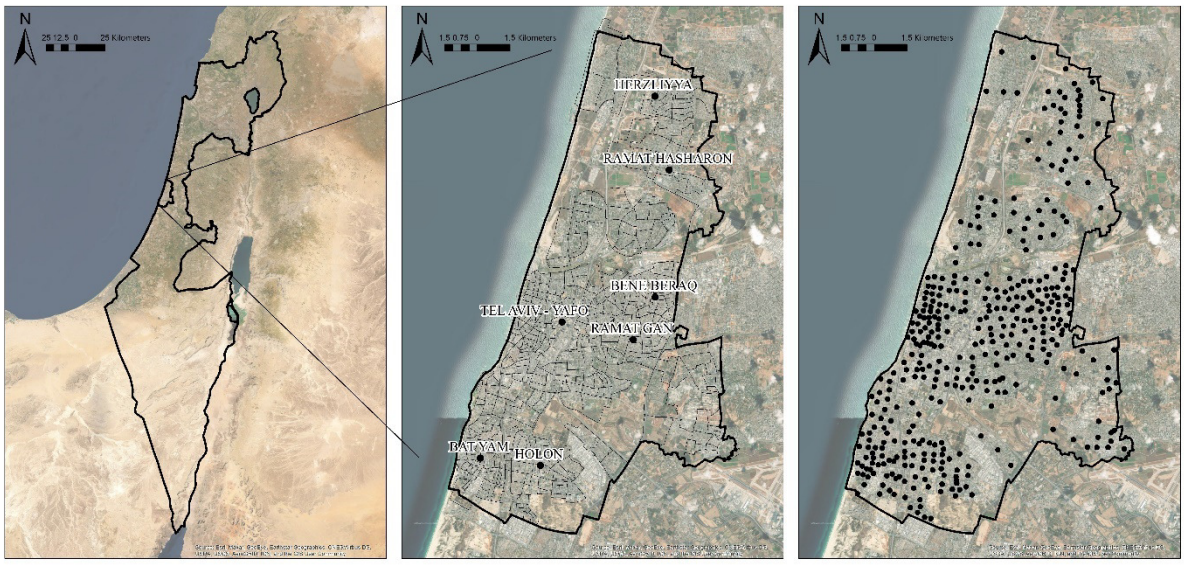


Figure 1: Case study area's location (left), its main cities (center) and the included statistical areas (right)

3.2. Data

We use anonymous monthly individual income and living address data supplied by the CBS for the whole Israeli population in the period 2008 – 2018. Matching residential addresses, we identify within the population aged 21 – 67, couples that lived together, and individuals that lived alone, in 2008 and in 2018. Each one of these is considered as a "household". The income of each household is the average of both incomes in the case of couples, or the income of the individual. Overall, we have income data for a set of 424,696 households in 2008 and 465,703 households in 2018, that lived in the 389 statistical areas included in the study. In addition, we use a dataset of more than 140,000 geo-located real estate transactions that took place in the Tel Aviv district during the period 1998 – 2018, from the Israeli Tax Authority. The data include price per square metre and several details about the properties transacted, such as number of rooms, surface area and age.

3.3. Analysis

The available data is processed following the steps summarized in Figure 2. From both data sources (household's income and real-estate transactions) we produce four indexes,

intended to depict the dynamics of the social landscape at the level of statistical areas. We calculate the actual 2018 values of all the transactions, according to changes in the consumer price index, bringing them to a common ground.

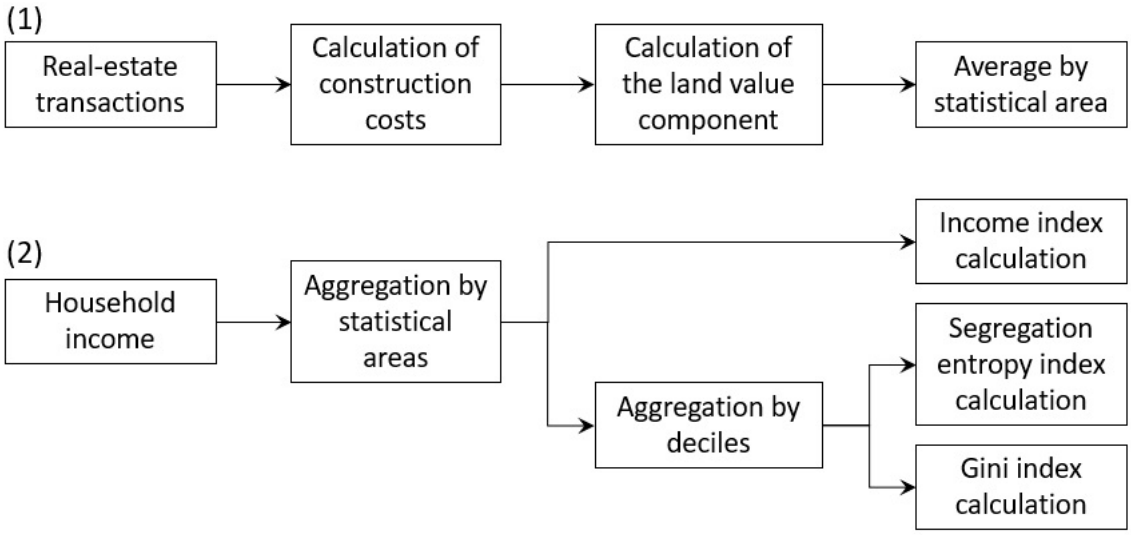


Figure 2: Data processing summary. (1) Calculation of average land values in each statistical area using the real-estate transactions. (2) Calculation of three different indexes of statistical areas using household incomes.

The construction cost for each type of residence (such as private houses, detached houses or apartments located in different stories) are available in Israel through Dekel corporation (www.Dekel.co.il). For each transaction, the land value component is calculated as follows:

$$LV = P/S - C \qquad (1)$$

In Equation (1), the land value per square meter component (LV) is the cost of a built square meter (the property price P divided by its size S) minus the construction cost (C) of a square meter of the specific type of dwelling. The LVs of all the transactions recorded in each statistical area are averaged according to the period in which they were performed: 1998-2008 is the first, and 2009-2018 the second.

The income of households during the years 2008 and 2018, are analysed separately by statistical areas. The yearly average income in each statistical area ($\overline{I_t}$) is divided by the national average income ($\overline{I_{Nac}}$) to calculate the income index (t is 2008 or 2018).

$$I_t = \overline{I_t} / \overline{I_{Nac}} \qquad (2)$$

The variable I_t has a value of 1 if the local average income is exactly equal to the national average income, it is larger than zero and theoretically not bounded from above.

For the calculation of the last two indexes, we aggregate all the households of the country by deciles: 10 mutually exclusive sets containing the lowest 10% of the incomes, then the 10% of the incomes immediately above the former, and so on until the 10% of the highest incomes. Using the national deciles lower, and upper-income values, we count, in each statistical area, the number of households that belong to each decile. Using his data, we calculate the Lorentz curve and then the Gini index (G_t) for each statistical area (t is, again, 2008 or 2018). By definition $0 \le G_t \le 1$, and the larger G_t, the more unequal is the statistical area.

Finally, using the same data, we calculate a socio-economic segregation index based on the segregation entropy index (Forest, 2005), defined by the following expression:

$$h_t = -\sum_{j=1}^{k} \left(p_{tj} \cdot \ln(p_{tj}) \right) \qquad (3)$$

Variable k in expression (3) is the number of social groups, in our case, since we use income deciles, k=10. p_{tj} is the number of households that belong to decile j at time t (2008 or 2018). If the population is distributed equally among the deciles (no segregation at all), then $h = \ln(10) \approx 2.302$. In case of maximal segregation (i.e., all the population belongs to a single decile), $h = 0$.

Summarizing, for each one of the 389 statistical area, and for each one of the years 2008 and 2018, we have the following measures:

(1) The average land value resulting from a previous decade of real-estate transactions. This land value is a measure of the perceived locational qualities of the specific place. Increasing land values means that the place is being highly valued as time passes. Decreasing land values signals the deterioration of the place over time.

(2) The income index that measures how the statistical area compares, in terms of the average household's income, with the national average household's income. A statistical area in which the income index rise, becomes richer compared with the national income average. The opposite implies that the statistical area is becoming, on average, poorer.

(3) The Gini index, that measures socio-economic inequality within the statistical area. An increasing Gini index means an increasingly unequal area.

(4) The segregation index that is an indication of the socio-economic homogeneity or the statistical area. If the area becomes more homogeneous, the segregation index decline. On the opposite, a higher segregation index over time indicates that more deciles are represented in the area, and hence it is becoming more heterogeneous.

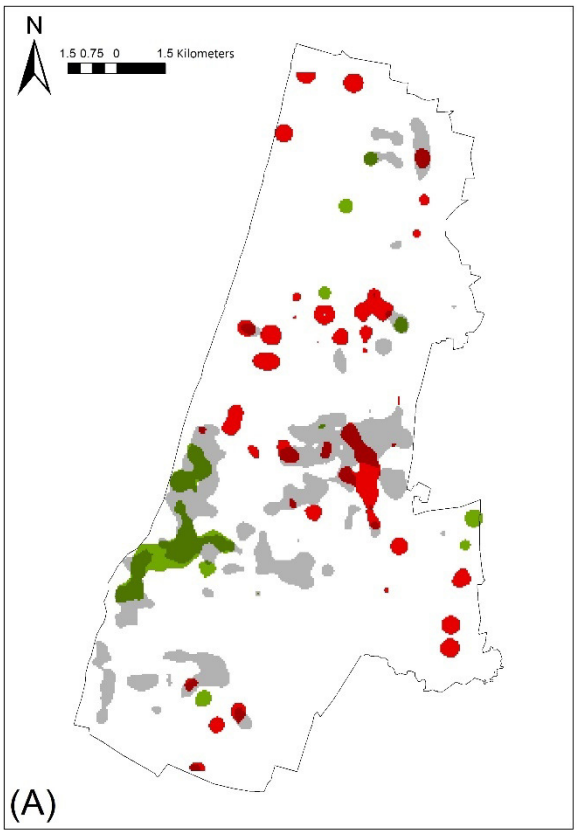
It is important to stress that, although the last three indexes were calculated using the same income data, they measure different phenomena and are not necessarily correlated among them. For example, a place may become richer on average over time (indicated by a rising income index) but this process does not say anything about the equality or inequality or the area (i.e., the Gini index). Similarly, it does not offer any clue about the level of social homogeneity (the segregation index). But the correlation between the Gini index and the segregation index, also, is far from being unequivocal: Although perfect equality ($G_t = 0$) implies perfect homogeneity ($h_t = \ln 10$), but the same change in the Gini index can be achieved by different changes of population composition between the deciles.

To assess the dynamics of the social landscape of the urban area, we calculate the differences between the values of all the four indexes between 2018 and 2008. But each of these index differences is defined for a specific statistical area represented spatially by a point, as shown in Figure 1 (right). In order to create a continuous surface all over the urban area, reflecting each one of the differences in the indexes, we use a non-

parametric procedure for extrapolating data called kernel density (KD) (Carlos *et al.*, 2010). Once the KD surfaces for each one of the four indexes are calculated, areas in which the indexes have increased or decreased over time are clearly delineated. The superposition of these increasing/decreasing zones is what allows for the description of the dynamics of the social landscape all over the urban area.

4. Results

The four indexes defined previously imply that a specific point in the urban area may have experienced an increase, no change, or decrease, regarding each one of them, potentially depicting twelve different trajectories over time. A full description of the social landscapes along all the possible trajectories, although possible, would be tedious. In addition, not all these trajectories are equally interesting. Therefore, we choose to describe one of the most fruitful subsets of trajectories: We focus on places where the land value had increased during the studied period and ask what happened in these places in relation to average income, inequality, and segregation. The results are graphically summarized in Figure 3. The grey areas shown in the maps are locations in which the land value has increased in 2018 compared in 2008. In other words, these are the locations in which people are increasingly willing to pay to live there, because of visible or invisible advantages of that specific place.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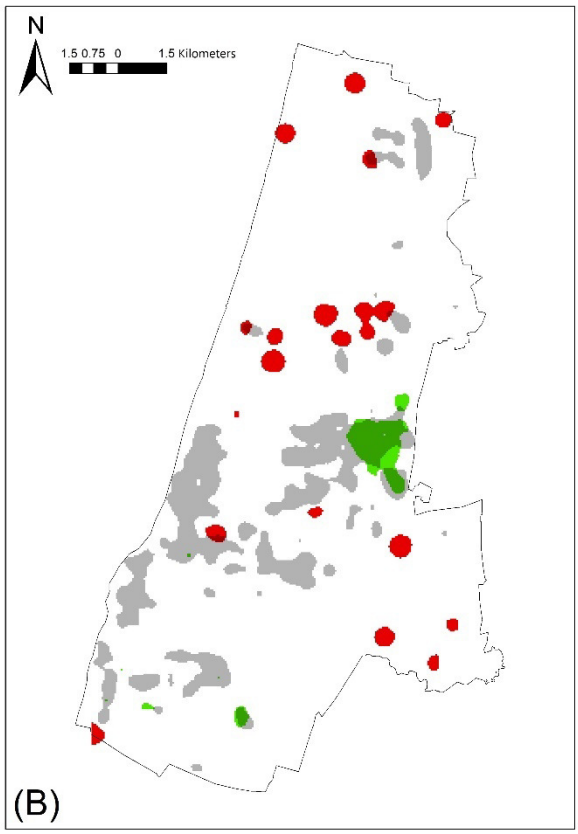
(A)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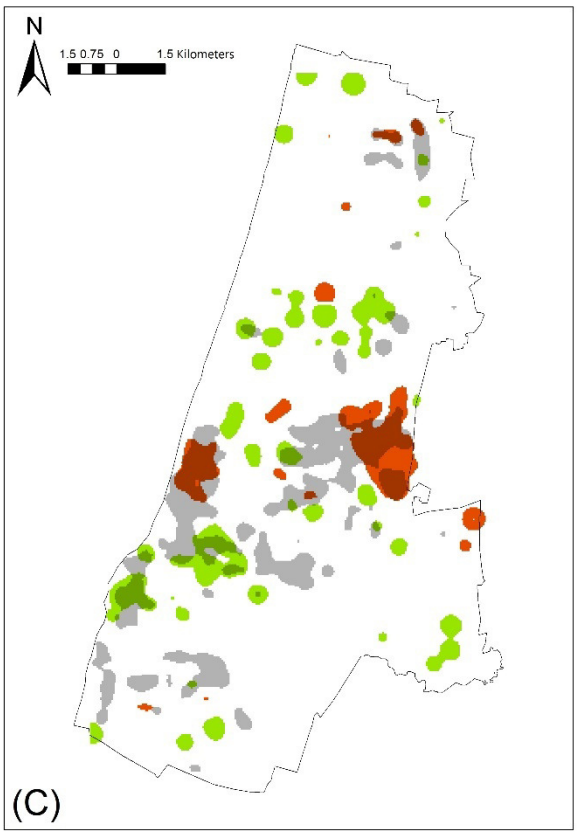
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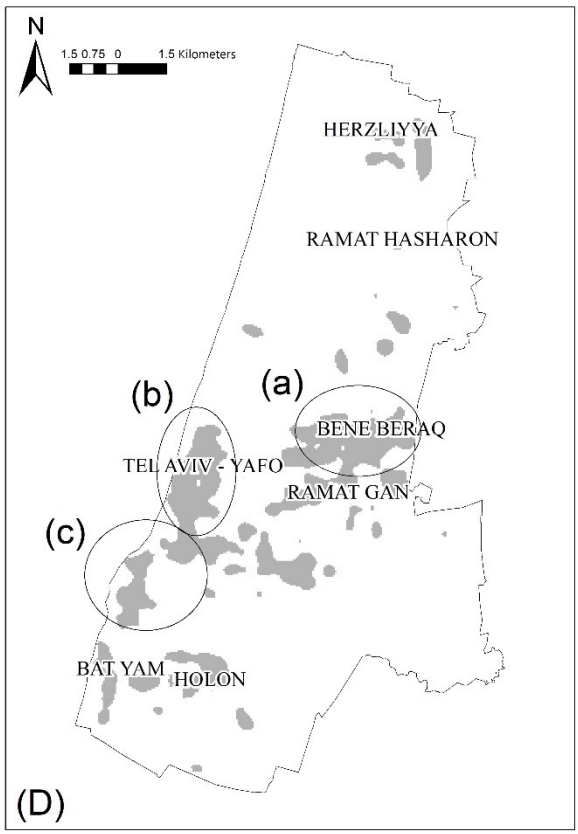
(C)


N
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HERZLIYYA
RAMAT HASHARON
(b)
(a)
BENE BERAQ
TEL AVIV - YAFO
RAMAT GAN
(c)
BAT YAM
HOLON
(D)

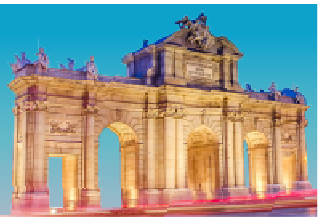
Figure 3: The dynamics of the social landscapes in the Tel Aviv district area. On all the maps, grey areas show places in which land values increased over time. (A) Increasing income index in green, decreasing in red. (B) Decreasing Gini index in green, increasing in red. (C) Increasing segregation index in green, decreasing in red. (D) Locations of complex dynamics of the social landscape.

But raising land values do not necessarily implies also rising incomes, as it can be seen in Figure 3A. There are, indeed, places in which both processes are correlated (green spots on the top of the grey areas near the coast), but in other places the average income decrease (red spots located in the east of the urban area). In Figure 3B inequality raises mostly in places where land values did not increase (small red dots all over the area), but there is a notable exception of decreasing inequality (in green) in an area with rising land values. Figure 3C shows the dynamics of socio-economic segregation in the urban area. There are two large red spots that coincide with raising land value areas: This indicates homogenisation processes (i.e., more segregation). There are also small green spots spread all over: Most of them do not coincide with raising land value areas, except for two, located in the south of the western red spot. Finally, figure 3D shows the areas in which the land value had increased, with the names of the cities to which these areas belong.

The two immediate conclusions can be drawn from Figure 3: First, that the social landscape dynamics are not simple, neither obvious. Second, that the fact that an area is being increasingly appreciated (as evidenced by higher land prices), can be related to several and contradictory social dynamics. Average income, inequality and segregation dynamics behave unalike in different areas, despite the common rising land value trends. Possible reasons and implications of the results are discussed in the next section.

5. Discussion

From Figure 3 we learn that, if we restrict the discussion about the social landscape of the Tel Aviv district during 2008-2018, to places with increasing land areas, there are three main outstanding locations worth to be discussed, marked in Figure 3D.



The first coincide roughly with the city of Bene-Beraq (ellipse "a" in Figure 3D). Several seemingly contradictory processes have taken place in this area. In parallel with increasing land values, the average income has decreased, while there is less inequality and a more homogeneous population (as evidenced by Figures 3A, 3B and 3C respectively). The main contradiction is, at first sight, the coexistence of higher land values with lower average incomes over time. This can be explained by the specific characteristics of the Bene-Beraq city: Together with certain neighbourhoods in Jerusalem, the city hosts the most established ultra-orthodox Jewish community in modern Israel (Malach, G. and Cahaner, L., 2020). This community has a strong sense of religious identity that leads it to protect itself from the surrounding secular influence (Cahaner, 2012), a tendency that defines clear urban geographical boundaries (Valins, 2003). A high population growth rate and a widespread reliance on an internal community welfare system, instead of the national social security, are two additional and relevant characteristics of this community (Malach, G. and Cahaner, L., 2020). Rising land values can be expected in this city that is already crowded and continuously growing in population, but still offers the benefits of a vibrant and alike religious and cultural community. Decreasing average incomes is also reasonable in a community that privileges long-life intellectual studies (often supported by community welfare) over career development and personal enrichment (Malach, G. and Cahaner, L., 2020). Increasing socio-economic homogeneity and equality are natural consequences of these trends and can be also explained by cultural and religious affinities.

The second outstanding location is the centre of the Tel Aviv city (ellipse "b" in Figure 3D). Tel Aviv is the largest and central city in the whole urban area, and is considered a "superstar" city, characterized, among other things, by rampant house price growth (Ben-Shahar, Gabriel and Golan, 2020). Tel Aviv is also considered a secular, multi-cultural and globally open city (Alfasi and Fenster, 2005). According to Figure 3B, there was no significant change in the inequality level in Tel Aviv during 2008-2018 (neither red nor green spots over the grey area). But along with the rising land values, also the average income increased (Figure 3A) and the city is losing its socio-economic heterogeneity (Figure 3C). The observed trends fits nicely with the predominant urban narratives about the city centre as a place that only a few, generally high-tech and

globally oriented workers, can afford to live (Kipnis, 2004; Frenkel, Bendit and Kaplan, 2013).

The third location is located very close geographically, in the south of the previous one (ellipse "c" in Figure 3D). Formally, this area is part of the same municipality (Tel Aviv-Jaffa), but it has very different characteristics compared with the city centre. Originally, Tel Aviv was founded in 1909 as a small Jewish suburb of Jaffa, that was the main city in the area, populated mainly by Arabs. Throughout the turbulent story of the Israeli-Palestinian conflict, Jaffa becomes a neighbourhood of Tel Aviv when it developed into a big city (Schipper, 2015). In the last decades, Jaffa has experienced the processes of gentrification traversed not only by the implementation of neo-liberal policies, but also by several ethnic struggles (Schipper, 2015; Sa'di-Ibraheem, 2020). Therefore, rising land values are expected in the area. The Gini index of inequality remained stable during the last decade as evidenced by Figure 3B (no green or red spots). But there is an increase in the average income and heterogeneity (Figures 3A and 3C, respectively). It seems that the income and segregation indexes reflect, indeed, on-going and contested gentrification processes: On one hand, more affluent dwellers are moving to the new real-estate enterprises developed in the area. On the other, the influx of new (and probably affluent) population makes the socio-economic composition more heterogeneous. But these processes are also being actively resisted by the dwellers of the gentrifying neighbourhoods (Sa'di-Ibraheem, 2020), so a the social landscape in the area seems to be unstable.

Possible explanations for the observed processes in the three selected urban areas were elaborated only after the social landscape emerged through the application of the suggested methodology to the urban area. The main goal of the methodology is, precisely, to depict the social landscape using exclusively the location and the values of the data required for the calculation. The method itself is totally blind regarding any additional social, historical, cultural, ethnic, or economic aspects. In other words, there is no need to know the urban area under scrutiny to depict the social landscape. The suggested methodology is intended to highlight geographical areas of interest for further inquiry. The discussion of the areas of interest that emerged using the methodology in the Tel Aviv district test case, demonstrates that the multi-scale social landscape is able

to identify places worth to be further analysed, offering a new tool to investigate complex urban dynamics.

6. Conclusion

Using detailed income data and real-estate transactions aggregated at the level of neighbourhoods, we developed a well-defined methodology able to describe the spatiotemporal dynamics of social landscapes in urban areas. Assessing the attraction of urban locations over time, along with income, inequality and segregation indexes, the changing spatial configurations of the urban space emerge and can be easily mapped.

Using the Tel Aviv district as a case study, we applied the methodology to depict and compare the social landscape in 2008 and 2018. The obtained temporal dynamics demonstrate that the social landscape described by the four indexes is far from being obvious. In addition, the comparison of the social landscape over time is a suitable tool to highlight both expected processes, as well as counterintuitive dynamics. This is the main goal of the methodology: To mark clearly urban areas that are worth to be further analysed, whether because they show the expected dynamics, or precisely because the obtained results are at odds with the expectations. Only an ex-post analysis based on local knowledge about the specific characteristics of the study area (historical, sociological, political, etc.) would be able, perhaps, to explain the observed social landscape patterns over time.

The suggested methodology can be used pursuing prospective or descriptive goals. A prospective goal is to identify urban areas in which a specific phenomenon takes place (for example, identifying urban areas in which gentrification processes are starting). If it is possible to define how the phenomenon is likely to be expressed by the dynamics of land values, average incomes, inequality, and segregation (or a subset of these), the suspected patterns can be easily identified and located. A descriptive goal, in comparison, does not need to define in advance what is being looked for, but aims at the identification of areas in which potentially interesting socio-economic urban phenomena are observed.

In our view, the lack of contextual data about the urban area is an advantage of the methodology. It allows its use for any city or urban region for which the required data

are available. The explicit objective of the method is to identify areas of interest and generate further questions about the social, geographical, economic, and historical drivers behind the observed social landscape dynamics. The implemented bottom-up approach using exclusively hard-data, has the potential to allow the identification of new urban phenomena. In other words, the suggested method is a possible complement to urban sociological studies focused in advance on specific areas or population groups.

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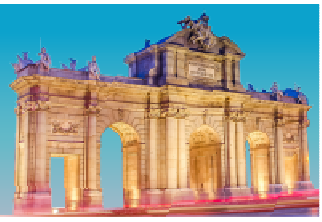

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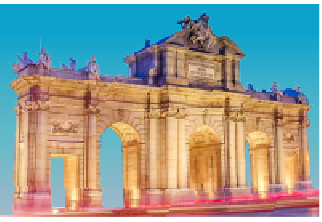

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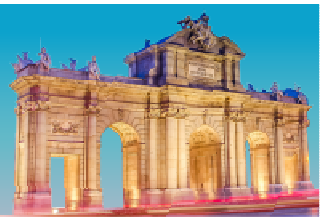

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