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Understanding changes in the geography of opportunity over time: The case of Santiago, Chile

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ABSTRACT

The geography of opportunity research has made significant progress in recent years. The use of composite indexes aimed at capturing the attributes of different urban areas has been particularly useful to deepen the understanding of the role that the urban context plays in people's life chances. However, little attention has been paid to the dynamic component of the geography of opportunity, that is, what explains its changes over time and whether or not those changes (positive or negative) are substantial.

The contribution of this work is that it offers a methodology (a conceptual framework, a composite geography of opportunity index and relative and absolute measures) that provides a holistic and in-depth approach to analyse not only the set of opportunities available in the different urban areas but also their change over time (how they change, the depth of those changes and the forces explaining it). The information generated through this approach has the advantage of better informing place-based policy interventions since it offers not only a clear classification of areas but also a useful method for comparing and monitoring the changes in the geography of opportunity over time.

1. Introduction

The geography of opportunity (GO) refers primarily to those structural attributes (social, economic, environmental and cultural) of a neighbourhood or larger area that affect people's life chances above and beyond their individual characteristics. Understanding the disparity in the distribution of opportunities across a city is relevant to the extent that residential mobility is constrained and frequently opportunities within cities are unevenly distributed (Galster, 2019; Galster and Killen, 1995; Ihlanfeldt, 1999; Rosenbaum, 1995). Several pieces of research have described the geography of opportunity in metropolitan areas using multidimensional indexes (Iceland, 1997; Lens, 2017; McClure, 2010, 2011; Wilson & Greenlee, 2016). However, we identify two gaps in the existing literature. First, little attention has been paid to the dynamic component of the GO and its mechanisms of change. That is, to understand how the GO changes over time, the mechanisms explaining such changes, as well as the depth of those changes. Second, there is a lack of research on the GO in the less developed regions. The great bulk of the research on this topic has been generated in cities in the developed world (Friedrichs, Galster, & Musterd, 2003, 2005; Galster, 2019). Yet, the conceptual framework that the literature on the geography of opportunity offers is particularly relevant to cities in less developed regions that show a high imbalance in the distribution of opportunities, as is the case of many metropolitan areas in Latin America and other regions in the Global South.

This paper proposes a dynamic approach to the GO conceptualization and methodology (that includes relative and absolute measurement) to address the gaps we identified in the literature that offers mostly static analyses of the GO. The following four points summarise the contributions of the work we present here. First, it considers urban and institutional dynamics (the land market activity and municipal fiscal capacity), enabling not only to portray the set of opportunities available in an urban area but also to understand the drivers of the GO's change over time. Second, by using both relative and absolute measures, it offers a novel way to measure changes in the GO that account for the depth of the changes, allowing discriminating between mere versus meaningful changes in the GO. Third, it expands the GO framework's scope and applicability, by applying it in an urban context outside the north-western world where it has been primarily studied. Fourth, from a policy perspective, the information generated through this approach has the advantage of better informing place-based policy interventions since it offers a precise classification of areas and a useful method for

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comparing and monitoring the GO's changes over time.

Additionally, we provide evidence on the relevance of considering the municipal scale to complement the neighbourhood scale analysis. Unlike cities in the developed world where the municipal scale shows relatively low relevance in explaining people's income mobility (see Andersson & Musterd, 2010), in cities in less developed regions, where the welfare system is particularly weak, the differences in public and private services and institutional supply vary significantly between municipalities. We also discuss the relevance of specific dimensions of the GO that show different outcomes compared to evidence obtained from cities in developed regions. For instance, evidence on the relevance of having good access to local employment appears significant in less developed countries (Boisjoly et al., 2017; Hernandez et al., 2020), whereas evidence from cities in developed regions is not conclusive (Fan, 2012; Hu, 2017a; Korsu & Wenglenski, 2010; Sanchez et al., 2004; Shen, 1998).

The methodology proposed here is implemented for Santiago Metropolitan Area (SMA) in Chile. It considers the municipal and neighbourhood scales. The geography of opportunity is measured through a GO index based on three composite sub-indices comprising a set of 26 variables obtained from different data sources covering a time frame of 10 years.

The article is organised in the following sections. First, we review the key works on the concept of the geography of opportunity and the different methodological approaches to measuring it. Second, we present the conceptual framework we propose for measuring the GO. Third, we describe the research design, introduce the city of Santiago in Chile as a case study, the data sources and the indices that derive from the conceptual framework. Fourth, we present the main results obtained at the municipal and neighbourhood scale. Fifth, we discuss the contribution of the conceptual framework, the methodology proposed and its implications for urban policy design.

2. Literature review

2.1. Geography of opportunity, income dynamics and policy relevance

The starting point of the conceptualization of the geography of opportunity is the concept of 'neighbourhood effect', which refers to the idea that poor neighbourhoods have a negative impact on people's life chances above and beyond the effects of their individual characteristics (Fisher & Weber, 2004; Sampson et al., 2002; Sampson & Raudenbush, 1999; van Ham et al., 2012; Wacquant & Wilson, 1989). Wilson (1987) raised the problem that structural changes, primarily related to a mismatch between the place of residence and job location and the departure of middle-income households from poor neighbourhoods, were translating into structural disadvantages due to the extreme concentration of poverty and racial segregation in the inner areas of cities in the U.S. The specific assumption is that exogenous structural factors contribute to the likelihood of low-income households experiencing upward income mobility (Iceland, 1997). The opportunities at the neighbourhood level operate through collective socialization (role and peer model), social control, social capital (supporting networks), access to job opportunities and institutional supply (Andersson & Musterd, 2010; Galster, 2012; Sampson et al., 2002).

Based on these studies, Galster and Killen (1995) coined the concept of the geography of opportunity to address the fact that opportunities are distributed spatially and not always in a balanced way. The geography of opportunity refers to the structure of the social, economic, environmental and cultural opportunities faced by different groups that inhabit metropolitan regions (Andersson & Musterd, 2010; Briggs, 2003; Galster & Killen, 1995; Squires & Kubrin, 2005; Wilson & Greenlee, 2016). The disparity in the distribution of opportunities across a city is relevant since residential mobility is constrained. Not everyone can move to where opportunities are, either because of discrimination or because housing is not affordable for them.

The geography of opportunity operates in very different ways at different scales, particularly in metropolitan areas, where the opportunities for socioeconomic mobility are strengthened or deteriorated—due to the concentration of advantages or disadvantages—depending on the place of residence (Andersson & Musterd, 2010). The GO's impact is both objective (access to opportunities and resources) and subjective (perceived structure of opportunities) (Galster, 2012; Galster & Killen, 1995).

Although initial assessments of the neighbourhood effect did not show a significant impact on people's life chances (see Kling, Liebman, & Katz, 2007), new assessments encompassing a longer period of time have shown more robust results (see Rothwell, 2015). Urban environments with greater social diversity and a good set of opportunities have a positive and statistically significant impact on the income mobility and social inclusion of low-income residents (Galster, Andersson, Musterd, & Kauppinen, 2008; Hedman & Galster, 2013). Particularly relevant is the work of Chetty et al. (2014), who measured the intergenerational mobility of parents and children through the use of longitudinal administrative income data for all districts in the United States. Their findings show that intergenerational upward income mobility varies significantly within different areas of the country. Those areas where people experience higher income mobility share the following five distinctive attributes: lower segregation, lower income inequality, better schools, greater social capital, and higher family stability. Furthermore, Eriksen and Ross (2013) show that the social composition in the environment in which housing is located is by no means trivial. Since the effect of poverty concentration is highly non-linear, even a slight reduction in poverty in places where social housing is located can have a strong effect on their residents. This is aligned with the work of Hedman & Galster, 2013, who suggest that reducing the presence of low-income households by one standard deviation and increasing the presence of middle-income households by the same proportion is associated with a 12.6% increase in the income of the low-income households. Conversely, a higher concentration of low-income households may reduce the employment rates and incomes of residents in that same social condition, due to the negative socialization of work, weak supporting networks, and the stigmatization of the area or neighbourhood due to the concentration of poverty.

A key element to consider is that the negative effect that disadvantaged neighbourhoods exert on low-income individuals are much stronger than the positive effects good neighbourhoods exert on low-income individuals (Galster, 2019, pp. 195–196). Regardless of the positive externalities, the most important benefit of good neighbourhoods is that they free the most vulnerable residents from experiencing the actively adverse effects of disadvantaged neighbourhoods.

The results obtained from the most recent research on the geography of opportunity are crucial to justifying policy interventions that promote social diversity and better opportunities where people live. However, the evidence generated is mainly bounded to the urban reality of northwestern cities. Applying the GO framework in other urban contexts and regions in the Global South that face a high imbalance in the distribution of opportunities within cities can help inform policies that could bring about sustainable and equitable development of cities. It can also contribute to the development of the GO framework since it would enable identifying the GO components or variables that are more relevant in less developed regions as well as the scale(s) that matter in explaining the GO compared to evidence compiled from northern cities.

2.2. Dimensions and urban scales of the geography of opportunity

2.2.1. Multi-dimensional indexes of the GO

The dimensions included in studies addressing the geography of opportunity describe the neighbourhoods' structural characteristics (Lens, 2017). These dimensions are exogenous to individuals, as they relate to larger structural forces (Galster, 2008). Recently there have been interesting and valuable attempts to generate composite indices

that capture the complexity of neighbourhoods' opportunities and enable a benchmark analysis that is useful to monitor and compare different urban areas (Lens, 2017; Lens & Reina, 2016; McClure, 2010, 2011; Walter et al., 2016; Wilson & Greenlee, 2016).

The dimensions of geography of opportunity most frequently found in the literature are i) education related to access to high-performing education and students in poverty (Chetty et al., 2014; Lens, 2017; Wilson & Greenlee, 2016); ii) employment, which includes access to jobs, job density and local economy (number, type and size of firms) (Iceland, 1997; Lens, 2017; Squires & Kubrin, 2005; Wilson & Greenlee, 2016); iii) public safety, including crime exposure (Lens, 2017; Sampson, 2001; Wilson & Greenlee, 2016); iv) housing affordability (Li, 2011; Mulliner et al., 2016; Sampson, 2001); v) local services (including financial services) and public health that includes mental health and life expectancy (Galster, 2008; Squires & Kubrin, 2005; Wilson & Greenlee, 2016), as well as the neighbourhood environment effect on children's development and opportunities (Acevedo-Garcia et al., 2014; Galster, Marcotte, Mandell, Wolman, & Augustine, 2007); vi) social mix related to poverty concentration and the socioeconomic composition of the area (Chetty et al., 2014; Andersson & Musterd, 2010); vii) connectivity that describes the levels of access to employment and service opportunities of households based on indicators such as access to public transport, travel time to work, among others (Guzman et al., 2017; Hu, 2017b; Mayer & Trevien, 2017; Tiznado-Aitken et al., 2016); and viii) urban life that refers to the vitality of an area in terms of its commercial, social and cultural activities that serves the residents and the population from other areas (Squires & Kubrin, 2005).

Despite the progress in the GO measurements, these still provide a static depiction of the GO falling short in their capacity to describe the dynamic component of the GO. Therefore, beyond the description of the GO in different areas, it is critical to advance in understanding how the GO changes over time, what are the mechanisms that explain such changes, and the depth of the changes in the GO.

2.2.2. *The scales of the GO*

A critical aspect to determine when measuring the effects of the geography of opportunity is the urban scale. The neighbourhood effect varies depending on the scales and definitions of urban areas (Galster, 2012; Sampson et al., 2002; van Ham et al., 2012; Wilson & Greenlee, 2016). Galster (2008) and Andersson and Musterd (2010) emphasize the importance of analysing what scale matters to explain the positive or negative effects of the geography of opportunity.

According to Galster (in Friedrichs et al., 2005) there are three scales of the geography of opportunity (GO): first, the neighbourhood scale, in which the differences in the GO occur in peer groups, social organizations and social networks; second, the municipal scale where differences in the GO are expressed in terms of education, health, recreation and safety; and third, the metropolitan scale, where the location of jobs according to type and skills required explains differences in the GO. Andersson and Musterd (2010, p. 40) tested Galster's three GO scales definition in Sweden. The results showed that the neighbourhood scale has a more significant effect on the opportunities faced by individuals compared to the municipal scale. However, according to the authors, given that the welfare state in Sweden guarantees equal access to services and infrastructure (including transport) in all of its districts, it is predictable that the effects at the municipal level will not be significant.

Someway the opposite occurs in cities in Southern regions where the welfare state, housing and public transport policies and the socioeconomic characteristics of the population are different from those generally described in the literature that discusses the GO mainly in cities in the developed world (see Galster, 2001; Galster, Andersson, Musterd, & Kauppinen, 2008; Andersson & Musterd, 2010). This is the case of many cities in Latin America and other regions in the South, where the differences between municipalities are extremely high. This justifies the pertinence of considering the municipal scale together with the neighbourhood scale to adequately capture the GO distribution.

3. A new GO framework: measuring the geography of opportunity from a dynamic perspective

While building upon the existing framework on the geography of opportunity, the methodology we propose here seeks to broaden the understanding of the different aspects that explain the GO by bringing to the analysis urban and institutional dynamics that work as drivers of change in the GO. Thus, besides portraying the set of urban attributes, we analyse the land and real estate market activity and the local government's fiscal capacity. These two institutional actors directly impact the built environment due to their capacity to (re)shape the urban attributes and the opportunities individuals encounter in their place of residence.

The methodology we propose acknowledges that all different urban agents can actively shape the attributes of their places of residence. According to Galster (Galster, 2019, pp. 23–24, 2001, p. 2116), there are four types of urban or neighbourhood actors: households, business people, property owners and the local government, that not only 'consume' places through their actions and decisions (e.g. housing, land, operating business, commercial activities, paying and collecting taxes) but also 'produce' places (e.g. by defining its socio-demographic characteristics, prestige, real estate attributes, type of land use, pollution, accessibility, public services and infrastructure).

Based on this specific approach, we propose to measure the GO through three dimensions that allow us not only to portray the set of opportunities available in a certain area but also to understand the mechanisms of changes in the GO over time. These dimensions are: (i) the municipal fiscal capacity; (ii) the urban land market activity, and (iii) the set urban attributes.

Altogether, these three dimensions enable a more comprehensive analysis of the structural components of the geography of opportunity. The measurement of the municipal fiscal capacity addresses the significant differences in the capacity of local governments to meet the needs of the population. The analysis of the urban land market provides information about the capital flow and investment in a specific area. Both dimensions complement the information provided by the set of urban attributes (amenities, urban infrastructure, social composition and services) that are present in different urban contexts. These three dimensions are mutually affected, as is shown in the flowchart in Fig. 1 below. For instance, the municipal fiscal capacity not only affects the number, type and quality of services and infrastructure available in localities i.e. the urban attributes but also determines the real estate and land market readiness to invest in an area, which at the same time impacts positively on the municipal tax base and revenues and therefore the local government's capacity to provide good quality services.

3.1. *Linkage between the urban land market activity dimension and the GO*

The economic vibrancy of a certain area can be easily derived from the urban land and real estate market activity. An active urban land market not only translates into a significant flow of capital into certain urban areas but is also linked to a boost in activities being hosted by the new buildings developed.

The linkage between the land and real estate market and the geography of opportunities lies in the fact that both are described and valued by assessing multiple location attributes. In the case of land and real estate, the assessment of a location's attributes results in a price/value ascribed to a specific piece of land or building. In the case of the GO, the assessment of a location's attributes describes the level of opportunities that individuals encounter in the surrounding area where they live. These attributes take a relative value as they are built based on a comparison with attributes in similar or competing areas (Galster, 2019, 2001). Therefore, the attributes of a specific area can take the form of either a price when it comes to the appraisal of the property and/or a set of opportunities for those living in that same area. The better the

geography of opportunity (which is given by the type of regulations, amenities, public infrastructure and the economic and social forces in the area), the higher the land price. Conversely, areas with poor geography of opportunity have lower property prices.

3.2. Linkage between the local government fiscal capacity dimension and the GO

Investment and service provision by local governments directly impact the quality of life and the opportunities that residents have access to (Galster, 2019, p. 184). Municipal revenues are generally split between centrally transferred funds and locally collected funds, mainly through licenses fees and property taxes. Normally, revenues from central government branches are ear-marked, which does not allow much room for manoeuvre for municipalities to prioritize certain activities, populations or areas. Conversely, municipal revenues have the potential to make a difference in terms of municipal investment and proactive actions taken by local authorities to better serve the population (Ingram et al., 2010; Krueathep, 2010).

The quality of the urban equipment and facilities, such as sport fields and green areas, roads, open spaces, and public buildings (e.g. libraries, community centres) as well as of the services (e.g. education, health, surveillance, waste collection, cultural offers, job training), varies according to the economic activities and population that local governments host, since they determine the local tax base. Hence, poor areas with a weaker tax base are likely to show a more limited service structure and low-quality facilities, offering fewer opportunities to residents. Massey and Denton (1993) exposed the vicious circle that affects deprived areas with a high concentration of poor population negatively impacting the municipal tax base, which in turn translates not only into the provision of fewer and lower quality services, but also to the further loss of well-off population, who move to better-served areas, reinforcing the process of decline in the opportunities available in the area.

3.3. Linkage between the urban attributes dimension and the GO

There is an increasing trend of measuring neighbourhood opportunities using a more holistic approach where the neighbourhood's different attributes are compiled into one index (Acevedo-Garcia et al., 2020; Lens & Reina, 2016; Reece et al., n.d; Wilson & Greenlee, 2016). Lens' (2017, p. 14) approach to measuring the geography of opportunity is of particular interest since it focuses on the assets and opportunities in places rather than the disadvantages and elements of neighbourhood distress—as is commonly presented in studies addressing the neighbourhood effect. Accordingly, McClure (2010, p. 107) states that neighbourhoods with a high level of opportunities are those that offer access to good jobs, good schools, and good affordable housing and are free of crime. The main idea behind this is that poverty clustering analysis is not enough (McClure, 2011).

Adding to this approach, the underlying assumption behind the urban attributes sub-index we propose is that the multiple features of an urban area have a combined effect on the residents' life chances. Some of these attributes can have an adverse impact on the geography of opportunity (e.g., high poverty rate, high crime levels, lack of green areas). Instead, other characteristics can positively contribute to the geography of opportunity (e.g., having access to functional connectivity, good educational establishments, a good network of medical centres and hospitals.

Unlike what is usually seen in similar studies that aim to obtain a smaller number of variables that explain the index variability, excluding some of the attributes that are correlated, we generate a comprehensive index of urban attributes, identifying those that have the most significant impact on people's life chances, combining and visualizing them altogether. The reason for doing so is that, although the variables we have selected can correlate, each one contributes through a specific mechanism to the geography of opportunity. Hence, there is no double counting. Each variable adds to the GO description differently regardless of whether they are correlated. Furthermore, in some cases correcting for a correlation between the dimensions of an index can be inappropriate since the correlation between some dimensions is essential to the phenomenon itself (this is also the case for other multidimensional phenomena such as wellbeing - for a more detailed discussion on this see Decancq & Lugo, 2013).

A comprehensive index of the urban attributes enables getting a clear picture of each of its variables' relative contribution (positive or negative), whether at the municipal level or the neighbourhood level. The dimensions included in the index of urban attributes we propose are the following seven: i) connectivity; ii) employment; iii) health and environment; iv) education; v) urban life; vi) safety; vii) neighbourhood social mix. These attributes allow identifying areas that offer more or less access to services, infrastructure and other social and urban attributes that affect individuals and households' life chances. Table 1

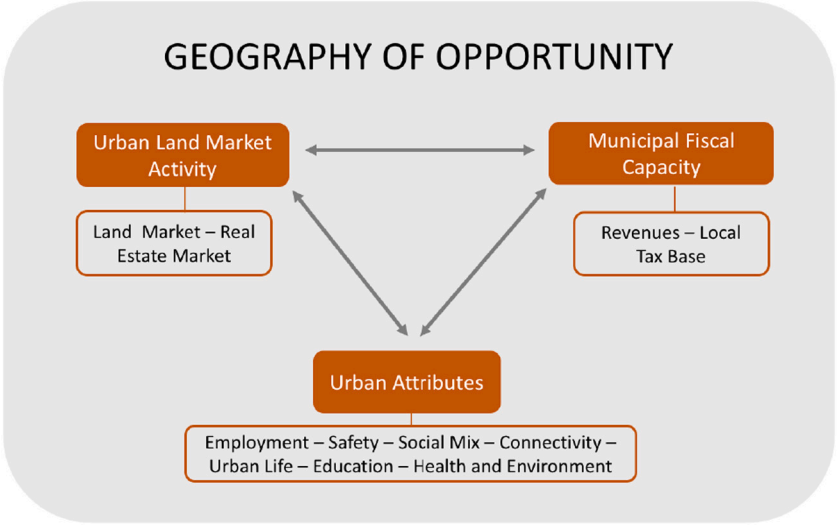

Fig. 1. Conceptual framework for measuring the GO.

Table 1
Contribution of each urban attribute to individuals' opportunities.

Urban Attribute Dimension	Effect on individuals' opportunities	Evidence in the literature
i) Connectivity		
	- Good connectivity improves access to jobs and services. - Poor public transport network negatively affects low-income households who are heavily reliant on this type of transport.	Carruthers et al., 2005; Cervero, 2013; Guzman et al., 2017; Hernandez & Titheridge, 2016.
ii) Employment		
	- Higher unemployment in the area is associated with lower chances of being employed (e.g. less efficacy of social networks). - Higher local job accessibility (jobs propinquity*) increases the chances of being employed (particularly for women and the youth) and shortens the time unemployed. - Lower accessibility to jobs increases the cost of finding a job (time and monetary cost) which also decreases the motivation to keep searching. - High unemployment in the area generates other negative externalities such as poor health and higher crime rates	Andersson et al., 2018; Andresen, 2012; Boisjoly et al., 2017; Brueckner & Zenou, 2003; Cervero, 2013; Dawkins et al., 2005; Dujardin & Goffette-Nagot, 2010; Gobillon et al., 2007; Hernandez et al., 2020; Hernandez & Titheridge, 2016; Hess, 2005; Ihlanfeldt, 1999; Johnson, 2006; Korsu & Wenglenski, 2010; Mejía-Dorantes & Soto Villagrán, 2020; Phillips, 2014; Plum & Knies, 2015; Priya Uteng & Turner, 2019; Sampson, 2012; Turner & Fouracre, 1995.
iii) Health and environment		
	- Unequal access to health services in different urban areas directly affects the health of the population. Low access to health services is associated with higher newborn mortality, lower rates of population vaccinated, complications of common or easily preventable diseases, and delay in the diagnosis conditions such as cancer. - Proximity to open and safe green areas prevents social isolation and promotes physical activity.	Abercrombie et al., 2008; Acevedo-Garcia et al., 2014; Babey et al., 2008; Cummins et al., 2007; Galster et al., 2007; Havard et al., 2008; Squires, Kubrin, 2005; Su et al., 2017; Wang, 2012; Weng et al., 2017.
iv) Education		
	- Access to high-preforming schools is associated with higher rates of income mobility (intergenerational) and higher rates of school attendance in young children. - Living in neighbourhoods where a high percentage of adults have college degrees gives students better expectations of their education and future work, network of contacts to obtain better jobs and reinforce the perception that education is the way to obtain stable employment and thus ensure greater well-being in the future - There is a strong correlation between concentrated school poverty and poor performance. - Schools with a high proportion of poor students show strong correlation with low attainment and tend to have less qualified teachers, with less experience and greater instability.	Boger, 2005; Chetty, Hendren, Kline, & Saez, 2014; Crowder & South, 2011; Horn et al., 2014; Lupton, 2004; Orfield & Lee, 2005.
v) Urban life		
	- Availability of public and private services and entertainment facilities in the neighbourhood reduces costs of living for low income households (affordable living); and improves integration to the rest of the city for it attracts people from other areas.	Mulliner et al., 2016, 2013; Squires & Kubrin, 2005.
vi) Safety		
	- Lower exposure to crime (safer neighbourhoods) is correlated with reduced stress and better mental health of residents and better school attainment of children. - High exposure to crime relates to lower cognitive skills in children, mental health problems and low community cooperation.	Katz et al., 2008; Kling, Liebman, & Katz, 2007; Lens et al., 2011; Sampson, 2001, 2012; Sharkey, Tirado-Strayer, Papachristos, Raver, 2012a; Stal & Zuberi, 2010.
vii) Neighbourhood Social Mix		
	- Physically segregated and socially homogenous in low income neighbourhoods are associated with lower mental health, antisocial behaviour, substance abuse, lower school attainment, lower labour participation in teenagers, and stigmatization. - Mixed neighbourhoods are associated with lower rates of teen pregnancy, higher school graduation rates, higher rate of employment and higher earnings in young adults (intra and intergenerational).	Chetty et al., 2016; Chetty, Hendren, Kline, & Saez, 2014; Friedrichs et al., 2005; Galster, 2001, 2012; Galster et al., 2008; Hedman & Galster, 2013; Wacquant, 2016; Wacquant & Wilson, 1989.

Note: * Jobs propinquity is a phenomenon relevant for large metropolitan areas (above 1.5 million population), which is a common feature of cities in Latin America and other regions in the Global South.

summarizes the contribution of each attribute to people's opportunities found in the literature.

Here we discuss the first two urban attributes: connectivity and employment opportunities since they are particularly relevant in the Latin American context where households' economic well-being is primarily explained by earned income. This because the social security systems fail to provide basic social and income security to households (Levy, 2019; Lustig, 2017). Evidence collected on these two attributes in Latin American cities shows some differences compared to evidence compiled from north-western cities (Appendix I provides further details on the urban attributes included in the index).

3.3.1. Accessibility and employment: principles, methods and findings

Proximity to opportunities has become crucial to evaluate the role of transport and land-use systems in social exclusion and equity (e.g. Banister, 2018; Lucas, 2012; Martens, 2016). Since the primary source of households' well-being and most prominent non-home destination is work, a substantial number of empirical studies have attempted to explain how jobs accessibility from the place of residence may affect employment status and earnings. Underpinning most of these studies is

the spatial mismatch hypothesis, SMH (Kain, 1968) that says the distance between the place of residence and jobs location affects employment.[1]

Several mechanisms support this hypothesis. Those searching for a job in an area with high access to local employment have more opportunities to find a job, shortening their period unemployed (Hess, 2005; Korsu & Wenglenski, 2010). Conversely, those searching for a job in areas with low access to local employment face higher costs (time and money) in the process as they have to travel longer distances. When job search costs increase, motivation to find a job opportunity decreases (Gobillon et al., 2007; Phillips, 2014); further, if the salary offered does not compensate for the travel cost the unemployed may be discouraged to accept the job (Brueckner & Zenou, 2003). The indicators most frequently used in the accessibility-based approach to analyse access to employment, education and service opportunities are proximity to public transport, car use, and travel time (e.g. Bissonnette et al., 2012; Grengs, 2015; Levinson, 1998; Shen, 2000).[2]

However, determining the causality of jobs accessibility in urban labour markets outcomes presents significant challenges.[3] Thus, it is not surprising that studies in cities in the United States and Europe that have empirically tested SMH (including the relative importance of its mechanisms and barriers) have found mixed results.

Nevertheless, recent research that has taken these difficulties into account provide strong evidence supporting the causal effect of poor job accessibility in worsening job market outcomes (Andersson et al., 2018; Dawkins et al., 2005; Johnson, 2006; Korsu & Wenglenski, 2010). Additionally, the neighbourhood effect literature shows that living in neighbourhoods with higher unemployment increases the risk of being unemployed in the future, compared to living in an area with lower unemployment rates (e.g. Dujardin & Goffette-Nagot, 2010; Plum & Knies, 2015). This trend prevails even when controlling for spatial mismatch (Sari, 2012). Also, areas of high unemployment generate other negative externalities such as poor health and disease (MacKay & Davies, 2008), and higher crime rates (Andresen, 2012).

3.3.2. *Accessibility and employment in Latin American cities*

Evidence from research on job accessibility in Latin America supports the SMH (Boisjoly et al., 2017; Hernandez et al., 2020). In the city of San Pablo in Brazil, for the low-income population, better job accessibility reduces the probability of having an informal job (Boisjoly et al., 2017). In the city of Montevideo in Uruguay, high job accessibility is associated with a lower probability of being unemployed (Hernandez et al., 2020). In the Latin-American region, where the stratification of access to opportunities is rather socioeconomic than by race or ethnicity, two main reasons explain why the geographic separation of workers and jobs harms employment outcomes. First, in general, the most vulnerable urban population in cities in Latin America live far from employment centres; they concentrate in the cities' outskirts, while urban jobs opportunities are mostly located in the central area of cities (Rodriguez, 2016). Second, the urban poor travel long distances and are held captive of inefficient and weak public transport systems (Cervero, 2013; Hernandez & Titheridge, 2016)) affecting their access to jobs and other economic opportunities (Carruthers et al., 2005; Guzman & Bocarejo, 2017), particularly for women who, on average, tend to work closer to home (Mejía-Dorantes & Soto Villagrán, 2020; Priya Uteng & Turner, 2019; Turner & Fouracre, 1995).

Based on the evidence discussed, for the connectivity dimension, we use i) travel time to work, ii) access to cars and iii) access to public transport, which are variables commonly used in studies that measure accessibility to jobs and other services (e.g. Guzman et al., 2017). To build the employment dimension, we use i) the number of firms in the local area, ii) the employment competition (the relationship between the workforce living in the area and the number of jobs offered in that area, and iii) the unemployment rate in the local area.

In general terms, the geography of opportunity framework we propose not only integrates the analytical advantages of the accessibility-based approach by considering connectivity as a dimension of the urban attributes of the place of residence but also brings accessibility into a broader set of urban attributes, which includes local employment indicators in the area. The advantage of this methodological decision, is that it can inform different sets of policies aimed at improving the opportunities available in an area beyond the planning of transport in the city, such as municipal fiscal policies, crime prevention strategies, tax exemptions/incentives for job creation in the area, quality of health services improvement, among others.

4. Research design

4.1. *The case study: Santiago's Metropolitan Area in Chile (SMA)*

Santiago is the capital of Chile and the most densely populated city in the country, concentrating 40.5% of the population (7 million according to the latest Census in 2017). It is located in the country's geographic centre, in a landlocked area near the Andes mountain chain. Santiago is the political, financial, educational and cultural centre of the country. It concentrates all the national government's main agencies and the financial and business headquarters of both national and international companies. It also hosts the largest proportion of universities (a total of 36 universities, accounting for 59% of the universities in Chile) as well as cultural centres.

In the SMA, poverty significantly reduced from 42.6% to 7.7% between 1990 and 2015. However, behind these macro changes, the net changes showing a high vulnerability to poverty remain hidden. According to the Chilean longitudinal survey PCASEN 2006–2009, 45.7% of the Chilean population experienced poverty during at least one year, which shows high mobility in and out of poverty (Maldonado and Prieto, 2015). In the SMA, 33% of the population fits into the category of vulnerable to poverty based on the CASEN 2015.[4]

This significant poverty reduction, and high vulnerability to poverty, did not occur in a neutral urban context. The SMA shows marked differences in the distribution of opportunities and resources across the city. Urban infrastructure, public and private services (health, education, commerce), public amenities, job places and crime incidence, among others, are radically different between municipal districts (Garreton, 2017).

As discussed in Section 3, accessing to stable and well-paid jobs is related not only to connectivity (e.g. Guzman et al., 2017) but also social networks to find employment (e.g. Miltenburg & van de Werfhorst, 2017) and the interaction between labour skills and work (e.g. Valiente et al., 2020). In the case of Santiago, high levels of labour polarization

[1] Kain (1968) argued that the Afro-American community living in inner cities faced persistent unemployment due to the suburbanisation of jobs together with the inability of this community to relocate near where jobs were being created.

[2] Since Hansen (1959, p. 73) defined accessibility as the potential of opportunities for interaction, the accessibility-based approaches have generated several new definitions and measurements, without reaching a consensus (El-Geneidy & Levinson, 2006; Páez et al., 2012).

[3] This type of analysis face three difficulties. First, the employment barriers to taking advantage of the proximity of job opportunities (Fan, 2012; Sanchez et al., 2004). For example, the employment competition, that is the rate of jobs offered over the labour force in the area (Merlin & Hu, 2017; Shen, 1998) and the lack of the skills required for the positions offered (Houston, 2005; Stoll, 2005). Second, the poor access to adequate microdata to identify endogenous scenarios such as the residential location that would enable making a direct link between accessibility issues and the individual employment outcome (Hu, 2017b; Korsu & Wenglenski, 2010). Third, there is a methodological problem. Findings on local job accessibility vary significantly depending on the method used (Bunel & Tovar, 2014; Ihlanfeldt & Sjoquist, 1998; Kain, 1992).

[4] Data from Ministry of Social Development (MDS, 2015).

Table 2
Top and bottom 3 municipalities of SMA based on social indicators.

Municipal districts	Poverty (%) *	Housing (%) with tax abatements**	Municipal schools scoring equal or over 450 points in PSU (%) ***	Municipal revenue per capita (US$)
Top 3				
Vitacura	0.3	0.4	86.8	818.1
Las Condes	1.3	1.7	72.6	713.1
Providencia	3.1	2.9	93.2	673.0
Average	**1.6**	**1.7**	**84.2**	**734.7**
Bottom 3				
La Granja	20.0	94.1	36.4	31.8
La Pintana	17.0	97.2	14.1	26.0
Cerro Navia	15.4	96.1	23.9	21.9
Average	**17.5**	**95.8**	**24.8**	**26.5**

Source: based in SII and SINIM data, 2016 *Data available from latest households' socioeconomic characterization CASEN survey; **Properties with an appraisal value equal or under US$35,000 app. are exempted from the property tax; ***PSU corresponds to a national test for students to entry universities.
Source: based in SII and SINIM data, 2016

hinder the access to good jobs. Fuentes et al. (2017) show that most of the population in Santiago (66.3%) lives in areas with a high proportion of unskilled workers. This highlights the relevance of proximity to local jobs in this type of urban contexts.

Table 2 shows the stark differences in social indicators (poverty rate, education performance, housing composition) and municipal resources (a proxy of local governments' capacity to meet the population's needs) among the top three and bottom three municipalities (out of the 34 municipalities that make up the SMA) are significant. Table 2 also shows that almost 100% of the housing stock in certain municipalities is exempted from property tax (designed to benefit social housing residents). This explains the scanty property tax collected by these municipalities that ironically are the ones that host the highest proportion of vulnerable population highly dependent on municipal services.

However, since the 2000s, the SMA has been experiencing significant changes in its urban development pattern that might entail changes in the distribution of opportunities across the city. These changes have occurred firstly in the housing supply, which, together with the growth towards the periphery, is now supplying a massive number of affordable residential high-rise buildings, contributing to the densification of the central area. Secondly, connected to the former, there has been a change in the population's demographic composition. The size of households has decreased, poverty has significantly reduced, and income per capita has increased (Bergoeing & Razmilic, 2017). Thirdly, the urban transport system has expanded and changed, including several new subway lines and a major reform to the public transport system that has redefined the mobility behaviours of a large proportion of the population. And fourth, there has been a consolidation of urban sub-centres; 19 sub-centres across the SMA have gained stability in the last decade (Truffello & Hidalgo, 2015).

Together, these changes lead to a redefinition of the urban structure within the SMA, which could impact the geography of opportunity for the most vulnerable population and, therefore, their chances of experiencing upward income mobility.

4.2. Data

We generated a GO index subdivided into three sub-indices (each one measuring one dimension of the GO) at two points in time (period 1 between 2002 and 2005; and period 2 between 2012 and 2015). The variables that build the indices were selected based on two criteria: (i) that they had the potential to change over time, and (ii) that they have been tested in previous studies that relate to the GO dimensions included in the conceptual framework proposed.

The data used was obtained from seven sources (see Table 2 for detailed information on the sources of data, variables and years analysed).

4.3. Method

4.3.1. Two relevant scales for GO: municipality and neighbourhoods

As discussed before, a critical aspect in the construction of GO indices is choosing the appropriate scale to describe the effect that the attributes of a given area have on its residents. In cities with a high imbalance in the distribution of opportunities, as is the case with the SMA, it is important to study the variations in the geography of opportunity not only at the neighbourhood scale, where the neighbourhood effect mechanisms relate to socialization and social capital but also at the municipal scale, where the type and quality of services and infrastructure offered by municipalities to their inhabitants is what makes this scale relevant (Andersson & Musterd, 2010).

The municipal scale corresponds to the lower political-administrative sub-division in Chile. Governed by popularly elected Mayors and Councils, who are in charge of the city administration, each municipality has its own master plan that is implemented with a large degree of autonomy (although the central government agencies have priority over the municipal master plan when their investments are set to be developed within or across one or more municipalities). Municipalities are responsible for the provision of health and education services for which they rely on central government transfers. Investment in infrastructure, amenities, and cultural and social services depends on the municipal revenues collected from property taxes and municipal permits. The SMA is subdivided into 34 municipalities with no metropolitan government. Their average size is 38.7 km^2 and their average population is 179,880 inhabitants. However, since the size and population vary significantly between municipalities, we used a per capita analysis to allow for comparison.

The neighbourhood boundaries we used in this research are the commuting zones defined by the Ministry of Transport. The criteria used to define these commuting zones' boundaries are the following: the political-administrative division, land regulations, geomorphological characteristics, physical and socioeconomic characteristics, and conditions of accessibility and connectivity. Fig. 2 shows the two urban scales analysed.

4.3.2. Dimensions, sub-dimensions and indicators of the GO

For each of the three dimensions of the conceptual framework of the GO, we generated a composite index comprising a total of 11 sub-dimensions and 26 indicators of opportunity. Each indicator has been assigned either a positive (+) or negative (−) sign to describe whether the information provided by the variable adds or subtracts within the index (see Table 3).

The three sub-indices generated are: The Urban Land Market Activity, ULMA sub-index, the Municipal Fiscal Capacity, MFC sub-index, and the Urban Attributes, UA sub-index. These sub-indices allow for identifying: (i) areas that are better or worse located in the city in terms of urban land and real estate market dynamism, (ii) areas that have more or less public resources to invest in infrastructure, provide good quality services and strengthen their communities, and (iii) areas that offer more or less access to services, infrastructure and other social and urban attributes that affect the life chances of individuals and households.

The ULMA sub-index describes the urban dynamism in an area and considers two main sub-dimensions: (i) the land market (highest appraisal value in the area) and (ii) the real estate activity (total square meters built in the year). The real estate activity works as a proxy of the urban economic dynamism in the area. For the land market indicator, we use the highest land appraisal since it discriminates better between areas than using the average land value, which brings together areas with very different sets of urban attributes.

The UA sub-index synthesizes in a single measure the information of

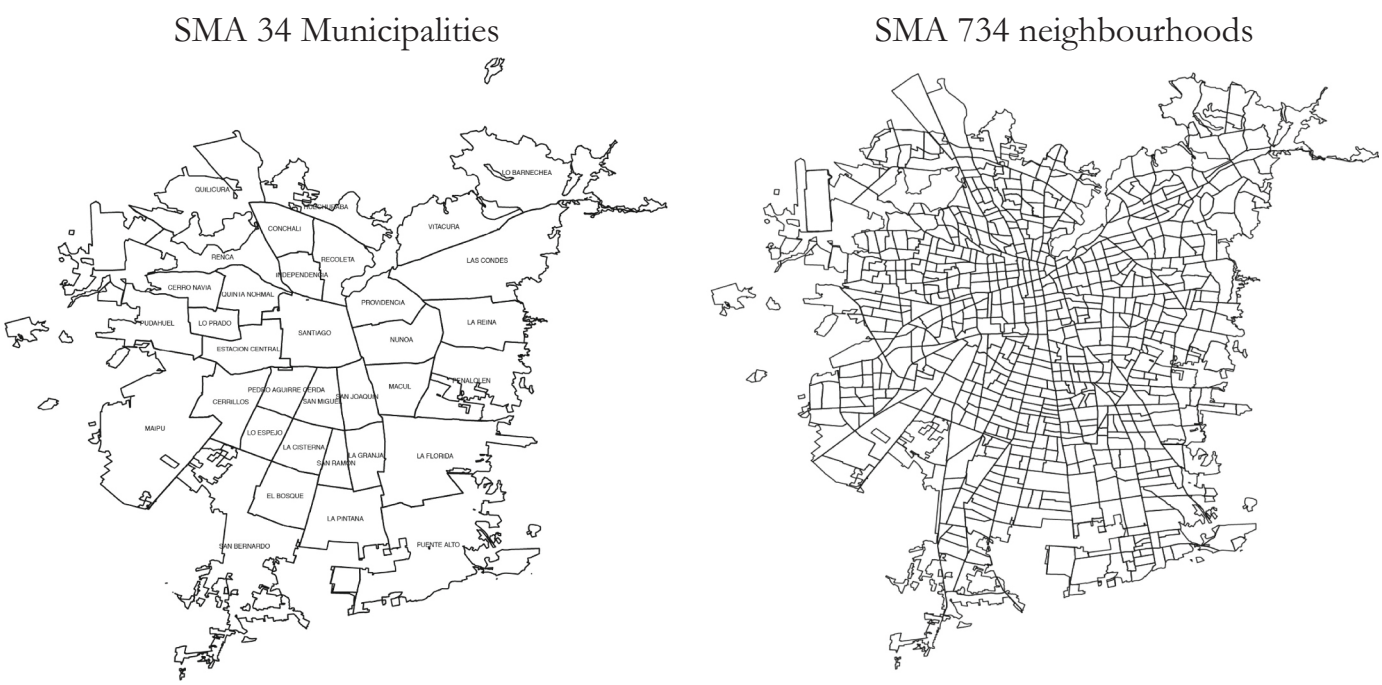

Fig. 2. The SMA's municipal and neighbourhoods (commuting-zones) boundaries.

Table 3
Dimension, sub-dimensions and indicators of the three sub-indices of the GO index.

Dimensions (sub-indexes) & subdimensions	Indicators	Scales*	Impact on sub-index	Years	Data source**
1. Urban Land Market Activity (ULMA)					
1.1 Land Appraisal	Commuting zone with highest land appraisal (US$/m2)	M & N	(+)	2005 2012	SII
1.2 Real Estate Activity	Total square meters built in the year (m2)	M	(+)	2005 2012	INE
2. Municipal Fiscal Capacity (MFC)					
2.1 Municipal Revenue	Municipal revenue per capita (US$)	M	(+)	2005 2012	SINIM
	Municipal Common Fund/Total Municipal Revenues (%)	M	(−)	2005 2012	SINIM
2.2 Local Tax Base	Municipal local tax revenues per capita (US$)	M	(+)	2005 2012	SINIM
	Property tax exemptions (%)	M	(−)	2008 2012	SINIM
3. Urban Attributes (UA)					
3.1 Connectivity	Average travel time by household (minutes)	M & N	(−)	2001 2012	EOD
	Public transportation stops and underground stations (n°/10,000 habs)	M & N	(+)	2016	Mapcity
	Automobile access by household (%)	M	(+)	2006 2013	CASEN
3.2 Employment	Unemployment rate (%)	M & N	(−)	2002 2012	INE
	Total of firms (n°)	M & N	(+)	2005 2015	Mapcity
	Employment competition (%)	M & N	(+)	2001 2012	EOD/INE
3.3 Health and Environment	Hospitals and health centres (n°/100,000 habs)	M & N	(+)	2016	Mapcity
	Health care system access (%)	M	(+)	2003 2013	CASEN
	Green areas with maintenance per inhabitant (m^2/habs)	M	(+)	2005 2012	SINIM
3.4 Education	High school graduation (%)	M	(+)	2002 2012	INE
	Students in poverty (%)	M	(−)	2006 2013	CASEN
	Students in public school scoring more than 450 in PSU Test (%)***	M	(+)	2005 2012	SINIM
3.5 Urban Life	Access to POIS****(n°/1000 habs)	M & N	(+)	2016	Mapcity
	Access to banks, ATM, supermarkets and pharmacies (n°/1000 habs)	M & N	(+)	2016	Mapcity
	Total square meters of commercial and entertainment premises built (m^2/year)	M	(+)	2005 2012	INE
3.6 Safety	Crime with violence and severe injuries (n°/100,000 habs)	M	(−)	2005 2012	Home Office
	Homicide (n°/100,000 habs)	M	(−)	2005 2012	Home Office
	Rape (n°/100,000 habs)	M	(−)	2005 2012	Home Office
3.7 Neighbourhood Social Mix	Social mix index	M	(−)	2002 2012	INE
	Poverty rate (%)	M	(−)	2002 2012	INE

Notes: *Municipality (M), Neighbourhood (N); ** SII (Internal Revenue Service), SINIM (Municipalities information system), EOD survey (Greater Santiago's origin and destination survey), INE (National Institute of Statistics), CASEN (Socio-economic characterization survey); ***PSU test is required to enter universities, 450 is the lowest score accepted by universities; **** POIS (Mapcity points of interest).

several sub-dimensions. The main assumption behind this sub-index is that its selected dimensions have a combined effect on the residents' life chances. This is the case, for example, of the intertwined relationship between social networks, connectivity and education/skills all captured in the UA sub-index. In other words, the UA sub-index reflects the relative contribution (positive or negative effects) of a neighbourhood or municipality to its residents. The seven sub-dimensions of this sub-index are:

(i) Connectivity, which measures the average travel time to work (minutes), public transportation stops and underground stations (n°/1000 inhabitants) and automobile access by household (%),
(ii) Employment, which contemplates unemployment rate (%), total number of firms (n°), and employment competition, that is, rate of jobs offered over the labour force in the area (%),
(iii) Health and Environment, comprising access to hospitals and health centres (n°/100,000 inhabitants), proportion of the population covered by the healthcare system, green areas with maintenance (m2/inhabitants),
(iv) Education, comprising the proportion of high school students that graduate (%), proportion of students in poverty (%), proportion of students in public school scoring over 450 in the national university entry test, PSU Test (%),
(v) Urban Life, which measures access to points of interest (POIS) (n°/1000 inhabitants), access to banks, ATMs, supermarkets and pharmacies (n°/1000 inhabitants, and total square meters build of commercial and entertainment premises (m^2),
(vi) Safety, which reflects the incidence of violent crimes and severe injuries (n°/100,000 inhabitants), homicide (n°/100,000 inhabitants), rape (n°/100,000 inhabitants), and
(vii) Neighbourhood Social Mix, comprising a social mix index based on the proportion of each socioeconomic group that goes between 0 and 1. Closer to 0 means there is a 20% distribution in the five income groups (quintiles), and close to 1 means there is less presence of one or several of those groups; and a poverty indicator (proportion of population that falls into the 40% with a lower income level)

The MFC sub-index provides relevant information on the capacity of local governments to attend the needs of the population. The components of this sub-index are: (i) Municipal Revenue, which considers the municipal revenue per capita (US$) and the share of the municipal common fund[5] over the total municipal revenues (%), and (ii) Local Tax Base, which estimates the municipal local tax revenues per capita (US$) and the proportions of properties with tax exemptions (%).

There are three methodological considerations of the GO index proposed. First, all of the indicators considered measure the opportunities of the place of residence, in two scales, the neighbourhood and the municipal scale, with the exemption of travel time to work, which is spatial in the sense that it does not refer necessarily to an actual attribute of the place of residence since it varies with each individual. Future research could combine in the same index a balanced measure of indicators of place and space, that is, physical and social attributes of the urban context, as well as the relationship between the areas analysed.

Second, and related to the previous point, the GO index does not incorporate information on urban attributes from nearby neighbourhoods. In the case of Santiago, the access to specific municipal programs is bounded to residents of the area, which would make the analysis of adjacent neighbourhoods located in different municipalities in the GO index much intricated. Future developments should assess the impact of adding a sub-dimension that takes into account the urban attributes of the nearby neighbourhoods. This, because residents in a low GO neighbourhood surrounded by higher GO neighbourhoods could have a better GO than areas with low GO surrounded by neighbourhoods with similar GO.

Third all of the indicators of opportunities considered here have the same weight, except for employment, which was given a different (higher) weight since as it was discussed in more detail in Section 3, it is the urban attribute that, in the short term, has the most significant impact on people's well-being. A more detailed weighing inquiry into the indicators is a pending task for future analysis.

4.3.3. Relative and absolute measurements of the GO

The analysis contemplates the combined use of both relative and absolute measurements of the GO. This has two advantages. On the one hand, it contributes to a more precise process of monitoring and comparing the changes in the GO over time. Most of the studies in the field use relative measures to rank the position of the urban scale studied. However, when comparing two periods, relative measurements only provide information on the urban areas that moved up or down in the ranking, but not much information on whether that meant a real upgrade or downgrade in the GO. The absolute measurement we propose allows for specifying clear thresholds (upper and lower cuts) that allow for a better classification of the areas as well as discriminating between mere changes and changes that represent a significant improvement or decline in the GO. On the other hand, the absolute measures contribute to a better understanding of the urban reality in societies where differences and inequalities (social, economic, urban) are particularly high as most countries in the Global South are. Instead, when the differences are not too wide, the relative measures become more informative and relevant, as in the case of cities in the northwestern world.

Using both GO measurements has some restrictions. First, from a policy perspective, dealing with two indicators makes decision making less simple. Second, for the absolute measure of GO, the cut-offs for each indicator could be considered arbitrary. In this study, we make a comprehensive proposal of cut-offs, but new studies should address this critical point that is characteristic of multidimensional measures such as poverty and quality of employment (Alkire & Foster, 2011; Sehnbruch et al., 2020).

The relative measurement describes the GO and its dimensions for each period by ranking and classifying the areas as follows: high, middle-high, middle-low and low GO. This method allows for capturing each urban area position compared to all of the rest, which is particularly informative in cities with high levels of inequality or an imbalance in the distribution of opportunities.

Complementarily, the absolute measurement allows for distinguishing improvements in the GO according to pre-established criteria regarding a minimum desirable standard. This is particularly useful in the analysis of change, as it identifies the thresholds that can explain areas changing their GO. The classification categories of the GO and its dimensions for the absolute analysis are high, middle-high, moderate, middle-low and low.

For the relative analysis, each variable was normalized using a process of standardization of values known as the z-score; this was performed for the 26 indicators of the 11 sub-dimensions of opportunity. The z-score is an arithmetic transformation of values that allows for comparing and combining indicators with different units, magnitudes and ranges, into a single index value. In formal terms, the z-score measures the distances of a x_i value with the measure of all μ values using units of standard deviation σ.

$$z_i = \frac{(x_i - \mu)}{\sigma}$$

Once the values are standardized, these are added or subtracted depending on whether they have a positive or negative impact on the

[5] The Municipal Common Fund (MCF) is a redistribution system of municipal revenues implemented countrywide. Each municipality contributes 50% of their revenues to MCF. The fund is then distributed back to municipalities based on criteria of social priority.

sub-dimensions. The values are divided by the number of indicators per sub-dimension. Then, the average of the 11 sub-dimensions for each urban area is calculated. In the specific case of the UA index, all of the sub-dimensions indicators have equal weight, except for the employment sub-dimension, as stated before. Finally, the three sub-indices value is re-scaled between a range of 2 and -2, where higher values indicate better geography of opportunity.

The GO relative changes and its dimensions are measured according to the number of positions each urban area goes up or down in the ranking between period 1 and period 2. This allows for getting a sense of the depth of the changes. The four categories are: (i) moved up 2 or more positions, (ii) moved up between 0 and 2 positions, (iii) moved down between 0 and 2 positions, (iv) moved down more than 2 positions.

The absolute measurement requires three steps. The first is to use two cut-off thresholds to classify the indicators of the GO into three categories. The upper cut-off is the 85th percentile of each indicator's distribution in the first period analysed, and the lower cut is estimated using the median of the same distribution. This gives us three categories: high (upper cut-off), middle and low (lower cut-off) for each indicator. Each category was given a value: high = 3, middle = 2 and low = 1. Then we added the value of each indicator in a sub-dimension to classify them into 5 categories (low, middle-low, moderate, middle-high and high). The ULMA sub-index has two sub-dimensions and one indicator in each. When applying the cut-off lines, each indicator will get a value ranging between 1 and 3; therefore, when adding the indicators of both sub-dimensions, the new value range obtained will be between a maximum of 6 and a minimum of 2. For this sub-index the 5 categories are classified assuming that: high = 6, middle-high = 5, moderate =4, middle-low = 3 and low = 2. The same procedure was carried out for the MFC sub-index with the values ranging between 12 and 4 to form the 5 categories, and for the UA sub-index, which has 7 sub-dimensions, where the sub-index values range between 35 and 7.

The second step is to assign the same categories used for the sub-dimensions to the GO index dimensions, which will generate 5 categories. The last step is to reuse those 5 categories of each dimension of the GO to estimate the holistic GO index, which means the value ranges between 15 and 3.

The GO absolute changes and its dimensions are estimated by measuring the difference between period 1 and period 2 for each sub-dimension on a scale that ranges between −4 to 4. This provides information on the changes that occurred and on the depth of the changes in the GO. The changes are classified as follows: (i) significant

Table 4
Descriptive statistics ULMA index; MFC index and UA index.

Indicators by subdimension's index	Period 1 (2002–2005)					Period 2 (2012–2015)				
	Obs	Mean	SD	Min	Max	Obs	Mean	SD	Min	Max
1. Urban Land Market Activity (ULMA) sub-index										
1.1 Land appraisal										
Commuting zone with highest land appraisal (US$/m2)	34	194	226	37	1,118,748	34	754	1,547	39	7,278
1.2 Real estate activity										
Total of square meters built in that year (m2)	34	161,534	237,771	2,636	984,366	34	213,355	228,396	3,519	815,961
2. Municipal Fiscal Capacity (MFC) sub-index										
2.1 Municipal Revenue										
Municipal revenue per capita (US$)	34	241	244	97	1,099,378	34	367	320	125	1269
Municipal Common Fund/Total Municipal Revenues (%)	34	38.8	28.8	2.4	84.9	34	37.0	29.4	2.0	87.5
2.2 Municipal Local Tax										
Municipal local tax revenues per capita (US$)	34	128	148	15	568,711	34	186	200	16	749
Property tax exemptions (%)	34	65.7	32.1	0.4	96.9	34	64.4	32.4	0.4	97.1
3. Urban Attributes (UA) sub-index										
3.1 Neighbourhood Connectivity										
Average travel time by household (minutes)	34	35.7	3.6	27.1	42.4	34	35.7	4.0	29.9	46.2
Public transportation stops and underground stations (n°/1,000 habs)	–	–	–	–	–	34	88.0	37.8	35.8	217.6
Automobile Access by household (%)	34	28.6	17.2	8.7	87.1	34	36.9	17.1	15.0	93.4
3.2 Employment										
Unemployment rate (%)	34	12.00	2.80	5.10	16.40	34	6.80	1.60	3.00	9.70
Total of firms (n°)	34	7,801	6,248	2,781	33,296	34	8,966	7324	2,970	34,300
Employment competition (%)	34	157.1	227.1	26.4	1,233.6	34	93.1	74.5	23.3	382.1
3.3 Health and Environment										
Hospitals and health centres (n°/100,000 habs)	–	–	–	–	–	34	32.9	48.1	5.4	256.2
Health care system access (%)	34	95.6	2.8	89.6	100.0	34	93.7	3.2	87.4	98.4
Green areas with maintenance per inhabitant (m2/hab)	34	3.4	2.2	0.0	10.5	34	4.8	2.6	1.5	12.5
3.4 Education										
High school graduation (%)	34	41.7	11.0	25.7	66.5	34	75.2	12.4	54.2	100.0
Students in poverty (%)	34	8.9	5.1	0.7	20.2	34	6.3	4.5	0.0	16.3
Students in Public School scoring more than 450 in PSU Test (%)	34	27.3	19.0	3.9	87.3	34	42.9	22.3	11.1	96.1
3.5 Urban Life										
Access to pois (n°/1,000 habs)	–	–	–	–	–	34	37.5	37.3	9.1	186.4
Access to banks, ATM, supermarkets and pharmacies (n°/1,000 habs)	–	–	–	–	–	34	11.9	13.0	1.1	68.2
Square meters of commercial and entertainment premises built year (m^2/year)	34	8,038	20,118	0	115,784	34	32,626	61,496	214	256,789
3.6 Safety										
Crime with violence and severe injuries (n°/100,000 habs)	34	1,248	518	482	3,283	34	1,256	668	435	3,879
Homicide (n°/100,000 habs)	34	4.4	3.0	0.0	11.4	34	3.7	2.0	0.8	9.3
Rape (n°/100,000 habs)	34	19.2	8.4	1.2	39.2	34	21.6	10.9	2.5	58.8
3.7 Neighbourhood Social Mix										
Social mix index	34	43.1	15.1	14.3	73.4	34	49.8	15.7	15.3	80.0
Poverty rate (%)	34	45.0	19.1	3.3	73.9	34	46.4	20.1	5.1	79.5

Source: CASEN, EOD, INE, Mapcity, SII, Home Office and SINIM (see Table 3 for details).

improvement, (ii) moderate improvement, (iii) no improvement, (iv) moderate decline, and (v) significant decline.

5. Results: GO Index and Sub-indices applied to Santiago Metropolitan Area

The analysis in this section provides evidence on the capacity of the GO index and sub-indices to i) portray and classify urban areas, which includes analysing the contributions of each indicator; ii) explain the changes in the GO over time as well as the depth of those changes.

Table 4 shows descriptive statistics. The information shown in the table is at the municipal scale, although several data was estimated at the neighbourhood scale (734 commuting-zones) and then aggregated to the municipal scale; this is the case, for instance, for the neighbourhood social mix (see also Tables A and B in Appendix II describing the correlation between sub-indices and between the 11 sub-dimensions that build up the GO).

5.1. Portraying and classifying urban areas

The GO index, when applied to the Santiago Metropolitan Area (SMA), provides a clear depiction and useful classification of the degree of opportunities that the different urban scales analysed (municipalities and neighbourhoods) offer to their residents (see Fig. 3).

From these results, it can be said that in cities with a high imbalance in the distribution of opportunities, like the SMA, the opportunities seem to be significantly shaped at the municipal scale, particularly in areas that fall in both extremes of the index (high and low GO). In these areas, almost all of the neighbourhoods that make up a municipality share the same type of opportunities. Conversely, the municipalities that fall into the intermediate categories of the index (middle-low, moderate and middle-high) show a more diverse distribution of opportunities between their neighbourhoods. Indeed, some neighbourhoods appear as islands of disadvantages in much richer areas in terms of their GO.

The information obtained from the index is particularly relevant for the design of policy outlines to improve the opportunities in certain areas. For instance, the data shows two distinctive urban scenarios of low GO that would require different policy intervention strategies. First, there are neighbourhoods that, despite showing a low GO, have a good location within the city –near the city centre— and are surrounded by other areas with a better GO (area circled in black in Fig. 3). Taking advantage of their location is a possibility that could be explored. Conversely, the extensive areas that show a very poor set of opportunities (area circled in red covering almost four municipalities in Fig. 3) are disturbingly disadvantageous and homogeneous. This reality should justify more intended policy interventions at both the neighbourhood

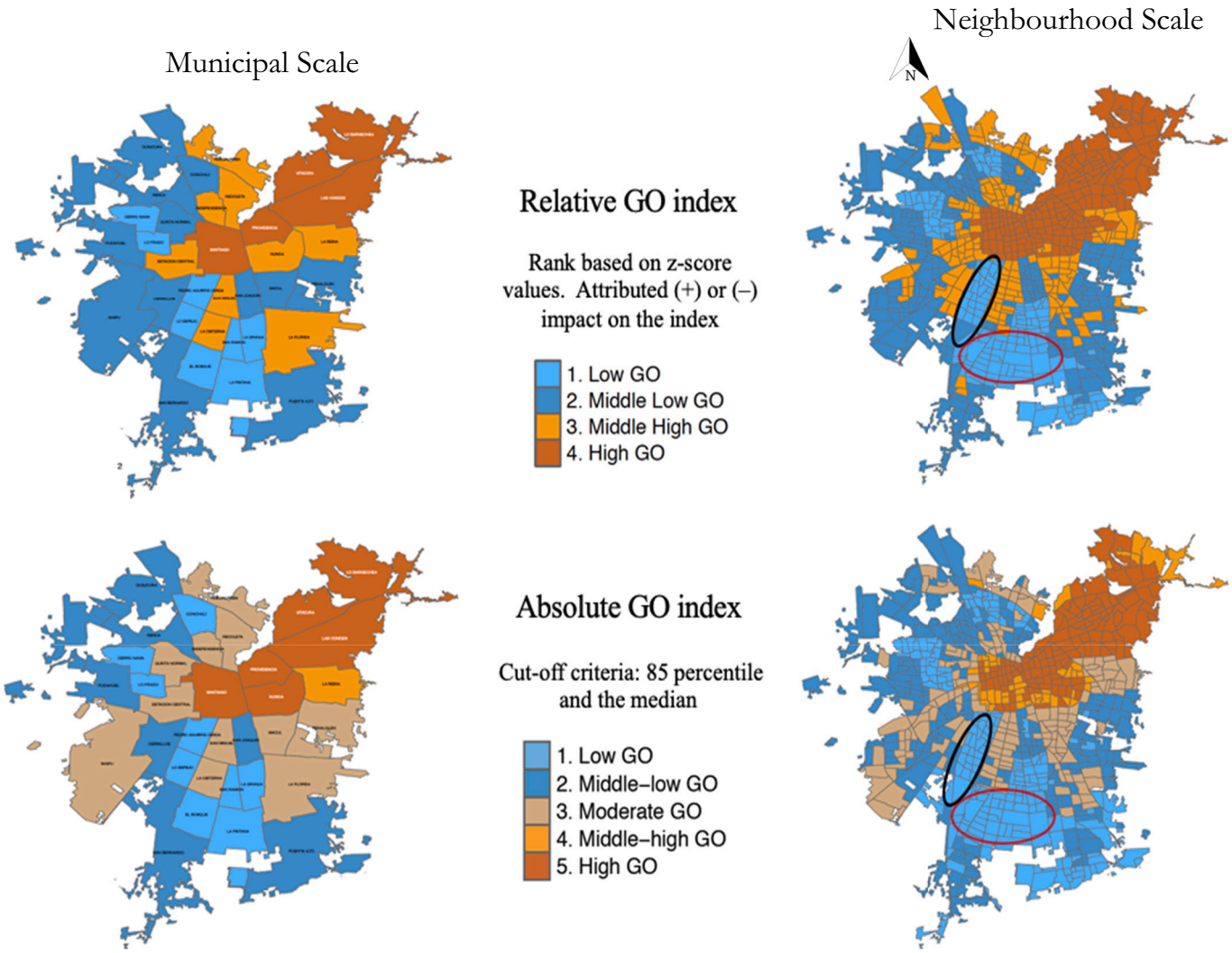

Fig. 3. Absolute and relative GO index at the municipal and neighbourhood (Period 2: 2012–2015).

Table 5
Relative GO index categories and its indicators values for period 2 (2012–2015).

Subdimensions and indicators	Low GO (8 municipalities; 159 neighbourhoods)	Middle-low GO (12 municipalities; 247 neighbourhoods)	Middle-High GO (9 municipalities; 164 neighbourhoods)	High GO (5 municipalities; 181 neighbourhoods)
1.1 Land appraisal				
Commuting zone with highest land appraisal (US$/m2)	91	210	493	3,594
1.2 Real estate activity				
Total square meters built in the year (m2)	10,468	162,200	167,642	417,182
2.1 Municipal Revenue				
Municipal revenue per capita (US$)	187	229	314	1,079
Municipal Common Fund/Total Municipal Revenues (%)	78.0	37.7	18.6	2.4
2.2 Local Tax Base				
Municipal local tax revenues per capita (US $)	32	110	187	615
Property tax exemptions (%)	93.5	81.6	46.6	8.2
3.1 Connectivity				
Average travel time by household (minutes)	55.3	52.8	45.7	33.3
Public transport stops and metro stations (n°/10,000 habs)	74.5	74.4	108.7	105.2
Automobile Access by household (%)	26.1	33.1	36.9	63.30.0
3.2 Employment				
Unemployment rate (%)	8.5	7.1	6.3	4.0
Total of firms (n°)	3,963	7,744	8,423	20,881
Employment competition (%)*	37.8	66.9	103.8	225.0
3.3 Health and Environment				
Hospitals and health centres (n°/100,000 habs)	9.9	11.0	37.5	114.0
Health care system access (%)	93.1	95.0	92.5	93.7
Green areas with maintenance per inhabitant (m^2/hab)	3.1	4.4	4.3	9.2
3.4 Education				
High school graduation (%)	64.7	72.7	78.3	92.4
Students in poverty (%)	8.8	7.4	5.2	1.7
Public school students scoring over 450 in national test (%)	22.2	39.8	47.6	74.9
3.5 Urban Life				
Access to pois**(n°/1000 habs)	3.2	6.5	14.1	34.7
Access to banks, ATM, supermarkets and pharmacies (n°/1,000 habs)	14.0	21.1	44.0	102.7
Total commercial and entertainment premises built in the year (m2)	2,669	33,761	36,456	70,941
3.6 Safety				
Crime with violence and severe injuries (n°/100,000 habs)	1144	1,083	1,505	1,401
Homicide (n°/100,000 habs)	4.4	3.7	3.3	3.3
Rape (n°/100,000 habs)	25.6	20.3	21.1	18.9
3.7 Neighbourhood Social Mix				
Social mix index ***	0.60	0.43	0.42	0.63
Poverty rate (%)****	68.2	49.8	40.6	13.9

Notes: * % of number of jobs overt total labour force within the neighbourhood and municipality; ** POIS (Points of Interest, Mapcity); *** The index goes between 0 and 1. Closer to 0 means there is a 20% distribution across the 5 socio-economic groups (quintiles), and closer to 1 means there is less presence of one or several of those groups; **** Poverty rate estimated on each of the 734 Neighbourhood within the 34 municipalities in SMA.
Source: CASEN, EOD, INE, Mapcity, SII, Home Office and SINIM (see Table 3 for details).

and municipal scales to enhance their residents' opportunities.

Complementarily, all of the indicators considered to build the GO index proved relevant in the classification and description of the GO. For example, when classifying the urban areas according to the relative GO index categories, the indicators provide valuable information to describe each of the areas. This data can guide the formulation of specific interventions tailored to the different needs and opportunities observed in the areas analysed (see Table 5). Therefore, not only does the GO index provide a clear classification, but also each sub-index and its indicators offer detailed information to foster improvements in the GO. For instance, the employment subdimension data can lead to concrete measures to increase the number and improve the quality of job opportunities people find in areas with low and middle-low GO. The indicators both of employment competition and the numbers of firms could be enhanced by creating strong incentives (e.g. tax breaks) for firms to locate in areas classified with low GO or setting direct support for entrepreneurial initiatives of residents in those areas.

5.2. Explaining changes in the GO

5.2.1. How has the GO in Santiago Metropolitan Area changed over time?

The GO index and the sub-indices make it possible to see the changes

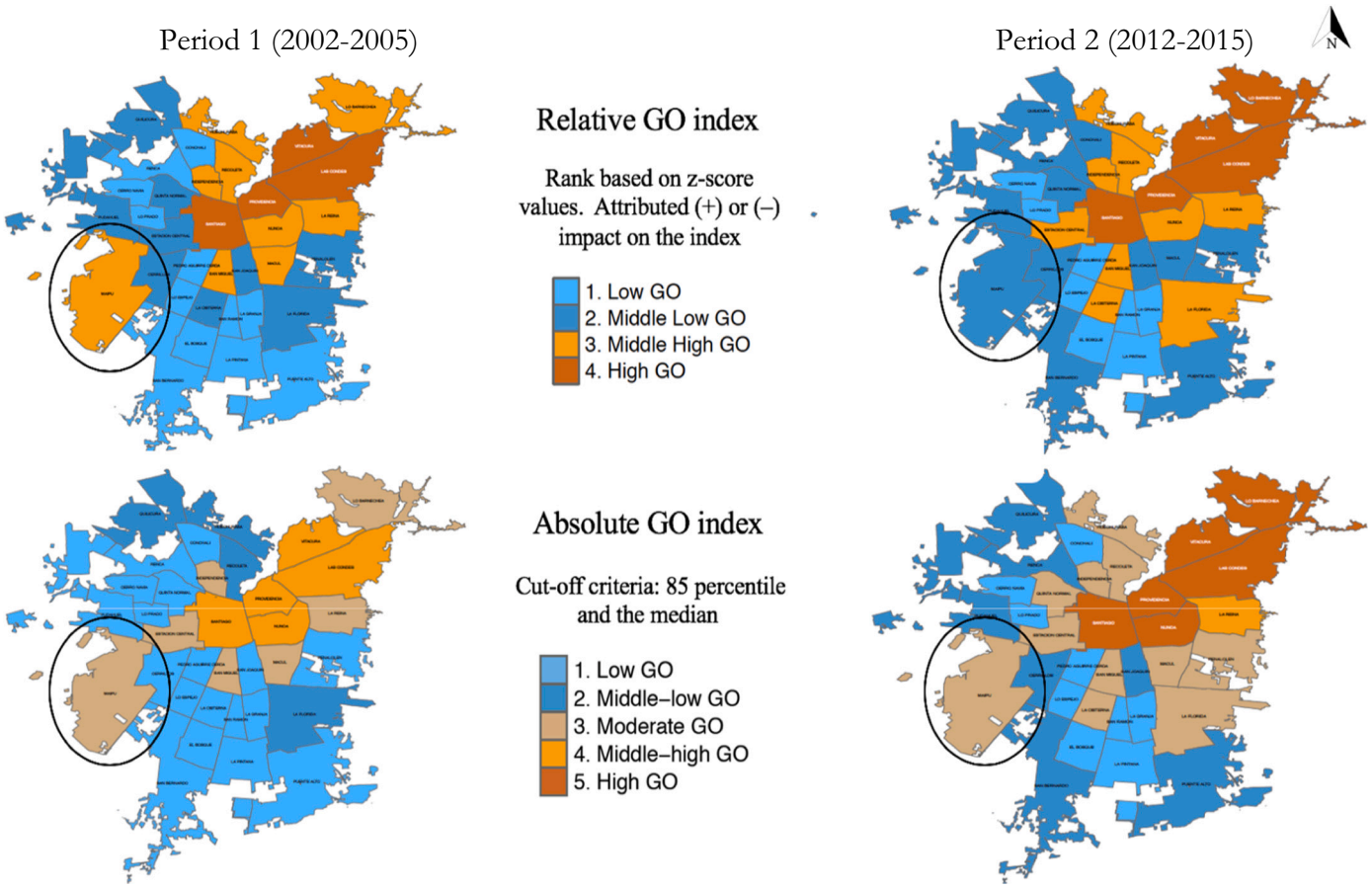

Fig. 4. Relative and absolute GO index measurement for period 1 and 2.

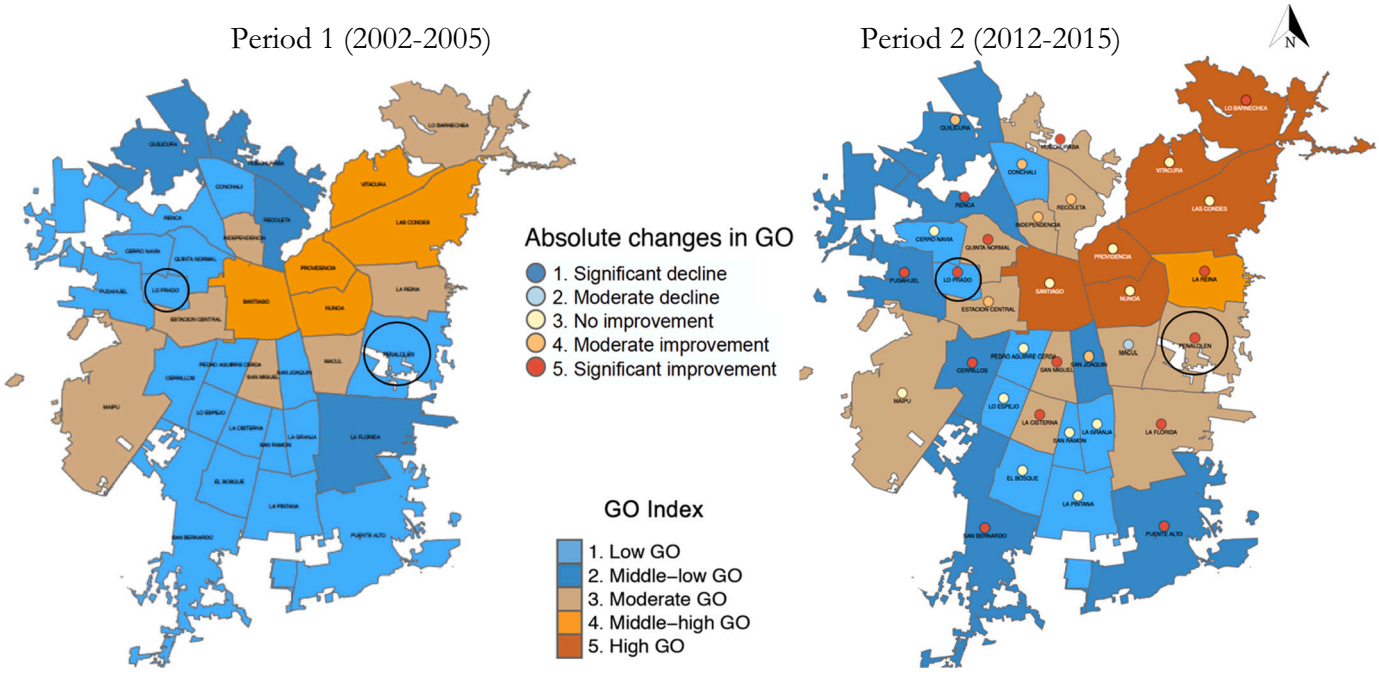

Fig. 5. Aboslute changes in the GO index in SMA between period 1 and 2.

in the distribution of opportunities over time, providing evidence on whether the different areas in a city have increased, maintained or decreased the opportunities they offer to their residents. As Fig. 4 shows, the Santiago Metropolitan Area experienced an expansion in the distribution of opportunities in the ten-year period analysed. The number of municipalities with a low GO decreased from 12 to 8 (according to the relative index) and 18 to 9 (according to the absolute index) between periods 1 and 2. The maps for the two periods also show a worrying persistence of clusters of low GO (areas in the maps coloured in light blue) located in the south-east and north-west part of the city.

Particularly relevant for monitoring and comparing the changes in the distribution of opportunities over time is the use of both relative and absolute measures. The absolute GO index leads to a deeper understanding of the level and extent of opportunities in certain areas. As Fig. 4 illustrates, in period 1 the absolute index shows a large number of municipalities that fall into the low GO category and none in the high GO category, whereas the relative index shows a more reduced number of municipalities in the low GO category and six municipalities in the high GO category.

Furthermore, when classifying and ranking urban areas, the absolute index offers a more rigorous analysis to assess the GO changes. The case of Maipú municipality (area circled in Fig. 4) explains this point. According to the relative index, Maipú had a middle-high GO in period 1, declining to a middle-low GO in period 2. This might be related to a positive change in other municipalities, making Maipú move down in the ranking, rather than its GO worsening. This becomes clear when using the absolute GO index (which defines thresholds moving up and down in the GO categories) where Maipú remains in the same GO

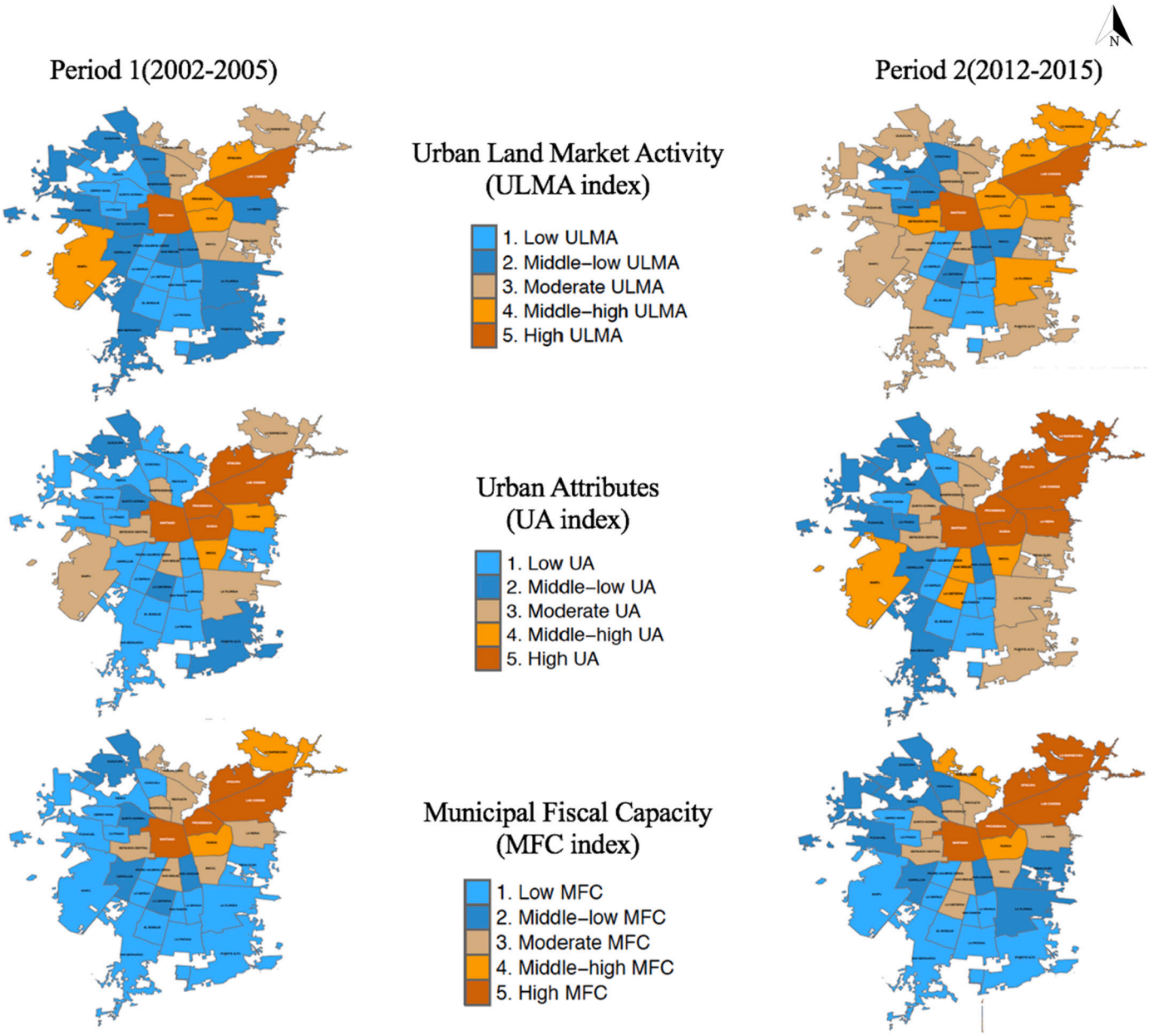

Fig. 6. Absolute GO sub-indices at the municipal scale for Period 1 and Period 2.

category in both periods.

5.2.2. How to discriminate between mere and meaningful changes in the GO?

The case of Maipú attests to the relevance of not only classifying the changes but also measuring the intensity or depth of such changes, which is usually not considered when using a relative index. Defining thresholds is key to obtaining a better understanding of whether moving up or down in the ranking implies a meaningful improvement or decline in the GO of an urban area.

The example provided here illustrates this point. As Fig. 5 shows, Peñalolén municipality (area circled on the right side of the maps) and Lo Prado municipality (area circled on the left side of the maps) both had a low GO in period 1, and both municipalities experienced a significant improvement in their GO in the 10 year period covered in this study. In the case of Peñalolén, the betterment of its GO made it move up two categories from low to moderate GO, whereas Lo Prado municipality, having experienced a similar level of improvement, remained in the low GO category. This means that the changes in the GO were not enough to bring this area out of its condition. Moving up the ranking is not necessarily related to a substantial improvement. From this example, it is clear that certain areas need a much stronger intervention to make them reach a minimum desirable standard. In areas with high disadvantages, residents are immersed in a reality that works as a sticky floor, hindering their progress. This pattern relates to what Galster (2019, pp. 148–149) presents as the nonlinear or threshold effect of neighbourhoods on both individuals' and neighbourhoods' change. Changing the reality in areas that have entered into a negative spiral due to the cumulous of disadvantages poses significant challenges to policy interventions. Neighbourhoods do not respond in a linear way to an intervention. It depends on the scale and context. Addressing the challenges in these areas requires the implementation of bold and innovative policies together with the allocation of significant public resources from the central and regional level to underpin the efforts at the local level.

5.2.3. What drives the changes in the GO?

To understand what drives the changes in certain areas, the GO sub-indices' separate analysis is particularly explicative of the different trajectories that urban areas follow. It also works as a useful tool to identify the barriers to improving the GO. In the SMA, the changes in the GO index are mostly driven by the urban land market activity followed by an improvement in the urban attributes, despite no apparent significant changes in municipalities' fiscal capacity (See also Figure A in Appendix III relative GO sub-indices at the municipal scale).

The maps in Fig. 6 illustrate how municipalities at the top and bottom of the ranking show a strong level of alignment and persistence over time in all of the estimated GO sub-indices. This is likely to be due to a process of reinforcement of either its advantages or disadvantages. On the one hand, areas with a low GO show no significant land and real estate market vitality, which in turn relates to low municipal tax collection and revenue sources and a semi-stagnant set of attributes and opportunities in both periods analysed. At the other extreme, but following the same pattern, areas with a high GO show high land prices and a very active real estate market, as well as consistently high municipal fiscal capacity and a rich set of urban attributes. Municipalities in the middle section of the rank (with middle-low, moderate and middle-high GO) are the ones that show a greater mismatch between the sub-indices. This is primarily due to the de-coupling between the urban land market dynamics and the capacity of the municipalities to capture the changes in the urban environment (see Table C in Appendix IV).

Furthermore, the alignment or misalignment between the GO sub-dimensions can actually work as a predictor of urban change. In the SMA, the municipalities that moved up in the GO ranking in period 2 were those that in period 1 had at least one of the GO sub-dimensions above the low GO category, whereas those that did not experience any change were those where in period 1 all three GO sub-dimensions fell into the low GO category.

6. Discussion

Geography of opportunity research has made significant progress in recent years. The use of composite indexes aimed at capturing the attributes of different urban areas has been particularly useful to deepen the understanding of the role that the urban context plays in people's life chances. However, little attention has been paid to the dynamic component of the geography of opportunity, that is, what explains its changes over time and whether or not those changes (positive or negative) are substantial.

The contribution of this work is that it offers a methodology (a conceptual framework, a composite GO index and relative and absolute measures) that provides a holistic and in-depth approach to analyse not only the set of opportunities available in the different urban areas but also how these change over time, the depth of those changes and the forces explaining it. The information generated through this approach has the advantage of better informing place-based policy interventions since it offers not only a clear classification of areas but also a useful method for comparing and monitoring the changes in the GO over time.

Particularly relevant for monitoring and comparing the changes in the GO over time is the combined use of relative and absolute measures. Most of the studies in the field use relative measures to rank the position of the urban scale studied. However, when comparing two periods, this measurement only provides information on the urban areas that moved up or down in the ranking, but not much information on whether that meant a real upgrade or downgrade in the GO. The absolute measurement we propose allows for specifying clear thresholds (upper and lower cuts) that allow for getting a better classification of the areas as well as discriminating between mere changes and changes that represent a significant improvement or decline in the GO. When analysing highly unequal urban contexts, an absolute GO index provides a more stringent, realistic and useful measurement, complementing and deepening the depiction of urban realities that a relative GO index can offer.

Empirically, applying the methodology to the Santiago Metropolitan Area has the benefit of not only bringing a new urban reality that contributes to the bulk of research in this field that is mainly concentrated in north-western cities, but also of testing our approach in a city that, although unequal, since the 2000s onwards has experienced substantial social, urban and economic changes, offering an interesting scenario to measure the extent to which those changes have expanded the opportunities across the city positively, affecting the life chances of its inhabitants.

From the results obtained, three main conclusions can be drawn. Firstly, the GO index and its sub-indices, beyond offering a precise classification of the different urban areas for each period analysed, proved useful to examine the changes over time. In effect, the dynamic analysis made it possible to see that most of the areas experienced a betterment of the GO over time (21 out of 34 based on the relative index and 19 out of 34 based on the absolute index) as well as to detect a worrying stagnation of areas of low GO. Although most of the areas improved in relative terms, our approach enables identifying that not all the areas experienced a relevant or meaningful improvement in absolute terms. The dynamic analysis also showed that the level of alignment or misalignment between the sub-indices somewhat predicts the chances of

an area changing over time. In the case of the SMA, places that improved their GO over time were those where at least one of the GO sub-indices was above the low GO category at the baseline (period one).

Secondly, the separate analysis of the three dimensions of the GO proved relevant to understand what drives the changes in GO, why the changes follow different trajectories and the obstacles to improving the opportunities in certain areas. In the SMA, the changes in the built environment and the opportunities available are significantly market-driven by the urban land market activity followed by an improvement in urban attributes, despite there being no apparent significant changes in the financial capacity of municipalities. Areas with a dynamic real estate and land market, and a reasonably rich set of urban attributes, are not captured through tax and revenues at the municipal level. This reveals a very obsolete set of rules and instruments managed by municipalities, limiting their capacity to capture the value added by the real estate activity.

Thirdly, the municipal scale (besides neighbourhoods) plays a central role in understanding the distribution of opportunities within the SMA for two reasons. First, the municipal capacity to invest and shape the opportunities of its residents (through the provision of services and infrastructure) is, for many local governments, extremely limited. And second, the high concentration of low GO neighbourhoods in certain areas, covering the territory of a whole municipality, and in some cases more than one, exposes residents to severe disadvantages. Changing the reality of one neighbourhood with a low GO will not make any difference if it is surrounded by the same type of areas with low opportunities and disadvantages. This justifies combining in the analysis of the areas and in the design of interventions the municipal and neighbourhood scales.

From a policy perspective, these results confirm the relevance of ensuring a balance between market-driven and public-driven forces of urban change; otherwise, relying only on private market investment as a driver of urban change, as happens in the SMA, will continue to bring positive changes to areas with pre-existing advantages that attract more private investments while relegating low opportunity areas to continuing to experience stagnation and divestment. Reversing the negative effect that low opportunities urban contexts have on their residents cannot be achieved without a stronger role of local governments in the provision of services and infrastructure. As Galster discusses in his latest book "Making our Neighbourhoods, Making Our Selves", the nonlinear threshold effect of neighbourhoods has substantial implications for the logic and strategies that underpin public policy interventions. Neighbourhoods do not respond in a linear way to an intervention. It depends on the scale and context. Levelling up the field in areas of low GO requires strong public intervention strategies capable of barring the negative spiral in which these neighbourhoods are immersed. This would imply taking measures such as expanding the role of the metropolitan and local governments, modifying the property tax scheme and diversifying the sources of revenue of local governments, and expanding the mechanisms available to implement structural social and urban policy measures.

Also, the GO index identifies three urban scenarios: i) large scale areas covering multiple adjacent neighbourhoods and even complete municipalities with low GO; ii) middle scale areas covering numerous adjacent neighbourhoods with low GO but a good location (near the city centre and close to areas with a better GO); and iii) small scale areas covering one or few neighbourhoods with low GO that appear as islands of disadvantage within a much better urban environment.

Each of the scenarios described present different challenges and opportunities that require a distinctive set of strategies (place-based and also institutional) to improve the GO. This type of analysis can help to set policy goals for each of the scenarios identified, such as reaching at least a moderate GO in a reasonable timeframe. For instance, in the case of the first scenario, that is, large scale areas of low GO, improving the opportunities available requires reversing the progressive departure of companies from these areas, and creating tax incentives to retain the existing companies and attracting new ones. In education it means setting up special programmes, and allocating national, regional and local resources to improve the quality of education offered to the most vulnerable students in low GO areas. And in terms of social mix, it implies making efforts to de-segregate the areas that are becoming progressively more socially homogeneous, creating incentives and making direct investments to stimulate a supply of housing and services that will generate mixed-income communities.

Complementarily, at an institutional level, the mismatch between the GO sub-dimensions in the case of the Santiago Metropolitan Area attests to the need to introduce changes to local governments' capacity to invest in their localities. This requires, on the one hand, advancing the long-overdue process of devolving power to both the metropolitan and local governments. Particularly relevant is for local governments to have the institutional capacity to scale up their interventions. Massively homogeneous areas of low GO require large-scale interventions capable of making structural changes that can stop the negative circle of disadvantages. On the other hand, it requires improving the municipal fiscal instruments that will enable local governments not only to take advantage of the benefits of private capital investment in their districts but also to diversify their source of revenue beyond property tax collection.

It is worth mentioning that the policy approach to address the unequal distribution of opportunities within cities is highly contextual. This research has focused on a city that represents to some extent the reality of cities in most of Latin America, where the vast majority of the urban areas have poor GO, and their residents are highly vulnerable. Policies such as 'moving to opportunities' in the U.S. that allocate housing vouchers to residents in deprived neighbourhoods to move to areas with better opportunities, while relevant, might not be the most appropriate in cities where only a few areas benefit from a good GO. In these scenarios, improving the urban context where most of the population lives may be a more effective and realistic approach.

Finally, in terms of further developments, two elements are worth exploring in more depth. First, in this research, we have considered a bundle of indicators of opportunities out of which employment was the only variable given a different weight. Future research in this field should consider an attempt to measure and test what matters more for individuals' life chances, adequately weighing the indicators, as this would represent progress in respect to most of the research in the field that gives the same treatment to opportunities. And second, given that there is more and better data available from cities outside the North Atlantic world, there is the opportunity to extend and deepen the use of this analytical framework to other cities in Latin America and elsewhere. The neighbourhood opportunities approach represents a particularly informative approach to study Southern cities characterized by a high imbalance in the distribution of opportunity.

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Declaration of competing interest

None.

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Appendix I: Urban attributes sub-index dimensions and indicators

i) Accesibility and ii) Employment (see in Section 3 in the main text)

iii) Health and Environment

Among the most commonly used indicators to explain the relation between the levels of health and wellness of the population and the place of residence is proximity to hospitals and other health facilities, as well as proximity to open and safe green spaces, which prevents social isolation and promotes physical activity (Squires & Kubrin, 2005). In the last two decades, several quantitative and qualitative studies have shown that specific characteristics of a place (for example, the type of construction or social environments) are relevant to explaining the health outcomes of its residents (Cummins et al., 2007). However, the inequality of access to health services in different urban areas directly affects the health of the population. This translates into different rates of infant mortality in newborns, different proportions of the population being vaccinated, complications of common diseases or of easy prevention, and delay in the diagnosis of diseases such as cancer, among others (Wang, 2012). Empirical studies have shown that social deprivation may have crucial effects on the prevalence of non-communicable chronic diseases (Havard et al., 2008; Su et al., 2017; Weng et al., 2017). Concerning access to green areas, it is known that insufficient physical activity contributes to obesity and increases the risk of diseases such as diabetes (Babey et al., 2008). In this line of research, Abercrombie et al. (2008) showed that access to parks and open spaces greatly increases the amount of physical activity of residents. A critical aspect of this dimension is the effect of the neighbourhood environment on children development and opportunities (Acevedo-Garcia et al., 2014; Galster, Marcotte, Mandell, Wolman, & Augustine, 2007).

iv) Education

The main indicators that describe the opportunities offered by a neighbourhood in terms of education are the levels of education of the adult population, the students' poverty rate and the performance scores of the schools. There is evidence from the United States that living in neighbourhoods where a high percentage of adults have college degrees gives students better expectations of their education and future work (Orfield & Lee, 2005), together with a network of contacts that allows them to obtain better jobs (Chapple, 2006). At the same time, neighbourhoods where the heads of households have high cultural capital reinforce the perception that education is the way to obtain stable employment and thus ensure greater well-being in the future (Crowder & South, 2011). Concerning schools that have a high percentage of students in poverty, studies have shown a strong correlation between concentrated school poverty and poor performance, and a significant improvement in standardized test scores when poor students attend middle-income schools (Boger, 2005). Also, schools with a high proportion of poor students tend to have less qualified teachers, with less experience and greater instability in their jobs (Hochschild & Scovronick, 2003; Lupton, 2004). Regarding students' academic achievements, the evidence shows that high levels of mathematics achieved in school increase the likelihood of having a high salary at work (Rose & Betts, 2004) and good reading proficiency helps explain academic success at university (Hock & Deshler, 2003).

v) Urban life

The vitality of an area in terms of its commercial, social and cultural activities reflects how much the neighbourhood offers not only its residents but also the population from other areas of the city that are attracted to it, and contributes to deepening the neighbourhood integration of the city (Squires, Kubrin, 2005). Furthermore, the density of activities and services has been signalled to be a critical element of what housing affordability means for lower-income households. Granting low-income families an affordable living in terms of the proximity to more and better local services appears to be more desirable and sustainable over time than granting housing affordability in isolated and poorly served neighbourhoods (E. Mulliner et al., 2016, 2013).

vi) Safety

Crimes involving violence, homicide and rape are indicators of the security of an area (Lens, 2017; Sampson, 2001; Wilson & Greenlee, 2016). In general, these crimes are covered by the national and local press, contributing to the increase in the perception of insecurity among the residents of the places where the crimes have been committed. In an investigation in the city of Chicago, R.J. Sampson (2012) found that neighbourhoods with a high level of violence are highly correlated with low health rates and low community cooperation. There is also evidence that proximity to places where there have been homicides negatively impacts on children's outcomes in regard to cognitive skills such as vocabulary and math assessment scores (P.T. Sharkey, Tirado-Strayer, Papachristos, Raver, 2012b).

vii) Social mix

Poverty concentration and the socioeconomic composition of the area represents a critical attribute of a neighbourhood. Large-scale social homogeneity generated by the excessive concentration of low-income households in some neighbourhoods has been conceptualized as a neighbourhood effect that causes the isolation of these areas from the city, which contributes to their stigmatization (Friedrichs et al., 2005; Galster, 2001, 2012; Wacquant, 2016; Wacquant & Wilson, 1989). The adverse effects of poverty and racial concentration do not work linearly but, rather, have thresholds. When neighbourhoods surpass the threshold between 20 and 40% the ghetto dynamics appears, which means that residents are exposed to spaces with a high prevalence of urban social disorder such as teenage pregnancy, drug use, unemployment, violence and crime, school dropout, and divergence in moral and social values, among other social ills (Galster, 2012; Sampson & Raudenbush, 1999; Squires & Kubrin, 2005; Wacquant, 2016). The range of concentrated poverty cut-off is explained for two reasons: i) poverty concentration varying in different settings; and poverty line definitions (e.g. absolute poverty versus relative poverty) varies between countries. The mechanisms of the neighbourhood effect work mainly through socialization via role models and the peer effect (Galster, 2008; Sampson et al., 2002; van Ham et al., 2012). All of these disadvantages negatively impact the life chances of the residents of these areas (Andersson & Musterd, 2010; Chetty et al., 2014; Chetty et al., 2017; Hedman & Galster, 2013). Significant differences have been found in teen pregnancy, high school graduation rates, earnings between young adults that grew up in neighbourhoods with a high poverty concentration and young adults that grew up in neighbourhoods with a low poverty concentration (Fauth et al., 2005; Galster, Marcotte, Mandell, Wolman, & Augustine, 2007).

Appendix II: GO sub-indices (relative and absolute) correlation for period 1 and 2

Table A
Correlation of the GO sub-indices (relative and absolute) for period 1 and 2.

Relative indexes	Period 1 (2002–2005)	Period 2 (2012–2015)	
Variable vs. Variable	*R*	*R*	*# of valid cases*
UA_index vs. MFC_index	0.9166***	0.8979***	34
MFC_index vs. ULMA_index	0.8472***	0.8309***	34
UA_index vs. ULMA_index	0.8617***	0.9204***	34
Absolute indexes	Period 1 (2002–2005)	Period 2 (2012–2015)	
Variable vs. Variable	*R*	*R*	*# of valid cases*
UA_index vs. MFC_index	0.8371***	0.8373***	34
MFC_index vs. ULMA_index	0.7719***	0.7572***	34
UA_index vs. ULMA_index	0.7555***	0.8266***	34

*** $p < 0.001$.

When the correlation between all 11 sub-dimensions that build up the GO index (see Table 3) is analysed in more detail it is apparent that the sub-dimensions that more strongly correlate with all of the others are 'employment', 'municipal tax base', 'neighbourhood connectivity' and 'urban life'. Conversely 'neighbourhood safety', using relative measures, shows no significant correlations with any other sub-dimension, and using absolutes measures, shows a slightly positive correlation with 'land appraisal,' 'real estate activity,' 'employment' and 'urban life.' This indicates that more vibrant areas also show higher crime prevalence. A possible explanation for this finding is that areas with a higher GO are those that generally host a significant proportion of floating population who come from other areas of the city either to work, shop or study or for recreational purposes. This is certainly different from what is generally described in the literature analysing the GO, in which crime is more frequently observed in deprived areas of a city.

Particularly relevant is the social mix sub-dimension since it covers the component of socialization in the residential area. From the perspective of the GO analysis, the assumption is that a more socially diverse urban environment can positively impact people's life chances as it might give access to more effective social networks, or more and better services and infrastructure, or at least avoid the disadvantages associated with high poverty concentration, as discussed in the literature review.

The results show that the correlation of this sub-dimension with all of the rest, even though it happens to be significant, is quite low compared to the correlation observed between the other sub-dimensions. The three sub-dimensions that more strongly correlate with 'social mix' based on the relative measures are 'land appraisal,' 'neighbourhood connectivity' and 'education.' In terms of absolute measurement, 'education,' 'urban life' and 'employment' are the sub-dimensions showing the strongest correlation. Regardless of the type of measurement, the general positive correlation somehow contradicts the broad understanding that the presence of middle-low and low-income households negatively impacts land prices and that higher land prices prevent middle-low and low-income households from living in those areas. Similarly, a higher social mix is associated with areas with more active urban life, and better connectivity, employment and education.

Table B
Correlation between the 11 sub-dimensions of the GO index for period 2 (2012–2015).

a) Relative sub-dimensions		1	2	3	4	5	6	7	8	9	10	11
1	Land Appraisal	_										
2	Real Estate Activity	0.73***	_									
3	Municipal Revenues	0.71***	0.80***	_								
4	Municipal Local Tax Base	0.76***	0.79***	**0.96*** **	_							
5	Neigh_Connectivity	0.66***	0.66***	**0.84*** **	**0.86*** **	_						
6	Employment	**0.80*** **	**0.81*** **	**0.89*** **	**0.91*** **	0.77***	_					
7	Health and Environment	0.51**	0.54***	0.75***	0.74***	0.56***	0.74***	_				
8	Education	0.69***	0.64***	0.75***	0.80***	**0.81*** **	0.77***	0.61***	_			
9	Urban Life	0.67***	0.71***	**0.81*** **	**0.82*** **	0.74***	**0.86*** **	0.63***	0.68***	_		
10	Neigh_Safety	0.15	0.08	−0.02	0.07	−0.06	0.06	0.06	0.22	−0.11	_	
11	Neigh_Social Mix	0.58***	0.57***	0.48**	0.45**	0.59***	0.52**	0.22	0.68***	0.47**	0.15	_
b) Absolute sub-dimensions		1	2	3	4	5	6	7	8	9	10	11
1	Land Appraisal	_										
2	Real Estate Activity	0.45**	_									
3	Municipal Revenues	0.66***	0.46**	_								
4	Municipal Local Tax Base	**0.77*** **	0.47**	**0.88*** **	_							
5	Neigh_Connectivity	0.64***	0.24	**0.78*** **	**0.79*** **	_						
6	Employment	**0.84*** **	0.62***	0.63***	0.71***	0.55***	_					
7	Health and Environment	0.60***	0.60***	0.65***	0.63***	0.43**	0.54***	_				
8	Education	0.55***	0.45**	0.54***	0.70***	0.63***	0.56***	0.35*	_			
9	Urban Life	**0.81*** **	0.59***	**0.86*** **	**0.84*** **	**0.75*** **	**0.82*** **	0.61***	0.60***	_		
10	Neigh_Safety	0.39*	0.36*	0.18	0.28	0.16	0.37*	0.22	0.24	0.41*	_	
11	Neigh_Social Mix	0.51***	0.42**	0.47**	0.54***	0.56***	0.64***	0.13	0.64***	0.65***	0.47**	_

* $p < .05$.
** $p < .01$.
*** $p < .001$.

Appendix III: Relative GO sub-indices in period 1 and 2

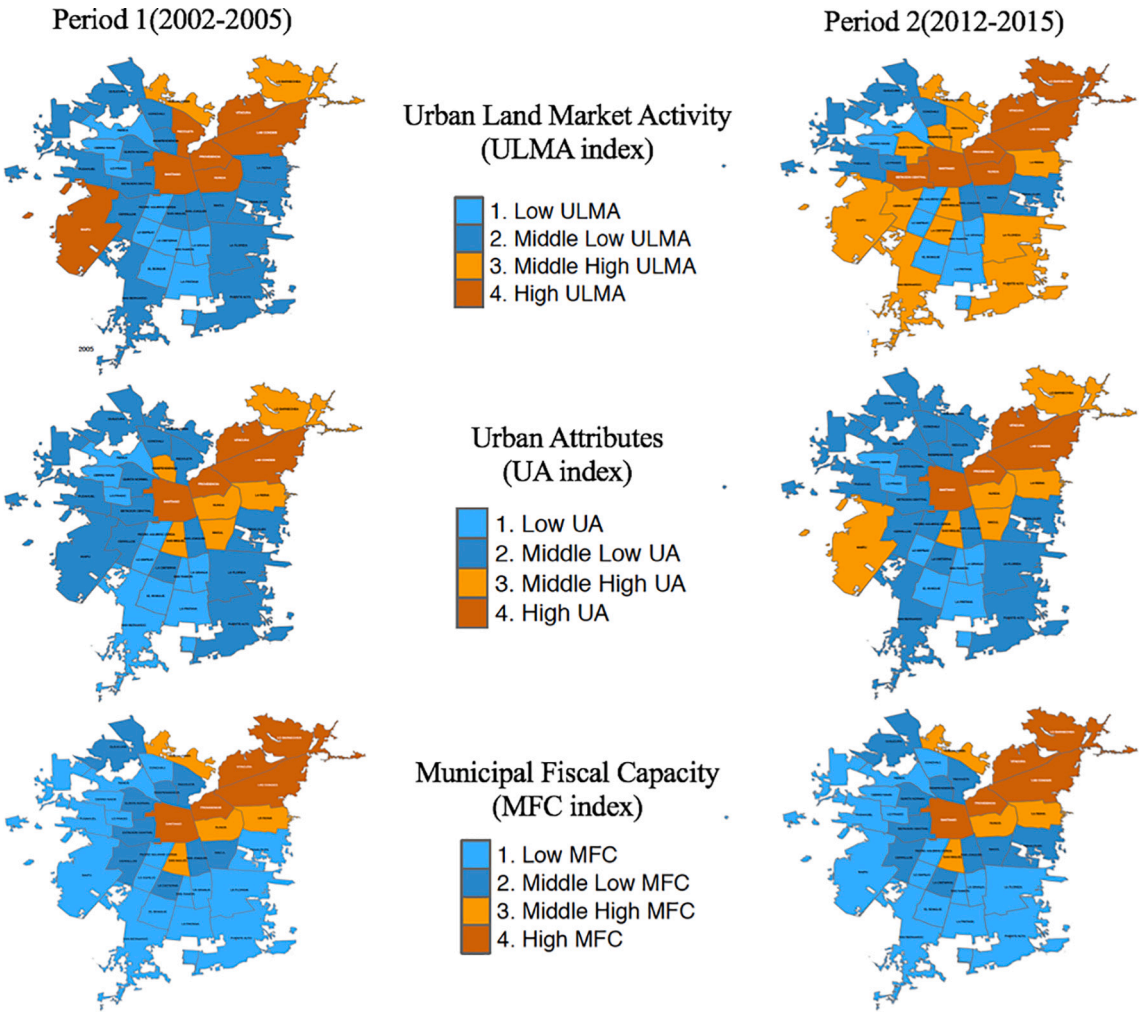

Fig. A. Relative GO sub-indices at the municipal scale.

Appendix IV: Different scenarios of decoupling between the three sub-indices of GO

Good examples of decoupling between the GO sub-indices are found in the municipalities of La Florida, San Bernardo, Puente Alto and La Reina. Specifically, La Florida municipality ranks quite high in terms of its relative ULMA sub-index, as well as in the UA sub-index, but rather low on the MFC sub-index. This municipality stands out for its very dynamic urban market in which strong commercial activity, an active real estate sector supplying apartment buildings located along the subway lines, and a particularly diverse socioeconomic background of its population converge.

Table C
Municipalities ranking based on the relative GO sub-indices for period 2 (2012–2015).

Relative measurement

Urban Land Market Activity	Urban Attributes	Municipal Fiscal Capacity
LAS CONDES	PROVIDENCIA	VITACURA
PROVIDENCIA	VITACURA	SANTIAGO
SANTIAGO	LAS CONDES	PROVIDENCIA
ESTACION CENTRAL	SANTIAGO	LAS CONDES
LO BARNECHEA	NUNOA	LO BARNECHEA
NUNOA	LA REINA	HUECHURABA
VITACURA	LO BARNECHEA	NUNOA
LA FLORIDA	MACUL	LA REINA
LA REINA	SAN MIGUEL	SAN MIGUEL
SAN MIGUEL	MAIPU	CERRILLOS
INDEPENDENCIA	LA CISTERNA	INDEPENDENCIA
RECOLETA	LA FLORIDA	RECOLETA
HUECHURABA	CERRILLOS	MACUL
LA CISTERNA	PUDAHUEL	LA CISTERNA
MAIPU	INDEPENDENCIA	ESTACION CENTRAL
PUENTE ALTO	PENALOLEN	QUILICURA
SAN BERNARDO	HUECHURABA	QUINTA NORMAL
CERRILLOS	QUINTA NORMAL	SAN JOAQUIN
QUINTA NORMAL	ESTACION CENTRAL	PENALOLEN
PUDAHUEL	RECOLETA	RENCA
MACUL	QUILICURA	PUDAHUEL
PENALOLEN	**PUENTE ALTO**	CONCHALI
QUILICURA	SAN JOAQUIN	LA FLORIDA
SAN JOAQUIN	SAN BERNARDO	SAN BERNARDO
CONCHALI	CONCHALI	MAIPU
LO PRADO	RENCA	PAC
RENCA	PAC	LO PRADO
CERRO NAVIA	LO PRADO	LO ESPEJO
EL BOSQUE	SAN RAMON	SAN RAMON
LA GRANJA	EL BOSQUE	LA GRANJA
LA PINTANA	LA GRANJA	**PUENTE ALTO**
PAC	LO ESPEJO	EL BOSQUE
SAN RAMON	CERRO NAVIA	CERRO NAVIA
LO ESPEJO	LA PINTANA	LA PINTANA

Another interesting example is the municipality of Huechuraba, which shows the opposite trend to La Florida. In Huechuraba, both the ULMA sub-index and the UA sub-index rank at a moderate level, whereas the MFC sub-index ranks high. This might be explained by the specificity of this municipality; although it has a large proportion of low-income population and a quite poor set of urban attributes and opportunities, it hosts a business district that works as a source of revenue (higher property taxes and commercial license fees) for the municipality.

The municipality of Macul has a different scenario as well. The UA sub-index ranks the municipality quite high, the MFC sub-index shows a moderate level, whereas the ULMA sub-index ranks it much lower than the other two indices. This is a particularly promissory scenario to foster housing and economic development, since this municipality offers a good set of urban attributes and opportunities to its residents, showing good municipal fiscal capacity, while the land prices are still quite low.

Finally, the municipality of Estación Central illustrates a case in which the land and real estate market are the forces driving the changes in the municipality.

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