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Understanding Changes in the Geography of Opportunity: The Case of Santiago, Chile

Working Paper WP18IB2

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December 2018

Abstract

Several pieces of research have been generated aimed at describing the geography of opportunity (GO) in metropolitan areas. However, little attention has been paid to the private and public-sector actions as part of the opportunities that are present in an urban areas as well as forces of urban change. Thus, this research proposes a methodology to measure the GO that not only depicts the set of opportunities individuals find in their place of residence but also encompasses the analysis of the land market and real estate investment and the local government fiscal capacity.

This paper offers an analysis of the geography of opportunity of Santiago Metropolitan Area (SMA) and its changes over time at the municipal and neighborhood scale using a multidimensional index compound by three sub-indices aimed at describing the geography of opportunity in a comprehensive way. The three indices generated capture the urban dynamics and urban context to which individuals are exposed to. These indices, both separately and together, allow capturing the set of opportunities that individuals find in their place of residence as well as monitor and compare changes in the GO over time.

The results show that the GO in Santiago Metropolitan Region is expanding. The great majority of the municipalities (21 de 34) has experienced positive changes in its GO in the 10 years in this research. Furthermore, the data also showed that the SMA host at least three type of cities. First, a city that shows high persistence in high GO. Second, a city that shows high persistence in low GO. And third, a city that is mutating and changing its GO with different levels of intensity (many of them moving up in the GO index categories, while few moving down) These most dynamic areas are those where the levels of social inclusion show better prospects.

Keywords: geography of opportunity, social inclusion, forces of urban change

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Understanding Changes in the Geography of Opportunity: The Case of Santiago, Chile

Introduction

In this paper, we offer an analysis of the geography of opportunity in Santiago Metropolitan Area (SMA) and its changes over time at the municipal and neighborhood scale using a set of three composite indices aimed at comprehensively describing the geography of opportunity, its changes over time and the depth of those changes.

The geography of opportunities refers primarily to those structural attributes of a neighborhood or larger area that affect people's life chances (Galster and Killen, 1995; Ihlanfeldt, 1999; Rosenbaum, 1995). Several pieces of research have been generated aimed at describing the geography of opportunity (GO) in metropolitan areas (Iceland, 1997; Lens, 2017; McClure, 2010, 2011; Wilson and 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. Second, although the great bulk of research on this topic has been generated in cities of the developed world (Friedrichs et al., 2003), the conceptual framework that the literature on the geography of opportunity offers is particularly relevant for cities in less developed regions that show high imbalance in the distribution of opportunities, as it is the case of Santiago's metropolitan area and many other cities in Latin America.

Therefore, while building upon the existing framework on the geography of opportunity, the methodology proposed in this paper aims to make a contribution on both the conceptualization and measurement of the geography of opportunity. We propose to broaden the understanding of the different aspects that explain the GO by bringing to the analysis urban and institutional dynamics that work as forces of change in the GO. Thus, besides portraying the set of urban attributes, we include in the analysis the land and real estate market activity and the local government fiscal capacity, as these two institutional aspects have a direct impact on the built environment given its capacity to (re)shape the urban attributes and the opportunities that individuals encounter in their place of residence.

Secondly, we provide evidence on the relevance of considering the municipal scale to complement the analysis at the neighborhood scale. Unlike cities in the developed world where the municipal scale shows quite low relevance in explaining people's income mobility (see Andersson and Musterd, 2010), in cities from less developed regions where the welfare system is particularly weak, the differences in public and private services and institutional supply vary significantly among municipalities.

The metropolitan area of Santiago represents an interesting case study to test the methodology proposed here. The city shows marked differences in the distribution of opportunities and resources. Urban infrastructure, public and private services (health, education, commerce), public amenities, job places, crime incidence among others are substantially different across municipal districts (see Garreton, 2017). Moreover, from 2000s onward, Santiago has experienced significant changes in the housing supply, urban transport system, distribution of

sub-centers and in the demographic and socioeconomic characteristics. These changes suggest that a process of redefinition of the urban structure and the distribution of opportunities within the metro area is taking place, and that might also be improving the levels of inclusion within the population.

The analysis of the Santiago Metropolitan Area (SMA) considers two scales: municipalities (34 municipalities) and neighborhoods (747 commuting zones). In order to measure the geography of opportunity we generated a GO index based on three composite sub-indices: the Urban Attributes sub-index based on a set of urban and social indicators of the areas analyzed, the Urban Land Market Activity sub-index based on land appraisal values and real estate activity data, and the Municipal Fiscal Capacity sub-index based on municipal revenues and tax base data to measure the capacity of local governments to attend the needs of the population. The construction of these indices comprises a set of 26 variables obtained from different data sources covering the years from 2002-05 to 2012-16.

Based on these three sub-indices we provide firstly a description of the geography of opportunity at the municipal and neighborhood scale and secondly a dynamic analysis of the changes in the GO index at the municipal and neighborhood scale.

This work is organized as follows. First, we present the literature review in which the concept of the geography of opportunity is discussed as well as the different methodological approaches to measuring it, where we discuss the conceptual framework we propose for measuring the GO. Second, we present the city of Santiago as a case study, describing the main features of the metropolitan area. Third, we describe the data and methodology, including the indices that derive from the conceptual framework. Fourth, we present the main results obtained at the municipal and neighborhood level. Fifth, we discuss the contribution of the conceptual framework, the methodology proposed and its implications for urban policy design.

Literature Review

Geography of Opportunity and Income Dynamics

The starting point of the conceptualization of geography of opportunity is the concept of 'neighborhood effect,' which refers to the idea that poor neighborhoods have a negative impact on people's life chances above and beyond the effects of their individual characteristics (Fisher and Weber, 2004; Sampson et al., 2002; Sampson and Raudenbush, 1999; van Ham et al., 2012; Wacquant and Wilson, 1989). Wilson (1987) raised the problem that structural changes, primarily related to a mismatch between the place of residence and jobs location plus the exodus of middle-income households from poor neighborhoods, 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 structural exogenous factors contribute to shape the likelihood of low-income households to experience upward income mobility (Iceland, 1997). The opportunities at neighborhood level operate through collective socialization (role and peer model), social control, social capital (supporting networks), access to job

opportunities and institutional supply (Andersson and Musterd, 2010; Galster, 2012; Sampson et al., 2002).

Based on this studies, Galster and Killen (1995) coined the concept of geography of opportunity to depict the fact that opportunities are distributed spatially and not always in a balanced way. Geography of opportunity refers to the structure of social, economic, environmental and cultural opportunities faced by different groups that inhabit metropolitan regions (Andersson and Musterd, 2010; Briggs, 2003; Galster and Killen, 1995; Squires and Kubrin, 2005; Wilson and Greenlee, 2016). Disparity in the distribution of opportunities across a city is relevant to the extent that residential mobility is constrained. Not everyone has the capacity to move 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 of socioeconomic mobility are strengthened or deteriorated—due to concentration of advantages or disadvantages—depending on the place of residence (Andersson and Musterd, 2010). The impact is both as an objective access to opportunities and resources and as a subjective perception of the structure of opportunities (Galster and Killen, 1995).

Although initial assessments about neighborhood effect have not shown a significant impact on people's life chances (see Kling et al., 2007), new assessments encompassing longer period of time have shown more robust results (see Rothwell, 2015). Urban environments with greater social diversity and a good set of opportunity have a positive and statistically significant impact on income mobility and social inclusion of low-income residents (Galster et al., 2008; Hedman and Galster, 2013; see review by Rothwell, 2015). 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 experienced more significant income mobility shared the following five distinctive attributes: lower segregation, lower income inequality, better schools, greater social capital, and higher family stability. Further, 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 concentration of poverty is highly non-linear, even a slight reduction in poverty in places where social housing is located can have a strong effect on its residents. This is aligned with the work of Hedman and Galster (2013, p. 117), 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 low-income households. Conversely, a higher concentration of low-income households may reduce employment rates and incomes of residents of that same social condition resulting from the negative socialization of work, weak supporting networks, and stigmatization of the area or neighborhood due to the concentration of poverty.

All in all, the results coming from the most recent research on geography of opportunity are key to justify policy interventions that aim at tackling social problems by promoting social diversity and better opportunities where people live.

Measuring Geography of Opportunity

Finding the Right Scale

The appropriate scale to measure the effects of the geography of opportunity is a critical aspect to be determined. The neighborhood effect varies depending on the scales and definitions of urban areas (Galster, 2012; Sampson et al., 2002; van Ham et al., 2012; Wilson and Greenlee, 2016). Galster (2008) and Andersson and Musterd (2010) emphasize the importance of defining the scale that 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 neighborhood scale in which the differences in the GO occur in the 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 differences in the GO are explained by the location of the job places according to the type and skills they require. Andersson and Mustard (2010, p. 40) tested Galster's three GO scales definition in Sweden. The results showed that the neighborhood scale has a more significant effect in 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 its districts, makes it predictable that the effects at the municipal level won't be significant.

Somehow the opposite occurs in the case of many cities in Latin America including Santiago's metropolitan area in Chile, where the differences between municipalities are extremely high. For instance, in the city of Santiago there are municipalities in which poverty does not exceed one percent, while in others it is higher than 20 percent.[1] The urban, social and economic context in cities from developing countries in which the welfare estate, housing and public transport policies and the socioeconomic characteristics of the population are different from those that are generally described in the literature that discusses the GO mainly in cities of the developed world (Andersson and Musterd, 2010; Chetty et al., 2014; Galster, 2001, 2008) justifies the pertinence and relevance of considering the municipal scale to adequately capturing the GO distribution.

Seizing the Dimensions of the Geography of Opportunity:

The dimensions included in studies addressing the geography of opportunity vary from case to case, although there are some key dimensions that are consistently present, namely those related to neighborhoods' structural characteristics (Lens, 2017). These dimensions have in common that are someway 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 are able to capture the complexity of neighborhoods' opportunities as well as to enable a benchmark analysis that can help not only monitoring but also comparing between different urban areas (Lens, 2017; Lens and Reina, 2016; McClure, 2010, 2011; Walter et al., 2015; Wilson and Greenlee, 2016). However, these measurements somehow are bounded to a static depiction of the GO, falling short in their capacity to describe the dynamic component of the GO and its mechanisms of change.

[1] Data obtained from National Municipal Information System (SINIM), 2016.

The methodology we propose here acknowledges that all different urban agents can actively shape the attributes of their places of residence. According to Galster (2001, p. 2116) there are four type of urban or neighborhood actors: households, business people, property owners and local government that not only 'consume' places through their actions and decisions (e.g. housing, land, operating business/commercial activities, paying/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 GO through three dimensions that allow not only to portray the set of opportunities available in certain area but also to understand the mechanisms of changes in the GO over time. These dimensions are: (i) the set urban attributes; (ii) the urban land market activity and (iii) the municipal fiscal capacity.

Linkage between the Urban Attributes Dimension and the GO

Lens' (2017, p. 14) approach to measuring the geography of opportunity is of particular interest as it focuses on assets and opportunities of places rather than disadvantages and elements of neighborhood distress—as it is commonly presented in studies addressing the neighborhood effect. Accordingly, McClure (2010, p. 107) states that neighborhoods with high level of opportunities are those that offer access to good jobs, good schools, good affordable housing and that are free of crime. The main idea behind is that poverty clustering analysis is not enough (McClure, 2011). There is an increasing trend to measure neighborhood opportunity from a more holistic approach. The dimensions of geography of opportunity most frequently found in the literature are: education related to access to high-performing education (Chetty et al., 2014; Lens, 2017; Wilson and Greenlee, 2016), access to jobs, including accessibility and job density and local economy (number, type and size of firms) (Iceland, 1997; Lens, 2017; Squires and Kubrin, 2005; Wilson and Greenlee, 2016), poverty concentration and the socioeconomic composition of the area (Chetty et. al, 2014; Andersson & Musterd, 2010), public safety, including crime exposure (Lens, 2017; Sampson, 2001; Wilson and Greenlee, 2016), housing affordability (Li, 2011; Mulliner et al., 2016; Sampson, 2001), local services (including financial services) and institutions, including health care services (Galster, 2008; Squires and Kubrin, 2005; Wilson and Greenlee, 2016).

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 translates not only in a significant flow of capital into certain urban area but also it can be 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 lays in the fact that both are described and valued throughout the assessment of a set of multiple location attributes. In the case of the land and real estate, the assessment of the location attributes ends up in a price/value ascribed to a specific piece of land and/or building (Kanemoto, 1988; Kok et al., 2014; Moore, 2009; Whipple, 2006), whereas in the case of the geography of opportunity, the

assessment of location attributes ends up describing the level of opportunities individuals encounter in the surrounding area where they live. All these attributes take a relative value as they are built based on a comparison with attributes in similar or competing areas (Galster, 2001). Therefore, 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. In other words, the better the geography of opportunity (which is given by the type of regulations in the area, amenities, public infrastructure and the economic and social forces in the area) the higher the price of the land. Conversely, areas with a poor geography of opportunity, translate into lower property prices.

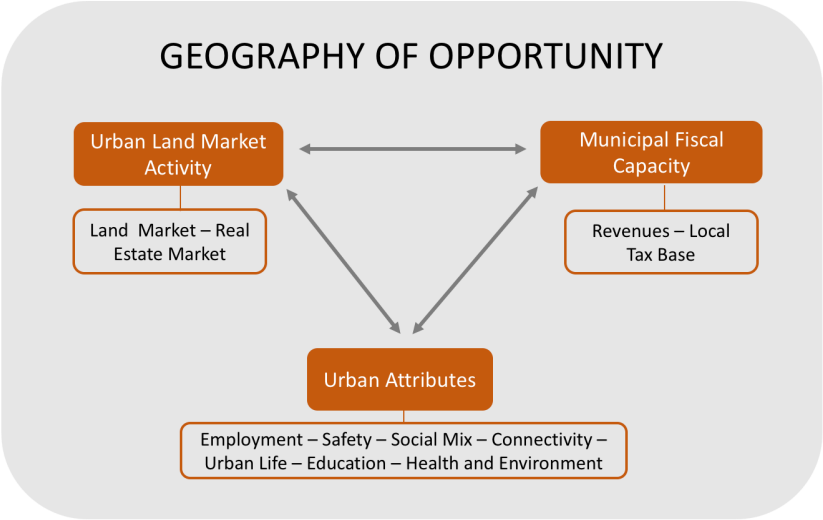
Linkage between the Local Government Fiscal Capacity Dimension and the GO

Investment and service provision by the local government have a direct impact on the quality of life and the opportunities residents might access to. Municipal revenues are generally split between those funds that are centrally transferred from those that are locally collected mainly through licenses fees and property taxes. Generally, revenues from central branches of the national government are ear-marked, not allowing much maneuver to municipalities to prioritize certain activities, populations and/or areas. Conversely, municipal revenues are the ones that have the potential to make a difference in terms of municipal investment and proactive actions taken from 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, public buildings (e.g. libraries, community centers) 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—main source of revenues of local governments. Hence, poor areas with a weaker tax base will likely show an also weaker service structure and low-quality facilities, offering less opportunities to residents. Massey and Denton (1993) clearly exposed the vicious circle that affect deprived areas with high concentration of poor population that negatively impacts municipal tax base, which translate not only into the provision of fewer services and of lower quality, but also in the further loss of well-off population that moves to better served areas, reinforcing the process of general decline in the opportunities available in the area.

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 that can be found 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, that is, they are inter-correlated dimensions, as is shown in the flowchart in figure 1 below. For instance, the municipal fiscal capacity affects not only the number, type and quality of services and infrastructure provided in their localities (an important part of the urban attributes of a certain area) but also determines the real estate and land market readiness to invest in the area, which at the same time, impacts positively the municipal tax base and revenues and therefore the local government capacity to provide good quality services.

Figure 1: Conceptual framework for measuring the GO



The Case Study: Santiago' Metropolitan Area in Chile

Santiago's Metropolitan Area (SMA), is the capital of Chile, and the most densely populated city in the country concentrating 40.5 percent of population (7 million according to the latest Census 2017). It is located in the geographic center of the country, in a landlocked area near the Andes mountain chain. Santiago is the political, financial, educational and cultural center of the country. It concentrates all the main agencies of the national government as well as 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 of cultural centers.

In the SMA poverty has been significantly reduced from 42.6% to 7.7% between 1990-2015.[2] However, behind these macro changes, the net changes showing a high vulnerability to poverty remain hidden. According to the Chilean longitudinal survey PCASEN, 45.7% of the Chilean population experienced poverty during at least one year, which shows a 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 CASEN 2015.

The significant poverty reduction, though high vulnerability to poverty, didn't occur in a neutral urban context. Santiago's Metropolitan Area 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, crime incidence among others are radically different among municipal districts. As it can be seen in table 1, the differences in social indicators (poverty rate, education performance, housing composition) and in the municipal resources (as proxy of local governments capacity to attend the needs of the population) among

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

the top three and bottom three municipalities (out of the 34 municipalities that make up the Santiago metropolitan area) are very significant.

Table 1: Top and bottom 3 municipalities of SMA based on social indicators

Municipal districts		Poverty (%) *	Housing (%) with tax abatements**	Education Municipal Schools with PSU score equal or over 450 points (%)***	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 (this works as a proxy of the proportion of social housing, which benefits of this tax abatement); ***PSU corresponds to a national test for students to entry universities.

However, since the 2000s the SMA has been experiencing significant changes in its pattern of urban development that might entail changes in the distribution of opportunities across the city. These changes have occurred in the housing supply, in the urban transport system, in the distribution and consolidation of urban sub-centers, and in the socioeconomic and demographic characteristics of the population.

In the last decade the housing supply started to shift from an almost universal provision of low-rise housing units in the peripheral areas of the city to a high densification in the central areas of the city together with low-rise housing developments through social housing and gated communities that continues in the outskirts. This trend is somehow connected with a change in the demographic composition of the population that is showing different housing preferences. In the last decade size of households decreased, the number of single-person household increased, poverty was significantly reduced and income per capita increased (Bergoeing and Razmilic, 2017). Particularly relevant are the changes observed in the transport system. Several new subway lines have been built in the recent past and a major reform to the public transport system was implemented 12 years ago, redefining mobility behaviors of a large proportion of the population. Particularly relevant is the fact that areas of the city with medium land prices were the most affected by this change in the commuting pattern, in particular the daily commute of women who tend to work closer to their place of residence (Prieto and Brain, 2016). Additionally, there are

now 19 sub-centers across the SMA that have gained stability in the last decade (Truffello and Hidalgo, 2015), which shows a change in the historically strong monocentric structure of the city.

Together, these changes are leading to a redefinition of the urban structure and of the distribution of opportunities within the SMA. This entails transitioning from a mono-centric to a polycentric city, which could have an impact in the geography of opportunity for the most vulnerable population and therefore in their chances to experience upward income mobility.

Data and Method

Data

For the analysis we selected a total of 26 variables to build the GO index that is 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 2012-2015). The variables were selected based on two criteria: (i) that they had potential to change over time and (ii) that they have been tested in previous studies that relate to GO dimensions included in the conceptual framework proposed.

The data used was obtained from seven datasets sources. First, the land value appraisal from the Internal Revenue Service (SII). Second, municipal data from the System of Municipal Information (SINIM). Third, neighborhood data provided by Mapcity, which includes information on employment and local economy, socioeconomic composition of the population, amenities and services (including POIs), educational level of the population, transport accessibility among others. Fourth, data on daily mobility from the Origin-Destination Survey. Fifth, building permits and employment data form the National Institute of Statistics (INE). Sixth, crime data from the Ministry of Interior. Seventh, the National Survey of Socioeconomic Characterization (CASEN). Table 2 provides detailed information on the sources of data, variables and years analyzed.

Method

Two Relevant Scales for GO: Municipality and Neighborhoods

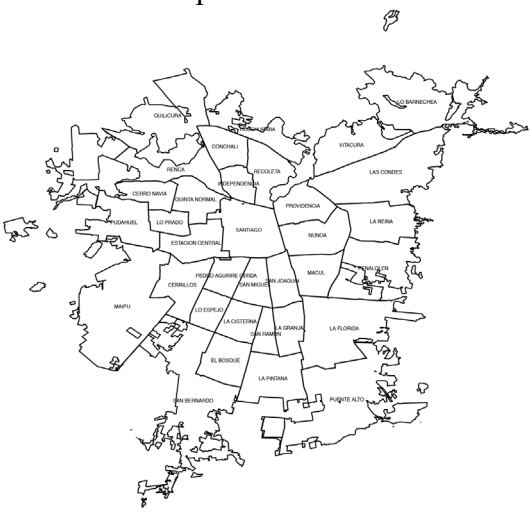
A critical aspect in the construction of GO indices is the choice of the appropriate scale to describe the effect that the attributes of a given area have on its residents. In cities with a high imbalance in the distribution of opportunities, as it is the case of SMA, it is important to study the variations in the geography of opportunity not only at the neighborhood scale, where the neighborhood effect mechanism relate more to process of 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 and Musterd, 2010).

The neighborhood boundary we used in this research are the commuting zones defined by the Ministry of Transport to study the origin and destination of trips in Santiago Metropolitan Region in 2012 (EOD-zones for its acronym in Spanish). The criteria used to define the

boundaries of these commuting zones are the following: the political-administrative division, the land regulations, geomorphological characteristics, physical and socioeconomic characteristics, and the conditions of accessibility and connectivity. Figure 2 shows the 734 neighborhoods in the SMA based on the EOD-zones. The municipality with the most commuting-zones (54) is Santiago municipality, and the municipalities with the fewest commuting-zones (11) are El Bosque and Lo Espejo.

Figure 2: SMA's municipal and neighborhoods (commuting-zones) boundaries

SMA 34 Municipal boundaries



SMA 734 commuting-zones boundaries

Dimensions, Sub-Dimensions and Indicators of the GO

Following the structure of the conceptual framework to measure the GO, for each of the three dimensions we have generated a composite index comprising a total of 11 sub-dimensions and 26 indicators of opportunity that we have identified in the literature. Each indicator has been assigned either a positive (+) or negative (-) sign to describe the way in which the information provided by the variable either adds or subtracts within the index (see table 2).

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 identifying: (i) areas that are better or worse located in the city in terms of its 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[3]) and (ii) the real estate

[3] The land appraisal of 2005 is segmented into zones with similar characteristics (ZCS for its Spanish acronym), defined according to the predominant uses of the land, similar level of development, size and shape of sites in each

activity (total square meters built in the year). The land value appraisal reflects the difference in urban, economic and social attributes of each municipality as well as of each neighborhood (commuting zones). The real estate activity works as a proxy of the urban economic dynamism in the area. For the land market indicator, we have chosen to use the highest land appraisal since it discriminates better between areas, compared to average land value which brings together in the same category municipalities with very different set of urban attributes. Hence, higher appraisal values in the ULMA sub-index reflect the access to good quality services in education, health, employment, connectivity and other urban attributes when compared to areas of medium or low land appraisal value as well as low real estate activity.

The UA sub-index synthesizes in a single measure the information of several sub-dimensions, all of which have influence on the social and income mobility of households. The main assumption behind this sub-index is that its selected dimensions have a combined effect on the life chances of residents. In other words, the UA sub-index reflects the relative contribution of positive and negative effects of a neighborhood or municipality on its residents.

The UA sub-index sub-dimensions are: (i) Health and Environment which comprises the access to hospitals and health centers (nº/100,000 inhabitants), proportion of the population covered by health care system, green areas with maintenance per inhabitant (m2/inhabitants), (ii) Employment, that contemplates unemployment rate (%), total number of firms (nº), and employment competition, that is, rate of jobs offered over the labour force in the area (%), (iii) Education, comprising proportion of high school students that graduate (%), proportion of students in poverty (%), proportion of students in public school scoring more than 450 in PSU Test (%), (iv) Neighborhood Social Mix, this comprises 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 5 socio-economic groups, 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% of lower income level), (v) Safety, that reflects the incidence of violent crimes and severe injuries (nº/100,000 inhabitants), homicide (nº/100,000 inhabitants), rape (nº/100,000 inhabitants); (vi) Urban Life, that measures access to points of interest (POIS) (nº/1,000 inhabitants), access to banks, ATM, supermarkets and pharmacies (nº/1,000 inhabitants, and total square meters build of commercial and entertainment premises (m^2) and (vii) Connectivity, that measures the average travel time to work (minutes), public transportation stops and underground stations (nº/1,000 inhabitants) and automobile access by household (%).

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 that considers, the municipal revenue per capita (US$) and share of the municipal common fund[4]

municipality. Each ZCS is assigned a base land value, which corresponds to the most common type of sites in each ZCS. There are sites with higher and lower prices with respect to the base value of the ZCS. The land appraisal of 2012 is segmented through the definition of homogeneous areas (HA). The AH corresponds to a segmentation based on the prevailing uses of the land of each municipality as well as on the urban attributes of an area. For comparison purposes, we adjusted the values to CPI 2012 values and converted to the average dollar value in the year 2012.

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

over the total municipal revenues (%), and (ii) Local Tax Base, that estimates the municipal local tax revenues per capita (US$) and proportions of properties with tax exemptions (%).

Relative and Absolute Measurements of the GO

The analysis offered here contemplates the use of both relative and absolute measurements of the GO. The relative measurement is used to describe the GO and its dimensions for each period by ranking and classifying the areas as high, middle-high, middle-low and low GO. This method allows capturing the position of each urban area compared to the all the rest, which is particularly informative in cities with high levels of inequality and/or imbalance in the distribution of opportunities.

Complementarily, the absolute measurement enables to distinguishing improvements in the GO according to pre-established criteria of what is a minimum standard desirable. This is particularly useful in the analysis of change, as it will clearly identify the thresholds that would 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 z-score, performed for the 26 indicators of the 11 sub-dimensions of opportunity. The z-score is an arithmetic transformation of values that allows 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 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 the indicators of the sub-dimensions have equal weight, except for the employment sub-dimension that was given a higher weight. Finally, the value of the three sub-indices are re-scaled between a range of 2 and -2, where higher values indicate a better geography of opportunity.

The relative changes in the GO and its dimensions between period 1 and 2 are measured according to the number of positions each urban area goes up or down in the rank from one period to another, which allows 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.

Table 2: Dimension, Sub-dimensions and indicators of the three sub-indices of the GO index

Dimensions (sub-indexes) & subdimensions	Indicators	Scales*	Impact on index	Years	Data source**
1. Urban Land Market Activity (ULMA) sub-index					
1.1 Land appraisal	Commuting zone with highest land appraisal (US$/m2)	M & N	(+)	2005 ; 2012	SII
1.2 Real estate activiy	Total square meters built in the year (m2)	M	(+)	2005 ; 2012	INE
2. Municipal Fiscal Capacity (MFC) sub-index					
2.1 Municipal Revenue	Municipal revenue per capita (US$)	M	(+)	2005 ; 2012	SINIM
	Municipal Common Fund/Total Municipa 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) sub-index					
3.1 Connectivity	Average travel time by household (minutes)	M & N	(-)	2001 ; 2012	EOD
	Public transportation stops and underground stations	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 (nº)	M & N	(+)	2005 ; 2015	SII
	Employment competition (%)	M & N	(+)	2001 ; 2012	EOD/INE
3.3 Health and Environment	Hospitals and health centres (nº/100,000 habs)	M & N	(+)	2016	Mapcity
	Health Care System Access (%)	M	(+)	2003 ; 2013	CASEN
	Green areas with maintenance per inhabitant (m^2/hab)	M	(+)	2005 ; 2012	SINIM
3.4 Educational	High school graduation (%)	M	(+)	2002 ; 2012	INE
	Students in poverty (%)	M	(-)	2006 ; 2013	CASEN
	Students in public school scoring more than 450 in	M	(+)	2005 ; 2012	SINIM
3.5 Urban Life	Access to pois****(nº/1,000 habs)	M & N	(+)	2016	Mapcity
	Access to banks, ATM, supermarkets and pharmarcies	M & N	(+)	2016	Mapcity
	Total square meters of commercial and entertainment	M	(+)	2005 ; 2012	INE
3.6 Safety	Crime with violence and severe injuries (nº/100,000	M	(-)	2005 ; 2012	Home
	Homicide (nº/100,000 habs)	M	(-)	2005 ; 2012	Home
	Rape (nº/100,000 habs)	M	(-)	2005 ; 2012	Home
3.7 Neighborhood Social Mix	Social mix index	M	(-)	2002 ; 2012	INE
	Poverty rate (%)	M	(-)	2002 ; 2012	INE

Notes: *Municipality (M), Neighborhood (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 (points of interest).

The absolute measurement requires three steps which are the following: The first step is to use two cut-off thresholds to classify the indicators of the GO into three categories. The uppercut is the 85th percentile of the distribution of each indicator in the first period analyzed, 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 add the value of each indicator in a sub-dimension to classify them into 5 categories (low, middle-low, moderate, middle-high and high). For example, 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 minimum of 2. Therefore, 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 11 sub-dimensions and 26 indicators. For the MFC sub-index, which has two sub-dimensions and 2 indicators per sub-dimension, the values range between 12 and 4 to form the 5 categories. And for the UA sub-index, which has 7 sub-dimensions, 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 dimensions of the GO index that 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 absolute changes in the GO and its dimensions are estimated by measuring the difference between period 1 and period 2 for each sub-dimension in a scale that ranges between -4 to 4. This not only provides information on the changes occurred but also the depth of the changes in the GO. These changes are classified as follows: significant improvement, moderate improvement, no improvement, moderate decline, and significant decline.

Results

Table 3 gives descriptive statistics of the 26 indicators used to build the GO index based on three composite sub-indices described above. All the information shown in the table is at the municipal scale, although several data have been built from estimations at the neighborhood scale (734 commuting-zones) and then aggregated to the municipal scale as it is the case, for instance, of the neighborhood social mix.

Table 3: 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	1,269
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	7801	6248	2781	33296	34	8966	7324	2970	34300
Employment competition (%)	34	157.1	227.1	26.4	1233.6	34.0	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 built of commercial and entertainment premises built in that year (m2)	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 h	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. Neighborhood 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

Geography of Opportunity Index and Sub-indices

One of the most important assumptions of this research has been that the three dimensions of the GO that structure the conceptual framework are significantly interconnected. From Galster's (2001) conceptualization, we can also assume that each dimension works both as producer and consumers of the places in which they take place. Thus, positive and negative changes in one dimension will affect the other dimensions outcomes. This means, for instance, that a very active urban land market, should be correlated with a strong municipal fiscal capacity and a rich set of urban attributes.

Overall the results show that there is a strong correlation between all the three indices both relative and absolute (see table 4). The correlation between the UA sub-index and the ULMA sub-indices is particularly strong. This proves the relevance of analyzing the three dimensions

proposed to obtain a more comprehensive understanding of the GO, especially when it relates to its changes over time.

Table 4: 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_inde	0.8472***	0.8309***	34
UA_index vs. ULMA_index	0.8617***	0.9204***	34

***p < 0.001

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_inde	0.7719***	0.7572***	34
UA_index vs. ULMA_index	0.7555***	0.8266***	34

***p < 0.001

When analyzed in more detail the correlation between all the 11 sub-dimensions that build up the GO index (see table 5 with the correlation matrix) it is apparent that sub-dimensions that more strongly correlate with all others are 'employment', 'municipal tax base', 'neighborhood connectivity' and 'urban life'. Conversely 'neighborhood 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 show also higher crime prevalence. Possibly an explanation for this finding is that areas with higher GO are the ones that generally host a significant proportion of floating population coming from other areas of the city either to work, shop, study or for recreational purposes, increasing the prevalence of crime in those areas. This is certainly different from what is generally described in the literature analyzing the GO, in which crime is more frequent observed in deprived areas of a city. Further, in the case of the SMA, the presence of police stations does not relate to safer environments but rather the contrary. More policy stations reflect more unsafe areas that needed more police control. For this reason, we decided not to use that indicator (commonly used in similar studies) and using simply crime prevalence.

Particularly relevant is the social mix sub-dimension as 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, more and better services and infrastructure, or at least avoid the disadvantages associated to high poverty concentration as it was discussed above in the literature review.

The results show that the correlation of this sub-dimension with all the rest, even though 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 the 'land appraisal,' 'neighborhood connectivity' and 'education.' In 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 impact land prices and that higher land prices prevent middle-low and low-income households to live in those areas. Similarly, higher social mix is associated with areas with more active urban life, better connectivity, employment and education. Hence it seems that in SMA areas with high land value, well connected, rich urban life, jobs and education opportunities are also areas with higher degrees of social mix.

Table 5: Correlation between the 11 sub-dimensions of the GO index for period 2 (2012-2015)

	Relative sub-dimensions	1	2	3	4	5	6	7	8	9	10	11
1	Land Appraisal	_										
2	Real Estate Activity	.73***	_									
3	Municipal Revenues	.71***	.80***	_								
4	Municipal Local Tax Base	.76***	.79***	**.96*** **	_							
5	Neigh_Connectivity	.66***	.66***	**.84*** **	**.86*** **	_						
6	Employment	**.80*** **	**.81*** **	**.89*** **	**.91*** **	.77***	_					
7	Health and Environment	.51**	.54***	.75***	.74***	.56***	.74***	_				
8	Education	.69***	.64***	.75***	.80***	**.81*** **	.77***	.61***	_			
9	Urban Life	.67***	.71***	**.81*** **	**.82*** **	.74***	**.86*** **	.63***	.68***	_		
10	Neigh_Safety	.15	.08	-.02	.07	-.06	.06	.06	.22	-.11	_	
11	Neigh_Social Mix	.58***	.57***	.48**	.45**	.59***	.52**	0.22	.68***	.47**	.15	_

*p<.05 ; **p < .01 ; ***p < .001

	Absolute sub-dimensions	1	2	3	4	5	6	7	8	9	10	11
1	Land Appraisal	_										
2	Real Estate Activity	.45**	_									
3	Municipal Revenues	.66***	.46**	_								
4	Municipal Local Tax Base	**.77*** **	.47**	**.88*** **	_							
5	Neigh_Connectivity	.64***	0.24	**.78*** **	**.79*** **	_						
6	Employment	**.84*** **	.62***	.63***	.71***	.55***	_					
7	Health and Environment	.60***	.60***	.65***	.63***	.43**	.54***	_				
8	Education	.55***	.45**	.54***	.70***	.63***	.56***	.35*	_			
9	Urban Life	**.81*** **	.59***	**.86*** **	**.84*** **	**.75*** **	**.82*** **	.61***	.60***	_		
10	Neigh_Safety	.39*	.36*	0.18	0.28	0.16	.37*	0.22	0.24	0.41*	_	
11	Neigh_Social Mix	.51***	.42**	.47**	.54***	.56***	.64***	0.13	.64***	.65***	.47**	_

*p<.05 ; **p < .01 ; ***p < .001

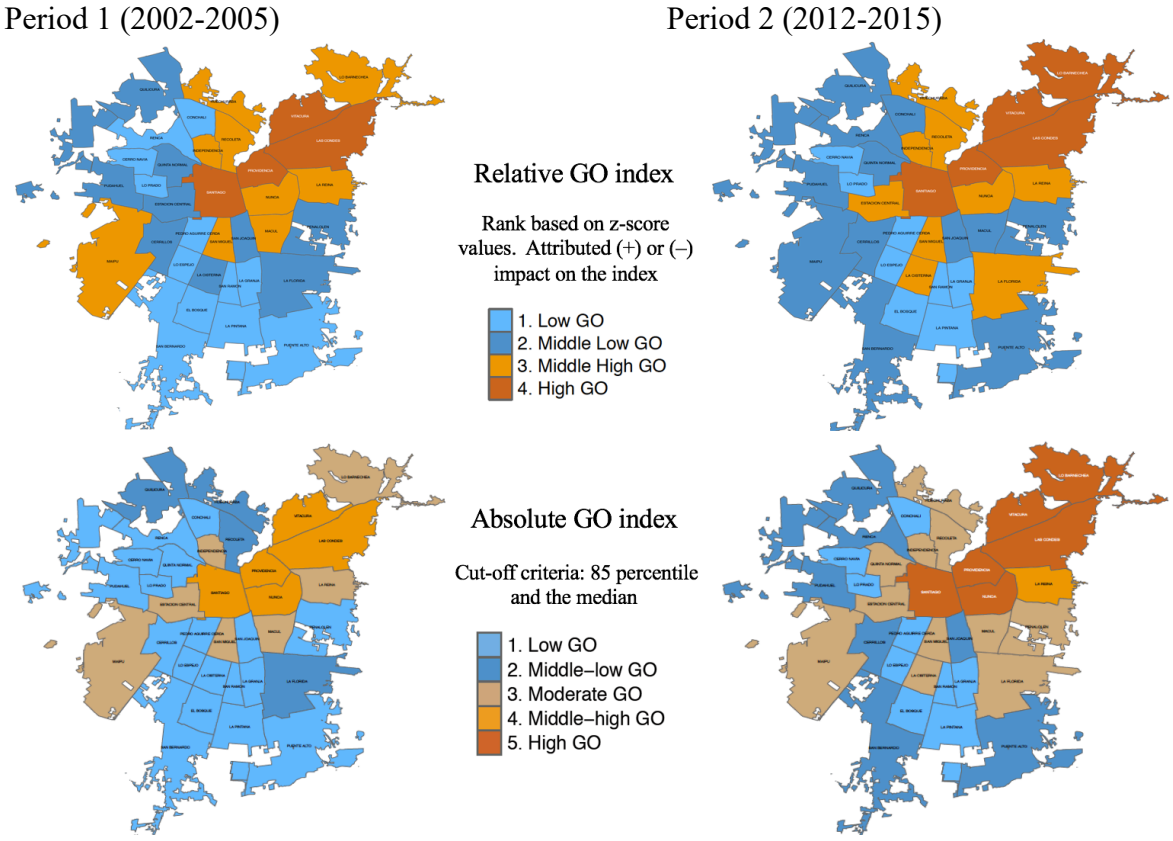
Relative and Absolute Measurement of the GO at the Municipal Scale

As Figure 3 illustrates, both GO indices (relative and absolute) in period 1 depicts a high concentration of municipalities that fall in the category of Low GO. The relative index though depicts a better GO than the absolute GO shows. Indeed, in period 1, no municipality classified within the high GO when using the absolute index. The scenario clearly changed over time. In period 2, a clear expansion in the distribution of opportunities occurred. The number of municipalities with low GO decreased from 12 to 8 (relative index) and from 18 to 9 (absolute index). However, the maps for the two periods show the persistence of clusters of Low GO located in the south-east part of the city (El Bosque, San Ramon, La Pintana, La Granja, Lo Espejo and Pedro Aguirre Cerda), as well as in the north-west (Lo Prado, Cerro Navia, Conchali).

The measurement of the GO based on absolute figures leads to a deeper understanding of the level and extent of opportunities that are present in certain areas, in this case, at the municipal scale. This means, setting up minimums and/or maximum thresholds for each dimension of the GO (and therefore its sub-dimensions and indicators) defining upper and lower cuts for each category.

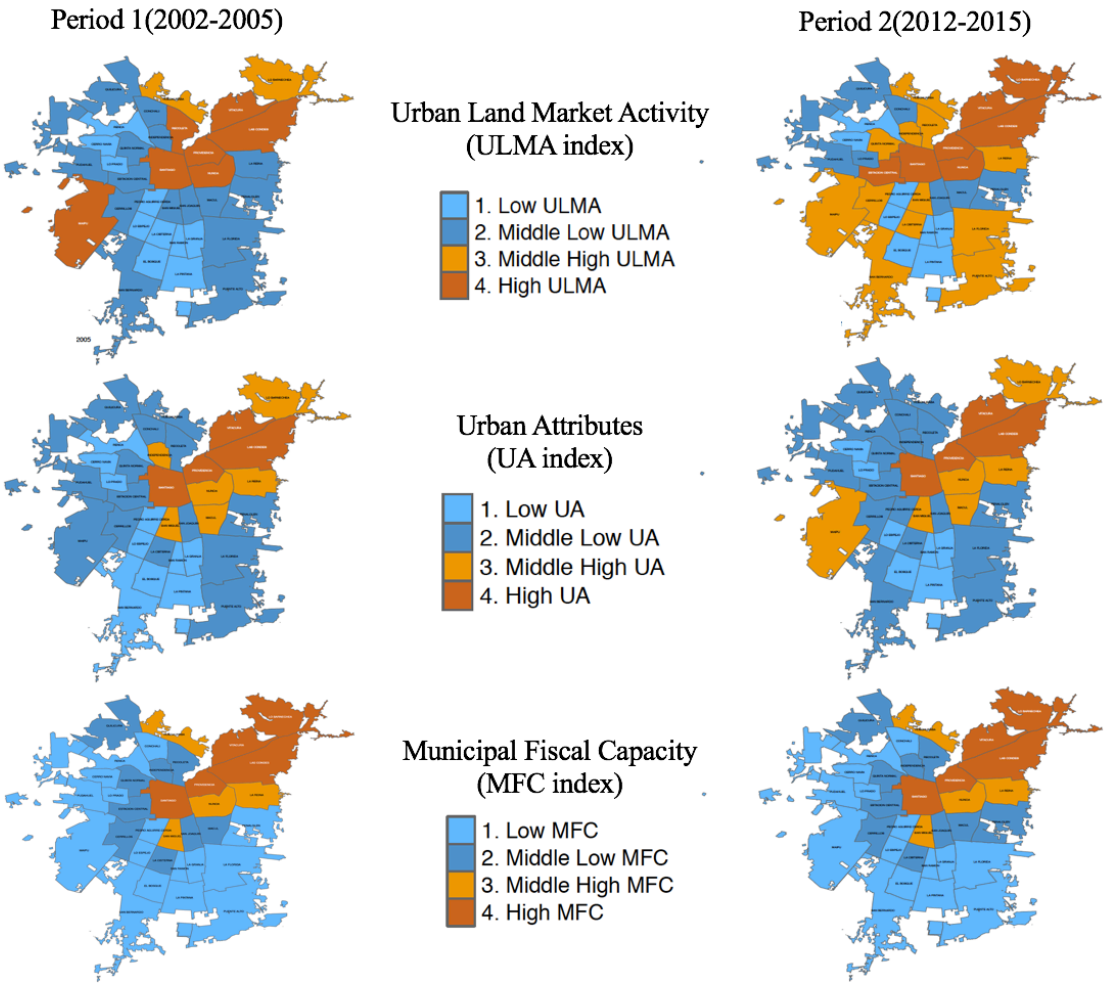
Indeed, the case Maipu municipality illustrates the benefits of complementing a relative and absolute analysis of the changes in the GO. According to the relative index this municipality had a middle-high GO in period 1 that decreased to middle low GO in period 2. This has to do with the fact that a positive change in other municipalities might have made Maipú move down in the rank, though it doesn't necessarily implies the its GO has decreased. This is clear when measuring the GO in absolute terms, where Maipu remain in the same GO category in period 1 and 2.

Figure 3: Relative and absolute GO index measurement for period 1 and 2



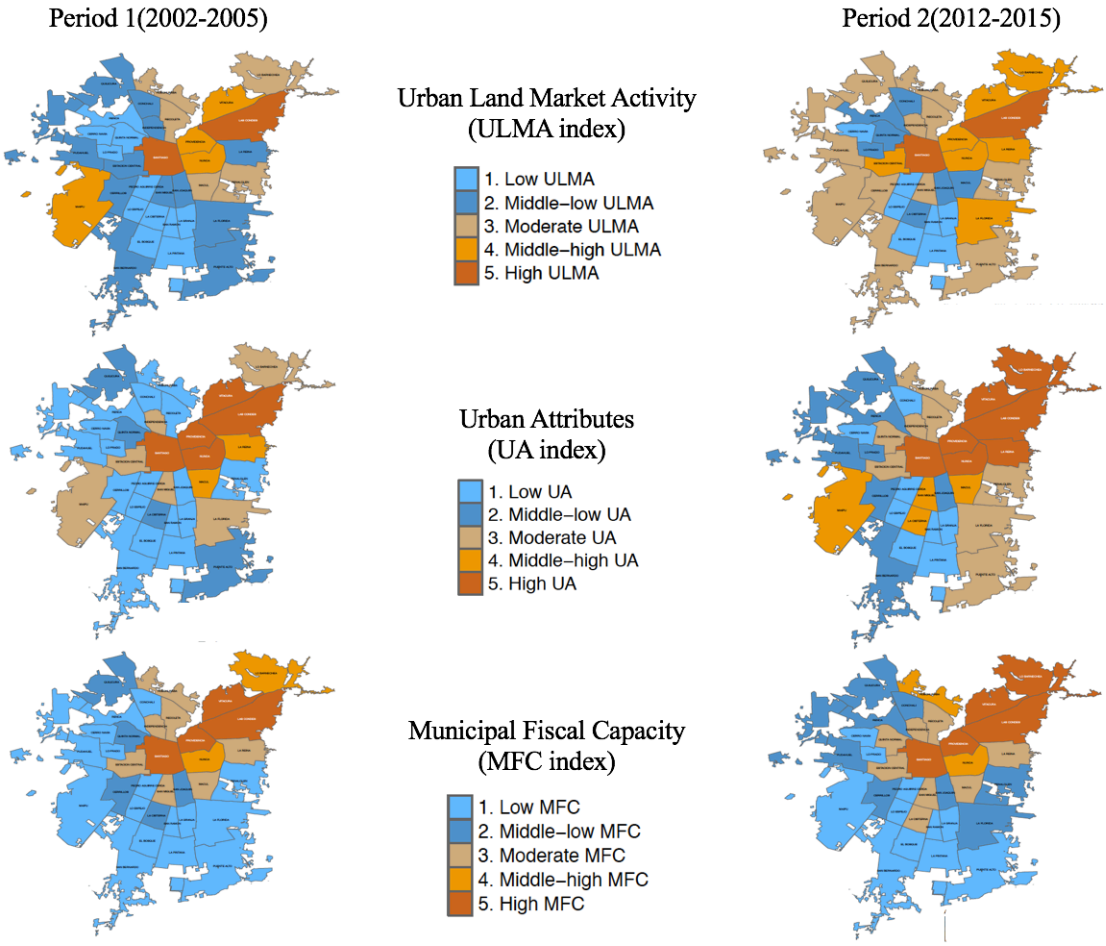
When analyzing the three dimensions of the GO separately (both in absolute and relative terms), in period 1 the land market and real estate activity appeared more concentrated than the urban attributes, mainly in the traditionally wealthy center-east area of SMA. The municipal fiscal capacity is particularly low for a great number of municipalities (44 percent). However, after 10 years, in period 2 the ULMA sub-index shows a much more active land and real estate market which is also more widely spread across the city, followed by a slight expansion in the urban attributes. The municipal fiscal capacity sub-index shows a slower pace of change. Therefore, the changes in the GO index appear clearly driven by ULMA sub-index followed by an improvement in UA, despite no apparent significant changes in the MFC sub-index (figure 4 with relative sub-indices and figure 5 with absolute sub-indices).

Figure 4: Relative sub-indices of the GO at the municipal scale



Unlike to the relative sub-indices, the absolute indices in period one show that the land market and real estate activity as well as the urban attributes, appear more spread out across the city, clearly increasing its intensity (quantity and quality) in period 2. It actually shows that the municipal fiscal capacity improved more to what the relative measurements showed.

Figure 5: Absolute sub-indices of the GO at the municipal scale



The maps presented in figures 4 and 5 illustrate how municipalities with low GO show a quite strong level of persistence in all the estimated GO sub-indices. This means that these municipalities had no significant land and real estate market vitality, which in turn relates to particularly low municipal tax collection and revenue sources and semi-stagnant set of attributes and opportunities for both periods analyzed. The same happens in the case of areas with high GO, where the land prices are high and the real estate market remains very active, and the municipal fiscal capacity and the urban attributes are also consistently high. However, when it comes to areas of middle-low, moderate GO and middle-high GO, there is a greater mismatch between the sub-indices, 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.

The decoupling between the dimensions of the GO in municipalities that are not part of either the top or the bottom of the rank (that show higher levels of alignment between the GO dimensions), display very interesting scenarios. For instance, La Florida, San Bernardo, Puente Alto and La Reina municipalities represents clear examples of the institutional delay in the municipal capacity to capture, through tax collection, the improvements in the GO. For instance (table 6), the municipality of La Florida 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.

La Florida municipality stands out for its very dynamic urban market in which converge a strong commercial activity, an active real estate sector supplying high rise apartment buildings located along the subway lines, and a particularly diverse socioeconomic background of its population.

Table 6: 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 (see table 6), that shows the opposite trend to La Florida. In Huechuraba, both ULMA sub-index and the UA sub-index, rank at a moderate level, whereas the MFC sub-index ranks high. This might be explained for 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 called "*Ciudad Empresarial*" (entrepreneurial city) where several companies' headquarters are located, generating higher property taxes and business and commercial license fees for the municipality.

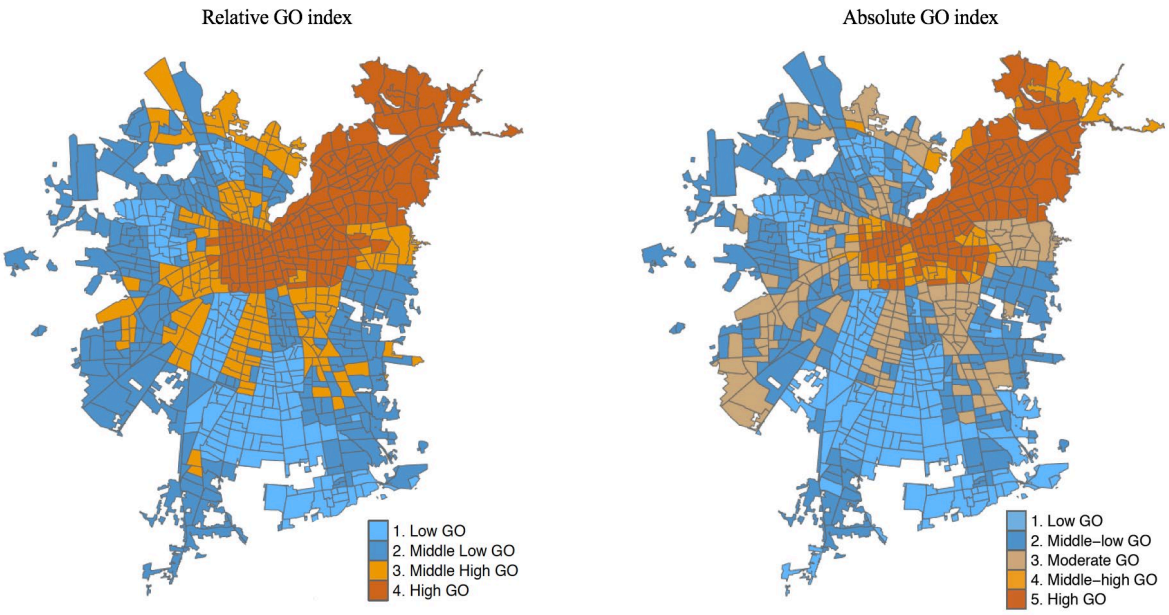
The municipality of Macul (table 6) sets a different scenario as well. The UA sub-index ranks the municipality quite high, the MFC sub-index shows a moderate level, whereas the ULMA sub-index ranks it much lower than the other two indices. This is a particularly promissory scenario to foster a housing and economic development. The area is socially inclusive and the 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 (table 6) illustrates a case in which the land and real estate market are the forces driving the changes in the municipality.

Geography of Opportunity at the Neighborhood Scale

When the geography of opportunity is analyzed at the neighborhood scale (represented in this case by the commuting-zones) it appears, again, in much more detail that the areas that are in both extremes of the GO index are highly homogeneous. Disturbingly homogeneous are the extensive areas that show a low GO. This is the case of the south of the SMA were all the neighborhoods show a very poor set of opportunities. Conversely, there are areas that show a mixed set of opportunities of its neighborhoods. The absolute GO index categories (middle-low, moderate, and middle-high) appear scattered across the neighborhoods comprising each municipality (figure 6).

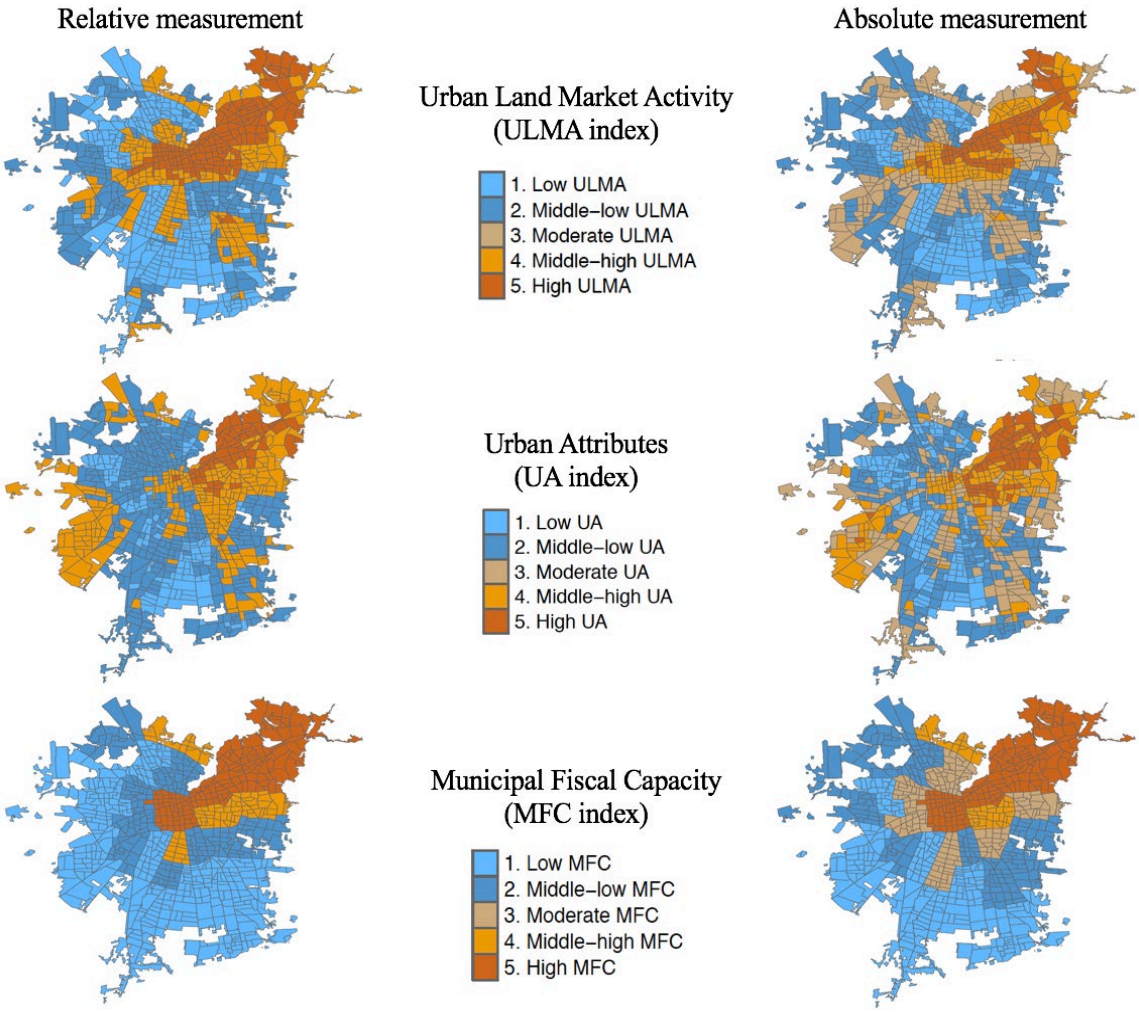
Figure 6: GO index at the neighborhood scale for period 2 (2012-2015)



From the maps in Figure 6 one can look closely at the opportunities and challenges that some municipalities face in terms of increasing the GO of its neighborhoods. For instance, the neighborhoods of Pedro Aguirre Cerda and Lo Espejo, both have a Low GO (in light blue) though they have a particularly good location within the SMA, being surrounded by areas of either high or moderated GO. Hence, there is much more potential to explore on these two municipalities in terms of taking advantage of their location.

Another case that stands out is the group of four municipalities located in the north-west area of the SMA (Conchali, Renca, Cerro Navia and Lo Prado) that form a semi-circle of low and middle-low opportunities that should justify a more intended policy intervention. Similarly, the group of four municipalities located to the south of the SMA (La Pintana, San Ramon, El Bosque, La Granja) should be intervened at both neighborhood and municipal scale to improve the opportunities of its residents.

Figure 7: GO sub-indices at the neighborhood scale for period 2 (2012-2015)



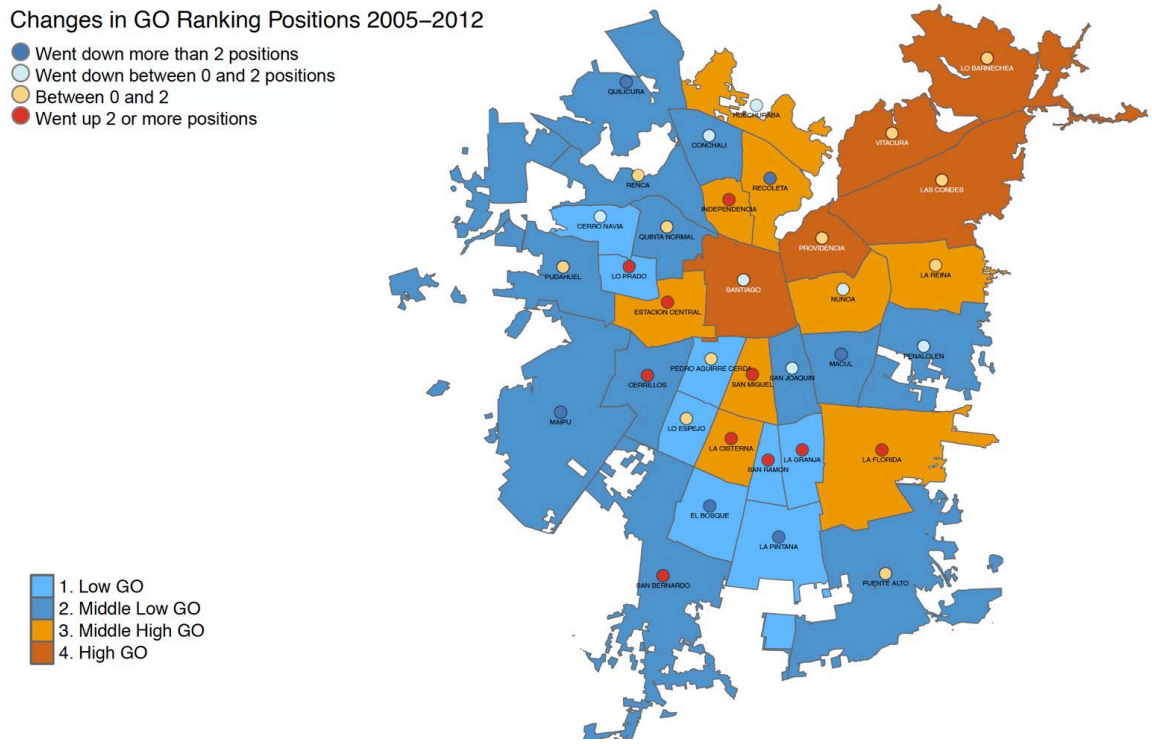
Measuring Changes in the GO at the Municipal Scale

Relative Changes in the GO

The relative GO index shows that in the 10 years analyzed, a significant proportion of the municipalities in the metropolitan area have improved their GO. However, as it's a relative measurement, the ranking also shows municipalities moving down due to others moving further up. Thus, to have a sense of the depth of the changes in the GO and its dimensions, we have measured the changes in the GO according to the number of places each municipality moved up or down between period 1 and 2. Figure 8 shows the direction and extent of the change in the GO index rank. For instance, it shows that some municipalities, even though moved up more than 2 positions, are still in the low GO category (as it the case of San Ramon, La Granja and Lo Prado), while others moved even further down in the low GO category (such as El Bosque and La Pintana).

La Cisterna municipality, represents a case in which the positive change in the rank (more than 2 positions) also translated into a change in its general GO index category, moving up from middle-low GO to middle-high GO (Appendix A presents the maps describing the changes for each sub-index).

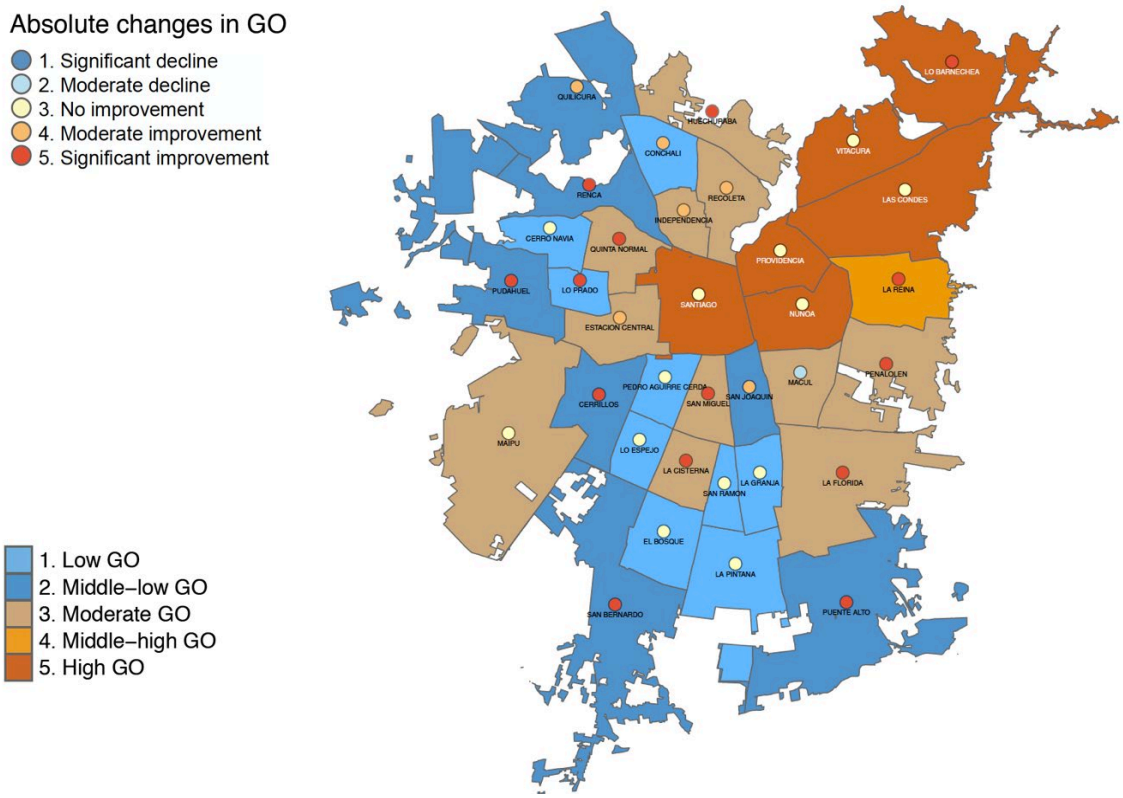
Figure 8: RELATIVE changes in the GO index in SMA between period 1 and 2



Absolute Changes in the GO

From the analysis based on the absolute changes in the GO, it becomes clear that the areas of the city that have experienced most significant improvements are those that fall into the categories in between the Low GO and High GO (see Figure 9). None of the municipalities have experienced a significant decline on its GO, and only one, Macul, has faced a moderate decline (see in Appendix B the maps describing the changes for each sub-index).

Figure 9: ABSOLUTE changes in the GO index in SMA between period 1 and 2



When comparing the municipalities according to all the indicators considered to build the GO index, we find that all the dimension (sub-indices) help in the classification and description of the GO at the municipal scale. From the data shown in table 7, four type of cities within the SMA can be identified: the two cities that represent the extremes of High and Low GO and the two groups in the center that comprise 21 municipalities in which the GO is changing in different ways.

Table 7: GO relative index categories and its indicators values

Subdimensions and indicators	Low GO (8 municipalities)	Middle-low GO (12 municipalities)	Middle-High GO (9 municipalities)	High GO (5 municipalities)
1.1 Land appraisal				
Commuting zone with highest land appraisal (US$/m2)	91	210	493	3594
1.2 Real estate activiy				
Total square meters built in the year (m2)	10468	162200	167642	417182
2.1 Municipal Revenue				
Municipal revenue per capita (US$)	187	229	314	1079
Municipal Common Fund/Total Municipa 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 transportation stops and underground stations (nº/10,000 habs)	74.5	74.4	108.7	105.2
Automobile Access by household (%)	26.1	33.1	36.9	63.3
3.2 Employment				
Unemployment rate (%)	8.5	7.1	6.3	4.0
Total of firms (nº)	3963	7744	8423	20881
Employment competition (%)	37.8	66.9	103.8	225.0
3.3 Health and Environment				
Hospitals and health centres (nº/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 Educational				
High school graduation (%)	64.7	72.7	78.3	92.4
Students in poverty (%)	8.8	7.4	5.2	1.7
Students in public school scoring more than 450 in PSU Test (%)***	22.2	39.8	47.6	74.9
3.5 Urban Life				
Access to pois****(nº/1,000 habs)	3.2	6.5	14.1	34.7
Access to banks, ATM, supermarkets and pharmarcies (nº/1,000 habs)	14.0	21.1	44.0	102.7
Total square meters of commercial and entertainment premises built in the year (m2)	2669	33761	36456	70941
3.6 Safety				
Crime with violence and severe injuries (nº/100,000 habs)	1144	1083	1505	1401
Homicide (nº/100,000 habs)	4.4	3.7	3.3	3.3
Rape (nº/100,000 habs)	25.6	20.3	21.1	18.9
3.7 Neighborhood Social Mix				
Social mix index	0.60	0.43	0.42	0.63
Poverty rate (%)	68.2	49.8	40.6	13.9

* % of number of jobs overt total labor force within the neighborhood and municipality; ** POIS (Points of Interest Mapcity);***The index goes between 0 and 1. Closer to 0 means there is a 20% distribution in the 5 socio-economic groups (ABC1, C2, C3, D and E), and close to 1 means there is less presence of one or several of those groups; **** Poverty rate estimated on each of the 734 Neighborhood within the 34 municipalities in SMA

The information provided by the 'Neighborhood Social Mix' sub-index is particularly interesting. According to this sub-index, the two groups of municipalities in the extremes of High GO and Low GO have the most homogeneous population (with high income in the former and low income in the latter), whereas the municipalities that have shown more dynamism in changing their GO show a much socially diverse population.

Changes in the GO and Social Inclusion in the SMA

The relevance of studying the changes in opportunities rests on the assumption that a better and richer set of opportunities in the place of residence would increase people's life chances. Thus, when measuring the changes in three variables of social inclusion (employment, education and poverty) for each GO index category between period 1 and 2, we find that the municipalities with low GO, even though they show a slight improvement in most of the indicators, are worst

off not only in relative terms but also in absolute terms (table 8). Conversely, the municipalities in the other 3 categories of GO show a significant improvement in all the social indicators. Somehow the municipalities that have experienced positive changes in the GO during the 10 years analyzed are also those that show an improvement of the levels of social inclusion of its population.

When looking to the employment indicators, municipalities with low GO show a reduction in the unemployment rate that is lower than of the municipalities in the other three GO categories. Additionally, the number of firms not only is the lowest but also has decreased further (21.9 percent) whereas in all the municipalities that fall in other GO categories the number of firms have increased significantly.

Table 8: Variation in social inclusion indicators between period 1 and 2 for each relative GO index category

	Low GO			Middle-low GO			Middle-High GO			High GO		
	Period 1	Period 2	Variation	Period 1	Period 2	Variation	Period 1	Period 2	Variation	Period 1	Period 2	Variation
1. Employment												
1.1 Unemployment rate	14.4%	8.5%	**-40.8%**	12.3%	7.1%	**-42.2%**	11.1%	6.3%	**-43.2%**	7.8%	4.0%	**-48.6%**
1.2 Number of firms	5072	3963	**-21.9%**	6507	7744	**19.0%**	6978	8423	**20.7%**	16158	20881	**29.2%**
2. Education												
2.1 High school graduation rate	31.9%	64.7%	**103.1%**	40.2%	72.7%	**80.7%**	46.0%	78.3%	**70.3%**	58.8%	92.4%	**57.1%**
2.2 Public school students scoring over 450*	19.2%	22.2%	**15.6%**	18.7%	39.8%	**113.6%**	27.8%	47.6%	**71.6%**	56.1%	74.9%	**33.5%**
3. Poverty												
3.1 Social mix index**	0.48	0.60	**24.3%**	0.34	0.43	**26%**	0.35	0.42	**21%**	0.55	0.63	**14%**
3.2 Poverty (40% of lower income)	62.4%	68.2%	**9.2%**	47.0%	49.8%	**5.9%**	38.5%	40.6%	**5.5%**	14.4%	13.9%	**-3.3%**

* National test (PSU) minimum score required to enter college/university; ** index value between 0 and 1, where 0 represents high social diversity (even distribution of all social groups) and 1 high social homogeneity.

Regarding education, the high school graduation rate in the municipalities showing low GO has improved substantially, though it's still much lower if compared to municipalities in the others GO categories. As to the students obtaining the minimum score to enter college/university the improvement has been particularly low, which is a worrying scenario given the low proportion of students that reach the minimum score.

Finally, poverty indicators show that the social homogeneity of the neighborhoods located in areas of low GO has increased significantly (proportion of people in the bottom 40% of the income distribution), in these areas are becoming more homogeneous in low-income population. The decrease in social diversity happened in each of the categories, though it's only the municipalities with high GO that show a decrease in poverty, which means that the areas are becoming increasingly homogeneous in high-income population as well.

Conclusions

The analysis presented in this paper comprises the elaboration of an index of geography of opportunity, (GO index) build upon three sub-indices aimed at comprehensively measuring the

dimensions of the GO as proposed in the conceptual framework. The analysis covered two urban scales: (a) municipalities: 34 municipalities that make up the Santiago Metropolitan Area and (b) 734 neighborhoods (commuting-zones). The index and sub-indices enabled the classification of these two urban scales based on, firstly, the urban land and real estate market activity through the ULMA sub-index; secondly, the municipal revenues and resources to attend the needs of the population through the municipal fiscal capacity MFC sub-index; and thirdly based on a set of urban attributes and opportunities through the UA sub-index. The construction of these sub-indices is based on a set of 26 indicators obtained from different data sources covering two periods—period 1 (2002-2005) and period 2 (2012-2015).

Methodologically, the challenge of measuring the GO and its changes over time is not only to adequately describe the GO but also to capture the depth of the changes. This study presented the analysis using both relative and absolute measurements, since the type of information they provide is complementary. The relative measurement allows to rank the position of each urban scale, which is valuable as it relates to all the rest of the urban areas analyzed. However, when comparing two periods, this measurement only provides information of the urban areas that moved up or down in the rank, but not much information on whether that meant a real upgrade or downgrade in the GO. Conversely, the absolute measurement allows to specify clear thresholds (upper and lower cuts) that enable a better classification of the areas as well as to understand whether the changes imply a real improvement in the geography of opportunity of a certain area.

The GO index, its sub-indices and sub-dimensions, show a high correlation that confirms the interrelation described in the conceptual framework. The three dimensions of the GO, that is, land and real estate market, urban attributes, and municipal fiscal capacity are interconnected. Specifically, the correlation between the 11 subdimensions that comprise the sub-indices of the GO show very interesting results that somehow depart from what is been generally discussed in the literature. For example, neighborhood safety in the SMA isn't related to low geography of opportunity but rather the opposite, the more vibrant is an urban area (better urban life, connectivity, employment, land market and real estate activity) the higher the prevalence of crime. Similarly, socially mixed areas correlate positively with more vibrant urban areas. This is a very interesting finding as it debunks the idea that the presence of residents of middle-low and low-income would negatively impact the quality of service, land market, properties values and so on.

The results show that the GO index and all the three sub-indices analyzed both separately and all together offer a good approach to understand the urban environment in which individuals living in different municipalities and neighborhoods are exposed to. The GO index showed different scenarios depending on whether the relative or the absolute measurement is used. What these two types of classification have in common is that in both extremes we find areas with a very low and a very high levels of opportunities, while in between there is a mix of areas ranging from middle high, middle low and/or moderate levels of opportunities.

As to the dimensions of the GO, the geographic distribution of opportunities when measured through the ULMA sub-index, appears to be more widely distributed across the SMA than the UA sub-index based on a set of urban attributes and further lowers its intensity when is analyzed through the municipal fiscal capacity (MFC) sub-index.

From a dynamic perspective, the results obtained show that the geography of opportunity in the SMA is expanding. The data reflect a very dynamic city, in which the great majority of the municipalities (21 out of 34) have experienced changes in its geography of opportunity in the time frame of 10 years covered in this research. Furthermore, it can be said that the SMA hosts at least three different type of cities, one that shows high levels of geography of opportunity, another one that shows very low geography of opportunity, and a third one that is mutating and changing its geography of opportunity with different levels of intensity (many of them moving up in the GO index categories, while few moving down). However, there are areas that show high persistence in low GO while others show high persistence in high GO, therefore the most dynamic areas are those in between these two categories of GO, which are indeed where the levels of social inclusion show better prospects.

The sub-indices perform differently in reflecting the changes in the urban areas analyzed. The ULMA sub-index shows changes that are much more significant than those shown by the sub-index describing municipal resources and revenues (MFC). The pace of urban change is captured through prices and real estate investment in a much more rapid and efficient way. Even though municipal activity changes accordingly to land prices and real estate activity, it moves slower.

At the neighborhood level, the analysis enables getting a deeper sense of the geography of opportunity in certain areas of the city, particularly those areas that show low GO. Residents residing in neighborhoods of low GO are also surrounded by neighborhoods of low GO, forming large areas that are highly homogenous in terms of the poor opportunities they offer to its residents.

To the question on whether positive changes in the GO translate in improvement in the inclusion of the most vulnerable population, it can be said that in the case of the SMA the population living in municipalities that have experimented changes in the GO index show positive changes in three indicators of inclusion: employment, education and poverty. Conversely, municipalities that fall into the low GO category not only show improvements that aren’t enough to meet minimum standards, but also in many cases are even worse than before.

In terms of policy implications, this research provides evidence on the areas of the city that need more support to improve the opportunities offered to its residents. There are municipalities, and neighborhoods within municipalities, that show clear disadvantages in terms of the opportunities they offer. The information generated through this research helps identifying the areas that need policy intervention that could expand the possibilities that the urban environment offers to the population living there. This is the case of the group of municipalities that haven’t shown significant changes in terms of its GO and therefore, consistently appeared at the lower end of all the rankings and indices used in the analysis.

It also contributes to identify opportunities for improvement and to foster a more socially inclusive urban development. As it was discussed for the case of the Municipality of Macul, the set of opportunities described through the Urban Attributes sub-index was very high for this municipality and the municipal resources and revenues were quite good (based on the MFC sub-index). However, in terms of its urban dynamism (based on the ULMA sub-index) Macul isn't much active. This municipality seems to be a good option for the development of inclusionary

housing that could offer low and middle-low income households the possibility to live in an urban context that is rich in terms of the possibilities it offers.

Similarly, in terms of opportunities for policy intervention, the results show that there are municipalities that even though are very low in their geography of opportunity, are particularly well located within the city and surrounded by municipalities with high and moderate GO. Strategic set of interventions could trigger a better development of these areas, benefitting its residents and attracting more population to live and work there.

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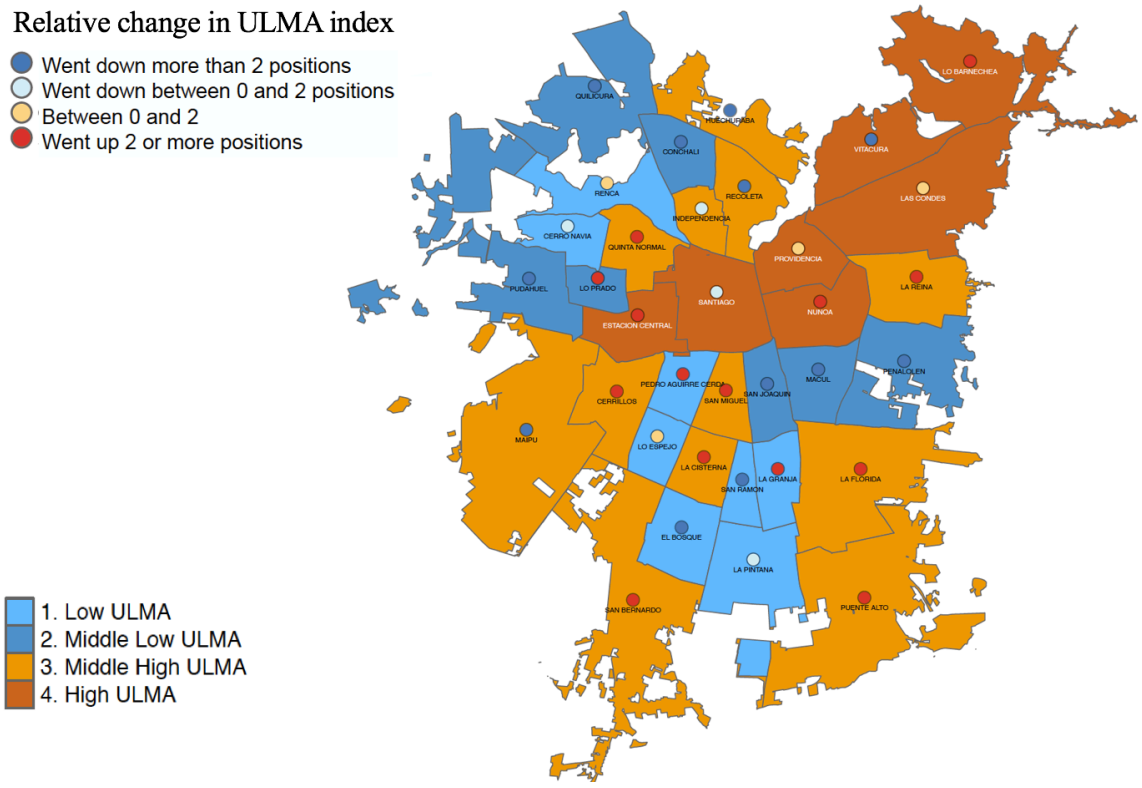
Appendix A: Relative changes in the GO for each sub-index

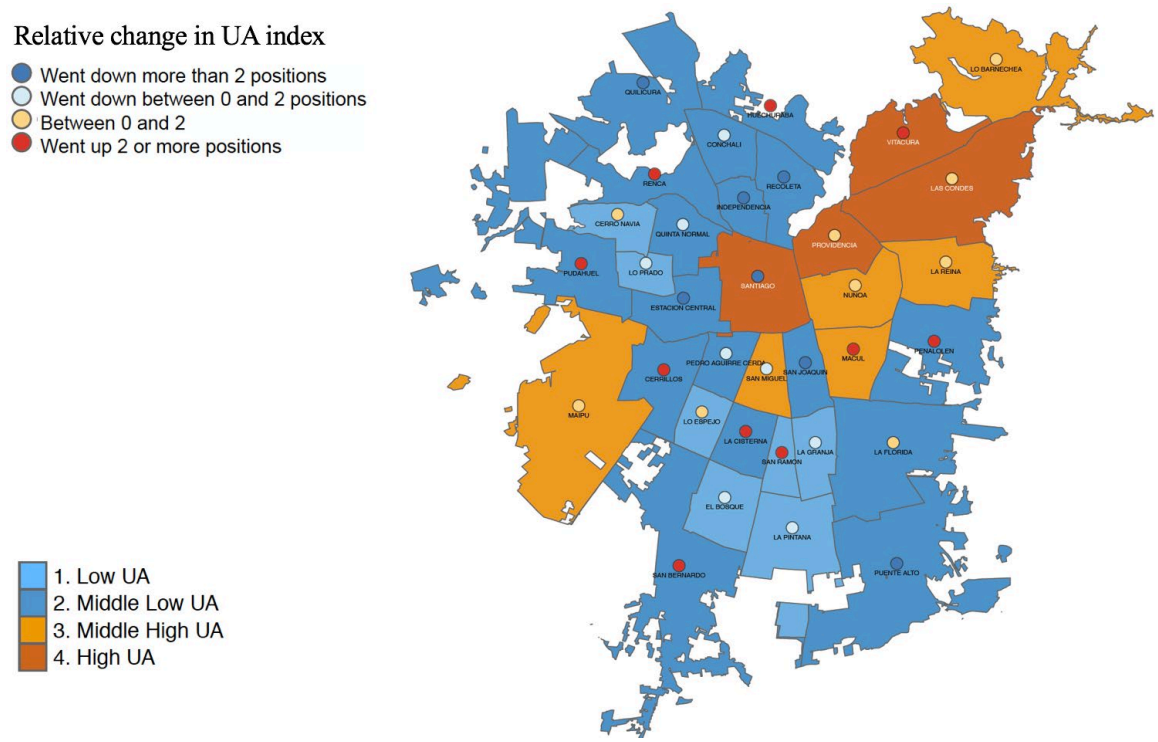
Figure 10: Changes in the relative ULMA index between period 1(2002 – 2005) and 2 (2012 – 2015)



When analyzing the changes in the urban land market dynamism between period 1 and 2, more than 50 percent of the municipalities have moved up in the ULMA sub-index rank (see figure 10). Further, a significant number moved up more that 2 positions. However, this doesn't mean that the changes would make municipalities move to a higher category. This is the case of La Granja and Pedro Aguirre Cerda that despite moving up in the rank they still show a low ULMA. Likewise, moving down in the rank doesn't necessarily translates in a change to a lower category either, as it's the case of Vitacura. Instead, Maipu and Recoleta, moved down to the extent of changing from high to middle-high ULMA, and Estación Central showed a land market dynamism that was so strong that moved up from middle-low ULMA to middle-high ULMA.

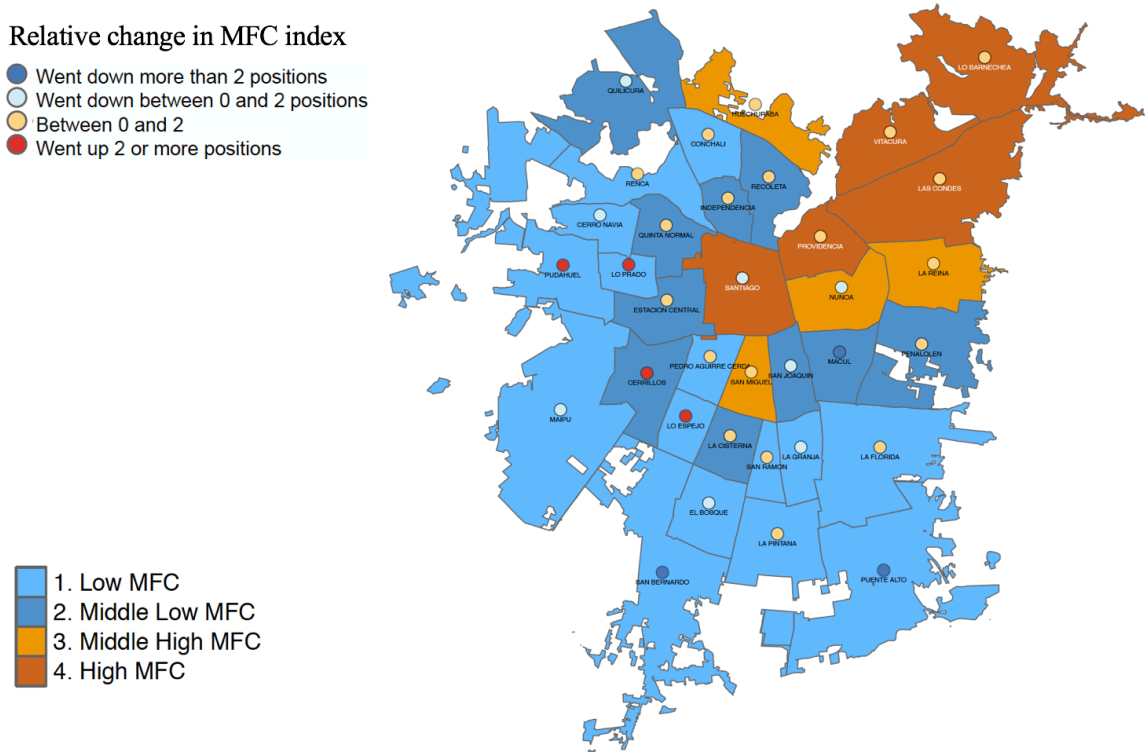
As to the urban attributes at the municipal scale, the UA sub-index shows that in period 1 these were highly concentrated, again, in the center-east area of SMA slightly expanding in period 2 mainly from low to middle-low GO. As figure 11 shows, three municipalities moved up from low GO in period 1 to middle-low GO in period 2, one moved up to middle-high GO while Independencia municipality moved down from middle-high to middle-low GO. Further, municipalities in the low GO category descended even further down in the UA ranking.

Figure 11: Changes in the relative UA index between period 1 (2002 – 2005) and 2 (2012 – 2015)



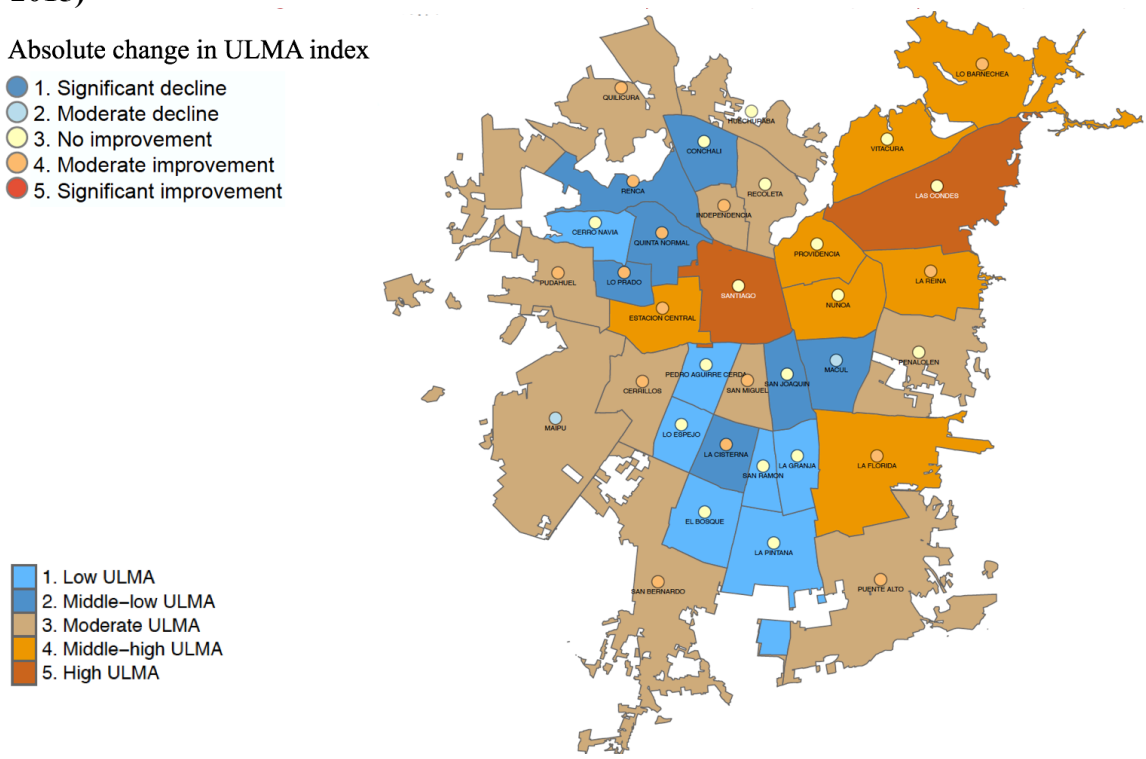
Finally, the municipal fiscal capacity MFC sub-index shows that in both periods this is the weakest GO dimension and that the changes aren't relevant. Only Peñalolen municipality moved up in the rank changing its classification from low to middle-low MFC. This means that the changes being experienced in the other two dimensions aren't being captured by municipalities through local taxes and that the pace of change is much slower than of the ULMA and UA sub-indices.

Figure 12: Changes in the relative MFC index between period 1 (2002 – 2005) and 2 (2012 – 2015)



Appendix B: Absolute changes in the GO for each sub-index

Figure 13: Changes in the absolute ULMA index between period 1 (2002 – 2005) and 2 (2012 – 2015)



In absolute measures, the urban land market has been activating significant areas of the city that were either not very dynamic or simply deprived or in urban decay (municipalities colored in blue and light-blue). This might be associated to the creation of new subway lines and the extensions of existing ones, the densification due to the housing supply characterized by high-rise apartment buildings, among others changes, which are rapidly reflected in prices of the land.

Out of the 34 municipalities that make up the SMA, 24 municipalities experienced an improvement in their GO based on the ULMA sub-index. However, when analyzing the depth of the changes between period 1 and 2 none of them reached a significant improvement in the GO but rather the improvement was primarily moderate or no improvement at all. Two municipalities experienced a slight decline (Maipu and Macul).

Figure 14 describes the changes in the urban attributes. The changes have been significant for a large proportion of the population as they affected 18 out of the 34 municipalities. For some municipalities, these improvements have translated into significant changes in the overall UA sub-index moving up more than two categories, as it's the case of La Cisterna that moved up from middle-low UA to middle-high UA, and Peñalolen that scaled up from low UA to moderate GO.

Figure 14: Changes in the absolute UA index between period 1 (2002 – 2005) and 2 (2012 – 2015)

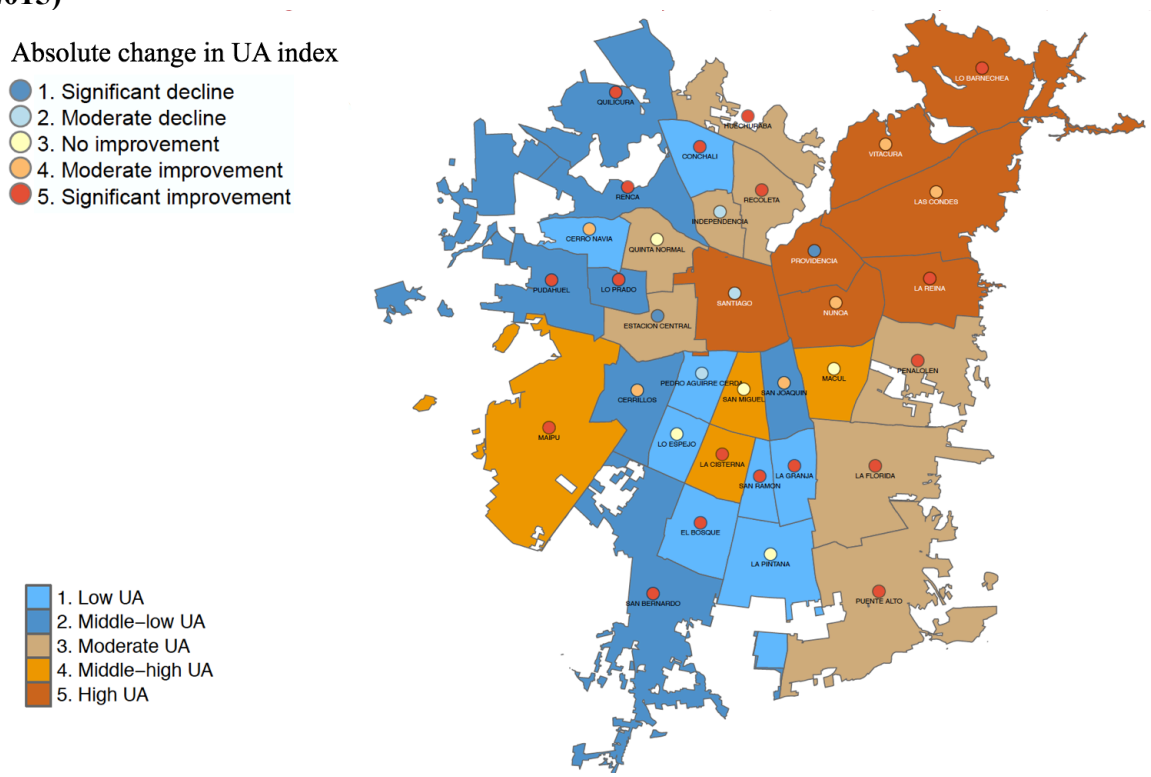
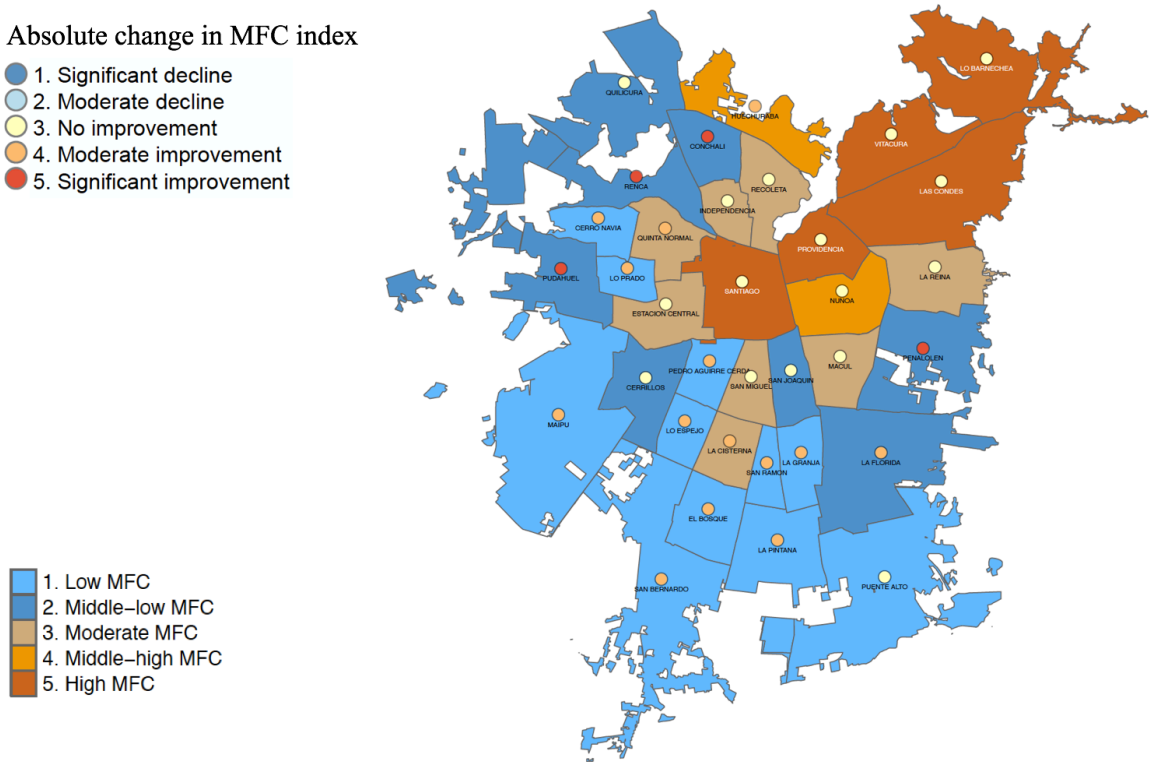


Figure 15: Changes in the absolute MFC index between period 1 (2002 – 2005) and 2 (2012 – 2015)



The changes in the MFC sub-index even though show an improvement over time, when compared to the other dimensions it clearly shows a slower pace of change. However, when analyzing the depth of the changes, a significant proportion of municipalities have experienced either moderate to significant improvement in their MFC sub-index as it's the case of municipalities that in period 1 classified in low MFC moving up to middle-low MFC (Peñalolen, Renca, Pudahuel, Conchali).