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**ESSAYS ON POLITICAL ECONOMY AND
TERRITORIAL DISPARITIES IN CHILE**

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Chapter 1: Introduction

The issue of inequality has been part of the debate in development studies ever since this discipline has existed, an interest that has been intensified since the Great Recession. Leading researchers have argued that inequality is one of the main social problems in the world (Milanovic, 2016; Piketty, 2014; Stiglitz, 2012). Meanwhile, international organizations such as the IMF and the World Bank have pointed out that excessive inequality can erode social cohesion, lead to political polarization and reduce economic growth. Currently, these institutions are promoting inclusive growth policies (Dabla-Norris, Kochhar, Suphaphiphat, Ricka, & Tsounta, 2015; IMF, 2017).

Inequality has many dimensions, ranging from income distribution, educational outcomes, to life expectancy, to name just a few. On the other hand, inequality can manifest itself at a certain moment or it can be the result of a cumulative process that is later revealed spatially. Territorial inequality arises from an asymmetric distribution of public goods, which ultimately results in an uneven distribution of social opportunities. Latin America's major cities are a perfect example of territorial inequality, since they are characterized by strong socio-spatial disparities and large differences in the provision of basic infrastructure across municipalities (Jordán, Rehner, & Samaniego, 2010). In some cases, the spatial asymmetries are the result of historical and geographical processes that shape societies (Portes, Roberts, Grimson, & Aliaga, 2005). However, territorial disparities depend also upon the interaction between social groups, governments and public policies, i.e., political economy.

This Thesis Project focuses on two elements associated with political economy that affect territorial inequalities. The first is the relationship between urban form and the uneven distribution of urban infrastructure, that is, how spatial organization influences the allocation of collective resources and hence, the opportunities that people have. The areas that make up a city differ significantly in the provision of basic infrastructure, in their access to the communications network, in the availability of green areas, in their

environmental quality, etc., and this significantly affects the possibilities of citizens to live the lives they deem appropriate.

At this point, the central hypothesis is that the distribution of public goods and social opportunities are related to, among other issues, the organization of urban space. In particular, the dissertation intends to provide answers to the following questions: what is the relationship between the main characteristics of urban form, such as density, diversity of uses (residential, economic, etc.) or the sprawl of the urban area, and urban inequality? How do these issues affect mobility or access to public goods? What role does metropolitan planning play in the provision of public goods?

The second major element of political economy that is analyzed is the incidence of distributive politics in inequality. The alleged aim of territorial development policies is to pursue economic efficiency or spatial equity. In Latin America in particular, regional policy has been largely dedicated to narrowing the gap across areas. However, all too often, these programs do not reach the most disadvantaged, not due to an inefficient design, but because of an institutional framework that generates misaligned political incentives and weak governance (Diaz-Cayeros, Estévez, & Magaloni, 2016). In other words, the distribution of basic infrastructure is not only based on a decision driven by technical issues, but also by authorities' electoral wishes. The underlying hypothesis is that politicians are moved by their desire to achieve or maintain power and, therefore, they will distribute public goods with the aim of maximizing their prospects at the polls.

Although the incidence of electoral incentives has been widely analyzed in the realms of political science (Golden & Min, 2013), it is a novel area in territorial studies, despite the implications that an arbitrary distribution of resources has for the governance of regions and localities. Recently, authors such as Luca & Rodríguez-Pose (2015), Psycharis, Zoi, & Iliopoulou (2015) and Rodríguez-Pose, Psycharis, & Tselios (2016) have contributed to open the debate within the discipline. The questions that are sought to be answered are: is the allocation of public goods distributed following territorial equity criteria, or do electoral

considerations also have an influence? What are the implications for the provision of public goods and, overall, for the development of urban areas and regions? What institutional mechanisms can reduce the electoral bias?

The Thesis Project focuses on how these issues affect the distribution of social opportunities in the Santiago Metropolitan Area (SMA) of Chile. The SMA is an appropriate case study for several reasons. It is the largest urban agglomeration in the country: it has 52 municipalities where more than 7.3 million people live (around 40% of the national population), accounting for 49% of national GDP. Moreover, it is one of the most unequal cities in the world. Its Gini index is 0.53 and the socio-spatial organization is marked by strong income differences across neighborhoods. Such sorting pattern is manifested in a strong socio-spatial segregation dynamic (Sabatini *et al*, 2001; Fuentes *et al*, 2017). As we will show throughout the Thesis, these differences affect the accessibility to public services of the different socioeconomic groups that inhabit the city

From the administrative and institutional dimension, the SMA has particularities that distinguish it from other metropolises of the continent. Despite its size, this territorial entity does not have financial autonomy and the governor (regional head) is appointed by the president. While the municipalities that make up the SMA have legal autonomy, they also suffer from limited financial maneuver and large disparities in budgetary terms. In fact, there is a huge income gap between richer and poorest municipalities, the latter being eight times poorer than the former¹. These asymmetries between municipalities are manifested in both, the local capacity to plan development initiatives, and the dependence on transfers from the central government, which result in municipalities with lower resources being more susceptible to political interference.

All these issues are addressed throughout four articles, which have already been published in prestigious international journals. The first is “*Urban form and environmental impact of commuting in a segregated city, Santiago de Chile*”, published in 2013, in *Environment*

¹ In 2019, the per capita budget of the richest municipality in the SMA was USD 1,495, while the poorest municipality had a per capita budget of USD 183.

and Planning B. This journal's Impact Factor in 2018 was 2,825, located in the first quartile within Urban Studies (See Annex 1).

The second article is "*Understanding Density in an Uneven City, Santiago, Chile: Implications for Social and Environmental Sustainability*", published in 2014 in Sustainability. The impact factor in 2018 was 2,592, situated in the second quartile of "Environmental Studies" (See Annex 2).

The third article is "*Distributive politics and spatial equity: the allocation of public investment in Chile*", published in 2018 in the Regional Studies. The journal's impact factor was 3,074 in 2018, in the first quartile of Economics (See Annex 3).

Finally, "*Paving the electoral way: Urban infrastructure, partisan politics and civic engagement*", was published in 2019 in World Development. This journal achieved an impact factor of 3,905 in 2018, which situates currently in first decile in Economics (See Annex 4).

Theoretical framework

Given the nature of this Thesis Project, our theoretical framework is structured around two axes: the relationship between urban form and inequality; and the incentives of distributive policy and inequality.

Urban form and inequality

The first two essays address the incidence of urban form on different aspects of inequality within the metropolitan area of Santiago. Urban form is one of the engines of sustainable development (Habitat, 2016): the way in which human activities are organized in space affects the environment (Legras & Cavailhès, 2016), social equity (Lee, Ambrey, & Pojani, 2018; Wei & Ewing, 2018) and economic efficiency (Krugman, 1997; World Bank, 2009).

Certain characteristics affect mobility and energy consumption, since the structure of the city influences the modal choice, travel time and distance (Banister, Watson, & Wood, 1997; Crane, 2000; Ewing & Cervero, 2010; Rickwood, Glazebrook, & Searle, 2008). Much of this debate has been focused on the incidence of urban sprawl. The European Environment Agency (EEA) has described it as “*the physical pattern of low-density expansion of large urban areas, under market conditions, mainly into the surrounding agricultural areas*” (Ludlow, 2006, p. 6). Urban sprawl also increases the distance between places of origin and destination, and encourages car usage because low density makes it more expensive to establish efficient public transport networks. The relationship between low density and automobile dependence is explained by the fact that expansive growth disperses economic activities, increasing travel times between homes and workplaces (Travisi, Camagni, & Nijkamp, 2010).

There seems to be an academic consensus about the association between low density, urban sprawl and car use. “*One of the cardinal features of sprawl is driving, reflecting a well-established, close relationship between lower density development and more automobile travel*” (Frumkin, Frank, & Jackson, 2004, p.117). On the contrary, in dense and multifunctional areas where complementary uses are close to each other, the distances traveled are normally smaller and the use of public transport is greater (Frank & Pivo, 1994). Compact developments are environmentally more sustainable, socially cohesive and economically efficient: they help protecting natural spaces, stimulate the use of non-motorized mobility and the use of public transport, they contribute to social cohesion by bringing together people from different social environments and allow more intensive and efficient use of resources (Ng, 2010; Williams, Burton, & Jenks, 2000).

A central element to understand urban form and sustainability is density (Habitat, 2016). It provides a first approach to the growth pattern of a city, and is probably the variable that best summarizes the urban form (Navarro & Ortuño, 2011). In cities with market-oriented economies, population density generally decreases together with the distance from the city center (Clark, 1951; Newling, 1969). This is not always true because several factors alter this pattern, such as residential segregation (Garnica-Monroy & Alvanides, 2019; Lima,

2001), rapid population growth, suburbanization processes, immigration, differences in households' typology, decongestion of economic activities and the use of information technologies (Kloosterman & Musterd, 2001).

Densification has a number of benefits. From an environmental perspective, it is deemed an alternative to contain population growth within the already built-up area, which allows a more efficient use of the previously developed space, protecting agricultural and natural land (Sokolow & Laird, 1996). It can also favor more sustainable transport options (Newman & Kenworthy, 2000). In dense and compact urban areas, people often walk, ride bicycles and use public transport more frequently due to better connectivity and shorter distances to final destinations (Ewing & Cervero, 2010). However, high density may also lead to the loss of open and recreational space in the built-up areas (Jenks, Williams, & Burton, 1996).

From the social dimension, densification is related to equity and social diversity because it favors access to social infrastructure and encourages a more diverse, inclusive and habitable urban environment by facilitating opportunities for social interaction. It can also reduce social segregation and isolation by improving the local social capital (Boyko & Cooper, 2011). A higher residential density promotes the interaction of residents if it is well-combined with other attributes of physical design (architectural design, streets that promote urban life, public space, mixed land use) (Talen, 1999). The impacts of densification on social integration depend on how density is combined with other urban attributes and infrastructures, since otherwise density can limit equitable access to social opportunities (Bramley & Power, 2009).

From an economic point of view, a minimum threshold is necessary for an efficient use of resources and to reduce the cost of providing infrastructure. Dense areas require less public spending on services and infrastructure than low-density urban developments (Carruthers & Ulfarsson, 2003; Hortas-Rico & Solé-Ollé, 2010). Additionally, it is related to productivity as higher density generates co-operation between companies and workers (Cervero, 2001; Ciccone & Hall, 1993; Rosenthal & Strange, 2004). A general conclusion in this regards is

that low-density cities face higher commuting rates (Wheeler, 2001), higher marginal transportation costs (Ciccone & Hall, 1993) and lower knowledge spillovers (Glaeser, 1998).

The academic debate about urban form and sustainability has focused mainly on cities in the US and Europe, where the above-mentioned characteristics have particular implications. However, in Latin American cities, the spatial structure represents a barrier to densification, due to the topographic conditions and the rapid urbanization processes with limited investment in infrastructure that characterized the twentieth century (Duque, Lozano-Gracia, Patino, & Restrepo, 2019). From the socioeconomic point of view, the expansion of the city is not due to low-density residential developments for the middle classes but, in large part, due to the location of the popular classes and social housing in the periphery (de Duren, 2018). Density does not always decrease as the distance from the center increases, as usually occurs in European and North American cities. Finally, a distinctive feature of these cities is the marked socio-spatial differences and residential segregation (Janoschka, 2002). These issues make worth a differentiated analysis for Latin American cities, to understand the incidence of certain characteristics of urban form on the distribution of social opportunities and inequality.

Distributive Politics and Inequality

If politics has to do with "who gets what, when and how" (Laswell, 1936), then distributive politics, which involves the allocation of government goods and services, lies at the heart of politics. In this Thesis Project, distributive politics is understood as that policy that involves taxes and/or transfers in decisions about the allocation of government goods and services to identifiable localities or groups (Golden & Min, 2013). A standard way of thinking about this is how public authorities distribute benefits to specific geographical areas, while the costs of such decisions are distributed among all voters (Weingast, Shepsle, & Johnsen, 1981).

Political science literature has systematically studied the relationship between the electoral game and the distribution of public resources (Golden & Min, 2013; Kramon & Posner, 2013), identifying different ways in which politicians can try to obtain electoral revenues. One way to classify these benefits is by attending to the type of program and beneficiary in question. On the one hand, we find allocation of benefits that follow some type of objective and public criteria in their distribution (i.e., programmatic distribution), while on the other hand, there is allocations where the distribution criteria are not known in advance (i.e., non-programmatic distribution). Both types of policies can be directed to individuals as well as groups, and the benefits can be irreversible (i.e., roads) or reversible (i.e., employment programs). Each of these variants in distributive politics results in different political dynamics.

Table 1. Political bias and type of program

		Political bias by beneficiary group	
		Collective	Individual
Type of Politics	Programmatic	Distribution rules (e.g., Formula-based transfers)	Rights (e.g., Concessions)
	Non-programmatic	Party Bias (e.g., Pork-barrel politics)	Clientelism (e.g., Patronage)

Source: own elaboration based on Stokes et al (2013)

More specifically, the programmatic distribution refers to a distribution where the allocation criteria are public and follow an actual distribution of benefits or resources. Often this type of allocation is subsequent to a public debate, understood as a governmental discussion or a bureaucratic process where distribution criteria are available for public deliberation.

Non-programmatic distribution is one in which there are no public criteria, or public criteria are destroyed by private interests, regularly partisan interests. There may also be strategies where political actors elaborate public and formal rules of distribution, but in practice, these rules are set aside in favor of electoral criteria. In other words, political actors ignore

legislation or what bureaucratic practice demands, channeling the benefits to certain groups, locations or individuals, who would not receive these benefits if the official criteria were applied.

The non-programmatic distribution can be subdivided if the delivery is individual (conditional) or collective (non-conditional). In the first case, the political authority provides a job or other type of individual advantages in exchange for political support (i.e., clientelism), while, in the second case, the political representative can assign public goods to certain electoral constituencies (i.e., pork-barrel politics). Under the first approach, the party offers material benefits on the condition that the recipient returns the favor voting or through other means of political support. In the second case, the distribution of benefits is driven by a non-conditional partisan bias, where the recipients can be certain territorial groups or units. The later strategy, which is more diffuse in terms of electoral revenues, is the focus of this Thesis Project.

From this classification, the literature has identified two large distortions in allocation strategies. The first refers to the distribution of benefits according to the type of voter, i.e., whether allocations benefit core (strongholds) or swing (undecided) constituencies. The second strategy is related to the time in which the benefit is delivered (Political Budget Cycles, PBC).

The main models for analyzing the distribution of public goods arise from Dixit & Londregan (1996), which is based on Lindbeck & Weibull (1987) and Cox & McCubbins (1986). In this model, politicians distribute public goods among groups of voters in an electoral district. The assumption is that voters have fixed ideological preferences and receive a given utility from the benefit they get; therefore, a voter will be able to modify his ideological preference to the extent that the rival party offers a transfer large enough to overcome her ideological attachment to her own party. In other words, because material outcomes can move constituents from their ideological preferences, votes can be "bought" through the distribution of benefits.

Voters more loyal to their political party require larger transfers than undecided ones to change their preferences and support the rival party. As undecided (swing) voters can be purchased at a lower cost, political parties compete for this electorate. Likewise, poorest constituents require lower per capita transfers to change their preferences than richer ones, because for the same transfer they get greater utility.

Although both political parties define their strategies towards the undecided population, the model also considers a scenario in which parties assign public goods to loyal voters. The latter is subject to information asymmetries. The argument is that, in a context where there is no information, distributing benefits to the undecided electorate is inefficient because part of this electorate will not change their vote once they receive the benefit. As a result, it is more efficient to assign assets to the party's electoral strongholds (core voters) because in these districts the benefits will never be misallocated. In short, to the extent that politicians have complete information on voter preferences, they can more effectively allocate transfers.

The second political strategy is related to the allocation of benefits according to the electoral cycle (Political Budget Cycles, PBC). This literature has focused on the manipulation of fiscal variables as the election period comes closer. There are two approaches to explain PBC: partisan and opportunist. The first establishes that PBC is determined by the ideology of the government (Alesina, 1987; Hibbs, 1977). Although fruitful for understanding ideological preferences, this approach does not properly apply to Latin America because in these countries there is no traditional left-right spectrum (Block, 2001; Shi & Svensson, 2006). The so-called opportunist approach (Nordhaus, 1975; Rogoff, 1990) indicates that politicians seek to maximize their chances of reelection, manipulating fiscal variables right before polls. In this context, the election period and the ideological distance from the opposition are key incentives for such manipulations.

This approach assumes information asymmetry between the ruler and the electorate, since the ruler seeks to demonstrate his ability to produce public goods without raising taxes (Shi & Svensson 2002). According to Alt & Rose (2006), PBC is influenced by the incentives of

the ruler and his ability to manipulate public finances. Incentives are given by electoral competition: as the scrutiny approaches, one should opt for the distribution strategies that maximize re-election options. The second condition refers to the institutional environment, which defines the possibilities for a discretionary use of public resources. In this regard, it is essential to advance into the mechanisms that limit PBC. Greater transparency reduces budget deficit and debt (Alt & Lassen, 2006), or the existence of a fiscal rule can mitigate PBC too (Rose, 2006).

There is extensive literature on PBC in developed countries (Block, 2001), and in recent decades the number of studies for developing countries has increased. The comparative analyses indicate that developing countries face more pronounced political cycles than developed ones (Block, 2001; Brender & Drazen, 2005; Shi & Svensson, 2006). However, many of these studies are at national level, with very little evidence regarding the institutionality that reduces political discretion at sub national scale. This Thesis Project seeks to deepen knowledge in distributive politics at urban and regional level, identifying both, the effects on territorial inequality, and the mechanisms that could reduce electoral bias in the distribution of benefits.

Hypothesis

Based on these theoretical considerations, we propose the following hypotheses:

Urban Form and Inequality

Hypothesis 1. The way in which human activities are organized in highly unequal cities is related to the distribution of public goods and the social opportunities of residents.

Hypothesis 1.1. There is a relationship between the characteristics of the urban form and inequality in the SMA.

Hypothesis 1.2. The urban form of SMA affects mobility patterns and access to public goods, affecting the social opportunities of residents.

Hypothesis 1.3. Sub-optimal metropolitan planning plays an important role in the unequal provision of public goods.

Distributive policy and inequality

Hypothesis 2: Politicians, motivated by their desire to maintain power, distribute public goods with the object of maximizing their reelection options, which affects the equity of territorial policies.

Hypothesis 2.1. Electoral motivations affect the distribution of public goods among the municipalities of a region and among the different areas that make up the SMA.

Hypothesis 2.2. Electoral motivations in the provision of public goods has implications for the development of metropolises and regions.

Hypothesis 2.3. There are institutional mechanisms that can reduce partisan bias in the distribution of public goods.

Methodology

The methodological strategy is based on quantitative analysis techniques. The study of the relationship between urban form and inequality leans on multiple regressions, while the essays on distributive politics use panel data analysis and fixed effects. In addition, throughout the research, Geographic Information Systems (GIS) are used to illustrate spatially the different variables. Some relevant aspects of the methodology are detailed below.

1) Methodology for metropolitan inequality analysis.

To calculate the levels of inequality in the Santiago Metropolitan Area, the multiple regression methodology has been applied, a standard methodological strategy in previous studies (Camagni et al, 2002; Lawrence, 1994). One of the advantages of this method is the

fact that it can eliminate the omitted-variable bias. The omitted-variable bias occurs when the omitted variable is correlated with the regressors included in the regression and when the omitted variable is a determining factor of the dependent variable. Therefore, if there is omitted-variable bias, the first OLS assumption $E(u|X_i) = 0$ is not met, which makes the OLS estimator inconsistent. That is, if an omitted variable is a determinant of Y_i , then it is in the error term, and if it is correlated with X_i , then the error term is correlated with X_i . Inasmuch as u_i and X_i are correlated, the conditional mean of u_i given X_i is non-zero.

The multiple regression model extends the simple model by incorporating additional variables as regressors. This allows for the estimation of the effect on Y_i of the variation of a variable (X_{1i}), keeping the remainder regressors (X_{2i}, X_{3i}, etc). The key issue is that, if data on omitted variables are available, then they can be included as additional regressors and therefore, the effect of a regressor can be calculated while keeping the other variables constant.

The multiple regression model is:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \dots + \beta_k X_{ki} + u_i, i = 1, \dots, n, \quad (1)$$

Where

- Y_i is the i -th observation of the dependent variable; $X_{1i}, X_{2i}, \dots, X_{ki}$ are the i -th observations of each of the k regressors; and u_i is the error term.

- The population regression line is the relationship between Y and X on mean in the population:

$$E(Y|X_{1i} = x_1, X_{2i} = x_2, \dots, X_{ki} = x_k) = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \dots + \beta_k X_{ki}$$

- β_1 is the slope coefficient of X_1 , β_2 is the coefficient of X_2 , etc. The coefficient β_1 is the expected effect on Y_i of change in X_{1i} , holding constant X_{2i}, \dots, X_{ki} . The coefficients of the other X s are interpreted similarly.
- The coefficient β_0 is the intercept term. It is the expected value of Y when all X is equal to 0.

2) *Methodology for analysis of political influence in investment distribution*

The strategy used to determine the relationship between electoral factors and investment distribution has, as a common element, the fact that databases contain observations of individuals over time (with their respective characteristics). Specifically, they contain electoral, investment and socioeconomic information at the municipality level for several years. This methodological strategy is used regularly in the analysis of distributive policy at the subnational level (Luca & Rodríguez-Pose, 2015; Psycharis, Zoi, & Iliopoulou, 2015; Rodríguez-Pose, Psycharis, & Tselios, 2016). Because multiple regression is a limited tool when the omitted-variable bias occurs, this methodology becomes a common strategy to compare countries, regions, cities, municipalities, etc. This problem is even greater when the omitted variables that differentiate municipalities are variables that cannot be observed, such as cultural factors.

To solve this problem, we work with databases called panel data, which contain information about individuals in time, that is, each municipality is observed for two or more periods. In this context, by studying changes in the municipalities over time, it is possible to eliminate the effect of the omitted variables that differ between municipalities, but which are constant over time.

To exploit such panel data, the existing literature suggests employing regressions of individual fixed effects. Additionally, two-way fixed effects have been incorporated into the investigations, that is, fixed effect at the level of individuals (municipalities) and temporary fixed effect (years). Two-way fixed effects are used when there are non-observable variables that are fixed over time, and together, non-observable variables that are constant between different municipalities but that change over time.

The notation for panel data is expressed in the model (1)

$$Y_{it} = \beta_0 + \beta_1 X_{it} + u_{it} \quad (1)$$

Where the first subscript, i , refers to the municipality that is being observed, the subscript t , refers to the period in which it is observed and u is the error term.

As noted, the methodological strategy employs regressions with fixed effects. In the case of individual fixed effects, the method considers those non-observable omitted variables that vary between municipalities but do not change over time. The individual fixed effects equation is expressed in model (2)

$$Y_{it} = \beta_1 X_{it} + c_i + u_{it} \quad (2)$$

Where:

c_i : ($i=1 \dots n$) is the unknown intercept of each municipality

Y_{it} : is the dependent variable (e.g., Investment), where i = municipality and t = time

X_{it} : represents the independent variable (e.g., Political Variable)

β_1 : is the coefficient for the independent variable

u_{it} : is the error term

The individual fixed effects regression model presents n different intercepts, one for each municipality. These intercepts absorb the influences of all omitted variables that differ from one municipality to another, but are constant over time. The inclusion of fixed effects for each municipality allows for avoiding the omitted-variable bias, derived from the omission of factors that vary between municipalities, but are constant over time within a municipality. The cultural attitudes towards municipal management is an appropriate example.

However, other factors could be affecting this regression leading to an omitted-variable bias. For example, during the sample period, technology could have been improving municipal management. As technological development affects in a similar way every municipality, including temporary fixed effects can eliminate its influence.

That is, by means of individual fixed effects, those variables that remain constant over time, but differ between different entities (e.g., cultural norms) are controlled. Meanwhile, the temporary fixed effects allow to take into account the variables that are constant among the

individual entities (e.g., technology), but that evolve over time. Two-way fixed effects is a combined model of individual and temporary fixed effects:

$$Y_{it} = \beta_1 X_{it} + c_i + \tau_t + u_{it} \quad (3)$$

Where c_i is the individual effect and τ_t is the temporary effect. The combined regression model of fixed individual and temporal effects eliminates the omitted-variable bias that appears both, by unobservable variables that are constant over time, and by those unobservable variables, which are constant between municipalities but vary in time.

Finally, another element incorporated is heterocedasticity and serial correlation control within an individual entity. In panel data, the variables are usually autocorrelated, i.e., correlated in time within an individual entity. In this sense, each estimate used works with clustered standard errors, in order to control for heterocedasticity and possible serial correlation, that is, temporal relationship in the sample that may affect the model.

3) *Geographic Information Systems (GIS)*

Apart from econometric techniques, Geographic Information Systems were used to spatially represent certain variables. Every essay considered at least the spatial distribution of the dependent variables, for example, density or investment distribution. The program used was ArcGis.

Structure of the Thesis

The remainder of the Thesis is structured in four chapters, corresponding to the four papers already published, and a last chapter with general conclusions. In what follows, I provide a brief summary of each chapter².

² Chapters are presented according to the format in which they were sent for publication following each journal's format requirements.

Chapter 2: Urban form and the environmental impact of commuting in a segregated city, Santiago de Chile

Written in collaboration with Xabier Gainza. Published in *Environment and Planning B* (2013). Quality indicators: JCR Impact Factor (2018): 2.825, 8/40 in *Urban Studies* (Q1).

The literature on the relationship between the built environment and journeys to work has identified population density and the combination of land uses as key features of the urban form, since they affect travel patterns. However, in cities with strong socio-spatial disparities such as the Santiago Metropolitan Area, there is no substantial evidence to support the argument that these characteristics are equally important.

The article performs a multiple regression analysis based on the methodology of Camagni, Gibelli, & Rigamonti (2002). These authors developed an environmental impact index that measures the performance of neighborhoods in a metropolitan area using modal choice indicators and travel time. We compute this index for the communes that make up the SMA and subsequently the identification strategy is based on estimating the effect of the variables of urban form (distance, density, diversity of uses) on this index.

The results show how the characteristics of urban form affect a segregated city: distance increases the environmental impact of mobility, mainly due to the monocentric nature of the SMA; density reduces impact; and the communes that contain mobility within their areas have a lower incidence. On the other hand, the impact depends heavily on the modal choice, the greater the use of public transport, the less environmental impact. Finally, we question the factors that influence the mode of transport used, among which the density, distance to the center and the competitiveness of public transport stand out, although the latter does so in a way that would be expected (greater competitiveness, less use of public media). The reason seems to be that the modal choice is strongly related to socio-economic conditions.

These results raise an interesting discussion and have significant implications for urban planning. To the best of our knowledge, containing the expansion of the city and creating compact areas that combine residential uses and economic activities would not only improve environmental performance, but it would also serve to reduce socio-spatial segregation if new employment is available in low-income areas.

Chapter 3: Understanding Density in an Uneven City, Santiago de Chile: Implications for Social and Environmental Sustainability

Written in collaboration with Xabier Gainza. Published in Sustainability (2014). Quality indicators: JCR Impact Factor (2018): 2.592, 44/116 (Q2) in 'Environmental Studies'

In order to contain the population within the limits of the city already built, densification policies are being carried out in many parts of the world. The reasons are that compact developments are environmentally more sustainable, socially cohesive and economically efficient: they help protect natural spaces, stimulate walking and the use of public transport, contribute to social cohesion by bringing together people from different social backgrounds and allow more intensive and efficient use of resources (Ng, 2010; Williams, Burton, & Jenks, 2000).

However, in unequal and segregated cities, the benefits of densification are not so obvious. The aim of this work is to identify and discuss some of the contradictions of densification in the SMA. In this sense, the working hypothesis is that the density depends on the distance to the center, the provision of amenities and the conditions of the neighborhood. In a polarized city like Santiago, where the distribution of these attributes and neighborhood conditions vary greatly between areas, access to social opportunities is strongly conditioned. The argument is that in Latin American cities density rates differ dramatically between areas and often do not follow a pattern as clear as in Europe, so there are huge disparities in mobility, accessibility and use of social infrastructure.

To understand the differences in density rates within the city, multiple regression is used. The analysis shows that the density of housing depends on the distance from the city center, the socioeconomic conditions and the availability of urban attributes in the area.

Based on these results, a discussion is raised regarding the implications it has for work-related journeys, the distribution of social infrastructure and environmental services provided by green areas. Although, at the metropolitan level, densification can favor a more sustainable travel pattern, it must be achieved by balancing density rates and addressing spatial differences in the provision of social services and environmental services. We believe that a metropolitan approach is essential to correct these spatial imbalances and promote a more sustainable and socially cohesive growth pattern.

Chapter 4: Distributive politics and spatial equity: the allocation of public investment in Chile

Written in collaboration with Xabier Gainza. Published in *Regional Studies* (2018). Quality indicators: JCR Impact Factor (2018): 3.074, 49/363 in Economics (Q1).

This study analyzes the weight of electoral factors in the allocation of investment from the central government to the municipalities. Specifically, three issues of distributive politics are analyzed. First, two types of electoral motivations are identified: if the investment is diverted to the municipalities governed by mayors of the central government party; and if there are political budget cycles, that is, if the investment varies throughout the term of the legislature, increasing as the elections approach and decreasing in subsequent years.

Secondly, we attempt to determine if the municipalities where the ruling party has won by a wide margin, or where there is greater electoral competition, receive more resources. One of the most discussed issues in the literature is to determine the main strategy to follow: over-finance the bastions (core voters) (Cox & McCubbins, 1986), or focus where the party has won by a narrow margin and, by virtue of this, they can lose power and move over to the opposition (swing voters) (Dixit & Londregan, 1996). We analyze this issue, but we also discuss whether the interests of the central or local government prevail. In other words,

if by favoring core or swing municipalities, what is sought is to improve the electoral prospects of the central government or, conversely, to help in the re-election of mayors.

Finally, the article addresses the implications for governance and discusses the mechanisms that could reduce electoral bias and improve investment allocation. We find four relevant elements: a) reforms aimed at increasing transparency and accountability in order to reduce arbitrariness; b) the development of multiannual budgets in order to reduce the influence of the political cycle; c) to create an independent investment planning office; d) mechanisms to address huge territorial inequalities. This is essential, not only in terms of social justice, but also to achieve a more balanced distribution of investment.

Chapter 5: Paving the electoral way: Urban infrastructure, partisan politics and civic engagement.

Written in collaboration with Xabier Gainza and José Acuña. Published in World Development (2019). Quality indicators: JCR Impact Factor (2018): 3.905, 26/363 in Economics (1st decile).

This research analyzes the incidence of electoral factors in the Santiago Metropolitan Area. There is abundant literature on distributive politics at subnational level and countries, but very little research on the urban scale. In this sense, the research is new and represents an important contribution to the field. Another new feature in this research is that we question whether citizen participation can be an element in reducing arbitrariness.

In order to analyze these issues, the distribution of two investment funds from the central government to the 52 communes of the SMA is examined. A significant difference between these two funds is that, while one is assigned to mayors directly, in the other it is citizen committees who manage resources. The different nature of the program allows us to see if the citizenry captures public resources for its own benefit when it is the administrator.

This research shows that when the investment passes through the hands of the mayors there are electoral motivations, while, if it is managed directly by the citizens, this is not the case.

When the mayors are the administrators, the central government benefits those of its political party, particularly those facing greater electoral competition. On the other hand, electoral bias is not identified when the citizen committees are in charge, and, in addition, they do not capture the resources for their own benefit.

Regarding the political implications of the results, it is suggested to favor citizen management to promote accountability and democratic practices. Concerning governance, a multilevel system composed of communes and a metropolitan authority is proposed, since this would be a new counterweight to reduce arbitrariness.

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Chapter 2: Urban form and the environmental impact of commuting in a segregated city, Santiago de Chile

Abstract. The literature on the relationship between the built environment and travel has identified population density and the mix of land uses as key characteristics of the urban form that affect travel patterns. However, in cities with strong socio-spatial disparities it is not clear if these characteristics account in the same way. In this article, we use regression analysis to estimate the influence of the spatial growth pattern of Santiago, Chile, on the environmental impact of commuting. Our findings can be summarized in three points: first, the travel impact increases as the city spreads out because of the monocentric nature of Santiago; second, the environmental impact of commuting could be reduced by containing commuters within the area they live; third, the use of public transport reduces the impact, but the modal choice does not only depend on the effectiveness of the transport system, but on the characteristics of the urban form and other socio-economic determinants. Consequently, we propose to reorient the growth pattern in three ways: redirecting land use policy to promote development within its already built area, developing compact areas where residential and economic activities are mixed and facing socio-spatial disparities as a way to encourage public transport use. This would reduce the environmental impact of commuting while, at the same time, tackling socio-spatial segregation.

Keywords: Urban form, sustainable travel, socio-spatial segregation, Latin America

Introduction

In recent years there has been an intense debate on the relationship between the urban form and travel (Banister et al, 1997; Crane, 2000; Ewing and Cervero, 2010; Rickwood et al, 2008). The way human activities are organized in the urban space affects travel and associated energy use, since the structure of the city influences the modal choice, the time spent travelling and the distance. Urban sprawl increases the length of daily trips and encourages the use of private transport, because lower densities make widespread public transportation networks unprofitable. By contrast, in dense and multi-functional areas where complementary land uses are closer, the trip distance is usually shorter and the

number of people using mass transit or walking is greater (Frank and Pivo, 1994). Therefore, the spatial growth (the distance) and the specific features of the urban form (the density, the functional diversity) seem to be the key issues when analysing sustainable travel patterns.

The aim of this article is to estimate the effects of the spatial form of Santiago, Chile, on the environmental impact of commuting. Much of the studies regarding travel and the urban form have focused on the U.S and, to a lesser extent, Europe, where sprawling forms of suburban development are blamed for increased car use (Cervero, 1996; Ewing, 1997; Giuliano and Narayan, 2003; Glaeser and Kahn, 2003; Handy et al, 2005; Schwanen et al, 2004; van de Coevering and Schwanen, 2006), but empirical analysis for Latin American cities is very rare. Nevertheless, the urban dynamic and the travel pattern of Latin American cities have specific features, so it is not clear if the characteristics of the built-up area account for travel in the same way. Firstly, most of Latin American megacities continue growing, which increases the distance of daily trips and the associated environmental costs. Secondly, strong disparities persist, both in socio-spatial characteristics and socio-economic conditions. Residential densities, for example, are much higher than in the U.S. and Europe and there are important disparities in residential density rates among the different areas of the city. Thirdly, the functional structure of many Latin American cities remains centralized, so balancing jobs and housing is a pressing issue as the city spreads out. Finally, accessibility and the modal choice are much more dependent on socio-economic conditions, despite the rapid pace of motorization of the past two decades.

We conduct a regression analysis to estimate the influence of Santiago's spatial structure on the environmental impact of commuting. The hypothesis is that the differences in commuting patterns, the modal choice and the time spent travelling, depend on the socio-spatial characteristics of the *comunas*. To contrast this hypothesis, we follow the methodology developed by Camagni et al. (2002), who created an Impact Intensity Index that synthesizes the environmental performance of the neighbourhoods, depending on the transport mode chosen and the time spent commuting. This methodology is used to meet the following research questions. First of all, the effect of Santiago's socio-spatial

characteristics on the environmental impact of commuting is analyzed. Next, we focus on the use of public and private transport to determine whether the environmental impact depends on the modal choice or not. Lastly, we explore the main reasons for using public transport by testing the influence of the characteristics of the urban form, its relative competitiveness and the average income of the area.

The remainder of the paper is divided into four sections. In Section 2, the literature review is conducted, focusing on three issues: to start with, we place the debate on the relationship between urban form and travel from a general perspective; after that, we bring this debate to the specific circumstances of Latin American cities; then, we explore Santiago's spatial growth and we characterize the travel pattern. In Section 3, the methodology to analyze the relationship between the urban form and the environmental impact of commuting is introduced. In Section 4, the most important results are displayed. Finally, the implications of our findings are discussed and the paper is concluded by raising some questions that should be borne in mind, not only to reduce the environmental impact of commuting, but also to achieve a fairer and more balanced travel pattern.

Literature review

On the relationship between urban form and travel

Recently, Ewing and Cervero (2010) conducted a meta-analysis of the relationship between the built environment and travel. They simplified in "5 Ds" the main factors identified in the literature: density, diversity, design, destination accessibility and distance to transit. Density and the diversity of land uses are probably the factors most studied within the planning and transportation literature. In most of the studies there is a significant relationship between density and the transport mode, i.e. car use decreases and public transport use increases with higher density (Newman and Kenworthy, 2000). Therefore, higher densities lead to less energy consumption and a more environment friendly transportation choice, although this also means more congestion and, thus, more time travelling; however, even though vehicles are less fuel-efficient in dense areas due to traffic congestion, ultimately fuel consumption per capita is still substantially less because people

drive much less (Ewing, 2008). On the contrary, people drive more in low-density suburbs and the overall gasoline consumption is usually higher.

Similarly, mixing different land uses influences transportation choices. Mixed land uses means a diversity of functional uses within a given area (residential, industrial, commercial, recreational), which usually reduces travel distance because compatible uses are in close proximity. The proximity of jobs and housing is probably the most important factor, since commuting accounts for a substantial part of the total distance travelled and the time spent on daily trips. Regarding commuting, linking jobs to housing usually increases mass transit usage and walking, whereas single-occupant vehicle usage declines (Frank and Pivo, 1994). Additionally, the distance travelled and the time taken on work-trips is usually less in multi-functional areas (Cervero and Duncan, 2006). Although it may seem obvious that living in a job-rich area may reduce work-trip time and distance, the relationship is not as strong as could be expected. In fact, Miller and Ibrahim found that balancing jobs and housing led to insignificant savings in the amount of distance travelled in their analysis of the Toronto area (Miller and Ibrahim, 1998). This could be explained by several factors. First, if work-places and households are mismatched, workers would have to commute outside their area of residence, even if they live in a job-rich area. Second, there are other factors for residential choice besides the access to work (Giuliano and Small, 1993), such as accessibility to non-work facilities, difficulties in finding a central residence between two workplaces in two-worker households, land use regulations, or the importance of housing and neighbourhood characteristics.

At the metropolitan scale, the functional organization of the city also affects travel. Often, the spread of the urban area and the distance to the city centre are critical dimensions, since work-places tend to be more accessible at central locations. However, this depends on the specific structure of the city, i.e., if it is functionally monocentric or polycentric. In a city undergoing rapid urban expansion, a polycentric development could contain the growth of commuting distances, as found by (Zhao et al, 2010) for the case of Beijing. Moreover, theoretically sprawled cities can lead to better accessibility to the work-place if employment is decentralized close to residential areas (like in edge-cities); indeed, because

the aggregate gasoline consumption is reduced when people travel in less congested routes, the environmental damage could be smaller (Glaeser and Kahn, 2003). While this can be the case if firms and residences locate close to each others in the process of decentralization, the opposite happens if jobs and housing are mismatched or jobs remain centralized (Ma and Banister, 2007). Actually, this also depends on the city size, since larger cities tend to have higher densities and higher commute-times; nevertheless, once the city size has been controlled for, there is no evidence of commute-time reduction for sprawling cities (Ewing et al, 2002). As a result, the spatial growth pattern and the city structure, along with the density and the mix of land uses seem to be key issues to understand the travel pattern and its environmental effects.

Urban form and travel in Latin American cities

Latin American cities have their unique characteristics in the spatial structure and the socio-economic conditions that affect travel pattern. Latin American cities in general and megacities in an increased manner are characterized by a process of urban sprawl and rapid growth of population in peri-urban areas (Jordán et al, 2010). In this region the spread of the built environment has not only been driven by low-density, suburban residential growth, but also by the displacement of lower income sectors to new developments, mainly in the periphery (Torres, 2008). Historically, the rural-urban migration accounted for the growth of the periphery. However, in the past few decades the residential pattern has changed. New residential suburbs are being built close to low income settlements, in some cases forming gated communities, in an increasingly fragmented scenario (Janoschka, 2002). As a consequence, the urbanization of the periphery combines low-density, high-class residential areas with high-density, low-income settlements. At the same time, the population of the central area is decreasing or at least stagnating in most of the megacities, although the city centre is still by far the densest area (Jordán et al, 2010).

This spatial growth pattern has significant impact on travel. The difference in residential density between areas is usually very high and, unlike most North American and European cities, the density may increase with the distance from the city centre for some areas.

Furthermore, the relationship between residential density and trip time and even trip distance might be positive. Usually, the new suburbs of the upper classes are located all over the metropolitan area, but still close to the central transportation axis, especially highways and main roads; on the other hand, low-class neighbourhoods are becoming less approachable and more isolated (Janoschka, 2002). Consequently, in the less dense suburbs work-trips could be shorter in time and even distance than in the overpopulated neighbourhoods.

The functional structure of most Latin American cities also differs from North American and Europeans. Historically, Latin American cities have been functionally monocentric, although nowadays there is a trend towards a more fragmented and polycentric spatial organization (Rojas, 2005). However, in spite of the decentralization of some economic activities, most Latin American cities remain more centralized around a Central Business District (CBD) than European and North American cities. This poses the question of distance and accessibility to the city centre, as well as the functional diversification of the areas, as critical issues when analysing commuting patterns.

Travel and accessibility are also determined by socio-economic conditions. The access to cars is strongly correlated with income, despite the motorization of the past two decades. Besides, the growth of the city has uneven socio-spatial and socio-economic effects, since not all the areas or social groups are affected in the same way. As the city grows and congestion increases, travel costs rise in terms of money and time. In advanced economies, improving the quality of transportation makes up for these social costs, but in Latin American cities, lower income groups have no compensation (Monzón, 2005). In practice, public transportation is often less competitive and less accessible in peripheral areas, meaning low income groups usually have lower mobility rates (Monzón, 2005).

The spatial organization of economic activities has also unequal effects on travel, depending on socio-economic conditions. The city centre hosts much of the employment whereas low-income workers usually live in the periphery, so distance and work-trip time is usually larger for the poor (Rodríguez Vignoli, 2008). In recent years, some jobs have been

suburbanized. Residential suburbanization attracts jobs to the periphery, especially services for medium and high income elites (housework, personal services, shopping mall employees, etc.). This results in a spatial mismatch since the new employment is decentralized to wealthier suburbs, whereas low skilled workers remain segregated in poor areas. The spatial mismatch hypothesis suggests worse labour market outcomes for inner-city minorities who are disconnected from suburban jobs opportunities (Gobillon et al, 2007), but it also impacts on travel. As service activities follow the peripheral migration of the upper classes, the distance between homes and workplaces is increasing for the unskilled workers who have to spend more time commuting to the wealthier suburbs.

The spatial growth of Santiago Metropolitan Area and the current travel pattern

The urbanization trends that characterize most Latin American megacities hold for Santiago de Chile. Santiago is a metropolitan region³ of 5.5 million inhabitants, 35% of the total population of Chile. Over the past sixty years, the population has grown around 4.5 million, spreading the urban area from 11.017 hectares in 1940 to 64.140 hectares in 2002 (Galetovic and Jordán, 2006). From the forties the population grew at higher rates than the urban perimeter, but in the nineties the growth pattern reversed; the spatial growth rate exceeded the population growth rate, leading to lower residential density rates for the whole metropolitan area.

There are two driving forces behind the spatial growth of Santiago. The first one is the housing policy, which traditionally located the new developments in the periphery (Ducci, 1997; Hidalgo, 2007). In Chile, the housing facilities provided by the state have been extensive since its main objective was to reduce the housing deficit, no matter the living conditions or the localization; actually, from the fifties between the half and two thirds of the homes provided each year were built, commissioned or financed by the state (Tokman, 2006). But the emphasis on reducing the housing deficit neglected the impacts on the urban

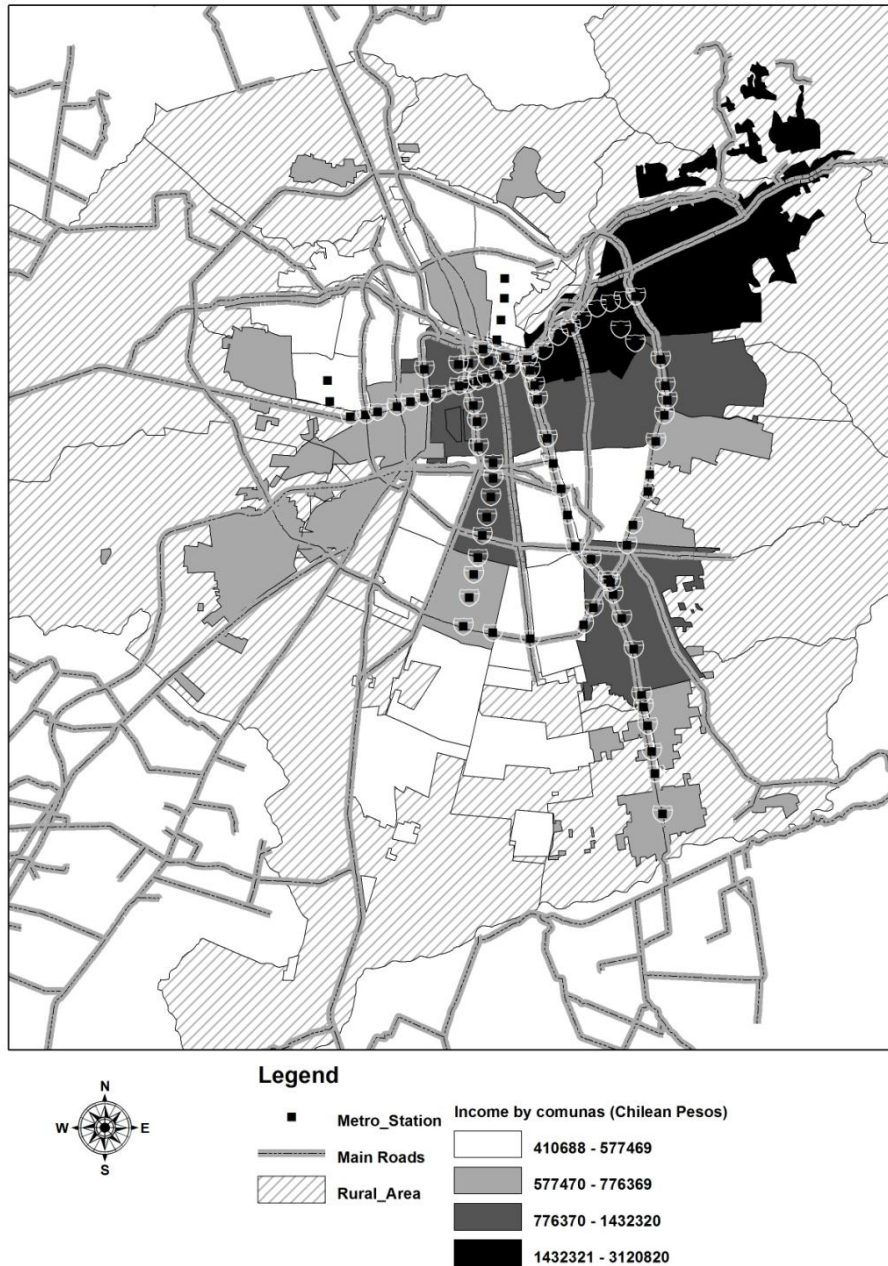
³ The Santiago Metropolitan Area (SMA) covers the 32 *comunas* of the Santiago province, plus San Bernardo and Puente Alto.

form. Public housing was systematically located in the periphery where the urban land was cheaper and plots were bigger, thus spreading the urbanized area.

The other driving force has been the metropolitan planning strategy, especially since the neo-liberal reforms of the late seventies. In 1979, the Military Government launched the so called “National Policy of Urban Development”, which incorporated the free market principles into urban planning. According to these principles, the land market was the mechanism to decide between agricultural or urban uses and thus, there should be no limit but market forces for the sprawl of the urban fringe. Consequently, the Military Government established an urban growth boundary of 100.000 hectares, while the built-up area was around 35.000 hectares. The plans implemented since the nineties limited the growth to 72.000 hectares and proposed target density rates. However, the urban perimeter kept on growing and strong disparities in density rates have persisted.

In fact, Santiago is socio-spatially segregated (Dammert, 2004; Sabatini et al, 2001): richest *comunas* cluster in the northeast, whereas the poorest spread to the south and the northwest (Figure 1). Residential density provides almost a mirror image: the lowest density rates are in the wealthy northeast, while in the city centre and some western and southern *comunas* the residential density rates are above 200 inhabitants per hectare. Residential segregation in Santiago has historical roots, but it seems that the driving forces of the spatial outgrowth have deepened its dimension and characteristics. Public housing systematically clustered low-income families on the urban fringe, while medium and high income families moved from the city centre to benefit from the amenities of suburban residential areas, in a *Tieboutian* sorting type (Tiebout, 1956). This residential location pattern spread the city eastwards and increased the gap between areas, thus reinforcing socio-spatial segregation in an already uneven city.

Figure 1: Socio-spatial segregation and main transportation infrastructures.



Source: MIDEPLAN (2006)

The growth of the city has gone hand-in-hand with the transportation infrastructure. In the past two decades, Santiago has undergone a rapid motorization, from 90 motor vehicles per 1000 inhabitants in 1991 to 137 in 2006 (SECTRA, 2006); this motorization has been driven by all income groups, but in the richest *comuna* the rate is 15 times higher than in

the poorest. The public transport network comprises bus and metro, being the bus the most frequently used transport mode, followed by car and metro; nevertheless, the transport choice differs considerably among areas: in the south more than 60% of commuters use public transport, whereas in the wealthy northeast this rate is less than 30%.

In 2007, the public transport was reformed into a system called *Transantiago*. Before the reform was undertaken, independent operators ran the bus network, so traffic congestion in the city centre was commonplace since most operators crossed main streets to gain travellers. *Transantiago* integrated bus and metro into a single fare system and bus routes were divided into local trips (routes within the same zone) and main trips (routes between different zones). Five years after its launch, no comprehensive evaluation of *Transantiago* has been conducted but some preliminary estimations show lights and shadows in the reform. The implementation entailed several problems, such as missing infrastructure, lack of buses in some routes, overcrowded buses and metros, too many transfers and increasing trip time in many routes (Pardo and Pedrosa, 2012). On the other hand, *Transantiago* introduced planning principles into transport, eliminated redundancies, improved the quality and the environmental standards of buses and benefited its users through the single fare system. The conversion to cleaner buses yielded environmental benefits, but even more important was the integration of bus and metro into a single fare, since it helped to increase the use of metro, particularly by low-income users (Pardo and Pedrosa, 2012).

Regarding travel flows, two major characteristics stand out. Despite the urban outgrowth that has decentralized some economic activities, Santiago today remains monocentric (Rodríguez Vignoli, 2008). The most dynamic activities cluster in the city centre, so over 40% of the commutes at peak hours end in the CBD. Apart from the CBD, just few *comunas* in the West (Maipú) and the East (La Florida) are strategic work-nodes due to the location of some industrial activities. But the travel pattern is not only from the periphery to the centre, also from the poorest to the richest areas. According to data from the latest Urban Mobility Survey (SECTRA, 2006), if *comunas* are classified by income quintiles, the richest areas (those of the fourth and fifth quintiles) attract almost 70% of the commuting trips. At the same time, the residents of the poorest areas have to commute to

the richest *comunas* and actually almost 60% of the commuters living in *comunas* of the first quintile and 50% of the second quintile travel to the richest *comunas*. As a result, the average work-trip time in poor *comunas* is more than twice the time of the richer *comunas*.

Research design and methodology

The spatial growth of Santiago has increased travel flows and, as a result, travel related air pollution is actually a major problem, as it stands among the most polluted Latin American cities. In this section we introduce the methodology to analyze the influence of Santiago's spatial form on the environmental impact of commuting. The aim was to identify different commuting patterns, which had different environmental impacts, and to contrast whether or not these differences are determined by the socio-spatial characteristics of the *comunas*. The hypothesis was that the differences in travel patterns, the time spent and the mode chosen can, to a certain extent, be attributed to the urban growth pattern.

Most of the research on the link between urban form and travel has been conducted using disaggregate models or, conversely, aggregate models. Disaggregate models have been used to test differences in individuals' travel choices and the relative importance of a variety of urban factors in those choices, whereas aggregate models have been used to compare average travel characteristics in neighbourhoods of different design or cities of different densities (Handy, 1996). Consequently, disaggregate models allow to control for individual preferences and socioeconomic characteristics, and may be appropriate to understand how and why urban form is linked to travel through individual decisions. Meanwhile, aggregate models are useful for analyzing the influence of urban growth on travel patterns, since many aspects of the urban form are better measured at an aggregate level (the neighbourhood as a whole) and provide further evidence on the potential effectiveness of land use policy on reducing automobile dependence (Handy, 1996).

In this paper we analyze the effects of the spatial growth pattern of Santiago on the environmental impact of commuting. Whereas it is possible to look at the effect of the built environment using disaggregate data (e.g. use GIS to measure land use diversity for buffers around individual households), our focus was on the influence of the metropolitan spatial

structure, so we conducted an aggregate analysis that considered the characteristics of the neighbourhoods as factors that may influence the commuting pattern. Therefore, the *comuna* was selected as the unit of analysis.

Usually, travel pattern is characterized in terms of distance travelled (Vehicle Miles Travelled –VMT-) (Bento et al, 2005; Cervero and Murakami, 2010) or travel related energy used (per capita gasoline consumption) (Banister et al, 1997; Newman and Kenworthy, 1989). These data were not available for Santiago, so we applied the methodology proposed by Camagni et al. (2002) and developed by Travisi et al. (2006), but adapting it to the data available and the specific circumstances of Santiago. These authors constructed an “Impact Intensity Index” that reflects the environmental impact generated by commuting in each area, given the modal choice and the time-length of commute-trips. Based on this index, we tested if the travel related environmental performance is related with particular features of Santiago’s spatial structure.

To obtain the Impact Intensity Index, we first weighted commute-trips by assigning a value to each trip, depending on the time of the journey and the transport mode chosen (Table 1). To avoid arbitrariness, we weighted trips based on two criteria. On the one hand, the car trip was weighted as the most polluting mode, followed by motorcycle and bus, metro, pedestrians, bicycle trips and transported passengers; conventionally, the car trip was weighted at 1.00 per passenger per minute, and the other modes, respectively: 1/3 motorcycle and bus, 1/5 metro and zero pedestrians, bicycle trips and transported passengers (considering that the impact of the passenger is already absorbed by the driver). On the other, we assumed that the impact of a trip per unit of time decreases with the trip length (to take into account that for a vehicle with catalytic converter pollution is higher at the start of the trip and lower as the fluidity of traffic increases, that the number of bus and trains stops is lower in longer journeys, etc.) (Camagni et al, 2002). The weighting system was deemed appropriate with respect to the literature (that considers car as the most polluting mode, followed by bus and train) and the transport system of Santiago, where mass transit is usually overcrowded.

Table 1. Weights by travel time and travel mode

Classes of trip time	Weights for			
	0–30 min	31–60 min	60 min or more	modes
Average trip time		15	45	75
Weight per time unit		1.20	1.00	0.80
Equivalent trip time		18	45	60
Walking or other soft means	0.00	0.00	0.00	0.00
Bus	0.33	0.13	0.33	0.44
Private car (driver)	1.00	0.40	1.00	1.33
Motorcycle	0.33	0.13	0.33	0.44
Private car (passenger)	0.00	0.00	0.00	0.00
Train, underground	0.20	0.08	0.20	0.27

Source: Camagni et al. (2002)

After weighting commute-trips, we had two values for each *comuna*, commuters and equivalent impact commuters. By comparing these two values we obtained the Impact Intensity Index for each *comuna*, which measures the average impact that can be assigned to every commute-trip made.

Formula: Impact Intensity Index for the k^{th} comuna

$$I_k = \frac{\sum_{ij} m_{ij} w_{ij}}{\sum_{ij} m_{ij}}$$

Where m_{ij} is the number of commuters moving within the k^{th} *comuna* plus the number of outward commuting trips generated in the k^{th} *comuna* for the i^{th} travel mode and the j^{th} trip time class; and w_{ij} is the weight assigned to the i^{th} travel mode and the j^{th} trip time class (Travisi et al, 2006).

Once the Impact Intensity Index was calculated for each *comuna*, we conducted a regression analysis to test if the environmental impact of commuting is explained by the spatial form of Santiago. The Santiago Metropolitan Area is divided in 34 *comunas*, thus the number of observations had to be limited to 34. The low number of observations did not allow reflecting the diversity of neighbourhoods by classifying *comunas* in different type of areas. Nevertheless, the estimations provided insights for a discussion on the relationship between urban form and travel pattern in cities with strong socio-spatial disparities.

Our analysis was formulated to answer three research questions. First, we wondered about the characteristics of the built environment that account for the travel impact. The Impact Intensity Index was considered as the dependent variable and the following characteristics of the spatial growth pattern as independent variables: the distance of the *comuna* from the city centre (*Distance_centre*); the residential density of the *comuna* (*Res_density*); the number of productive businesses per capita by *comuna* (*Prod_pop*); and the mobility self-containment capacity (*Self_cont*), a variable that estimates to what degree mobility is contained within an area, measured as the ratio between the number of commuters moving within the *comuna* and the number of commuters moving within and outside the *comuna* (Travisi et al, 2006). Based on these variables, the following linear model was estimated:

$$\begin{aligned}
 (\text{ImpactIntensity Index}) = & \beta_0 + \beta_1(\text{Distance_centre}) + \beta_2(\text{Res_density}) + \\
 & \beta_3(\text{Prod_pop}) + \beta_4(\text{Self_cont}) + \varepsilon_k
 \end{aligned}
 \tag{1}$$

The model was estimated with Ordinary Least Squares (OLS) technique, so the hypotheses of constant error variance (homoscedasticity) and no spatial autocorrelation across observations were tested.

$$\begin{aligned}
 \text{Var}(\varepsilon_i) &= \sigma^2, & \forall i \\
 \text{Cov}(\varepsilon_i, \varepsilon_j) &= 0 & \forall i, j
 \end{aligned}$$

The hypothesis of homoscedasticity was not rejected⁴ and the level of spatial autocorrelation was not high⁵. Therefore, OLS technique was estimated as suitable.

Second, we wondered whether the modal choice is related with the environmental performance and, if so, how does the share of public and private transport affect the travel impact. The share of public transport (*Pub_trans_share*) and private transport (*Pri_trans_share*) was calculated as the percentage of all commute-trips made by public or private transport. These variables were not included in model (1) because problems of multicollinearity due to the high correlation between *Pub_trans_share* and *Pri_trans_share* and other variables did not allow making inferences with respect to these variables. Therefore, the relationship between the environmental impact and the modal choice was estimated through Models 2 and 3:

$$(\text{ImpactIntensity Index}) = \beta_0 + \beta_1(\text{Distance_centre}) + \beta_2(\text{Prod_pop}) + \beta_3(\text{Self_con}) + \beta_4(\text{Pub_trans_share}) + \varepsilon_k \quad (2)$$

$$(\text{ImpactIntensity Index}) = \beta_0 + \beta_1(\text{Distance_centre}) + \beta_2(\text{Self_con}) + \beta_3(\text{Pri_trans_share}) + \varepsilon_k \quad (3)$$

Lastly, we wanted to identify the factors behind the use of public transport and, particularly, to test if the relative competitiveness of public transport was the main reason for its use, or other factors played that role. We assumed as an indicator of the competitiveness of public transport (*Comp_pub_trans*) the average time taken for trips made by private transport in comparison with public transport (time commuting in private transport/public transport). Apart from the competitiveness, we focused on income and two

⁴ White's test for heteroskedasticity - Null hypothesis: heteroskedasticity not present

Test statistic: LM = 12.7606

with p-value = P(Chi-square(14) > 12.7606) = 0.545452

⁵ Moran's I=0.082

characteristics of the urban form as factors that may influence the modal choice, distance and residential density. As a result, the following model was estimated:

$$(Pub_trans_share)_i = \beta_0 + \beta_1(Distance_centre) + \beta_2(Res_density) + \beta_3(Comp_pub_trans) + \beta_4(Income) + \varepsilon_k \quad (4)$$

The data used in the analysis comes from several sources. Travel data comes from the last *Origin and Destination Survey of Household Travel* (SECTRA, 2006), a household travel survey conducted by the Transport Planning Office of the Planning Ministry that brings together data on travel modes and trip times of over 6.000 respondents of the Santiago Metropolitan Area.⁶ The geographical variables are from Galetovic and Poduje (2006), income data from MIDEPLAN (2006) and information of business activities' location from the Internal Revenue Service database (SII, 2005).

Result section

The estimation of the relationship between the characteristics of the growth pattern and the travel impact is displayed in Table 2. The Impact Intensity Index and the distance from the city centre are positively related, so the impact increases as the distance does, due to the monocentric structure of Santiago. Meanwhile, there is a negative relationship between residential density and the Impact Intensity Index: the higher the density, the smaller the impact. This outcome is consistent with the literature on urban sprawl, which considers that the environmental impact is usually smaller in denser areas. Regarding the variables of the functional diversification of the areas, the number of productive businesses per capita and the index are positively related, probably because of the commuters that the *comuna* attracts to the business activities. In this sense, containing mobility within the *comuna* reduces the travel impact, as shown by the coefficient relating the mobility self-containment capacity and the Impact Intensity Index.

⁶ The data of the survey are available at <http://sintia.sectra.cl/>

Table 2. Characteristics of the spatial growth pattern and the travel impact

Dependent variable: Imp_Inten_Index

	<i>Coefficient</i>	<i>Std. Error</i>	<i>t-ratio</i>	<i>p-value</i>	
const	0.271	0.036	7.430	3.46e-08	***
Distance_centre	0.007	0.001	5.062	2.13e-05	***
Res_density	-0.0004	0.0001	-2.608	0.014	**
Prod_pop	0.712	0.186	3.823	0.0006	***
Self_Cont	-0.203	0.066	-3.067	0.005	***
R-squared	0.679	Adjusted R-squared	0.635		
No. of observations	34				

Apart from the characteristics of the spatial growth pattern, the environmental effects of commuting depend on the transport mode. The estimations show that the environmental impact is negatively associated with the use of public transport and positively with private transport (Tables 3 and 4). These are the expected outcomes, since we weighted commute-trips depending on the transport mode and the time spent, assigning lower values to commute-trips on public transport. Thus, the outcomes would only have been different if the time spent on public transport would have been much longer than the time spent on private transport. It should also be noted that the estimations for the variables included in the first model are confirmed in the second and third models, i.e. the distance from the city centre and the number of productive businesses per capita in the *comuna* increase the environmental impact, whereas the capacity to contain travel within the *comuna* lowers the impact.

Table 3. Public transport share and the travel impact

Dependent variable: Imp_Inten_Index					
	<i>Coefficient</i>	<i>Std. Error</i>	<i>t-ratio</i>	<i>p-value</i>	
const	0.274	0.042	6.495	4.14e-07	***
Distance_centre	0.007	0.001	5.878	2.23e-06	***
Prod_pop	0.623	0.207	3.017	0.005	***
Self_Cont	-0.213	0.069	-3.085	0.004	***
Pub_trans_share	-0.140	0.063	-2.227	0.034	**
R-squared		0.662	Adjusted R-squared		0.615
No. of observations	34				

Table 4. Private transport share and the travel impact

Dependent variable: Imp_Inten_Index					
	<i>Coefficient</i>	<i>Std. Error</i>	<i>t-ratio</i>	<i>p-value</i>	
const	0.168	0.019	8.893	6.53e-010	***
Distance_centre	0.005	0.001	4.965	2.57e-05	***
Self_Cont	-0.139	0.054	-2.591	0.015	**
Pri_trans_share	0.236	0.034	6.962	9.82e-08	***
R-squared		0.762	Adjusted R-squared		0.738
No. of observations	34				

Our next step was to identify the reasons for the use of public transport. We focused on three set of factors: the competitiveness of public transport; the characteristics of the urban form that may have influence on the modal choice, such as the distance to the city centre and residential density; and income (Table 5). According to our estimations, there is an evidence of inverse relationship between the competitiveness of public transport and its share, i.e., despite the relative competitiveness of the public transport in the *comuna*,

commuters choose private transport. This may seem counterintuitive, but the reason seems to be that the modal choice is also influenced by the characteristics of the urban form and income. Regarding distance, the further the *comuna* from the city centre, the greater the use of public transport. In many cities longer trips are more often made by car, but in Santiago mass transport usage increases as the distance does, probably because of the peripheral location of low-income commuters. Residential density is also positively related with the share of public transport. According to the estimations of model 1, density has a favourable effect on the environmental impact of commuting. This means that, despite longer trips due to congestion in denser areas, the wider use of public transport in the most populated *comunas* exceeds the negative impact of longer trips. Last, there is a negative relationship between income and the public transport share, meaning that the richer the *comuna*, the lower the use of public transport.

Table 5. Factors for the public transport share

Dependent variable: Pub_trans_share					
	<i>Coefficient</i>	<i>Std. Error</i>	<i>t-ratio</i>	<i>p-value</i>	
const	0.421	0.084	5.033	2.32e-05	***
Comp_pub_trans	-0.183	0.084	-2.185	0.037	**
Distance_centre	0.005	0.002	2.183	0.037	**
Res_density	0.001	0.0003	3.226	0.003	***
Income	-6.89e-08	2.69e-08	-2.558	0.016	**
R-squared	0.706	Adjusted R-squared	0.665		
No. of observations	34				

Discussion and conclusions

Santiago has grown in the last decades at an accelerated rate, but the growth was socially and spatially uneven. The growth of the periphery was boosted by the housing policy, where new dwellings could be built at a lower cost; by contrast, in the well-off northeast

low-density suburban development expanded the city eastwards. Regarding the functional structure, the spread of the city did not lead to a significant decentralization of the economy, but on the contrary centripetal forces played their role attracting the most dynamic activities to the CBD.

The spatial growth pattern of Santiago has far-reaching social and environmental effects. According to the analysis, urban form characteristics have influence on the modal choice and the time spent commuting, thus affecting the environmental performance of the *comunas*. Our findings could be summarized in five points. First, the distance from the city centre and the environmental impact of commuting are positively related; as the city expands while functionally remaining monocentric, work-trip time and the associated energy consumption increase. Second, like in North American and European cities, in Santiago the environmental impact of commuting is lower in denser areas. Third, the functional diversification of the areas could reduce the impact if commuting is contained within the *comunas*. Our estimations show a positive relationship between the number of productive businesses per capita and the Impact Intensity Index and a negative relationship between the mobility self-containment capacity and the Impact Intensity Index; thus, a functional redistribution would increase the environmental impact in those areas where new businesses locate, but the pressure on the CBD would be reduced and the overall effect on the metropolitan area would be positive by containing commuters within the area they live. Four, the use of public transport reduces the environmental impact, whereas the use of private transport increases it. Five, the use of public transport depends on its relative competitiveness but there is a negative relationship, meaning that the more competitive the transport in the *comuna*, the lower its use. This is so because aside from its relative competitiveness, public transport use depends on the wealth of the *comuna*, the distance from the city centre and density.

Judging by the results, it seems that containing the spread of the city and creating compact areas where residential and economic activities are mixed would improve the environmental performance by facilitating commuting within the *comuna*. In addition, it could also help reducing socio-spatial segregation if the new employment is located closer

to low-income *comunas*, since workers from the whole metropolitan area would be attracted to the new employment subcentres.

Obviously, limiting the spatial growth of the city and encouraging a different functional organization raises several questions. On the one hand, the effects of land use regulations and, particularly, growth boundaries for slowing down suburbanisation and reducing auto use remain unclear (Jun, 2004). Furthermore, the several growth boundaries established in Santiago since the late seventies were modified as the urban perimeter grew, which limited the effects in containing the spatial growth. Thus, it seems that redirecting land use policy to encourage development within the already built area and promoting brownfield redevelopment programmes could be more effective. In Santiago, an inner city recovery program was launched that, despite its problems (increases in real estate values, the construction of new urban artefacts in traditional neighbourhoods, the loss of the traditional nature of the area) has redirected new citizens towards the centre, as well as yielding other social benefits (preservation of green spaces, cost savings in infrastructure and public goods, employment creation) (Rojas et al, 2004).

Fostering a more dispersed and polycentric functional organization also entails difficulties. A functional redistribution of the economic activities would not lead to a more balanced commuting pattern if workers have to cross-commute to the new employment subcentres. In addition, firms seek localization advantages in their location decisions and these depend on proximity to other firms, meaning the conditions and the scale of localization economies should be considered. Similarly, not all the jobs are equally movable. It seems that productive activities could be easier redirected to low-income *comunas*, since personal services for medium and high classes, which account for much of the employment for low income citizens, will remain in peripheral suburbs as long as the upper classes are not attracted to the centre.

Apart from the distribution of households and employment, the impact of mobility depends on the transport choice. Increasing the use of public transport reduces the impact, but in Santiago the modal choice depends on the relative effectiveness of the transport system, as

well as on income and urban characteristics. According to the literature, not only do higher densities lead to longer trips due to congestion, but also to more environment friendly transportation choices. These results are confirmed for the case of Santiago, since the greater use of mass transit in denser areas offsets the longer time spent by commuters, thus the overall environmental impact is lower in the densely populated *comunas*. However, unlike in many western cities where longer trips are more often made by car, in Santiago the distance increases the use of mass transit. This is probably because low-income workers, that are the main users of public transport, commute from the peripheral *comunas* to the city centre. In this sense, results show that the modal choice also depends on socioeconomic determinants, particularly income. The use of a car is a matter of social status, despite its democratization in the past two decades. Consequently, it seems that improving the transportation network would have limited effects, as long as changes in the growth pattern, the transportation habits and the social conditions are not addressed.

All in all, this paper presents a preliminary study on the relationship between the urban form and travel in a city characterized by strong functional, socio-spatial and socio-economic disparities. Nevertheless, the research has found some limitations. The unavailability of direct data did not allow quantifying the effect of particular characteristics of the growth pattern on the environment, i.e. *how many* miles travelled or *how much* energy would be reduced by changes in particular features of the built environment. Also, the methodology used to overcome data limitations was based on weighting of commute-trips, which made results dependant on those weights. However, trips were weighted based on realistic criteria (car as the most polluting mode, followed by motorcycle, bus and train), especially considering the circumstances of Santiago (overcrowded buses and metros). Lastly, just commute-trips were considered and, despite their share in total trips, other trip purposes are becoming more important.

In spite of these limitations, the results provide a starting-point for future research on the implications for travel of the spatial growth pattern of Latin American cities. Particularly, we believe two topics deserve further research. On the one hand, comparative analysis between Latin American cities, in order to gain understanding on how socio-spatial

disparities affect travel. On the other, the policy implications of Latin American megacities' growth pattern, since traffic related environmental damage is a pressing issue as cities keep on growing.

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Chapter 3: Understanding density in an uneven city, Santiago de Chile: implications for social and environmental sustainability

Abstract: Efforts to promote infill development and to raise densities are growing in many cities around the world as a way to encourage urban sustainability. However, in cities polarized along socio-economic lines the benefits of densification are not so evident. The aim of this paper is to discuss some of the contradictions of densification in Santiago de Chile, a city characterized by socio-spatial disparities. To that end, we first use regression analysis to explain differences in density rates within the city. The regression analysis shows that dwelling density depends on the distance from the city centre, socioeconomic conditions and the availability of urban attributes in the area. After understanding the density profile, we discuss the implications for travel and the distribution of social infrastructures and the environmental services provided by green areas. While at the metropolitan scale densification may favour a more sustainable travel pattern, it should be achieved by balancing density rates and addressing spatial differences in the provision of social services and environmental amenities. We believe a metropolitan approach is essential to correct these spatial imbalances and to promote a more sustainable and socially cohesive growth pattern.

Keywords: density; urban sustainability; socio-spatial segregation; travel; social services; green areas; Santiago de Chile

Introduction

Looking at the big picture, building dense cities and densifying urban areas are desirable planning goals. In several parts of the world densification policies are being implemented to contain population growth within the built area and to reduce suburbanization. The rationale for infill development and densification is that high-density, compact developments are meant to be more sustainable, socially cohesive and economically efficient urban forms since they help protecting farmland and open space, they encourage walking and the use of mass transportation, they contribute to social cohesion by bringing together people from different social backgrounds and they allow a more efficient and

intensive use of urban resources because less public expenditure is required to support services and infrastructures (see [1-4] for an overview of this debate and [5, 6] for a critique of the arguments for densification and compact urban forms).

However, density is a multifaceted concept. Depending on its meaning and definition, the rationale, the specific objectives and the scale, density and densification can have several meanings. Moreover, the distribution of buildings and population within a city is very uneven, so although increasing overall density rates may be a desirable planning goal at the metropolitan scale, it can deepen contradictions within the city depending on how it is obtained. For instance, promoting infill development and containing suburban sprawl may contribute to a more efficient use of services and a more sustainable transportation choice, but at the expense of housing affordability and more access to green space in particular areas of the city [7]. Density also allows for a better access to services because social infrastructures are closer, but it may worsen neighbourhood problems and area dissatisfaction [8].

These contradictions are further complicated in cities polarized along socio-economic lines. In Latin American cities (and in much of the non-Western world) density rates differ dramatically across areas and as such, there are strong differences in mobility, accessibility and the use of social infrastructures and amenities. In this social context, the debate on density and sustainability should go beyond the coordinates “suburbanization” vs. “compactness” and consider critically the living conditions and the accessibility to opportunities for people from different social strata due to the spatial distribution of houses, jobs, services and urban amenities.

The aim of this paper is to provide a framework for discussing densification in cities where strong socio-spatial disparities persist. We illustrate these issues for Santiago de Chile, a socio-spatially segregated city [9] where the debate on densification as a mean to contain built-up area sprawl is going on. To that end, we first analyze the relationship between density and several urban attributes, in order to understand what the drivers of densification are. Economic theory has shown that the density profile of a city is basically a function of

income, accessibility and living space, i.e. as income rises, households tradeoff between accessibility and living space, so density declines with the distance from the city centre where workplaces, services and amenities are closer to each other. However, residential choices also vary depending on the availability of urban attributes, so the density profile may also be explained by the distribution of these urban features across the city. Our hypothesis is that density depends on the distance from the centre and the functional organization of the city, as well as on the availability of urban attributes, such as social equipment and green areas, and the neighbourhood condition. In a city polarized along socio-economic lines where the distribution of urban attributes and the neighbourhood condition vary strongly across areas, the access to social opportunities is severely affected. Thus, our research aims at understanding the role of these urban features in explaining the density profile, in order to discuss its implications for social equity and environmental sustainability.

We focus on two issues we believe deserve particular attention. First, on accessibility and travel. The academic literature has advocated for densification as a way to reduce automobile usage and to encourage a more sustainable transportation pattern. In Santiago, the spread of the built-up area and rising incomes are leading to a rapid motorization that has major consequences for congestion and air pollution, so land use intensification could help containing population and foster the use of mass transit, walking and cycling. However, given the strong disparities in density rates, densification policies may need to be compensated in high-density areas to attain a more rational transportation pattern. Second, we discuss the implications for the distribution of social infrastructures and the environmental services provided by green areas. High-density areas of the periphery lack adequate social infrastructures and green areas, so understanding the implications of density and densification policies is a key question for redressing these deficits in the provision of social and environmental services.

We support our claims on GIS, regression and statistical analysis. The geographical analysis lied in mapping the density profile and the distribution of economic activities, social equipment and green areas. The distribution of these urban features was analyzed at

the census district level, the scale that fits best the neighbourhood. Regression analysis correlated dwelling density with neighbourhood attributes and socioeconomic variables. In addition, mobility and socioeconomic indicators were analyzed at the *comuna* (municipality) level, to discuss the implications of the density profile for mobility and accessibility to economic activities, social infrastructures and the environmental services provided by green areas.

The remainder of the paper is organized in eight sections. Section two provides a literature review of the relationship between density and sustainability, underlying the implications of densification for sustainable planning. We focus on three issues: the theories that explain the density profile of a city; the impacts of density on the environmental, social, and economic dimensions of sustainability; and the problems and contradictions that arise when promoting densification. After the literature review, the density profile of Santiago is explained. In section four the research methodology and the data are explained. Section five presents the results of the regression analysis. In sections six and seven the implications for accessibility and the urban living conditions of the density profile are discussed. Finally, the paper concludes by raising some key issues that should be considered when discussing densification in cities characterized by socio-spatial polarization.

Literature review

Explaining the density profile of a city

Density is probably, the single variable that summarizes best the urban form [10]. In general terms, density can be defined as the number of physical units or people in a given geographical unit, but this simple definition masks an elusive concept that depends on what is being considered in the numerator (people, dwellings, jobs, etc.) and the denominator (total area or residential area, gross or net), the data source and the analytical tools (census statistics, GIS, satellite images) and the scale (the dwelling, the block, the neighbourhood, the district, the municipality, the city, the metropolitan area, the country) (see [11] for an exhaustive overview).

In fact, although density provides a first approach to a city's growth pattern, the distribution of people in different parts of the city can vary significantly. The density profile reflects the spatial variations in density rates within a city. In cities with market-oriented economies population density usually declines with the distance from the city centre. As explained by the Alonso-Mills-Muth model, households tradeoff between accessibility to workplaces and services, which are usually set in central areas, and living space. Consequently, densities are higher closer to the Central Business District (CBD) as competition for land increases prices and living space has to be reduced to make real estate investments profitable, whereas in the suburbs lower pressure on land allows bigger dwellings. In theoretical terms, this location pattern has been summarized by a population density distribution in which density declines exponentially with the distance from the city centre [12, 13]. However, cities are increasingly complex so, rather than a single centre, a polycentric structure fits better the contemporary city's functional organization. As a result, high density areas may be close to the several subcentres. On the other hand, distance alone fails to explain much of the spatial variation of densities, but these are also related to the spatial distribution of other urban attributes. Indeed, neighbourhood amenities and services play an important role in the determination of densities, not only at the intra-metropolitan level [14, 15] but also between metropolitan areas [16].

Density and sustainability

Density is a key dimension of urban sustainability. It reflects the intensity of land use and thus has major consequences for a sustainable use of urban resources. Densification, for instance, is seen as an alternative to contain population within the already built area, which allows for a more efficient use of previously developed urban area and helps protecting agricultural and undeveloped land. It can also favour more sustainable transportation choices. In dense and compact urban areas people usually walk, cycle and use mass transit more frequently because of the better connectivity and the shorter distance to final destinations. In social terms, density is related to social equity and diversity because it favors access to social infrastructures and encourages a more diverse, inclusive and livable urban environment by facilitating opportunities for social interaction. Economically, a

minimum density is necessary for an efficient use of urban resources and to reduce the cost of providing infrastructure. These arguments have been very influential in planning and there have been widespread claims to raise density as a mean to achieve a more sustainable urban growth pattern, although they have also been criticized for not being empirically grounded and not guaranteeing the alleged benefits. Let's discuss in more detail some of the implications of density and densification for sustainable planning.

The relationship between density and travel is probably the most widely studied. In their seminal work, Newman and Kenworthy [17] associated transport energy consumption to density. Other studies confirmed that density is related to distance [18], modal choice [19] and energy consumption [20]. The density effect is due to better walking conditions, shorter distances to transit service, and less free parking in dense areas compared to low-density, suburban areas [21]. The impact on travel time is ambiguous because shorter distances are offset by congestion [22] but ultimately fuel consumption per capita is usually less because people drive much less in densely populated areas [4]. These arguments have been criticized in several ways. Some argue that the impact of urban form on travel cannot be reduced to a single variable because other variables also have influence [23]. In addition, density and travel may be correlated but this does not necessarily mean causality between them [24]. Last, the implications of density and compactness have been very influential in urban planning, although their benefits were not fully tested [6].

Dense residential developments may also contribute to a more efficient use of land, resources and infrastructure. Higher density benefits land preservation by putting less pressure to convert habitat and farmland to urban uses [25]. Nevertheless, high density may also result in the loss of open and recreational space within the built-up area [1]. Less open space is likely to have adverse effects on urban biodiversity and on the ecosystem services provided by green areas; additionally, it can also limit recreational opportunities. There is also evidence that high-density development patterns require lesser public expenditures to support services and infrastructures than do low-density developments [26-28]. The relationship however may not be linear but U-shaped, that

is, expenditures decrease first as density increases, but beyond a threshold expenditures increase with higher densities [29].

Other dimensions that are linked to density are social equity and the quality of urban life, although the direction of this relationship is far from clear. Higher residential density promotes resident interaction and sense of community if well combined with other physical design attributes (architectural design, streets that encourage urban life, public space, mixed land use) [30]. In this sense, it can reduce social segregation and isolation by enhancing local social capital [11]. The impacts on social integration depend, however, on how density is combined with other urban attributes and infrastructures since otherwise can limit equal access to social opportunities. In this vein, Bramley and Power found contradictory results on the impacts of compact urban forms on social sustainability; according to their analysis, density worsens neighbourhood problems and area dissatisfaction, while improving access to services [8].

Densification policies

Despite the, sometimes, ambiguous effects of high-density, concerns about raising densities are growing in several parts of the world [2, 3]. There are essentially three ways to densification [31]: direct state-driven interventions (through, for example, public housing provision); supply-side policies via stimuli (incentives) to market producers or, contrary, land use regulations; or demand-side measures, for example using taxation to influence households' location preferences (i.e., taxing differently various housing types, or increasing the cost of using car).

However, densification is a complex process that often faces several problems. Housing consumption patterns in Europe, North and South America reveal that a large part of the population prefers low-density, suburban developments, although certainly there are groups who seem to attach relatively more value to centrality and live at higher densities than would be expected from their incomes. If this is the case, urban planning has to reorient individual preferences and correct market outcomes in the name of improving social,

economic and environmental performance. In addition, fostering infill development may be particularly troublesome in already built-up areas, as people often oppose densification because it is associated with crowding and thus perceived by residents as a factor that erodes the aesthetic quality of the neighbourhood [32]. Lastly, densification may not be the most effective solution in every case. The potential of fostering infill development is limited because it operates at the margins represented by new construction since new buildings are just a small portion of the housing stock [33]. In fact, depending on the specific planning objective other tools may be more effective, for example, changes in transportation costs for reducing car dependency or zoning and land use regulations for preserving natural land [34].

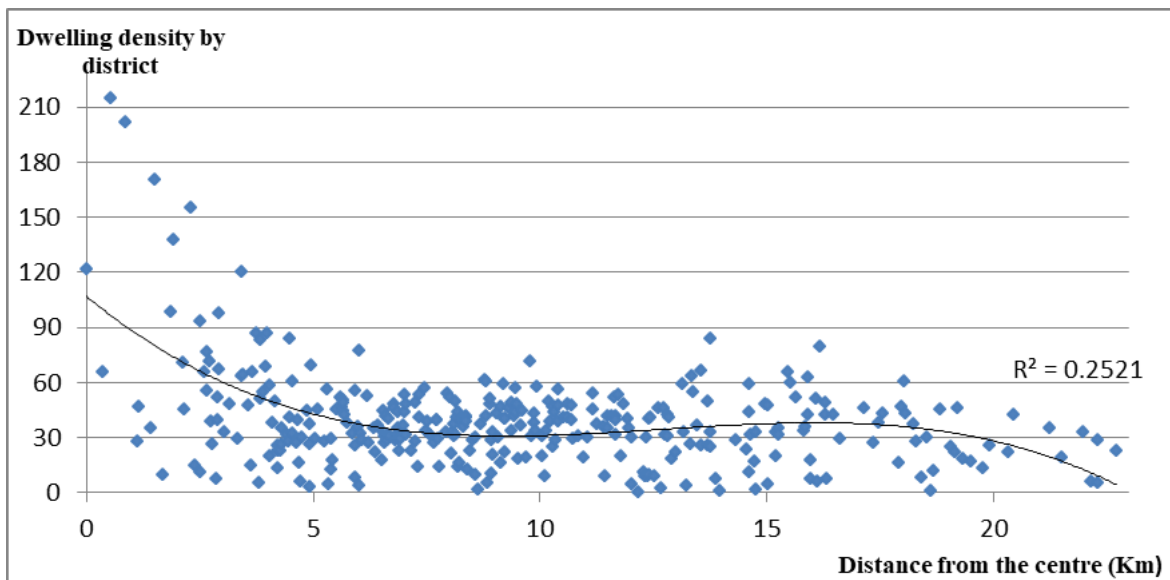
The density profile of Santiago

The Santiago Metropolitan Area (SMA) is an urban area of 6.1 million inhabitants, the 35% of the total population of Chile (INE, Estimated population density 2012). SMA is composed of the 32 *comunas* (municipalities) of the Santiago province, plus the adjacent *comunas* of San Bernardo and Puente Alto and covers 84,000 ha and a continuous urban area that is estimated to slightly exceed 60,000 ha [35]. Population and the built footprint have expanded steadily over the past three decades driven by the economic dynamism of the city, although the built area has grown at a higher rate than population, meaning a decrease in density rates [36]. Nevertheless, residential density within the built-up area is 84 inhabitants per ha, which is medium by international standards (see www.demographia.com for international comparisons).

There are strong differences in density rates within the metropolitan area. As mentioned above, for most cities with market-oriented economies density declines with the distance from the city centre. This pattern holds for Santiago (Figure 1). However, density also depends on households' socio-economic conditions. Figure 2 shows dwelling density at the census district level (mind that the darkest areas represent the 75, 90 and 99 percentiles respectively, to show where the very high density areas are). The densest districts are located in the city centre and the low-income peripheral *comunas* of the South and the

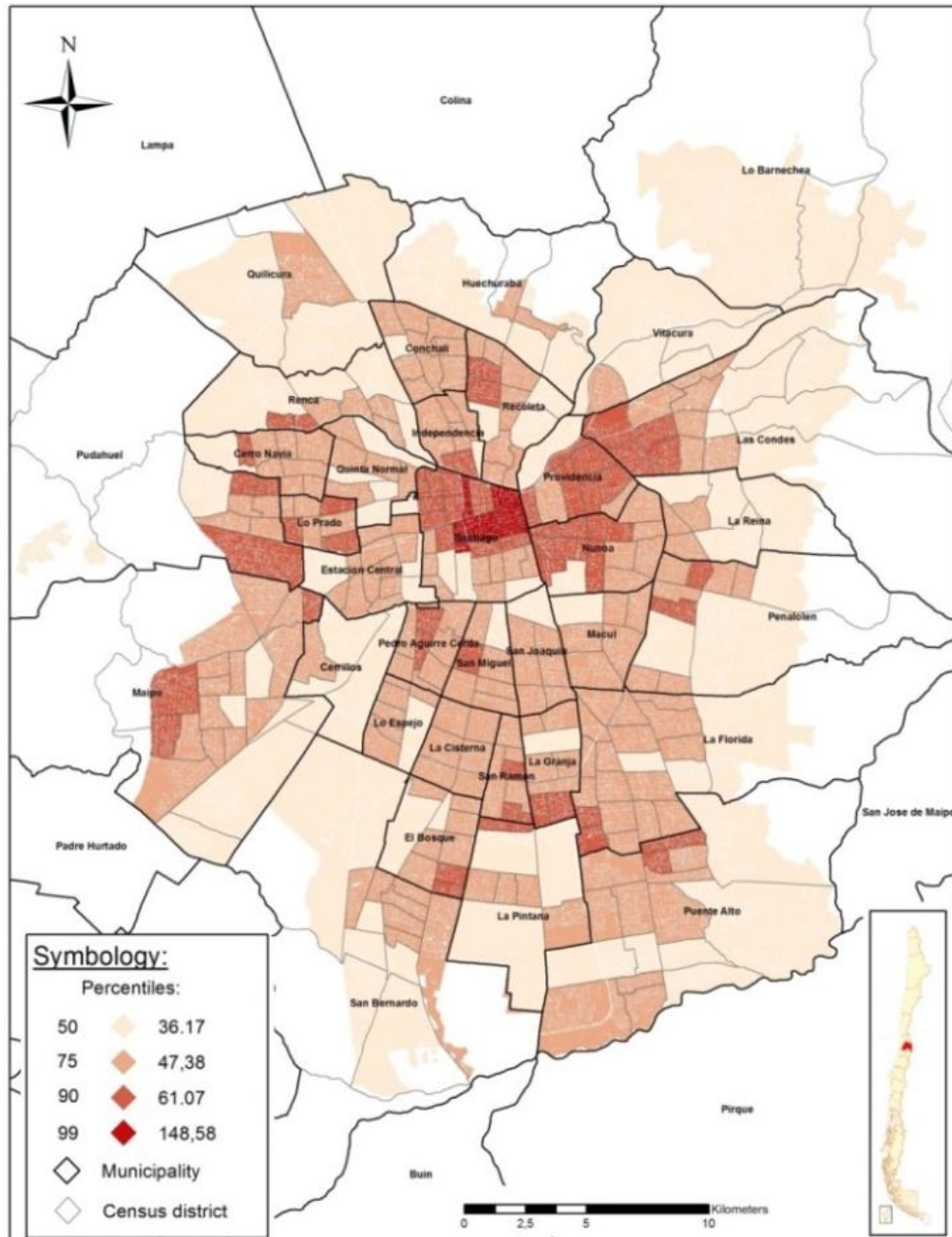
Northwest. Accessibility to employment and services explain the density of the central area whereas social housing is responsible for the high density rates in the periphery. In Chile the housing facilities provided by the state have been extensive since its main objective was to reduce the housing deficit [37], but the emphasis on reducing the housing deficit neglected the impacts on the urban form. Maximizing housing supply led to peripheral locations and numerous houses per project in order to reduce construction costs, thus spreading the urbanized land and concentrating large parts of population in these areas.

Figure 1. Relationship between dwelling density and the distance from the centre (km), sorted by district



Source: Author's own elaboration based on the Pre-census data

Figure 2. Dwelling density at the census district level

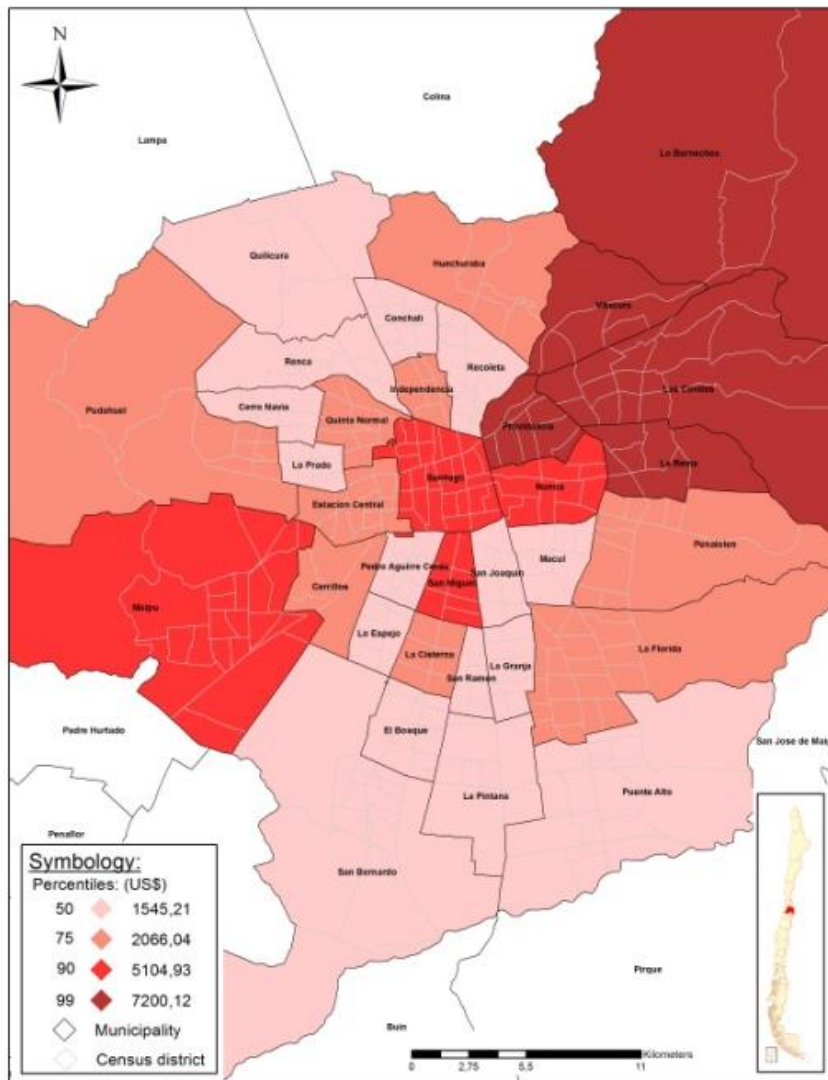


Source: Author's own elaboration based on the Pre-census data

The density profile of SMA reflects the spatial distribution of households along socio-economic lines. Santiago stands among the most unequal cities in the world, with an income based GINI of 0.55 (UN set the alert line of inequality on an income based GINI of 0.40; other Latin American cities above this line are Bogotá (0.61), Mexico City (0.56),

Quito (0.54), Rio de Janeiro (0.53), Buenos Aires (0.52) Guatemala City (0.50) and Montevideo (0.45) whereas below stands Caracas (0.39)) [38]. Santiago is socio-spatially segregated [9, 39]: richest *comunas* are clustered in the northeast cone (Providencia, Vitacura Las Condes, Lo Barnechea) whereas the poorest spread to the south and the northwest (Figure 3). Residential segregation in Santiago, as well as in other Latin American cities, has historical roots, but it seems that recent changes in the urbanization pattern by both the public and the private sector are changing its dimension and characteristics. Social housing is being decentralized further out the metropolitan area, which is deepening accessibility related inequalities and worsening living conditions since they often lack basic social services and infrastructures [40]. Additionally, new residential patterns for the elite are also emerging on peri-urban land and some working-class *comunas*. Since the 1990s intra-metropolitan migration from inner city to the periphery is taking place (almost every central *comunas* lost population, whereas some peripheral *comunas* experienced population growth rates of 200%). New residential developments in peri-urban areas include low-density, scattered mega-projects (up to 50.000 inhabitants), many of them designed as gated-communities [36, 41]. Along with the urban fringe, upper-income groups are also moving to traditional *comunas* where social housing prevails. This is quite a new phenomenon since historically socio-spatial division was at the *comuna* scale, but the new residential patterns of middle- and high-income dwellers are transforming the homogeneous social structure of these *comunas*. This phenomenon, however, is not leading to a social mix but to a reduction on the geographical scale of segregation [9]. Richer and poorer neighbors locate closer to one another but this *results in 'tectonic' juxtapositions of polarized socioeconomic groups rather than in socially cohesive communities* [42] (pp. 2458). Nevertheless, some positive effects for social integration have also been pointed out, such as bringing jobs into the neighbourhoods, improving public services and even sparking a renewed sense of pride among lower- class residents [43]. Regarding densities, the new location pattern of upper-classes is balancing density rates at the *comuna* level but increasing fragmentation inside the *comunas*, as lower density residential developments cluster close to high-density housing for low-income dwellers.

Figure 3. Household income by *comuna*



Source: Author's own elaboration based on SINIM data

Along with the housing policy and households' location preferences, planning has been a major force in shaping the density pattern of Santiago, particularly since the orthodox neoliberal reforms of the late seventies. In 1979 the Military Government launched the so called "National Policy of Urban Development", which incorporated free market principles into urban planning. The land market was the mechanism to decide between agricultural or urban uses and thus, market forces guided the spread of the urban fringe [44]. In fact, an urban growth boundary of 100,000 ha was established, when at that time the built-up area

was around 40,000 ha. These radical changes had major consequences as the boundary had no real effect in controlling the spread of the urbanized area and low-density residential patterns emerged in the periphery and along main transportation axis. In 1994 a new plan was approved to correct some of the spatial imbalances produced by the neoliberal policies.

The Santiago Metropolitan Regulatory Plan (SMRP) was committed to control the excessive spatial growth and the urban area was reduced to 60,000 ha. It also increased density rates to 150 inhabitants per ha and reinforced central government's role in planning [45]. However, in 1997 the SMRP was modified to extend the urban area 17,000 ha and to stop the densification process started three years before. It also introduced conditional planning, by which the private sector was responsible for providing the infrastructures needed in the new residential developments. Conditional planning introduced the private sector into planning and contributed to a further segmentation of the housing market since the new residential areas were targeted for middle- and high-income households, whereas almost no social housing was constructed in these areas [46]. In 2003 the SMRP was again updated to include some southern and western areas within the city limit and in 2013 a new amendment was approved to extend the city other 10,000 ha and to define average and maximum density rates.

The many changes in metropolitan planning during the past two decades reflect the difficulties of regulating the spatial growth pattern of Santiago. The successive extensions of the urban area were aimed at regulating the inorganic growth of some areas but, on the other hand, encouraged new residential developments in the periphery, contributing further to the spread of the urban footprint. By contrast, densification was not considered as a mean to reorient urban growth within the city limits, with the exception of the 1994 SMRP and some local plans. In the central *comuna* of Santiago an inner-city recovery program was implemented to attract middle- and high-income residents, but at the metropolitan scale densification has not been a priority. The latest amendment included average and maximum density rates for different areas of the city, but these were intended to meet technical norms, not strategic goals.

Data, research strategy and variables

After characterizing the density profile of SMA, in this section we deal with the research strategy and the data used to understand the role of urban attributes in explaining density and its social and environmental implications.

The research strategy comprised three stages. First, a geographical analysis was conducted at the neighbourhood level to understand the density profile of SMA. The census district was chosen as the scale for the analysis because it is the geographic unit closest to the neighbourhood. Block and census district data came from the 2011 pre-census, the information gathered previously for the 2012 census. The 2012 census data was not available due to technical problems in the census design and the previous 2002 census was considered too old given the socio-demographic changes of the past decade, so the 2011 pre-census information was judged as optimal. The pre-census compiled physical information of dwellings, commercial and productive activities, social infrastructures, green areas and the streets' state of conservation. This information was geocoded and analyzed at the block and census district level using ArcGIS 10 software. Geographical analysis included mapping the density profile of Santiago, the distribution of productive and commercial activities, green areas, social equipment and transport infrastructures.

In addition, regression analysis was carried out to analyze what neighbourhood attributes have an influence on the density profile. As mentioned, the academic literature has explained density variations as a product of the functional organization of the city, i.e. the distance to the city centre, the distribution of productive activities, and the availability of services and amenities in the area. Given this theoretical framework, the following equation was considered to investigate the relationship between density and urban characteristics in Santiago

$$d = f(FO, SE, NC, GA) \quad (1)$$

where d , dwelling density, is a function of: the functional organization of the city (FO), including the distance to the city centre and the distribution of productive and commercial

activities; the social equipment (SE), including schools, sport facilities and other social services; the neighbourhood condition (NC), including the quality of streets and sidewalks and the availability of facilities; and the green areas (GA). Dwelling density was considered as the dependent variable instead of population density, because it reflects land use intensity and, besides, it was the only variable available from the pre-census (nevertheless, in the 2002 census dwelling and population density were correlated, $R^2=0.84$). The distance to the city centre was calculated as straight-line (Euclidean) distance between census district centroids and the city centre (Plaza Italia). For the distribution of productive, commercial, educational, social, sport and neighbourhood facilities densities were used, i.e. number of units per census district area. The density of neighbourhood facilities included the amount of bike lanes, benches, garbage bins, street lights, roofed bus stops and playgrounds per area, so this variable, as well as the quality of streets and sidewalks, were deemed as proxies of the neighbourhood condition. The quality of streets and sidewalks was derived from the number of streets and sidewalks in bad conditions reported in the pre-census, i.e. the lower the amount of streets and sidewalks in bad state, the better the neighbourhood condition. Last, green areas were calculated as total vegetation per square meter, including designated and non-designated green space. This information was provided by the Ministry of Housing and Urbanism (MINVU). Although just designated areas would be a better indicator of the social and aesthetic services provided by parks and green areas, total vegetation was considered because it reflects better the environmental services provided by urban vegetation.

As little is known about the exact nature of the relationship between neighbourhood attributes and the density profile of a city, extent testing was conducted to determine the best possible fit between dependent and independent variables. The following model was estimated as it seemed satisfactory with respect to the theoretical framework and the empirical fit:

$$\begin{aligned}
 Lg(dens)_i = & \beta_0 + \beta_1(dist) + \beta_2(\lg(prod)) + \beta_3(\lg(com)) + \beta_4(\lg(educ)) \\
 & + \beta_5(\lg(soc)) + \beta_6(\lg(sp)) + \beta_7(\lg(neigh)) + \beta_8(\lg(str)) \\
 & + \beta_9(\lg(sidew)) + \beta_{10}(veg) + \varepsilon_i
 \end{aligned} \tag{2}$$

where ε represents the stochastic error term. The model was estimated with Ordinary Least Squares (OLS), given the linear relationship between variables.

Apart from neighbourhood characteristics, a second regression model was estimated introducing socioeconomic variables. Model 2 incorporated the following variables: disposable budget per capita, in order to understand the influence of municipal expenditures; and a dummy variable for neighbourhoods belonging to rich and poor *comunas* to analyze whether household's average income has a different influence on dwelling density depending on socioeconomic status. These variables were only available at the *comuna* level since the pre-census did not provide socio-economic information. Santiago is divided at the local level into *comunas* that, despite their size (from 50,000 to 850,000 inhabitants), represent the lowest statistical unit. Using data from different scales entailed some limitations. The analysis would benefit if socioeconomic data would have been available at the census district level because the potential influence of a wider range of socioeconomic variables could have been tested. Moreover, *comuna*-level socioeconomic data may soften spatial inequalities since disparities between neighbourhoods are somewhat compensated at an aggregate level. While acknowledging these limitations, the research strategy and the data used provided an adequate framework for understanding the influence of the functional organization of the city, the availability of urban attributes and the neighbourhood condition in explaining the density profile.

Table 1. Descriptive statistics of the variables

Variable name	N	Mean	S.D.	Min	Max
Neighbourhood-level	339				
Density	339	38.76	25.82	0.128	215.2
Distance	339	9518.3	4975.1	0	22718
Productive facilities	339	61.203	92.785	0	935
Commercial facilities	339	219.50	188.31	3	1731
Educational facilities	339	18.133	15.206	0	118
Sport facilities	339	5.2212	4.9627	0	39
Public services	339	3.9911	8.2316	0	107

Neighbourhood facilities	339	121.6	106.06	0	809
Streets in bad condition	339	385.76	299.46	5	2324
Sidewalks in bad condition	339	371.83	277.13	5	2153
Vegetation	339	64.696	61.739	0	475
Comuna-level	34				
Household Income (USD)	34	2,204	1,617.3	924.5	7,464.6
Disposable budget per capita (USD)	34	361.5	331.5	112.6	1,182.3

Understanding density in Santiago

The estimation of the relationship between neighbourhood attributes and dwelling density is displayed in Table 2 (Model 1). It is worth noting that all variables are measured in densities except distance (meters) and vegetation (square meters) to reflect the relative intensity of urban attributes in an area. Similar to other cities, in Santiago also density declines with the distance from the city centre, although probably less because of the housing policy, which located large segments of population away from the urban core, and because of the inorganic growth pattern of the city; in fact, the coefficient relating density and distance is small in absolute values (0.06 percentage points per km). The other two variables of the functional organization of the city, the density of productive and commercial activities show a negative and positive relationship, respectively. Dwelling density declines where more productive facilities are located because some industries are designated in non-residential areas. By contrast, commercial activities are a magnet for residents, so dwelling density increase in denser commercial areas. Regarding the variables related to social equipment, the density of schools and sport facilities increase dwelling density, whereas public services decrease density. This is so because the stock of school and sport facilities depend on population, but the distribution of public services in the metropolitan area is decided mainly by the regional or the national government. Authorities cluster public services in the centre of the neighborhood to ease accessibility, causing dwelling density to be lower where public services are concentrated. The availability of neighbourhood facilities and the quality of sidewalks also have positive impacts on density, while the quality of streets has a negative impact; beware that the fewer streets and

sidewalks in bad state, the better the neighbourhood condition, so the negative coefficient reflects that dwelling density rises where sidewalks are in better condition, whereas it declines where streets are in worse state. This may be due to the distribution of responsibilities among authorities at different spatial scales. Local governments are responsible for neighbourhood facilities and sidewalks, whereas regional and national governments are mainly in charge of streets. As a result, neighbourhoods vary in their state of conservation depending on local authorities' expenditures. Thus, local governments' expenditure on facilities has an impact on density since the better the neighbourhood condition, the higher the density. Last, vegetation is negatively related to density. This is the expected outcome since in neighbourhoods where large designated and non-designated green areas exist there is less urban land for residential uses.

Table 2. Regression of neighbourhood level attributes and economic condition on dwelling density (N=339)

Variables	Model 1		Model 2	
	Coeff.	P> t	Coeff.	P> t
distance	-.0000678	0.000	-.0000612	0.000
lg_prod	-.1725768	0.000	-.1647651	0.000
lg_comer	.2867376	0.000	.2328639	0.001
lg_edu	.3235016	0.000	.3133129	0.000
lg_sport	.1337914	0.026	.1233934	0.040
lg_pub_serv	-.0963492	0.043	-.0944277	0.045
lg_neighb_facil	.2277922	0.037	.2294492	0.039
lg_sidewalk	-2.106483	0.000	-2.224725	0.000
lg_streets	2.0396	0.000	2.204095	0.000
vegetation	-.0048482	0.000	-.0045535	0.000
budget_sq			1.08e-06	0.023

poor_dummy			.3305232	0.023
rich_dummy			(dropped)	
cons	1.829137	0.000	1.424186	0.008
R-squared	0.4129		0.4312	
Adj R-squared	0.3874		0.4013	

The results are basically explained by diverse location preferences and complex interactions underlying market outcomes, land use planning and the distribution of responsibilities among authorities at different scales. Distance and the density of commercial activities reflect the priority given by households to accessibility to work (proxied by distance) and shops relative to space. Other urban attributes also influence location choices and concentration in particular areas of the city, such as the density of schools, sport facilities, neighbourhood infrastructures and sidewalks' condition. On the other hand, land use planning and zoning is the reason why density decreases where productive activities are located, since large part of industrial activities are located just in designated areas. Vegetation also is more abundant where density rates are lower due to zoning, but also because less land has been converted to urban uses. Last, local governments' expenditure help to understand the distribution of urban attributes across neighbourhoods, thus influencing residential location choices and dwelling density.

In fact, Model 2 supports the positive influence of municipal expenditures on dwelling density, as illustrated by the coefficient relating dwelling density and disposable budget per capita. Model 2 also shows that income and density are inversely related in high- and low-income areas, i.e., while in rich *comunas*, the higher the income the lower the density, in low-income areas the opposite is true, the higher the income the higher the density. The results suggest high income household's preferences for low-density living whereas low-income households value accessibility and the greater availability of urban attributes in dense areas at the expense of reduced living space and environmental services. This is reasonable considering the lack of social services, infrastructures and connectivity in low-

income peri-urban areas [40], reflecting low income households' preferences for living in better connected dense areas where basic services are available.

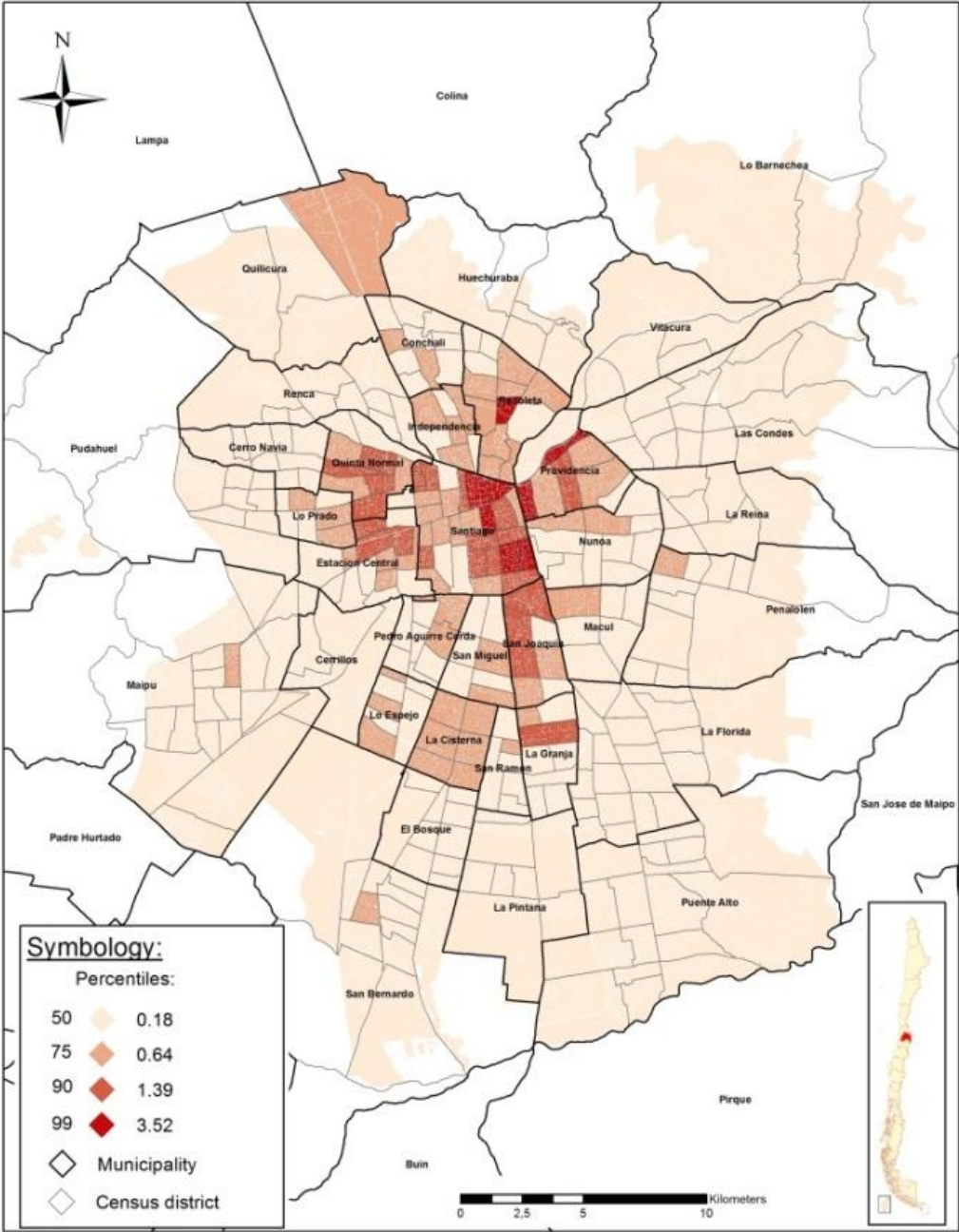
Implications for accessibility and travel

Mobility is a critical issue that has far reaching social and environmental implications. In the past three decades Santiago has undergone a rapid motorization that has increased traffic congestion and air pollution. Nowadays Santiago suffers from among the worst air pollution problems in Latin American cities, due to the high concentration of PM 10, PM 2.5, CO and NOx [35]. From a social perspective, there are significant differences in motorization and mobility rates depending on socioeconomic status despite the rapid increase in auto ownership of all income groups, thus affecting equal access to social opportunities [47].

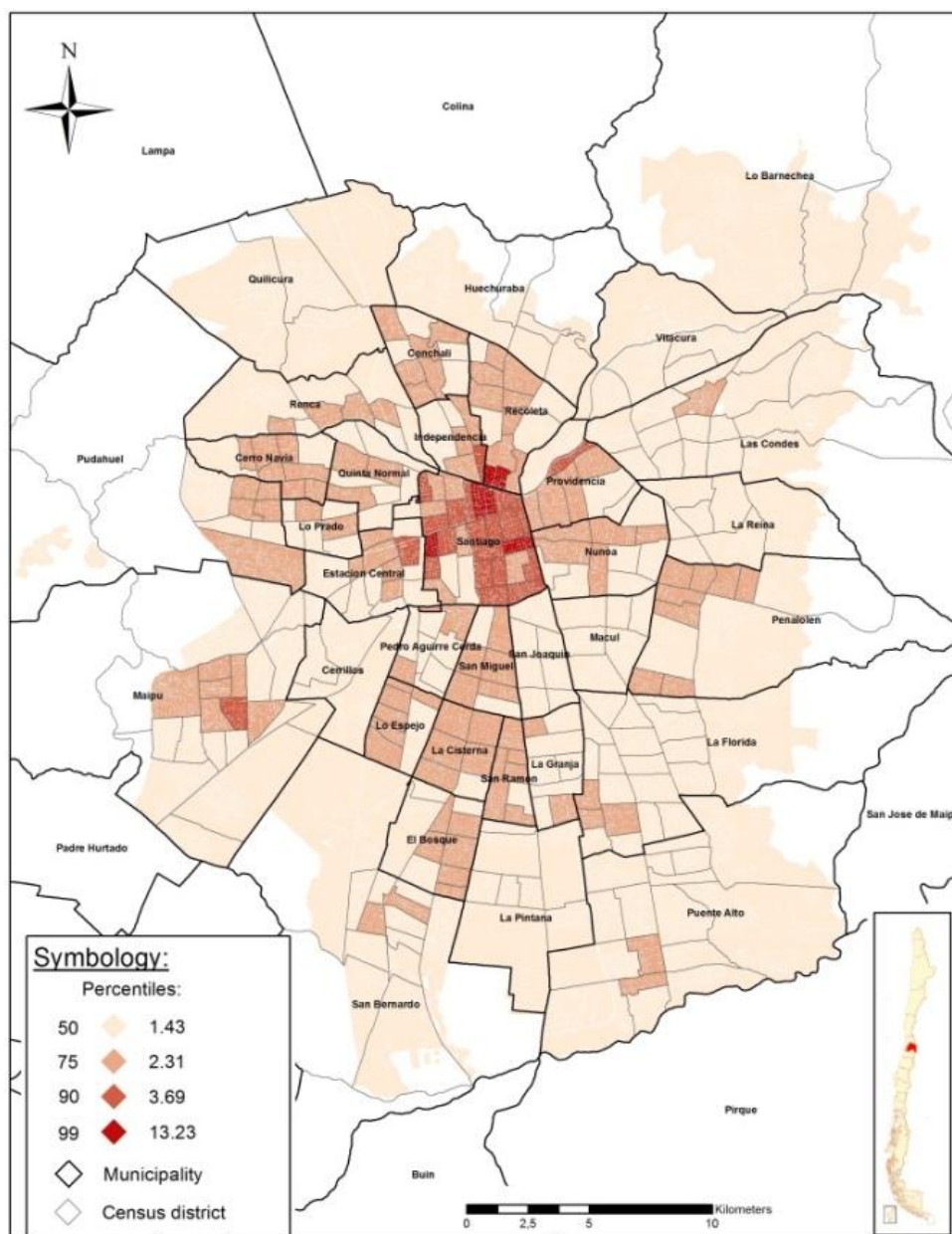
The urban growth pattern and neighbourhood characteristics influence accessibility and travel. On the one hand, although income dominates the household vehicle ownership decision, some built environment characteristics also have an influence, such as dwelling unit density, local land use mix, street layout, distance to CBD and proximity to Metro [48]. On the other, the modal choice, the time spent travelling and the environmental impact are also affected by the urban form and the spatial organization of the city [49]. Despite the urban outgrowth that is gradually transforming the city into a metropolitan region with several employment nodes, Santiago today remains, to a large extent, monocentric. Productive activities cluster in Santiago and some other *comunas* of the first ring, whereas commercial activities are even more centralized (Figure 4). The spatial organization of economic activities defines the commuting pattern and, thus, over 40% of the commutes at peak hours end in the CBD [50]. As mentioned, the city centre also hosts densest districts because of the priority given by residents to accessibility to employment and commerce. Consequently, the city centre is where a higher percentage of commuting is contained within the area.

Figure 4. The distribution of productive (a) and commercial (b) activities

a) Location of productive activities



b) Location of commercial activities



Source: Author's own elaboration based on the Pre-census data

However, the mobility pattern is not only from the periphery to the centre, but also from low- to high-income areas. If *comunas* are classified by income quintiles, the richest areas (*comunas* of the 4th and 5th quintiles), attract almost 70% of commuting trips. Moreover, the commuters from the richest *comunas* move within their area and there are almost no work-trips to the poorest areas. By contrast, almost 60% of the commuters of the first quintile and 50% of the second travel to the richest *comunas*. This is particularly important

for populated *comunas* of the periphery. Maipú, San Bernardo, Puente Alto, La Florida, where more than 2.3 million people live, lack productive and commercial activities so people have to commute to the CBD or cross-commute to rich areas. As a result, average work-trip time in these *comunas* exceeds 40 minutes, more than twice the time of richer *comunas* [50].

This mobility pattern has far-reaching implications for social and environmental sustainability. As the city expands while functionally remaining monocentric, travel time increases, especially for those living further out, and the environmental impact of commuting worsens [49]. From a social perspective, the time spent on working trips is an important source of inequality for those workers that have to commute to the city centre or have to cross-commute from poor to rich *comunas*. In fact, the uneven distribution of jobs could be used as a proxy for measuring conditions of social exclusion since people living in job-poor neighbourhoods would have to travel greater distances to participate in the workforce than people in job-rich areas, holding other effects constant [51].

Land use policy could be used to achieve a more sustainable and fairer mobility pattern. At the metropolitan scale, containing the spread of the built-up area and promoting infill development could reduce the environmental impact of commuting. On a previous work we showed that, like in other cities, in Santiago also densification favours a more environmental friendly transportation pattern because of the wider use of mass transportation [49]. However, in dense areas trips are also longer due to the peripheral location and the traffic congestion, although the overall environmental impact is lower because the wider use of public transport offsets the negative impact of longer trips. Thus, while for the metropolitan area promoting infill development would contain suburbanization, at the *comuna* level balancing density rates would support more rational transportation choices, meaning increasing density in some areas and reducing density in others. Reducing density rates in the periphery and promoting densification in areas close to the city centre is no easy task. The housing policy, responsible for much of the residential developments of the periphery, considered only the price of the land and building costs, but not the cost of communications nor other social infrastructure, so social housing areas have

high density rates but lack adequate accessibility, social infrastructures and amenities [52]. Redressing these deficits would reduce traffic congestion while improving the living conditions in these areas. Additionally, there is room for densifying some areas of the well-communicated *comunas* of the north and the well-off northeast. To that end, a combination of incentives and regulations on the housing supply and demand, and direct state-driven interventions (i.e., public housing provision) may need to be employed.

Along with infill development and balanced density rates, a better jobs-housing balance would allow commuters to move within their area of residence. While the decentralization of some industries could lead to a new spatial equilibrium, we believe promoting more compact areas where residential and economic activities are mixed would be more effective. Our regression analysis showed that dwelling density is related to the density of productive and commercial activities, so creating compact areas where residential spaces mingle with productive and commercial activities could also help balancing density rates. Obviously, the conditions and the scale of localization economies should be weighted. Firms seek localization advantages in their location decisions and these depend on proximity to other firms. Nevertheless, the positive effects should be considered, not only for mobility, but also for reducing residential segregation and improving the living conditions through more compact communities.

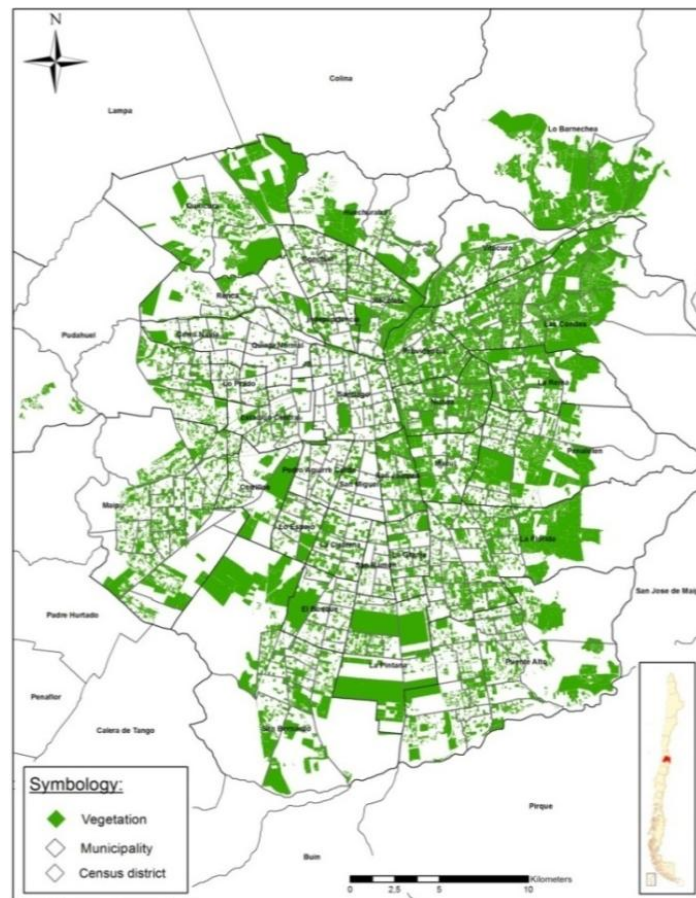
Implications for the provision of social and environmental services

Dwelling density is also relevant for the distribution of social infrastructure and the environmental services provided by urban vegetation. According to our estimations, social services are related to dwelling density, meaning densest areas have the densest network of social, educational, sport and neighbourhood facilities. This may be the expected outcome since the distribution of social services and infrastructures depend on population, but it is somewhat interesting given the socio-spatial polarization that characterizes the SMA. Nevertheless, differences in access to social services are not due to their spatial distribution but to their quality in different areas of the city. The northeast cone hosts high quality

services typical of a global city, whereas social infrastructures in other *comunas*, particularly in the periphery, lack quality standards [53].

By contrast, the distribution of vegetation is more uneven. Regression model showed that dwelling density and the urban vegetation are inversely related. The East and, particularly, the low density northeast cone hosts the greatest amount of urban vegetation, whereas in high density areas such as the central *comuna* of Santiago and some *comunas* of the west and the south, green areas are significantly scarcer (Figure 5). However, rather than on density, the distribution of vegetation depends on income. The five richest *comunas* have 34% of total surface while in the five *comunas* with the lowest income barely exceeds 8%. If instead of total vegetation, only parks are considered it holds that the higher the household income, the greater the total green surface, the bigger the size and the better the accessibility [54].

Figure 5. The distribution of urban vegetation.



Source: Author's own elaboration based on MINVU data

Land use policy favours the proliferation of green areas in low-density settlements. Current regulation for calculating the amount of green surface sets different minimum standards for low- and high-density settlements. In areas where residential density is below 70 inhabitants per ha the required minimum green surface is 10 sq meter per inhabitant, whereas in high-density settlements minimum surface is much less [55]. As such, in high-density *comunas* where social housing is localized average green area is 1.3-3.5 sq meter per inhabitant [56]. Another significant side-effect is the scatterization of small areas at the expense of big parks because a minimum size is not defined [54]. While small parks are usually more accessible, social and ecological functions of green areas require a minimum surface, as well as vegetation cover and design characteristics [54].

Green areas are essential for the quality of life and urban sustainability. Contemporary research has shown the aesthetic, psychological, health, social, economic and environmental benefits of natural features [57]. The latter are particularly important in Santiago considering the scope of the environmental problems, particularly air pollution. Green areas provide basic environmental services such as air and water purification, wind and noise filtering and microclimate stabilization, key functions for the urban metabolism. As such, the uneven distribution of vegetation does not allow fulfilling these functions in particular areas of the city. In addition, the East and the South, where low-income families reside, also present worst environmental conditions, such as higher concentration of air pollutants and lower protection levels against natural hazards like floods [58]. While the distribution of environmental conditions is the result of the urbanization process and more affluent peoples' location choices in areas of better environmental standards (under the Andean cordillera, where air pollutants and water flow downstream), the uneven distribution of urban vegetation does not provide adequate natural conditions to alleviate environmental problems in low-income settlements, thus reinforcing environmental injustice and segregation [59].

A major limitation to overcome inequalities in social and environmental service provision is the governance structure. *Comunas* are responsible for budget, land use planning and public service delivery, but in practice municipal autonomy is limited. This is particularly

harmful for lower-income *comunas* where social housing is located, since while the central government decides its location in a top-down process, municipalities remain responsible for providing public services as paving, lighting, drainage, basic health care, and primary and secondary education. Local authorities rely on property and other local taxes (i.e. business, vehicular taxes, etc.) but the tax scheme reinforces income gaps between wealthier and poorer urban areas because tax revenues are much lower in low-income areas [60]. Wealthier municipalities are able to levy more resources through the property tax because land and asset prices are much higher [61] and because they can also obtain more revenues from other taxes (for instance vehicular taxes, since more residents own a car). Complementary funding sources exist but they do not compensate for income and revenue disparities, in part because money transfers from the central government do not fully account for the social services provided by low-income *comunas* given their limited revenues, and also because wealthier municipalities have more negotiating power with the central government [53]. The result is a self-reinforcing mechanism for socio-spatial disparities in which wealthier municipalities are able to provide better public goods and services.

Different institutional mechanisms could be adopted to reduce spatial disparities in social and environmental services provision, from reforming cooperation mechanisms between *comunas* to re-shaping or even creating new governance structures at the metropolitan scale. While the former could yield some partial benefits if compensatory mechanisms are well designed and rich areas are efficiently enforced to redistribute wealth, a metropolitan governmental authority can favour policy coherence and improve service delivery across municipal boundaries [60]. Currently there are no strategic, metropolitan-wide planning mechanisms, despite major metropolitan problems, such as urban sprawl, transportation, housing policy, the spatial dimension of social services' provision or the environmental problems. A metropolitan authority would provide a comprehensive, city-wide, approach to urbanism, thus better coping with the challenges that pose urban growth and densification with respect to mobility, accessibility, the distribution of social opportunities and the environmental conditions.

Concluding remarks

The aim of this paper has been to introduce some issues that should be borne in mind when considering densification in cities characterized by socio-spatial polarization. To that end, we first have analyzed the role urban conditions have for explaining density in different areas of the city. Leaving aside the uncertainty about causality, regression analysis has shown that dwelling density in the SMA is related to the functional organization of the city, the availability of urban attributes in the area, the neighbourhood condition, local authorities' expenditures and the socioeconomic conditions. The city centre hosts the densest districts due to the high concentration of commercial activities in the area, although some peripheral *comunas* also have very high density rates because of the housing policy. On the other side, high-income areas adjacent to the CBD have low density rates, thus having better access to employment, services and amenities while maintaining good environmental standards. Given this density profile, density declines with the distance from the city centre, although less than in other cities with market-oriented economies. Commercial activities are a magnet for residents, thus increasing density, whereas productive activities decrease density because much of them are clustered in non-residential areas. Other urban attributes also help understanding dwelling density. The availability of social services, collective facilities and good neighbourhood conditions have positive impacts on density, while the quality of streets has a negative impact. This may be due to the distribution of responsibilities among authorities at different spatial scales, since *comunas* are responsible for providing public services and neighbourhood infrastructures whereas regional and national governments are in charge of streets. Thus, *comunas'* expenditure on social services attracts residents to the area and, in fact, regression analysis' results show that municipal budget also has a positive influence on dwelling density. On the other hand, vegetation is negatively related to dwelling density because where urban space is designated as green area, less land is available for residential use. Last, income has the opposite influence on density in rich and poor areas, i.e., in rich areas density decrease as income rise whereas in poor areas the reverse happens. This points out to divergent preferences for the rich and the poor, the former valuing low-density living and the latter better accessibility and availability of urban attributes at the expense of higher density rates.

These results suggest that any policy related to densification needs to be taken cautiously and should consider the scale, its objectives and the specific benefits of a density policy. While at the metropolitan scale promoting infill development and increasing density rates could help containing urban sprawl and favour a more sustainable mobility pattern by reducing travel distance and encouraging public transport usage, it may deepen disparities between *comunas* if specific objectives and density targets in different areas of the city are not considered. As such, raising density at the metropolitan scale should be complemented by balancing density rates between *comunas* and favouring a more decentralized organization of economic and commercial activities, in order to favour the jobs-housing balance. Regarding the provision of social services and environmental amenities, the priority should be correcting spatial imbalances. In some peripheral *comunas* where social housing is located, density is too high and lack adequate social and environmental conditions, so reducing density rates would improve the living conditions while facing socio-spatial segregation. By contrast, density could be raised in some areas close to the city centre with better social and environmental conditions, dealing with spatial imbalances in these *comunas*, while coping with the general goal of densification at the city level. A metropolitan approach is essential for a comprehensive urban planning that aims at tackling the implications of the urban growth pattern for environmental sustainability and socio-spatial equity. Major challenges, such as suburban sprawl, transportation, the housing policy, the distribution of social services and environmental amenities are metropolitan in scope, so metropolitan-wide governance mechanisms should be considered. While reforming actual coordination mechanisms could yield some benefits if richer *comunas* are efficiently enforced to transfer resources to poorer *comunas* to compensate for their lack of adequate social and environmental conditions, we believe a metropolitan authority would be a better institutional response for the challenges the city faces.

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Chapter 4: Distributive Politics and Spatial Equity: The Allocation of Public Investment in Chile

This paper analyzes the influence of electoral concerns on investment distribution from the central government to Chilean municipalities. Drawing upon panel data, the paper shows that investment is mediated by pork-barrel and political budget cycles, as well as favouring the relatively better-off areas. Estimations also reveal that resources are channelled to the municipalities where the vote margin in local elections is larger whereas national results are not relevant, indicating that local governments' lobbying capacity is prioritized over national electoral interests. Based on these results, the implications for regional governance and for reducing the margin of arbitrary allocations are discussed.

Keywords: Distributive politics; pork-barrel; political budget cycle; equity-efficiency trade-off; regional governance; Chile

Introduction

How is public investment allocated? Is it distributed in response to social equity or economic efficiency criteria, or mediated by political considerations? Economic and regional development literature has traditionally analyzed the role of public investment as a trade-off between equity and efficiency (Richardson, 1979). This debate has recently intensified with the contributions of the new economic geography literature, which state that spatial agglomerations of economic activity may benefit national growth and, thus, policies that seek to reduce regional economic inequalities may in fact be nationally inefficient (Martin, 2008). Intermingled in this debate stand the questions about the spatial organization of the state and whether decentralization may favour a more efficient and balanced spatial pattern or, conversely, be a further source for spatial inequalities and inefficiencies (for a theoretical discussion, see Rodríguez-Pose and Gill (2005); for empirical evidence of the effects of devolution on regional disparities Rodríguez-Pose and Ezcurra (2009) and Lessmann (2012)).

Beyond efficiency and equity considerations, in the past two decades a burgeoning literature on distributive politics has documented the significance of partisan and electoral concerns for public resource distribution in many countries around the world (Golden and Min, 2013; Kramon and Posner, 2013). The underlying hypothesis is that politicians are motivated by the desire to retain public office and, consequently, *elected officials allocate specific types of goods to specific groups of constituents in electoral districts at specific times in the electoral cycle* (Golden and Min, 2013, p.78). Political interference includes manipulating fiscal variables along the electoral cycle to convince voters that the politicians have recently been doing ‘an excellent job’, i.e. the political business cycle (Rogoff, 1990), showing political favouritism for culturally constructed population subgroups (Kramon and Posner, 2013) or benefitting particular areas to maximize their re-election chances, i.e. ‘pork-barrel’ (Tavits, 2009).

This paper analyzes the existence of political concerns in the distribution of investment funds from the central government to municipalities in Chile, and its implications for territorial cohesion. In particular, it drives attention to three aspects of distributive politics. First, the existence of electoral concerns in investment distribution is explored and contrasted with the capacity of municipalities to generate revenues and to formulate investment projects. The aim is to test whether public investment, when mediated by pork-barrel and political business cycle considerations, pursues efficiency by concentrating on the relatively better-off areas, at the expense of spatial equity. Second, the paper explores how grant allocation varies along the electoral cycle in both, municipalities that are ruled by political parties of the central government’s ruling coalition, and rival municipalities. Third, it examines whether the central government transfers resources to the municipalities where the vote margin in local and national polls is larger or, conversely, where competition is stronger. The purpose is to determine not only whether core or swing municipalities are benefitted, but also if distribution follows national government’s interest or, on the contrary, is due to municipal governments’ capacity to put pressure on the central government, encouraged by their electoral power. Based on these results, the paper explores the implications for area governance and the mechanisms to reduce the chances for a political bias on investment fund allocations.

The analysis draws on panel data of public investment funds from the central government to the 345 Chilean municipalities over the period 2004-2014. The period covers three local polls and three national polls, in which the winning coalition was from both political branches, two left-wing and one right-wing. The political variables considered are municipal and national electoral results, whereas socioeconomic data includes municipal revenues per capita, municipal staff expenses per capita, population and the percentage of people below the national poverty line. The econometric analysis relies on fixed-effects and generalised method of moments (GMM) (Arellano and Bover, 1995; Blundell and Bond, 1998) to control for potential endogeneity.

This paper adds three novelties to the literature on the relationship between distributive politics and regional development. Firstly, it analyzes how the burden of using investment for electoral concerns is distributed along the electoral cycle and between allies and rival local governments. Other studies of which the authors are aware focus on the variations of fiscal transfers or taxes in election years, but how the effects of this fiscal manipulation are distributed along the term in office and across localities with different political alignment remains understudied. Another original contribution is that it is tested whether political influence is exercised to benefit the electoral prospects of the central government or, conversely, it is due to local governments' lobbying capacity in a bottom-up process. This result is particularly important because understanding the nature of the political game is fundamental for the success of any policy meant to reduce the margin for discretionary allocations. One last novelty is that the paper explores, for the first time, the existence of political influence on investment grant transfers to Chilean municipalities. Previous analyses focused on the influence of economic variables for presidential elections (Cerdeira and Vergara, 2007) and on the access to publicly funded benefits from the perspective of voters (Calvo and Murillo, 2012) but, to the best of the authors' knowledge, no study has revealed the influence of political factors in public investment distribution in Chile. The existence of a political bias is relevant because, being Chile a highly unequal country, the goal of balancing socio-spatial differences may be undermined if redistribution is mediated by electoral concerns. Beyond this particular case, the paper also discusses the institutional

mechanisms to cope with political distortions, contributing in this way to the debate about their implications for regional development.

The remainder of the paper is organized as follows. In the next section the theoretical framework is built from the literature on distributive politics. In section three, the case study is characterized in terms of Chile's socio-spatial characteristics, the multi-level governance system and the sub-national finance mechanisms. Section four presents the data and the methodology for the empirical analysis. In section five the results are explained. The paper concludes by contextualizing the results and discussing their implications for local governance.

Distributive politics and regional development

In broad terms, distributive politics refers to how public authorities confer geographically concentrated benefits while diffusing costs across voters (Weingast, Shepsle and Johnsen, 1981). This definition, though, may be too broad, since it includes pork-barrelling as well as resource allocation in lagging areas, which may be a political goal under territorial cohesion criteria. To narrow the conceptual framework, Stokes et al. (2013) differentiate among distributive strategies according to their programmatic vs. non-programmatic nature. For a distribution to be programmatic, rules of distribution have to be formalized and public, and they have to shape the distribution of resources, whereas in non-programmatic distributions the criteria for allocations are not rendered public.

Within non-programmatic distributions, two of the most spread political distortions are concentrating resources in particular geographical areas with electoral motifs and manipulating the timing of the fiscal variables. Political business (or budget) cycle (PBC) is the term used to identify the variations on budget expenditure or taxes along the electoral cycle. The existence of a PBC has been widely studied by macroeconomists, showing that monetary and fiscal policies tend to be expansionary before an election (Willett and Keil, 2004). Empirical analyses have demonstrated the existence of a PBC in several countries around the world, but the magnitude differs across countries. This is so because PBCs

depend on the institutional conditions under which incumbent political leaders have greater ability and incentives to manipulate policy variables along the electoral cycle (Alt and Rose, 2006).

Although the bulk of the literature on PBCs has used national-level data and macroeconomic variables, other studies have focused on the local level. In fact, Veiga and Veiga (2007) argue that the hypothesis of the PBC is better suited to the local level because the economic evaluation of local service delivery, such as education, infrastructures or amenities, is easier than the economic assessment of national services such as defence, legal institutions or income redistribution. Evidence of manipulating fiscal variables at the local level has been found in both, developed and developing countries. In France, Foucault, Madies and Paty (2008) found that local governments increased all categories of public spending in pre-electoral periods. Likewise, opportunistic behaviour has been reported for Portugal, but Veiga and Veiga (2007) suggest that mayors tended to reduce taxes and increase expenditure on highly visible items shortly before elections, whereas expenditures remained the same or even decreased for the less visible items. Along the same line, Drazen and Eslava (2010) showed for Colombian localities that politicians targeted infrastructure spending prior to elections while other types of expenditure, such as interest payments, transfers to retirees, and payments to temporary workers, fell in election years. In Brazil, over the period 1980-2005 a decrease in the fiscal surplus occurred in election years because local expenditure increased while local tax revenues and investment declined (Sakurai and Menezes-Filho, 2011).

Empirical analyses on arbitrary spatial allocation of resources are based on two different formal models. For the 'core supporter model' politicians will channel resources to support groups because the optimal strategy for risk-averse candidates is to redistribute to core supporters (Cox and Mc Cubbins, 1986). Assuming that swing groups are riskier investments, Cox and Mc Cubbins (1986) predict that politicians will invest little in opposition groups, somewhat more in swing groups, and the most in their support groups. By contrast, Dixit and Londregan (1996), building on Lindbeck and Weibull (1987), state that if political parties are equal in their abilities to allocate redistributive benefits, they will

woo groups that are most willing to switch their votes. Alternatively, if parties differ in their ability to target redistributive benefits to different groups, they will favour their own core constituencies ('machine politics').

Empirical evidence on 'pork-barrels' supports both the core and the swing voter hypothesis or, to be more precise, core vs. swing 'districts' hypothesis, as research overall is based on data from electoral units rather than individual voters (Golden and Min, 2013). Moreover, there is no pattern of tactical distribution depending on the electoral system, the grant allocation scheme, the scale, the spending type or the geographical context. Analyses of grant allocations to core areas include advanced democracies such as the U.S. (Ansolabehere and Snyder, 2006), Greece (Rodríguez-Pose, Psycharis and Tselios, 2016) or Scandinavia (Tavits, 2009), as well as new and developing democracies like Albania (Case, 2001), Mexico (Costa-I-Font, Rodríguez-Oreggia and Lunapla, 2003) or South Africa (Kroth, 2014). On the contrary, evidence on targeting swing areas has been reported for countries of the Global North (i.e. Australia (Denemark, 2000), Sweden (Johansson, 2003), England (John and Ward, 2001), South Korea (Kwon, 2005), Canada (Milligan and Smart, 2005), Portugal (Veiga and Pinho, 2007)) and the Global South (i.e. Ghana (Banful, 2011) and Brazil (Brollo and Nannicini, 2012) (see Table A1 in the Appendix for a selection of the empirical research).

Several studies have analyzed the implications of electoral distortions for regional development, placing them within the equity-efficiency trade-off. Castells and Solé-Ollé (2005) found that in Spain efficiency criteria played a limited role, while infrastructure needs and political factors mostly explained the geographical distribution of infrastructure investment. In Turkey, Luca and Rodríguez-Pose (2015) concluded that regional investment is motivated by politics and efficiency, as the state concentrates resources in relatively better-off areas rather than distributing them to the poorest areas. In Germany, the councils with the same political affiliation as the state received more grants, and efficiency considerations appeared to be less important than redistributive concerns (Kemmerling and Stephan, 2002). Last, Cadot, Röller and Stephan (2006) found evidence of electoral motifs for regional transport infrastructure investment in France, despite its economic returns

being low. As they summarize graphically: *roads and railways are not built to reduce traffic jams: they are built essentially to get politicians re-elected* (Cadot, Röller and Stephan, 2006, p. 1151).

The Chilean institutional context

Chile is a highly centralized country, in spite of some mild steps towards decentralization since 2002. Spatially, it is organized in three government tiers. The national government is the major institution as it controls the different ministries, sub-secretaries and departments, and the governance of lower tiers. At the regional scale, the regional government has limited autonomy because it represents national government's interests and it has no revenue raising capacity of its own. The regional government is also the administrator of the National Fund for Regional Development (NFRD). Given the dependence of the regional government from the national government, the Chilean governance framework works in real terms as a two-tier system (national and local). At the local level, *comunas* are legally autonomous, but in practice decision-making capacity and autonomy are limited as local authorities are highly dependent on central funds.

Local budgets are financed through their own sources of revenue, a horizontal transfer system and the central government grant mechanisms, such as the NFRD. *Comunas* generate their own revenues through commercial licenses (34% of the total), property taxes (32%), circulation permits (11%) and other fees (OECD, 2013). The high dependence on commercial licences and property taxes reinforces income gap between wealthier and poorer areas since poorer *comunas* collect much less revenue from these. This disparity is reinforced because low-income properties (mostly social housing) are exempt from paying the property tax. The municipalities with the highest municipal revenues are located in remote regions of the north and south, and in the Metropolitan Region of Santiago (see Figure B1 in the Appendix).

The Municipal Common Fund (MCF) works as a horizontal equalisation fund, but it barely compensates for imbalances between the revenues that municipalities generate on their

own. This is partly because the disparities are too large to address completely, and partly because the MCF mainly accounts for operational expenditure (OECD, 2013). As a result, large income disparities persist.

The NFRD is the most important fund for regional development. The distribution of funds across regions is determined largely by the territorial characteristics and the population under social vulnerability conditions of each region, thus it is meant to pursue equity. Nevertheless, there is no spatial correlation between poverty and public investment because investment is greater in the remote regions of the south and the north than in the rest of the country (see Figure B2 in the Appendix). Municipal governments apply for the NFRD in a competitive process for which applications are evaluated through a standard methodology based on costs and benefits, and their technical feasibility. Afterwards, the regional government decides which proposals will be sent to the National Budget Office, which then determines whether proposals fit the national guidelines. Since the regional government and the National Budget Office are appointed by the central government and the NFRD is not formula-based, there is wide margin for targeting funds with electoral motifs. Furthermore, this scheme has significant pitfalls for local autonomy. First, because applications must match nationally defined guidelines, municipalities may not receive funds if proposals are not aligned with the National Budget Office's priorities. Second, given the revenue shortages resulting from the municipalities' own sources of funding, the NFRD has become a major source for municipal operational financing, despite being intended as a fund for long-term projects (OECD, 2013).

Data and methodology

The empirical analysis considers NFRD investment transfers, electoral and socioeconomic data for 345 Chilean municipalities for the period 2004-2014. Effective public investment per capita is regarded as the dependent variable because the NFRD is by far the most important transfer mechanism, accounting for 75 percent of the total regional investments defined at the regional level in the period analyzed. Data for this variable comes from the National System of Municipal Information database.

Independent variables are related to local and national election results. Since independent variables are related with political factors, the years of local and national polls and their results are taken as variables which are exogenous to fiscal policies. In Chile, local elections are held on October's last weekend once every four years, and the fiscal year starts on January 1st and finishes on December 31st. Local polls, therefore, take place during the last term of the fiscal year, which means that, following the assumption of PBC literature that voters are backward-looking and short-sighted (Alesina, 1989), investment expenditure in election years can be a factor that influences voting. Moreover, polling dates are fixed and decided exogenously from local authorities' interests, although considering that all municipalities hold elections on the same day, *sensu stricto*, election effects could possibly be caused by general time effects that coincidentally occur in the election years, and not necessarily by elections. The time period of the dataset includes the result of three local polls (2004, 2008 and 2012) and three national polls held one year after local elections (2005, 2009 and 2013).

The following political variables are considered: *coalition*, a dummy variable that takes the value 1 if the mayor is from one of the political parties of the central government coalition, and 0 otherwise; *year of the term of office* ($y_{t=0...3}$), where 0 is the year of municipal election; and *vote margin* of municipal and national elections. Vote margin is the percentage difference between the number of votes of the election winner and the second competitor in the previous election, an indicator used as a measure of electoral competition (Kroth, 2014)¹.

Apart from political variables, four control variables related with municipal performance and local socioeconomic conditions are included: *municipal revenues per capita*; *staff expenses per capita*, i.e. the expenditure in salaries for municipal staff, which is regarded as a proxy for local governments' technical capacity to formulate project proposals; *poverty*, i.e. the percentage of people below the poverty line; and *population*.

Table 1. Descriptive statistics of the variables

Variable	Description	N	Mean	S.D	Min	Max
Investment per capita	Effective public investment per capita (thousands of Chilean pesos)	3795	56,226	11,469	0	1,858,503
Coalition	A dummy equals 1 if the mayor belongs to central government's coalition	3795	0.4158	0.4929	0	1
Year 0	Year of municipal elections	3851	0.2688	0.4433	0	1
Year 1	One year after municipal election and year of national elections	3851	0.2688	0.4433	0	1
Year 2	Two years after municipal elections	3851	0.2688	0.4433	0	1
Year 3	Three years after municipal elections	3851	0.1792	0.3836	0	1
National vote margin	Margin of victory in national election	3775	0.02572	0.1768	-0.6857	0.7216
Municipal vote margin	Margin of victory in municipal election	3791	0.1626	0.1342	0.0002	0.8168
Poverty	Percentage of people below national poverty line	3791	17.493	8.8644	0.11	58.33
Population	Total estimated population	3795	48,954.68	75,448.93	134	602,203
Staff expenses	Expenditure in municipal staff salaries per capita (thousands of Chilean pesos)	3795	69.3551	144.667	6.884	2,558.761
Municipal revenues	Municipal revenues per capita (thousands of Chilean pesos)	3795	59.213	96.716	1.0552	2391.3

Note: All fiscal variables were adjusted to thousand pesos of 2014 and these are found to per capita level to compare properly between *comunas*

Five econometric models were developed. These adopted a fixed-effects (FE) heteroscedasticity and autocorrelation robust estimation with municipal effects. Robust standard errors were estimated clustering them at the municipality level to control for serial and spatial correlation. Model (1) aimed to test the existence of pork-barrels and PBC in investment allocations, considering *coalition* as a proxy for pork-barrel and municipal election year ($y0_t$) as a proxy for PBC. Additionally, Model (1) intended to assess whether investment funds pursued equity by being concentrated in lagging municipalities or, conversely, were directed to the most dynamic areas for efficiency reasons. The variables *municipal revenue*, *staff expenses*, *poverty* and *population* accounted for characteristics of local technical capacity and socioeconomic conditions. These variables are expressed in logarithms and grouped in vector Z_{it} in all the econometric models.

$$\text{Log (public investment per capita}_{it}) = \alpha + \beta_1 \text{coalition}_{it} + \beta_2 y0_{it} + \gamma Z_{it} + \sigma_i + \tau_t + u_{it} \quad (1)$$

Another research purpose was to analyze how investment grants are distributed during the term of office and whether the time-distribution varies between municipalities ruled by mayors from different political parties. Two models were developed. Model (2) aimed to determine the effect of election years for localities ruled by mayors belonging to a party of the central government's coalition and non-coalition municipalities, whereas Model (3) sought to identify whether there are differences between coalition mayors and non-coalition mayors in the years after local elections. Both models worked with interaction terms between the variables *year* and *coalition*.

$$\text{Log (public investment per capita}_{it}) = \alpha + \beta_1 \text{coalition}_{it} + \beta_2 y0_t + \beta_3 (\text{coalition}_{it} \times y0_t) + \gamma Z_{it} + \sigma_i + \tau_t + u_{it} \quad (2)$$

$$\text{Log (public investment per capita}_{it}) = \alpha + \beta_1 \text{coalition}_{it} + \beta_2 y1_t + \dots + \beta_4 y3_t + \beta_5 (\text{coalition}_{it} \times y1_t) + \dots + \beta_7 (\text{coalition}_{it} \times y3_t) + \gamma Z_{it} + \sigma_i + \tau_t + u_{it} \quad (3)$$

Two final questions refer to whether resources are concentrated in core or swing municipalities, and whether the national government's or local governments' interests are

prioritized when channelling resources. Models (4) and (5) aim to determine whether the coalition government allocates more resources to core or swing local governments but, while Model (4) considers municipal election vote margin, Model (5) includes national election vote margin.

$$\text{Log (public investment per capita}_{it}) = \alpha + \beta_1 \text{ coalition}_{it} + \beta_2 y0_t + \beta_3 \text{ municipal vote margin}_{it} + \beta_4 (\text{coalition}_{it} \times \text{municipal vote margin}_{it}) + \gamma Z_{it} + \sigma_i + \tau_t + u_{it} \quad (4)$$

$$\text{Log (public investment per capita}_{it}) = \alpha + \beta_1 \text{ coalition}_{it} + \beta_2 y0_t + \beta_3 \text{ national vote margin}_{it} + \beta_4 (\text{coalition}_{it} \times \text{national vote margin}_{it}) + \gamma Z_{it} + \sigma_i + \tau_t + u_{it} \quad (5)$$

FE estimations may suffer from potential endogeneity, since higher/lower investment at election t may increase/decrease votes given to the governing party at subsequent polls (Luca and Rodríguez-Pose, 2015). By the same token, socioeconomic conditions and the variables related with the local technical capacity may also be affected by reverse causality as it seems plausible that they are, at least partially, explained by investment grant allocations. To control for the robustness of FE results, every model was estimated with the lagged investment using generalised method of moments (GMM). These models were tested using difference-GMM (Arellano and Bond, 1991) and system-GMM (Arellano and Bover, 1995). While the former includes only past differences, the latter instruments variables with past levels and levels with past differences. Although both yielded similar results, system-GMM was selected since political and socioeconomic factors could be persistent over time and, according to Blundell and Bond (1998), this extended estimator is preferable under time series persistence. Consequently, a robust two-step estimator was finally adopted.

System-GMM was calculated using the extension proposed by Roodman (2006) for Stata as it provides wider margin for treating the variables and displays the Hansen test for the validity of instruments. When using this methodology, variables must be treated as exogenous, predetermined or endogenous. Political variables were considered exogenous

whereas socioeconomic variables were deemed to be endogenous since territorial characteristics are supposed to shape NFRD allocations.

Result section

In Table 2 the results are summarized. According to Model (1), Mayors belonging to the central government's coalition parties received 10 percent more public investment than non-coalition mayors, suggesting pork-barrel politics. It seems too that there is a political budget cycle because investment increased 10 percent during municipal election years. Model (1) also captures what municipalities funds were directed to, accounting for socioeconomic conditions and local governments' technical capacity. The distribution of investment is positively related with local governments' revenues and staff expenses: when municipal revenues and staff expenses increased one percent, public investment per capita grew 0.34 and 0.3 percent, respectively. Therefore, investment distribution does not seem to align with its territorial equity objective since those *comunas* with higher revenues and higher staff expenses received more funds. The latter result reinforces a non-equitable distributive pattern because richer *comunas* tend to expend more on staff, thus having greater capacity to apply for investment projects. Besides, population appeared to be negatively associated with public investment per capita, a reasonable result since most populated areas tend to receive fewer funds per inhabitant. Finally, the percentage of people below the poverty line is not related with investment distribution.

Table 2. FE estimation results

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
coalition (dummy)	0.103*** (0.0337)	0.0860** (0.0343)	0.150*** (0.0463)	0.0988*** (0.0334)	0.0916*** (0.0340)
y0 (dummy)	0.102*** (0.0196)	0.0757*** (0.0272)		0.102*** (0.0197)	0.102*** (0.0196)
y0 x coalition (dummy x dummy)		0.0641* (0.0382)			
y1 (dummy)			-0.0895***		

				(0.0281)	
y2 (dummy)				-0.0806**	
				(0.0313)	
y3 (dummy)				-0.0454	
				(0.0367)	
y1 x coalition (dummy x dummy)				-0.0833**	
				(0.0391)	
y2 x coalition (dummy x dummy)				-0.0421	
				(0.0460)	
y3 x coalition (dummy x dummy)				-0.0694	
				(0.0566)	
Municipal election, vote margin (%)				-0.132	
				(0.166)	
Municipal election, vote margin x coalition (% x dummy)				0.540**	
				(0.221)	
National election, vote margin (%)					0.165
					(0.132)
National election, vote margin x coalition (% x dummy)					-0.148
					(0.226)
Municipal revenues (log)	0.338***	0.338***	0.334***	0.331***	0.342***
	(0.0647)	(0.0647)	(0.0648)	(0.0642)	(0.0646)
Population (log)	-0.970***	-0.969***	-0.973***	0.0669	-0.0126
	(0.351)	(0.351)	(0.351)	(0.342)	(0.359)
Staff expenses (log)	0.297***	0.296***	0.302***	0.300***	0.290***
	(0.0694)	(0.0694)	(0.0702)	(0.0686)	(0.0707)
Poverty (log)	-0.0502	-0.0528	-0.0464	-0.0428	-0.0463
	(0.0370)	(0.0371)	(0.0375)	(0.0364)	(0.0365)
Constant	17.60***	17.61***	17.69***	10.34***	11.12***
	(-3.447)	(-3.449)	(-3.450)	(-3.362)	(-3.522)
Municipal FE	YES	YES	YES	YES	YES
Within	0.110	0.110	0.111	0.114	0.111
Observations	3,776	3,776	3,776	3,776	3,760
Number of id (municipalities)	345	345	345	345	345

Notes: The dependent variable and all explanatory variables are expressed in logarithms. Robust, clustered standard errors in parentheses. Level of statistical significance ***p<0.01, **p<0.05, *p<0.10.

Models (2) and (3) were intended to estimate how investment is distributed along the term of office, but while Model (2) captures public investment allocations to coalition- and non-coalition mayors in election years, Model (3) identifies whether there are differences in the years after local election. According to the estimations, in election years investment increased 7.6 percent (Model 2), whereas in the subsequent year after the municipal election investment dropped by 9 percent and two years after the municipal election the decrease was 8 percent (Model 3).

Although investment fluctuates along the term in office countrywide, there are significant differences between areas depending on their political alignment. Because Models (2) and (3) work with interaction terms between the variables *year* and *coalition*, the following equations were calculated to capture the interaction terms, and thus reflect the time-effect for the different municipalities:

The estimated equation from Model (2) is:

$$\text{Estimated per capita investment} = 17.61 + 0.0860(\text{coalition}) + 0.0757 (y_0) + 0.0641 (y_0 \times \text{coalition}) + \gamma Z_{it} + \sigma_i + \tau_t + u_{it} \quad (6)$$

The estimated equation from Model (3) is:

$$\text{Estimated per capita investment} = 17.69 + 0.15 (\text{coalition}) - 0.0895(y_1) - 0.0833 (y_1 \times \text{coalition}) + \gamma Z_{it} + \sigma_i + \tau_t + u_{it} \quad (7)$$

Equation (6) captures the performance of investment in election years. In non-coalition municipalities, investment increased by a factor of 0.076 in election years (the y_0 coefficient), whereas in those aligned with the central government, investment was raised by a factor of 0.14. From Equation (6) too, the different levels of investment that would result depending on the budget cycle (municipal election year vs. non-election year) and the mayor's political affiliation were estimated (Table 3). Apart from significant differences depending on their political alignment, these results indicate that investment is more stable in non-coalition *comunas* because it increases less in election years and decreases less in non-election years.

Table 3. Expected values of investment according to mayors' political affiliation and year

	Coalition	Non- coalition	Difference
Year of election	30.906	28.795	2.111
Non year of election	27.575	28.476	-901
Difference	3.331	319	3.012

Note: the expected values of investment were adjusted to thousand pesos of 2014 and these are found to per capita level

Based on Model (3), Equation (7) displays the interaction between mayors' political membership and the subsequent year after the election. This equation shows that the burden falls mostly on localities ruled by mayors of political parties in the ruling coalition at the national level since, given the interaction terms, the net effect in coalition municipalities is -0.17 and -0.09 in non-coalition municipalities. So, while the level of public investment decreased in the years after municipal elections without political distinction, *comunas* with coalition mayors were particularly responsible for 'footing the bill'.

Finally, it was estimated whether investment is directed to core or swing areas and whether national or local election results were taken into account. Models (4) and (5) included vote margin as an indicator for core or swing municipalities, but while Model (4) considers municipal election results, Model (5) introduces national election data. The municipal vote margin of the mayors aligned with the central government's coalition appears to be relevant, whereas the national vote margin is not. Thus, the central government concentrates more investment in core *comunas*, but only municipal electoral prospects are considered when distributing resources. These results suggest a *bottom-up* political influence as funds are channelled to areas where coalition mayors have a bigger vote margin in local polls, while national election results are not relevant. The rationale may well be that distributive politics is mediated by local governments' ability to obtain more funds, encouraged by their electoral results.

In addition, investment distribution to coalition and non-coalition localities depending on the municipal vote margin was estimated (see Figure C1 in the Appendix). The *coalition*

variable changes both the intercept and the slope of the *municipal vote margin*, indicating that municipal vote margin increases investment in coalition localities, whereas is slightly reduced in non-coalition localities.

In order to test for possible endogeneity, Table 4 presents GMM results for the five models. The consistency of system-GMM relies on two hypotheses: instrumental variables must not be correlated with the error terms, and a negative first-order autocorrelation (AR1) in residuals may be observed, but no second-order autocorrelation (AR2). The Hansen test indicates that instrumental variables are valid, while the Arellano-Bond tests for AR1 and AR2 show no second-order serial auto-correlation, thus indicating valid GMM estimations. Moreover, these are overall consistent with FE results for the five models, since all political and socioeconomic variables except municipal revenues appeared to be significant in the GMM estimations.

Table 4. System-GMM estimation results

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Investment per capita (log)	0.476*** (0.0304)	0.484*** (0.0304)	0.508*** (0.0312)	0.485*** (0.0267)	0.459*** (0.0320)
coalition (dummy)	0.209*** (0.0767)	0.281*** (0.0702)	-0.146 (0.191)	0.202*** (0.0750)	0.170** (0.0777)
y0 (dummy)	0.139*** (0.0247)	0.280*** (0.0671)		0.132*** (0.0264)	0.130*** (0.0241)
y0 x coalition (dummy x dummy)		-0.406** (0.182)			
y1 (dummy)			-0.210*** (0.0774)		
y2 (dummy)			-0.288*** (0.0666)		
y3 (dummy)			-0.352*** (0.0829)		
y1 x coalition (dummy x dummy)			0.0815 (0.201)		
y2 x coalition (dummy x dummy)			0.510*** (0.185)		

y3 x coalition (dummy x dummy)			0.632***		
			(0.214)		
Municipal election, vote margin (%)				-0.888**	
				(0.378)	
Municipal election, vote margin x coalition (% x dummy)				1.585***	
				(0.509)	
National election, vote margin (%)					0.0403
					(0.272)
National election, vote margin x coalition (% x dummy)					0.673
					(0.527)
Municipal revenues (log)	0.0426	0.0412	0.0429	0.0371	0.0476
	(0.0375)	(0.0381)	(0.0372)	(0.0386)	(0.0401)
Population (log)	-0.200***	-0.193***	-0.195***	0.831***	0.797***
	(0.0356)	(0.0352)	(0.0361)	(0.0325)	(0.0364)
L.1 Staff expenses (log)	0.281***	0.287***	0.261***	0.293***	0.271***
	(0.0530)	(0.0510)	(0.0525)	(0.0498)	(0.0542)
Poverty (log)	-0.0302	-0.0366	-0.0210	-0.0200	-0.0264
	(0.0313)	(0.0310)	(0.0321)	(0.0318)	(0.0339)
Constant	6.147***	5.966***	6.084***	-1.061*	-0.534
	(0.645)	(0.630)	(0.670)	(0.561)	(0.662)
Observations	3,427	3,427	3,427	3,427	3,415
Number of id (municipalities)	345	345	345	345	345
Number of instruments	266	266	266	301	265
Arellano-Bond test for AR (1)	-10.07	-10.11	-10.22	-10.22	-9.92
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Arellano-Bond test for AR (2)	1.06	1.11	0.79	0.80	0.97
	(0.291)	(0.269)	(0.428)	(0.425)	(0.331)
Hansen test	272.90	272.35	257.09	290.73	269.60
	(0.250)	(0.244)	(0.417)	(0.493)	(0.253)

Notes: GMM dynamic panel data-two step (Stata command *xtabond2*). The variables municipal revenues, population, staff expenses and poverty are considered to be weakly exogenous. Robust standard errors in parentheses for GMM estimates, p-value in parentheses for Hansen and Arellano-Bond tests. Level of statistical significance ***p<0.01,**p<0.05,*p<0.10.

Discussion and conclusions

Like other countries of the Global North and South, in Chile investment grant allocations are mediated by electoral concerns, and not only by equity or efficiency goals. The analysis above shows the existence of pork-barrel politics because the municipalities with mayors belonging to a party ruling the national government receive 10 percent more investment funds than the rest of the municipalities. These results align with other studies that argue that when local (or regional) governments are ruled by the party in charge of the central government, they obtain more benefits than those others controlled by the opposition (Bertelli and John, 2010; Solé-Ollé, 2013).

Additionally, elected officials consider timing since on election years investment is up to 10 percent greater. The burden of such a political business cycle is distributed unevenly across time and space: the fiscal excesses of election years are paid mainly during the subsequent two years and, although investment increases on election years countrywide, it is mainly coalition municipalities that benefit from the political cycle's fluctuations. Subsequently, coalition *comunas* have to pay mainly for this higher level of investment, whereas in non-coalition *comunas* it remains more stable. This result highlights the importance of taking a dynamic and spatial perspective in the analysis of political business cycles, an issue not adequately addressed in the literature. Other studies have focused on the opportunistic behaviour in election or pre-election years, but understanding how fund distribution varies throughout the electoral cycle and between allies and rivals is necessary for appropriate institutional responses to cope with timing in the manipulation of fiscal variables. Some of these are discussed below.

One of the key issues to understand the nature of the distributive game is determining whose interests are furthered by a discretionary fiscal allocation. In Chile, municipal election results are related with investment distribution, whereas national election results are not relevant. Investment is channelled to coalition municipalities with a higher vote margin in municipal elections, pointing to core *comunas* as the main beneficiaries of such investment. Our estimations, thus, side with the empirical evidence supporting a tactical

distribution in favour of core areas. Tavits (2009) argues that targeting core municipalities is the most likely strategy to be followed because voters require less stringent cognitive capacities since, if the ruling party is the same on the local and national level, there is no confusion about whom to reward. In a similar vein, Brollo and Nannicini (2012) state that if voters are not able to distinguish the source of transfers and political credit spillovers occur in favor of municipal governments, aligned municipalities receive more transfers.

Nevertheless, rather than suggesting a conservative strategy by the central government to protect itself from the cognitive asymmetries of the electorate, for the authors this result highlights local governments' ability to put pressure on central policy-making. The central government decides on disbursements, but municipal electoral results give local politicians a stronger capacity to exercise influence in the competition for grants. The importance of lobbying is reinforced by the fact that in every model staff expenditures are positively related with investment. In this sense, the hypothesis would be that *comunas* with strong mayors and larger bureaucratic structures have a greater capacity to formulate sound proposals and to put pressure on disbursers.

The latter is a particularly relevant contribution of this paper. In the academic literature remains understudied whether the distribution of national grants is mediated by central governments' interests or local governments' power. However, determining if fund allocation responds to top-down or bottom-up pressures is fundamental to design efficient control mechanisms and has significant consequences for regional development. In a centralized state moving slowly towards devolution, local governments' lobbying capacity is a further distortion, particularly when territories are highly heterogeneous and may therefore have different, perhaps opposing, interests (Rodríguez- Pose and Gill, 2005). Such distributive pattern penalizes the territories not aligned with the central government, but it could also lead local governments benefitted from political favouritism to a fiscal trap because the incentives for prudent local budgets are suppressed (Psycharis, Zoi and Iliopoulou, 2015).

Apart from the particular concerns of the electoral game, the analysis yields important implications for territorial cohesion. Chile has the third-highest Gini coefficient on income distribution in South America (ECLAC, 2014) and also registers the second-highest level of territorial disparity among OECD countries (OECD, 2013). Under these socio-spatial conditions, spatial equity seems a rather relevant policy to aim for and yet, investment is concentrated in municipalities with higher municipal revenues and higher local staff expenses. Determining the particular causes for such a regressive distributive pattern lies beyond the scope of this paper, but it may well be due to an efficiency bias in investment planning. Investment favours the relatively better-off because concentrating resources in these areas is usually more efficient from a cost-benefit perspective, despite increasing territorial disparities. As such, the NFRD is meant to be a regional redistributive fund but this function is clearly limited, especially if it is mediated by political influence.

Different policy procedures and instruments could narrow the incentives for arbitrariness and lead to a more equitable spatial distribution. First, if non-programmatic allocations are fed by the absence of formalized and public rules of distribution, policy reforms should be oriented to increase transparency and accountability. Indeed, the level of influence of electoral cycles on the fiscal balance depends on the degree of transparency (Alt and Lassen, 2006). Increasing transparency and accountability mainly requires political will, although overcoming politicians' lack of enthusiasm for such reforms may be a rather difficult obstacle.

Second, mechanisms for mid- and long-term investment planning could be considered. The actual design of the NFRD allows local governments to rely on investment grants to finance operational expenditures (OCDE, 2013), but this is a pitfall that distorts its strategic nature and increases the margin for discretionary distribution. In addition, the design of the fund generates "December fever", since it has to be disbursed before that fiscal year finishes (December 31st) in order not to be penalized in subsequent years (Tarschys, 2003).

In this context, the introduction of an independent planning office for regional investment would help with the recovery of such a strategic perspective. For this body to operate

alongside electoral purposes it is not only necessary to separate the political sphere from the administrative sphere, it is likewise necessary to set up stable finance mechanisms. Multi-year budgeting could be a valuable fiscal policy because it can give local governments greater certainty about future funding, which enables them to plan and manage their expenditure more effectively. Although multi-year budgeting is not free of political clout, it could decrease political influence if the time frame of the budgeting period and investment planning differs from the term of office. Besides, consideration can be given to the use of fixed multi-year ceilings, similar to the United Kingdom or Sweden (Hawkesworth, Melchor and Robinson, 2012).

A third policy change should go in the direction of designing institutional mechanisms to reduce the gap between *comunas*. From the authors' perspective, one of the most striking results of the above econometric analysis is the importance of municipal revenue and staff expenses for investment distribution. Local public employees' capacity to design sound proposals is essential because selection is based, *inter alia*, on the proposals' technical feasibility. Horizontal transfer mechanisms should be improved in order to reduce income disparities. Increasing the contributions to the equalisation fund would level the provision of public goods between areas, while reducing differences in municipalities' capacities to formulate projects if they are used to improve local bureaucracies' skills and resources. An alternative method for resolving this problem is exploring the mechanisms by which different *comunas* could temporarily join up when applying for investment grants. Local collaborations would not only lead to agglomeration economies by sharing staff resources and technical expertise, they would reinforce the strategic perspective of investment planning too if, beyond each *comuna*'s interests, the wider context were considered.

Let us not sound naïve and pretend that these policy recommendations will remove every political obstacle. The political bias is a constitutive element of the distributive game because politicians are office-motivated and the electorate enjoys receiving benefits, even at the expense of inefficiencies imposed on the majority. As a result, any attempt to erase completely the electoral influence will be unsuccessful. However, these policy proposals

would limit the scope of unjustified political discretion and lay the basis for a more equitable fiscal distribution.

Endnotes

¹*Coalition* and *vote margin* variables change over time and across municipalities. *Year of the term of office* variable changes over time, but it is constant across municipalities because elections are held the same day in all municipalities.

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Appendixes

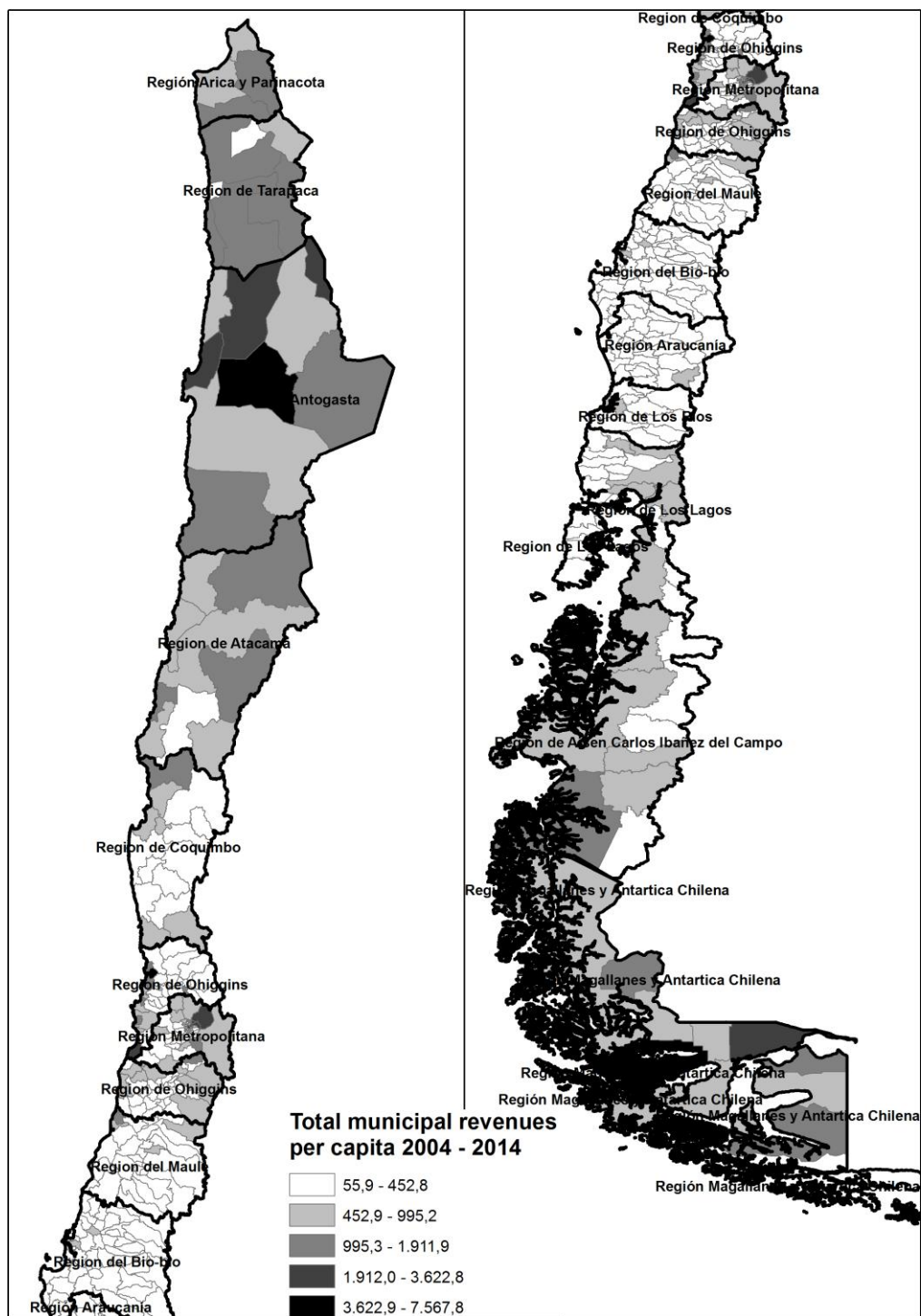
Appendix A

Table A1. Selected empirical research of grant allocations to subnational governments

Paper	Country	Grant transfers	Political bias
Ansolabehere and Snyder (2006)	U.S.	State transfers to counties	Core counties
Banful (2011)	Ghana	Intergovernmental transfers to local governments	Swing districts
Brollo and Nannicini (2012)	Brazil	Federal transfers to municipal governments	Swing municipalities
Calvo and Murillo (2004)	Argentina	Federal spending and revenues to provinces	Core provinces
Case (2001)	Albania	Social assistance block grants to local governments	Core communes
Costa-I-Font, Rodríguez-Oreggia and Lunapla (2003)	Mexico	Federal public investment to regions	Core municipalities
Denemark (2000)	Australia	Constituency level grants	Swing constituencies
Johansson (2003)	Sweden	Intergovernmental grants to municipalities	Swing municipalities
John and Ward (2001)	England	Central grants to local governments	Swing constituencies
Kwon (2005)	South Korea	National subsidies to provinces	Swing provinces
Kroth (2014)	South Africa	Intergovernmental transfers to provinces	Core provinces
Milligan and Smart (2005)	Canada	Regional spending to local institutions	Swing electoral districts
Remmer (2007)	Argentina	Provincial level spending	Swing provinces
Rodríguez-Pose, Psycharis and Tselios (2016)	Greece	Regional public investment	Core constituencies
Tavits (2009)	Denmark, Finland, Norway, and Sweden	National government grants to municipalities	Core municipalities
Veiga and Pinho (2007)	Portugal	Municipal grants	Swing municipalities

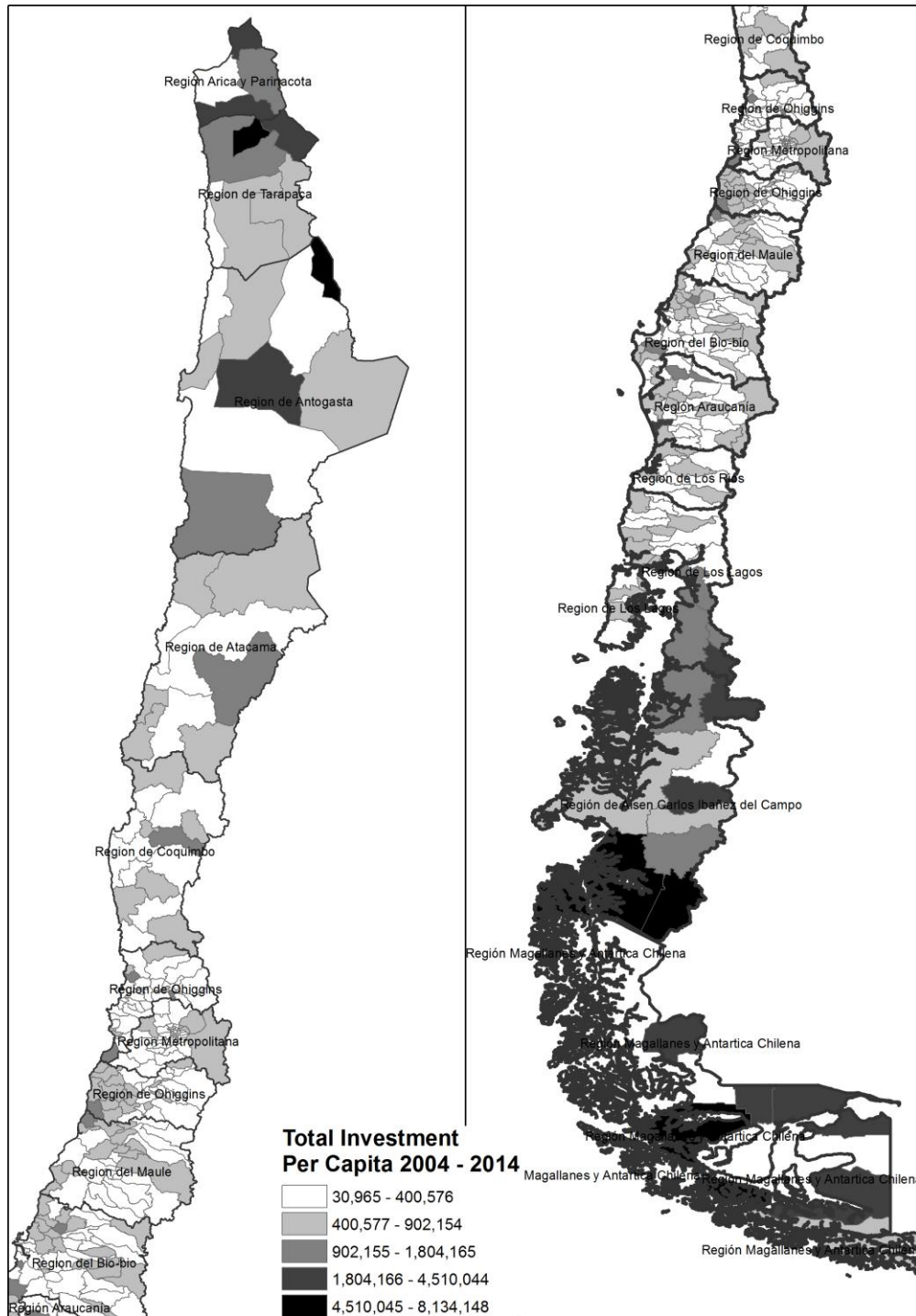
Appendix B

Figure B1. Municipal Revenues Per Capita, 2014-2014 (thousands of pesos)



Source: Calculations based on data from the National System of Municipal Information

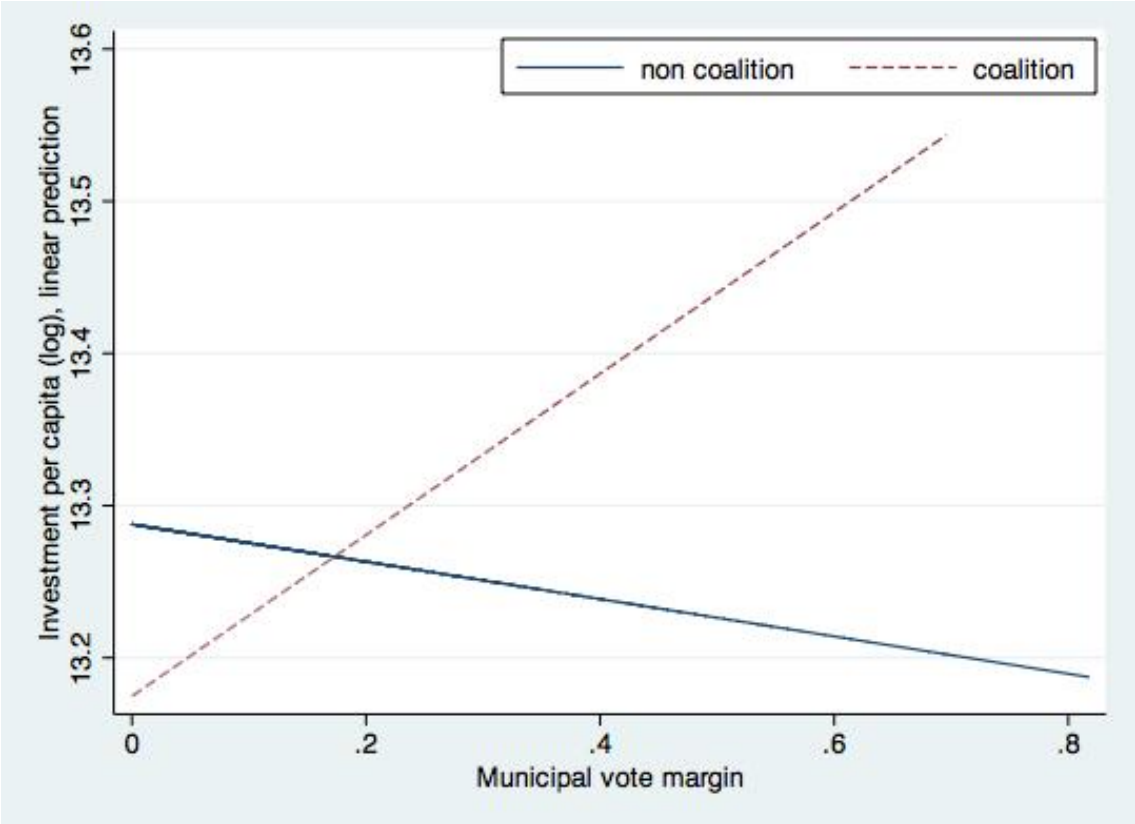
Figure B2. Public Investment Per Capita, 2004-2014 (thousands of pesos)



Source: Calculations based on data from the National System of Municipal Information

Appendix C

Figure C1. Estimated investment in coalition and non-coalition *comunas*



Chapter 5: Paving the electoral way: Urban infrastructure, partisan politics and civic engagement

This paper analyses the incidence of political factors and social capital on the allocation of public investment in the Santiago Metropolitan Area, Chile. Considering panel data on a decentralized investment program distributed through local governments and a program that is geared directly to citizen organizations, the paper explores whether investment is equally subject to electoral concerns and rent seeking under different program designs. Our estimations show that decentralized investment favours aligned municipalities where competition is stronger, but long-lasting local leaders also seek their own benefits. By contrast, transfers directly channelled to beneficiaries are free from political clout and, additionally, there is no sign of capture by organized interests. Based on these results, the paper discusses the implications for metropolitan governance, highlighting the potential role of the local social capital and a two-tier governance scheme to retain the gains from decentralization, acquire economies of scale in metropolitan service provision and reduce the margin for pork barrelling.

Keywords: Distributive politics, Pork-barrel politics, Social capital, Urban governance, Latin America Chile

Introduction

The allocation of public resources within different city areas is a key question for urban governance because it affects the provision of local infrastructure and shapes the urban growth pattern. General explanations place this issue somewhere between the metropolitan governance structure, the ideology of incumbents and technical considerations imposed by bureaucratic decision standards, but different social and political factors may mediate investment decisions. The recent wave of decentralization has strengthened the role of local governments as service providers, introducing questions about the distribution of responsibilities between different government tiers and the adequate transfer system to finance urban infrastructure. Decentralization favors flexible ways of providing services

(Ahmad & Brosio, 2009; Kahkonen & Lanyi, 2001); yet, local governments may pursue their own electoral aims in the distribution of public goods (Livert & Gainza, 2018). As the literature on distributive politics stresses, since politicians are motivated by their wish to retain public office (Golden & Min, 2013), local governments may allocate urban infrastructure bearing in mind their re-election chances.

In a similar vein, the delegation of powers to local authorities has motivated participatory reforms to include citizens in decision-making. Civic engagement in public affairs is a quest for deepening democracy and improving the quality, accountability and flexibility of services because social capital increases citizen control over public goods (Gaventa & Barrett, 2012). However, associations can also capture local resources if organized groups free ride the public good for their own advantage (Platteau, 2004).

This paper explores the influence of political factors and social capital in the allocation of investment from the central government to the municipalities of the Santiago Metropolitan Area (Chile), and its impact on the urban dynamic. The paper focuses on three potential determinants for urban investment distribution. First, we analyze if partisanship mediates intergovernmental transfers, in particular, if distribution favors urban areas ruled by mayors aligned with the central government. The aim is not only to test the existence of ‘pork-barrel’ politics, but to understand the sources of such a political bias. Theoretically, distribution could be driven by the electoral aspirations of the national government or, instead, may be due to the capacity of municipal governments to put pressure on central policymaking, encouraged by their electoral results. Second, we examine the role of social capital interceding in grant allocations. As mentioned, the participation of community organizations in urban governance can improve responsiveness and accountability by reducing the margin for pork barreling. However, it runs the risk of capture and rent seeking. Third, we evaluate tactical distribution under different transfer systems. We contrast if political interests and the local social capital are likewise to influence redistribution when mayors are the intermediaries or when beneficiaries administer grants directly. Based on the results, the paper discusses the impact of these potential determinants over urban governance.

The analysis draws on a unique panel dataset that includes information on electoral results, the local social capital, municipal finance, area characteristics and investment from the central government to the 52 municipalities of the Santiago Metropolitan Area (SMA) over the period 2009-2017. Two investment grants are scrutinized as dependent variables: a decentralized program channeled through local governments and another geared directly to self-organized citizen committees without the intervention of local governments. The intention is to test whether different institutional designs are equally tied to capture by electoral concerns and interest groups. The identification strategy relies on fixed-effects considering heteroskedasticity and autocorrelation robust estimation, and generalised method of moments (GMM), to control for potential endogeneity.

We follow the assumption underlying the literature on distributive politics that politicians hold electoral goals when allocating collective goods. However, different causal mechanisms may drive the distribution of investment in the two programs we inspect. In one case, the rationale is highly partisan, i.e., the links between the central government and aligned mayors mould the distributive pattern to raise the outcomes of the party in national or local ballot. By allocating larger amounts of funds to areas controlled by their co-partisans, incumbent governments can boost the reputation of aligned mayors, which, in turn, is likely to enhance the expectations of the party on national elections (Tavits, 2009). Yet, if voters associate political credit spillovers with municipal governments, a bottom-up logic to support the electoral strategy of mayors would prevail.

When investment does not go through different government tiers, though, the procedure is rather indirect. Incumbents may strive to please the constituency concentrating disproportionate amount of assets in districts where they obtain electoral advantage. We expect, thus, stronghold areas to be benefited even when users themselves administer funds. This research adds four important contributions. First, despite a burgeoning research on larger scales, the literature has paid scant attention to tactical distribution on a city level, albeit having profound implications for urban governance. Second, the paper sheds light on whose electoral prospects are furthered from the distribution of intergovernmental grants. Most studies implicitly assume a top-down agency to benefit the central government, but

our estimations point also to local strongmen's power at attracting funds for their constituents. Third, the paper evinces the role of community-based organizations reducing the margin for parochialism in the distribution of public goods. The literature has not sufficiently addressed how civic engagement can limit electoral motivations in the allocation of collective resources, and this article attempts to fill this gap. Finally, the paper discusses the margin for tactical arbitrariness under different metropolitan governance frameworks. For the authors, the latter is a particularly relevant contribution as it yields significant policy implications.

The remainder of the paper is organized as follows. In the next section, we summarize the academic literature on the two main issues we address: the electoral motifs in the distribution of intergovernmental transfers and the potential role of community organizations to foster civic engagement or capture public resources. After the theoretical framework, the research hypotheses are displayed. Next, we characterize the SMA in terms of its governance framework and the local political context. Section five presents the data and the methodology for the empirical analysis, and section six summarizes the main results. In section seven, we explore the implications for urban governance. The paper concludes with some reflections about the analysis and venues for further research.

Literature review

Intergovernmental transfers and tactical distribution

Over the last two decades, several studies have documented how politicians use their control over intergovernmental transfers to reinforce their electoral prospects. Golden & Min (2013) give an exhaustive overview of research on distributive politics. In some cases, the tactics include over financing co-partisan local strongholds (Lara & Toro M., 2018; Luca & Rodríguez-Pose, 2015; Timmons & Broid, 2013), or punishing unaligned mayors (Brollo & Nannicini, 2012). Another strategy to persuade undecided voters consists in increasing transfers as the electoral race approaches, the so-called political budget cycles (Corvalan, Cox, & Osorio, 2018; Livert & Gainza, 2018; Veiga & Veiga, 2007). One

further type of manipulation is to favor the electoral expectations of fellow politicians by concentrating investment in either core (Kauder, Potrafke, & Reischmann, 2016; Tavits, 2009) or swing (Johansson, 2003; John & Ward, 2001) constituencies. Although not particularly tied to the urban arena, this research provides useful insights for understanding how urban governance is shaped by electoral aims, since most metropolitan areas are governed by a complex mishmash of municipalities that rely on transfers from senior levels to complement their own revenues (Bird & Slack, 2007). In the end, *intergovernmental fiscal transfers constitute a powerful instrument that politicians use to win, exercise, and retain power* (Bonvecchi & Lodola, 2010, p.179).

Parochialism is often associated to authoritarian regimes or new democracies of the Global South, but there is also ample evidence of government discretion in mature democracies of the Global North. In general, the literature shows that local incumbents politically aligned with the center obtain higher levels of discretionary grants, but there is no clear-cut pattern depending on the geographical context, the electoral system, the type of good delivered, the allocation mechanism or the institutional source for political coercion (see Golden & Min (2013), Kramon & Posner (2013) and Livert & Gainza (2018) for inventories).

Some argue that electoral systems influence distributive policy outcomes. In single-member systems, the linkages between elected authorities and the constituency are very tight because a sole representative reaps the merits for a given project brought to the district; on the contrary, in multimember districts, several representatives can claim the credit, so voters do not know whom should they reward (Ashworth & Bueno de Mesquita, 2006; Lancaster, 1986). Although this discussion refers to national electoral rules, to some extent, metropolitan governance can be seen through the lens of a single-member system. Each municipality within a metropolitan area elects one representative (the mayor) that will try to attract government expenditure on public goods toward its constituency. Consequently, mayors have strong incentives for engaging in political opportunism as they can claim the credit for the new infrastructure in the area.

One of the hottest debates is what procedure yields the highest electoral advantage, concentrating goods in core areas or targeting swing districts where fellow politicians confront stronger competition. Theoretically, two alternative hypotheses are derived from electoral competition models. Assuming that swing voters are riskier investments, Cox & McCubbins (1986) argue that an optimal strategy for risk-averse candidates is to redistribute to core supporters. On the other hand, Dixit & Londregan (1996) predict that if political parties are equal in their abilities to allocate redistributive benefits, they will support those that are most willing to switch their votes. Empirical research on transfers to local areas has found support for both hypotheses. Tactical distribution to core areas has been documented in the U.S. (Ansolabehere & Snyder, 2006), Mexico (Costa-i-Font, Rodríguez-Oreggia, & Lunapla, 2003), the Nordic countries (Tavits, 2009) and Greece (Rodríguez-Pose, Psycharis, & Tselios, 2016), whereas evidence in favor of swing municipalities include Brazil (Brollo & Nannicini, 2012), Sweden (Johansson, 2003) and Portugal (Veiga & Pinho, 2007).

Another factor that shapes the distributive pattern is the nature of the resource transferred. As Kramon & Posner (2013) show, the answer to the question who benefits from distributive politics varies depending on the patronage good. In broad terms, the resources local governments obtain from senior levels can be sorted in either transfers or purchases of goods and services (grants, investment programs, etc.). Transfers complement the fiscal resources of local governments: since municipalities have limited revenue-raising capacity, they rely on senior levels to close the gap between revenues and expenditures. Apart from central-to-local, most countries have horizontal equalization transfers to tackle the differences in revenue rising among areas (Bird & Smart, 2002).

Compared to transfers, public goods are rather exposed to targeting along geographical lines because they can be used to please the residents where they are located while excluding those outside the district (Milesi-Ferretti, Perotti, & Rostagno, 2002). Following the discussion above around electoral systems, these authors argue that the incentives for politicians to rely on transfers or public purchases depends on electoral rules, proportional

systems being more prone to higher spending on transfers, while majoritarian to public good spending.

The distribution criteria and the institutional design of the allocation mechanism affect the structure of opportunities too. A general distinction is between programmatic vs. non-programmatic. Specific purposes earmark programmatic assignments, whereas in non-programmatic transfers the incumbent government has full discretionary power. Likewise, distribution can follow a pre-arranged formula based on area characteristics or not⁷. As a rule, earmarked and formula-based distribution reduces the margin for the arbitrariness that allows politically motivated targeting, but technocratic allocation schemes are not free from tactical politics. Banful (2011) and Timmons & Broid (2013) attest that even under a formula, intergovernmental grants can be handed out according to partisan criteria. Looking at the source of political interferences, Litschig (2012) shows that in Brazil the population estimates entering the formula were manipulated.

One final key issue is to understand whose electoral prospects are furthered by tactical targeting, central or local incumbent's. In much of the literature the prevailing assumption is that, since the central government decides on disbursement, distribution follows its interests. Veiga & Veiga (2013), for instance, showed that the Portuguese central government used transfers to the municipalities along the electoral cycle to secure votes in legislative elections. Tavits (2009) also argues that, by supporting their strongholds, central level incumbent parties can boost the image of those local leaders which, in turn, is likely to enhance the electoral return for the party on national elections. From a theoretical approach, Borck & Owings (2003) propose an explanation that follows a similar storyline: according to their model, grant distribution is partly determined by the lobbying efforts of interest groups and local governments, but then the central government transfers money across areas pursuing its re-election expectations.

⁷ Formula-based allocation schemes usually include demographic and socioeconomic conditions. In some cases, municipal fiscal efficiency indicators are also considered to provide incentives to local governments.

The above-cited research assumes, albeit implicitly, a top-down agency following the electoral plans of the central government. However, Migueis (2013) found evidence that aligned local leaders increased their vote share in municipal elections as a consequence of the extra-transfers they managed to get from the central government, whereas municipal incumbency did not report any reward in national elections. A similar result was reported by Livert and Gainza (2018), who showed the importance of vote margin in municipal elections, whereas the vote margin in national ballot was not significant. These authors go even further and hypothesized that local leaders' lobbying capacity over central policymaking is the key source to attract funds, rather than national disburser's electoral prospects.

Social capital, civic engagement and capture

Recent literature on urban governance has stressed the positive outcomes of civic engagement for deepening democracy and extending accountability and control in the provision of public goods. Collective decision-making fosters the construction of citizenship, harbors empowerment and inclusion and improves the performance and the quality of public services (Gaventa & Barrett, 2012; Andrews, 2012). The cooperation between local governments and the civil society yields different advantages. By playing an active role, citizens and local governments are able to engage into a synergetic relationship that is not to be found in centralized, hierarchical governance forms (Ostrom, 1996). Community organizations develop expertise and capacities for addressing social problems too, hence matching users' preferences and lowering production costs. Last, civic engagement improves responsiveness and accountability as it entails wider forms of control and influence over public service providers (Ackerman, 2004).

Civil society organizations can also attract resources to the community since, in several discretionary grant programs, eligible groups apply to secure funds from the central government. In this regards, Lowry & Potoski (2004) found evidence of a positive relationship between the associational density and the grants attracted, implying that organizations have the capacity of influence discretionary spending from senior levels. A

similar conclusion is drawn from Lowe, Reckhow & Gainsborough (2016), but in this case the authors warn about the asymmetries across organizations. The capacity of developing a competitive application varies widely because some civic actors lack the necessary resources and the levels of involvement in grant seeking differ. In spatial terms, these authors found that competition for federal awards could exacerbate disparities between and within regions (Lowe, Reckhow & Gainsborough, 2016).

There are further cautions. Under some circumstances, citizen engagement can have negative consequences stemming from disempowerment and a reduced sense of agency, lack of accountability and representation in networks, denial of state services and resources, and reinforcement of social hierarchies and exclusion (Gaventa & Barrett, 2012). One reason for the inaccuracy of the outcomes is that very different items tend to be gathered under the participatory governance umbrella. For instance, the seminal work by Putnam, Leonardi, & Nanetti (1993) that links institutional performance with the presence of networks of formal and informal associations and the accompanying norms of generalized trust and reciprocity involves both, social structures (networks, formal and informal associations) and the intangibles stemming from these (trust, reciprocity). However, each dimension is likely to have a different impact (Andrews, 2012). In fact, Knack (2002) found that, while generalized reciprocity and social trust improve government performance, there is no effect for aspects of social capital identified with civic engagement, such as activity in associations. This is so because the beneficial effects of membership depends not only on its purpose, diversity and inclusiveness, but on the intensity of activities (Stolle and Rochon, 1998, cited in Knack (2002)).

Moreover, civic engagement may impose risks in terms of capture and institutional underperformance (Sidel, 2005). Organizations can free ride the public good and place particularistic ambitions before the collective aim. Although capture may occur in different government tiers, proximity and the institutional design of the local state may aggravate it because local level politics suffers from less scrutiny and politicians find stronger pressure for coercion. On this point, Bardhan & Mookherjee (2000) assemble a formal model of the determinants of capture, including the greater cohesiveness of special purpose groups and

the higher level of voter influence at the local level. According to these authors, if local governments have no capacity to raise resources on their own and spending depends on intergovernmental transfers, pressures for patronage would be greater because local institutions do not have to pay the cost of their own outlays (the *moral hazard* argument).

Following this line of enquiry, Khemani (2010) argues that grants-financed spending at the local level enables politicians to target benefits to organized groups in exchange for political support. The capture of public resources not only affects the provision of public goods, but it influences the institutional design of intergovernmental transfers too. When higher tier politicians face increasing participation by swing voters, they will have incentives to decentralize spending because it enables them to win elections by dividing swing voters and targeting core supporters on the local level (Khemani, 2010).

Research hypotheses

Based on the above theoretical framework, we posit the following research hypotheses:

Hypothesis 1: Municipalities ruled by mayors aligned with the central government will receive more investment.

Hypothesis 2: The greater the electoral power of the mayor, the greater the investment obtained thanks to the lobbying efforts of local strongmen.

Hypothesis 3: The greater the presence of specific-purpose organizations⁸, the greater the investment attracted to the municipality as they try to capture resources for their own benefit.

Hypothesis 4: The institutional design of the transfer system moulds the distributive pattern. Decentralized investment is rather exposed to capture by strong local mayors,

⁸ We define specific-purpose organizations as entities created to fulfill a common goal on specific issues. In the analysis, specific-purpose organizations stand for neighborhood associations.

whereas specific-purpose organizations will attract more investment if transfers are directly geared to eligible groups.

The Santiago Metropolitan Area

The multilevel governance framework

The Santiago Metropolitan Area is made of 52 municipalities (*comunas*) that inhabit over 7.3 million people. It is by far the largest metropolitan area of Chile as it stands for 40% of the population and 49% of the national GDP. Like other Latin American metropolises, the SMA is characterized by high levels of inequality and residential segregation (Jordán, Rehner, & Samaniego, 2010).

The political geography of the SMA is formally organized in three scales (local, regional, central), but in real terms decision-making is confined just to the local and the national level. The regional government has limited power because the governor (*intendente*) is appointed by the national cabinet and follows its guidelines. Moreover, unlike in many other OECD countries, the regional government does not have financial autonomy and, besides, subnational government expenditure and revenue are concentrated at the municipal level (OECD, 2017). Below the regional scale, there is no metropolitan authority and *comunas* are responsible for basic duties, such as planning and regulation, local ordinances, community development, urban service delivery and so on. Following Slack's (2007) typology, the SMA's governance can be characterized as one-tier and fragmented, in which 52 autonomous governments deliver services within their own boundaries.

Since Chile is a highly centralized country, local governments have limited competencies and subnational revenue and spending is very low compared to other OECD countries⁹. Municipalities generate their own revenues through commercial licenses, property taxes,

⁹ In 2014, subnational spending accounted for 13.1 of total expenditure and 3.0% of GDP, compared to 40.2% and 16.6%, respectively, for the average OECD countries. Concomitant, local revenue is among the weakest: 3.2% of GDP compared to 16% OECD average (OECD, 2017).

circulation permits and other fees, but they barely cover the local expenditure responsibilities (OECD, 2013). Consequently, municipal governments suffer from limited financial maneuver and have to rely heavily on grants and subsidies from the central level¹⁰ (OECD, 2017). A horizontal transfer mechanism works as an equalization fund to tackle the strong disparities in revenue raising across *comunas*, but this mechanism does not compensate for the large income disparities (OECD, 2013).

Central government transfers include grants for education and health, current transfers for operational spending and investment transfers. There are several regional funds and grants by different ministries, and most programs follow a similar scheme: municipalities submit project proposals and these must surpass a technical evaluation and a complex set of filters and intermediaries. This framework has been criticized on different fronts (OECD, 2017). On the one hand, it favors the fragmentation of projects and deters local governments from designing strategic proposals that involve the coordination of various actors. On the other, most grants are awarded to projects that follow the guidelines from the national government, but these do not necessarily meet local demands.

There is a further risk. Although earmarked, these programs do not follow a pre-established formula and are appointed by central institutions, thus, leaving room for tactical targeting. In fact, recent research has focused on electoral motivations in the allocation of investment from the central government to Chilean municipalities (Corvalan, Cox & Osorio, 2018; Lara & Toro M., 2018; Livert & Gainza, 2018). Using national level data, these studies have found evidence of political budget cycles and distributive distortions to benefit partisan mayors. However, we lack understanding if urban investment is also tied to capture by political ambitions and about the role of social capital reducing the margin for arbitrariness.

¹⁰ Grants and subsidies account for 51.1% of municipal revenue vs. 38% for OECD average (OECD, 2017).

The political context

Electorally, the SMA is divided along the traditional right wing/left wing axes. In national elections, political parties of both ideological spectrums go together in party coalitions, *Concertacion* on the left and *Alianza* on the right, because a “binomial” electoral rule¹¹ encourages major parties to include their candidates into larger inter-party agreements (Valenzuela, Somma, & Scully, 2018). Moreover, coalitions are stable over time and opponents do not swap from one block to the other, which means there are permanent links between allied parties. Our sample covers two national elections won by the right (2009 and 2017) and one by the left (2013).

Vote concentration around the two coalitions splits in municipal polls and several contenders compete. Parties that join for presidential elections do present their own choices; hence, the highest vote share in municipal ballot does not usually exceed 20%. Additionally, local politics depends more on *comunas*' particular circumstances and the specific nature of indigenous competition. In Chile, municipal dispute tends to be rooted more in the personal appeal of the candidates and less in programmatic and partisan commitments (Luna, 2014). As such, the local arena does not fully reproduce national level rivalry: national parties cannot easily control the organization, local groups and independent candidates contend, and powerful mayors exert their dominance (Suárez-Cao & Muñoz, 2017).

In spite of the local party diversity, *comunas* can be sorted into right or left depending on organizations' support for one or the other block in presidential disputes. Figure 1 captures the electoral map in the three municipal elections that make our sample. The vote for leftist candidacies tends to concentrate in the city centre, the south side of the inner ring and some southwest *comunas*, while traditionally the northeast cone, the north and the south supports right-wing parties. To some extent, the electoral cartography reproduces the socioeconomic

¹¹ The “binomial” electoral formula created districts that elected only two representatives, forced partisan lists to run only two candidates per district and assigned both seats to the winning list only if obtained twice the vote of the runner up list (Valenzuela, Somma, & Scully, 2018, p. 136).

divide across areas: the poorer *comunas* of the southern inner ring and the west are bulwarks for the left, whereas the right dominates the wealthy northeast and the periphery. Taken as a whole, the right holds the greatest municipal power, especially when local elections coincide with its victory in national elections.

Figure 1. The political spectrum in 2008, 2012 and 2016 municipal elections

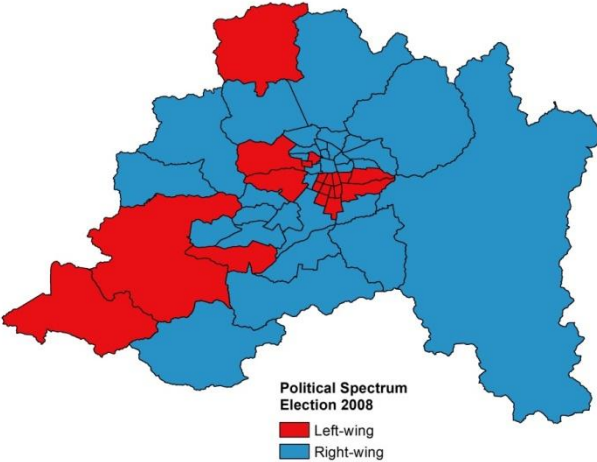


Figure 2. The political spectrum in 2012 municipal elections

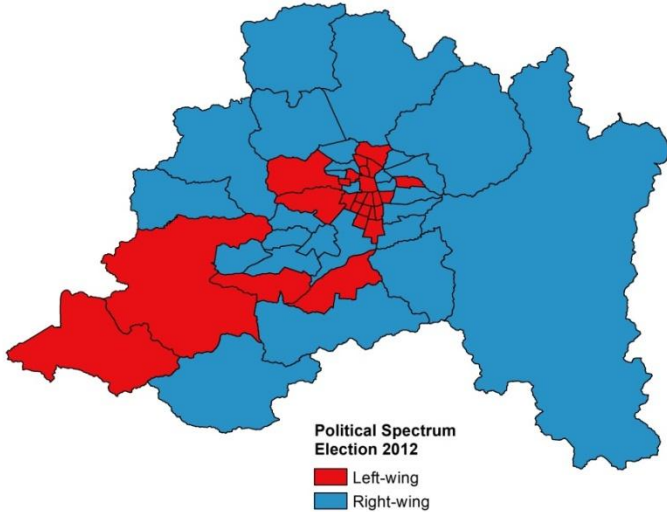
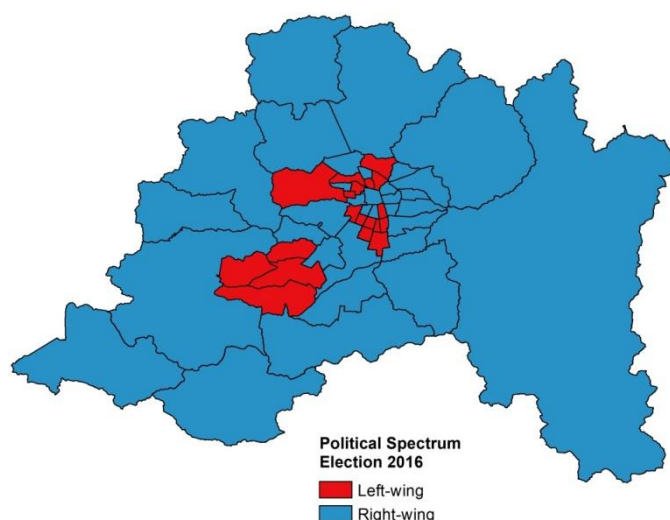


Figure 3. The political spectrum in 2016 municipal elections



Urban investment programs, data and methodology

In order to test any potential bias towards electoral tampering and capture, we examined the distribution of two urban investment programs from the central government to the 52 *comunas* of the SMA over the period 2009-2017: the Urban Improvement Program (UIP) and Participatory Paving (PP)¹². The programs are comparable in size, aims and scope. The average investment per capita is 4.4 and 3 thousand Chilean pesos in UIP and PP, respectively (a chart of the mean investment by year can be found in Annex 1). In addition, both intend to improve the standard of living of the vulnerable population by concentrating on areas that lack basic infrastructure, although the UIP finances social equipment (health infrastructure, street lightning, paving, parks, green areas, sports grounds, community centers, etc.), whereas PP focuses on street paving. A final point, the assignment process follows a similar path; in both procedures, the National Investment System evaluates projects on a technical and socioeconomic basis. Nevertheless, a striking difference between them ensures an appropriate case selection to test the hypothesis outlined above.

¹² In Spanish, *Programa de mejoramiento urbano* and *Pavimentos Participativos*, respectively.

While municipalities present proposals to regional institutions for UIP funds, in the case of PP ad-hoc created citizen committees submit proposals directly to the Ministry of Housing and Urbanism, without going through local governments. Committees have to co-finance between 5 and 30 percent of the construction costs, except for the most vulnerable committees and for 50 municipalities with the highest poverty rate.

These two programs were selected as dependent variables, whereas data on political outcomes, the presence of community-based organizations and a set of area characteristics were included as independent variables. We did consider seven political determinants. First, since the *Intendente* is appointed by the central government, we calculated a dummy that is equal to 1 if the mayor is from the regional government political party, and 0 otherwise. Second, we incorporated mayor's *Periods* in charge as a measure of the possible capacity of mayors re-elected to exercise power. Previously, Pribble (2015) evinced that the mayor's length of tenure had a significant effect on local institutions' administrative capacity because re-elected mayors that seek a political career get involved in a more effective institutional performance. We further analyzed the interaction between *Intendente* and mayor's *periods* since, hypothetically, long-lasting strongholds were to be benefitted whereas powerful rival mayors have damaged. Fourth, we included the *Victory margin* in municipal and national elections to evaluate whose electoral prospects were backed through tactical distribution. The vote margin in municipal elections was selected to show mayors' pressure over central policy-making supported by their electoral results, whereas the victory margin in national elections would illustrate the central government's strategic behavior. We covered the interaction between *Intendente* and the *Victory margin* in municipal and national elections too, i.e., the influence of vote margin in those municipalities politically aligned with the regional governor. The latter was introduced to signal which areas should result benefitted. If investment appeared to be channeled where the victory margin is higher, that would be indicative of core areas being compensated for their support, whereas a negative sign would indicate central disburser's strategy to support loyal areas where competition is stronger.

The results of local and national polls were taken as exogenous to investment decisions since polling dates are fixed and decided aside the wishes of local and national authorities. In Chile, mayors are elected by simple majority and councilors by a proportional representation system. Municipal elections are held on the last Sunday of October once every four years and the newly elected authorities take office on the 6th of December. National polls also take place in the last Sunday of October, but a distance of a year separates local and national ballots. The sample includes the results of three local (2008, 2012 and 2016) and three national elections (2009, 2013, 2017).

Since the second purpose of the research strategy was to test the potential consequences of social capital, we examined four indicators associated with social cohesion: two for the presence of community-based organizations (total number of *Associations per capita* and *Neighborhood associations per capita*) and two that reflect the absence of social cohesion (the *Crime rate* and the *Homicide rate*). While *Associations per capita* is a proxy for the local social capital as it brings into a single variable the organizational density in the *comuna*, *Neighborhood associations per capita* shows the presence of institutions on specific urban issues. From the theoretical discussion, we hypothesized that a dense network of associations could increase accountability and reduce incumbents' margin for tactical distribution, whereas the presence of neighborhood associations could be indicative of interest organizations trying to attract urban investment. The *Homicide rate* gathers the number of homicides per 100,000 inhabitants and the *Crime rate* encompasses various forms of crimes of greater social connotation per 100,000 inhabitants, including aggravated assault, murder, rape, robbery, burglary, motor vehicle theft, etc. Past research in Chile has considered these two indexes to be negative indicators of social cohesion (Calo-Blanco, Kovářík, Mengel & Romero, 2017). Accordingly, we deemed they could potentially explain adverse collective behavior and perform as proxies for negative social capital.

We entered a set of controls related to the socioeconomic conditions of the *comuna* and the urban environment. Socioeconomic variables are *poverty*, i.e., the percentage of people below the poverty line, *municipal revenues per capita* and *professional employees per capita*. The latter stands for local governments' technical capacity to formulate projects

when competing for funds. Lastly, we added the *new housing space* constructed since both programs intend to finance urban infrastructure. We calculated values in logarithmic terms to control for non-linear relations.

Table 1. Descriptive statistics of the variables

Variable	Obs	Mean	Std. Dev.	Min	Max
UIP	468	237,477.3	191,125.3	0	1,218,681
UIP per capita	468	4.40554	6.768986	0	56.97124
PP	468	236,530.7	379,809.2	0	3,444,969
PP per capita	468	2.917823	6.85489	0	59.68391
Intendente	468	0.2200855	0.4147474	0	1
Period	468	2.309829	1.464845	1	6
Margin winner Municipal election	468	21.19012	15.88665	0.03808	68.09021
Margin winner Presidential election	468	11.60561	21.6133	-61.53358	61.17464
Neighbourhood associations per capita	468	0.000866	0.0009194	0.000007	0.006077
Associations per capita	468	0.002104	0.0015477	0.000191	0.010791
Crime rate (per 100,000 inhabitants)	468	3,333.56	2,505.376	940.8053	19,223.22
Homicide rate (per 100,000 inhabitants)	468	2.144666	2.368386	0	21.72968
Municipal revenues per capita	468	94.96581	100.9248	7.95	542.91
Professionals per capita	468	0.002764	0.0461981	0.000065	0.004015
New Housing Space	468	78,709	116,592.3	0	762,233

Note: All fiscal variables were adjusted to thousand pesos of 2017 and these are found to per capita level to compare between *comunas*.

In order to test the influence of these variables, the following econometric model was designed for each of the two urban investment programs:

$$\text{Log}(UI \text{ per capita}_{it}) = \alpha + \beta \mathbf{X}_{it} + \gamma \mathbf{Z}_{it} + \delta \mathbf{W}_{it} + \mathbf{YV}_{it} + \sigma_i + \tau_t + u_{it} \quad (1)$$

Where *UI* represents urban investment and \mathbf{X}_{it} , \mathbf{Z}_{it} , \mathbf{W}_{it} , \mathbf{V}_{it} are vectors that bring together, respectively, the variables related with political factors, the presence of community-based

organizations and negative social capital, the area's socioeconomic conditions and urban characteristics.

For analytical purposes, we estimated two econometric models for each investment program, one that accounted only for main political variables and another that included the interactions between key variables too. The models adopted a two-way fixed-effects (FE) heteroscedasticity and autocorrelation robust estimation with municipal and year time effects. Robust standard errors were estimated clustering them at the municipality level to control for serial and spatial correlation.

Although a FE strategy provides a sound methodological basis, we conducted an extra test to check the robustness of estimations. FE results could be biased if investment is endogenous to past compromises, i.e., if higher or lower investment at period t depends on previous decisions because several infrastructure projects extend over one period. Consequently, we relied on difference-GMM (Arellano & Bond, 1991) to check the strength of every model, treating investment variables as endogenous to past performance.

Result section

The results of the econometric analyses are set out in Table 2. According to estimations, UIP is exposed to different forms of electoral influence, whereas PP lacks political clout. The significance of the variable *Intendente* signals that municipalities aligned with the political party of the regional governor got 66% more UIP funds than foe municipalities (Model 1). This result is consistent with the partisan bias reported in the academic literature and endorses the first hypothesis. Besides, there is a significant negative relation between mayoral *Periods* in charge and the urban infrastructure attracted to the *comuna* as investment decreases by 26% per additional term. Although this outcome may seem contradictory, we should understand it along with the political affiliation of the mayors because it is likely that the effect of periods in charge varies depending on partisan alignment.

Table 2. Fixed-effects estimation results

	UIP per capita (ln)		PP per capita (ln)	
	Model 1	Model 2	Model 3	Model 4
Intendente (Dummy)	0.6624** (0.23)	0.4035 (0.56)	-0.0128 (0.14)	0.3388 (0.24)
Period (Dummy)	-0.2640** (0.09)	-0.3531** (0.11)	-0.0466 (0.07)	-0.0051 (0.08)
Margin municipal election (%)	0.0035 (0.01)	-0.0005 (0.01)	-0.0007 (0.01)	0.0009 (0.01)
Margin presidential election (%)	0.0112 (0.01)	0.0197 (0.01)	-0.0001 (0.00)	-0.0017 (0.00)
Intendente x Period		0.3226* (0.15)		-0.1270 (0.09)
Intendete x Margin_municipal		-0.0026 (0.02)		-0.0077 (0.01)
Intendente x Margin_presidential		-0.0323* (0.01)		0.0080 (0.01)
Neighbourhood associations per capita (ln)	0.0785 (0.17)	0.1356 (0.21)	-0.1318 (0.09)	-0.1523 (0.09)
Associations per capita (ln)	-0.1040 (0.19)	-0.1541 (0.20)	0.2027 (0.17)	0.2077 (0.17)
Crime rate (per 100,000 inhabitants)	-0.0001 (0.00)	-0.0001 (0.00)	0.0003 (0.00)	0.0003 (0.00)
Homicide rate (per 100,000 inhabitants)	0.0289 (0.03)	0.0223 (0.03)	-0.0055 (0.03)	-0.0006 (0.03)
New Housing Space	0.0156 (0.07)	-0.0197 (0.06)	0.0021 (0.05)	0.0108 (0.05)
Municipal revenues per capita (ln)	-0.1333 (0.43)	-0.1549 (0.43)	0.2962 (0.29)	0.2370 (0.28)
Professionals per capita (ln)	-0.0443 (0.08)	-0.0132 (0.08)	-0.0671 (0.04)	-0.0962* (0.04)
Poverty (ln)	0.5869* (0.25)	0.6029* (0.25)	0.3435 (0.18)	0.3210 (0.18)
Cons	-0.9672 (2.48)	-0.3889 (2.45)	1.3185 (2.14)	0.5059 (2.11)
N	466	466	280	280
R-Squared (within)	0.2234	0.2521	0.2988	0.3122
Number of id	52	52	43	43
FE Municipalities	YES	YES	YES	YES
FE Year	YES	YES	YES	YES

Note: Standard errors, clustered by municipality, reported in brackets. ** p<0.01, * p<0.05

Model 2 gives additional evidence of how tactical politics is displayed across partisan lines, encompassing the influence of time and the vote share in those municipalities ruled by mayors belonging to the regional governor party. The *Margin of Victory* in presidential elections affects the funds directed towards loyal municipalities (the interaction between *Intendente* and *Margin_presidential*), whereas the vote share in local elections is not

significant. This is a striking evidence for partisan favoritism, but it also highlights which areas are targeted through grant allocations. The negative coefficient shows investment goes towards aligned municipalities where the regional governor party won by a lower share, i.e., towards those aligned municipalities that confront stronger competition. Therefore, our results side with the empirical research supporting a tactical distribution in favor of swing areas.

One important question is to depict whose electoral prospects are furthered through distributive politics. We hypothesized that the greater the electoral power of the mayor, the greater the investment obtained thanks to its lobbying efforts. We found partial support for this hypothesis. The length in office positively affects fund allocations, but the vote share in local elections is not significant, indicating that mayoral electoral prospects are not credited. In other words, tactical distribution is the result of a top-down agency to support the electoral outcomes of the central government, but long-lasting local mayors campaign for grant allocation. Beware that the negative sign of the variable *Periods* turns into positive when it is combined with mayoral affiliation to the political party of the regional governor (the interaction *Intendente* and *Periods*). So, enduring, aligned local strongmen attract funds for their constituents backed by their electoral support, but rival, abiding mayors are penalized. These results seem to disclose an empirical basis to Borck & Owings' (2003) model in which distribution is partly determined by the lobbying efforts of local governments, but then the central government makes the final decision bearing in mind its own re-election chances.

Equation 2 accounts for the total effects of the above-mentioned interactions. In the case of *Intendente* and *Periods*, estimations attest that in those *comunas* governed by mayors aligned with the political party of the regional governor, an additional period of governance will result, on average, on 3% increase of investment funds. Regarding the distributive tactic across stronghold areas, a 1% decrease in the vote margin in aligned *comunas* will lead to 1.26% increase as a way to benefit disputed municipalities.

$$\text{Log}(UI\text{per capita}) = 0.4035(\text{Intendente}) - 0.3531(\text{Periods}) + 0.0197(\text{Margin National}) + 0.3226(\text{Intendente} * \text{Periods}) - 0.0323(\text{Intendente} * \text{Margin National}) + \gamma Z_{\{it\}} + \sigma_i + \tau_t + u_{it} \quad (2)$$

Another research goal was to unravel the role of social capital. Since municipalities present project proposals to UIP funds, associations could pressure local incumbents to attract grants for the community. As a result, hypothetically, a greater presence of local social capital would lead to higher investment. Nevertheless, our estimations show no influence by organizations as both variables for the associational density are not significant. Relatedly, the two variables that summarize negative social capital turn out to be not significant.

In sharp contrast to UIP, PP program is absent from strategic targeting. Not a single political variable was found to be significant (Models 3 and 4). Moreover, no statistically significant relation was detected for the four indicators that accounted for the local social capital. This result is somewhat counterintuitive since we considered as a working hypothesis that if transfers were to be geared directly to eligible groups, the presence of associations on specific urban issues would help attracting funds because these would work to secure grants for the community. Interestingly, no sign of rent seeking is observed. On the other hand, there is no statistically robust association for the two variables we used to approach negative social capital. We foresaw these indexes to be inversely connected as they are proxies for a collective inability to organize around a common goal, but they did not report any meaningful influence.

Given these results, we conducted an additional test to contrast further the potential influence of community organizations. In this case, we created dummy variables for different associational density thresholds. Dummies adopted the value 1 if the density of associations in the corresponding *comuna* was equal or below 20%, 40%, 60% and 80% of the *comuna* with the highest density, respectively. Estimations can be found in Annex 2-5. Results match those observed in the previous exercises for every variable: incumbent affiliation, the number of mayoral periods and the margin of victory in presidential elections remain indicative of a partisan bias in the allocation of UIP funds, whereas when beneficiaries administer funds, no sign of appropriation by the local social capital was found. There is just a slight variation in the coefficient for a density of neighborhood associations above 80%, which turns to be negative and significant for the distribution of

UIP, although not for PP. This result seems to indicate that in those *comunas* in the highest associational density quintile, a greater presence of neighborhood organizations is beneficial for attracting investment when mayors manage funds. However, if users run investments programs, a greater presence of associations remain not significant. Overall, these results are consistent and corroborate the influence of political factors when mayors act as brokers, though no indication of free riding by community associations is observed. These results also bring to light how the institutional design of the transfer system moulds the distributive pattern, supplying an empirical underpinning to our fourth hypothesis.

Control variables produced fairly similar results for the two programs. UIP is positively related to the area's poverty rate, a reasonable link since it is intended to improve the conditions where vulnerable citizens live, but no statistically significant correlation is reported for *professionals per capita*. The latter is a remarkable outcome since municipalities differ strongly in their capacity to develop competitive project proposals and UIP allocates funds based on technical considerations. Consequently, we expected *professionals per capita*, a proxy for the technical capacity of local governments, to be positively related, but no influence is observed.

Table 3 supplies the difference-GMM results. As discussed, this strategy allows us to contrast the scores when taking investment as endogenous to previous decisions. The Arellano–Bond tests for AR1 and AR2 reports no second-order serial autocorrelation, whereas the Hansen test indicates that instrumental variables are valid. Overall, GMM provide additional robust support. For every model, the distribution of UIP is mediated by the same political factors identified in FE estimations: fellow mayors are systematically over financed, the results of presidential elections are credited but municipal ballot makes no difference and, finally, experience is significant for aligned local leaders. GMM estimations confirm there is no sign of capture by civil society organizations in any of the investment programs analyzed. There is just a slight variation in the performance of the vote margin in presidential and municipal elections for PP, which turned to be significant. Nonetheless, main political variables remain non-significant, indicating there is no interference when users handle funds.

Table 3. GMM estimation results

	UIP per capita (ln)		PP per capita (ln)	
	Model 1	Model 2	Model 3	Model 4
Dependent Variable Lagged	0.2949** (0.11)	0.2563* (0.11)	0.2626** (0.09)	0.2725* (0.11)
Intendente (Dummy)	0.7451*** (0.20)	0.3343 (0.52)	-0.0243 (0.13)	-0.0299 (0.27)
Period	-0.1381 (0.08)	-0.2059 (0.11)	0.0469 (0.04)	0.0464 (0.05)
Margin municipal election (%)	-0.0056 (0.01)	-0.0075 (0.01)	-0.0052* (0.00)	-0.0056 (0.00)
Margin presidential election (%)	0.0177** (0.01)	0.0259*** (0.01)	-0.0046 (0.00)	-0.0067 (0.00)
Intendente x Period		0.3266* (0.16)		-0.0542 (0.12)
Intendete x Margin municipal election		0.0120 (0.02)		-0.0007 (0.01)
Intendente x Margin presidential election		-0.0359** (0.01)		0.0115* (0.00)
Associations per capita (ln)	0.2445 (0.13)	0.1551 (0.17)	0.0690 (0.11)	0.0406 (0.12)
Neighbourhood associations per capita (ln)	0.1442 (0.19)	0.1223 (0.19)	-0.1081 (0.11)	-0.0556 (0.11)
Crime rate (per 100,000 inhabitants)	0.0000 (0.00)	0.0000 (0.00)	-0.0001 (0.00)	-0.0001 (0.00)
Homicide rate (per 100,000 inhabitants)	0.0038 (0.03)	-0.0073 (0.02)	-0.0039 (0.02)	-0.0009 (0.02)
New Housing Space	-0.1589*** (0.04)	-0.1720** (0.06)	-0.0896 (0.05)	-0.0871 (0.06)
Municipal revenues per capita (ln)	0.0303 (0.14)	0.0707 (0.15)	0.2619** (0.10)	0.2457* (0.10)
Professionals per capita (ln)	0.2551 (0.24)	0.3119 (0.29)	0.1145 (0.17)	0.1175 (0.17)
Poverty (ln)	0.5076*** (0.15)	0.6790*** (0.18)	0.2985 (0.19)	0.3423 (0.19)
Cons	265.6200* (107.87)	252.8407 (130.75)	-360.1091*** (89.75)	-354.9148*** (54.54)
N	414	414	211	211
Number of id	52	52	38	38
FE Municipalities	YES	YES	YES	YES
FE Year	YES	YES	YES	YES
AR (1)	-2.46 0.014	-2.38 0.017	-2.86 0.004	-2.77 0.006
AR (2)	1.54 0.123	0.66 0.508	-0.45 0.649	-0.44 0.66
Hansen	32.58 0.113	29.51 0.58	22.2 0.567	24.09 0.193
N. of instruments	40	38	40	38

Note: Standard errors, clustered by municipality, reported in brackets. ** p<0.01, * p<0.05

Implications for metropolitan governance

These results have important implications for the institutional design of grant transfers and the governance of metropolitan areas. Decentralized urban investment that goes through mayoral control is influenced by partisan and electoral concerns, whereas direct grant allocations to beneficiaries have no political interferences. Constituencies voting for the party of the regional governor are systematically over financed to back the re-election possibilities of the incumbent when transfers are channeled through local governments. The electoral tactic that seems to yield the highest returns in the ballot is to concentrate urban goods where competition is stronger, since municipalities where the vote margin in presidential elections was lower were the most benefitted amongst strongholds. This strategy is consistent with previous research reporting a tactical distribution to favor swing areas.

Nevertheless, not every investment flow seems akin to distributive politics. Although there might be alternative political mechanisms that our research strategy was not able to identify, estimations imply that a program designed to distribute funds straight to beneficiaries is not hampered by partisanship. We believe there are two reasons why decentralized programs are subject to political influence, whereas direct grant allocations are not. First, although pork barrel politics is primarily used to cement the electoral prospects of the national government, long-lasting local chiefs seek their piece of the cake. This intuition is based on the significance of the variables related to presidential elections results (and the insignificance of local polls), but also on the influence of the mayoral periods in charge. On the contrary, transfers to users are not mediated by tactic concerns, even though, hypothetically, the central government could conduct a strategy to maximize its own electoral utility favoring stronghold constituencies. A major conclusion is that, when mayors act as strongmen knocking the central government's door, a decentralized investment program is rather exposed to political duress.

A second reason for direct assignments to be free from political distortions is the role of community-based organizations. Since citizen committees apply for PP funds, strong local

leaders have no chance to lobby the central distributor. Besides, there is no signal of capture, as the variables related to social capital remain non-significant for both programs. Recall that rent seeking could potentially result under the two program designs, in the case of decentralized investment by compelling mayors to attract investment, and in the case of direct transfers by reaping public goods for the sake of their community. Our results hence provide additional evidence of the importance of community-based organizations for accountability and control. Regarding the program design, results point to a stronger involvement of the civil society in the provision of public goods to back the positive outcomes discussed earlier, since no risk of particularistic appropriation is appreciated.

The indications above bring forward important implications for the governance architecture of the metropolitan area. Similar to other cities around the world, the SMA is administered by a fragmented political geography. Mayors and local councils are selected in competitive polls but, above them, there is no elected, metropolitan authority. Contrariwise, the regional governor does not have to compete in the ballot as it is appointed by the central government, which is to open the door to favouritism in the distribution of public goods. An elected metropolitan authority would not be fully absent from political motivations but it would introduce another mechanism of checks and balances, hence limiting the scope for partisan politics.

Furthermore, the current governance framework faces important limitations. First, although decentralization brings decision-making closer to citizens and improves the responsiveness of services to local demands, it also leads to large fiscal disparities among local governments. In fact, the current vertical and horizontal transfer system barely compensates for imbalances between the revenues that municipalities generate on their own and their expenditure responsibilities. Second, municipalities held strong administrative, economic, social and environmental interdependencies that cannot be properly accommodated in a decentralized framework. Third, there are issues that have a metropolitan-wide nature, such as transportation, urban services, or strategic urban planning.

Alternatively, a two-tier governance framework made of a democratically elected metropolitan authority and *comuna*-level local governments could take advantage of the agglomeration benefits of the upper tier, while retaining the flexibility of the bottom tier for urban service provision. Obviously, a two-tier structure raises concerns about the obligations of each level, the efficiency losses that may be engendered and the lack of transparency as duties are diluted. The distribution of responsibilities should be clearly defined to avoid duplication and general confusion about who citizens are paying for and which tier is responsible when providing services (see Bird & Slack (2007) for a tentative distribution of responsibilities in a two-tier model). Nevertheless, if responsibilities are clearly demarcated and taxes correctly specified among different government levels, a two-tier system is likely to render benefits by acquiring economies of scale at the metropolitan level and retaining the flexibility of local service delivery. Regarding fund distribution, it will reduce the margin for electoral motivations in the distribution of resources across areas, although it may well happen that total investment in the entire metropolitan area diminishes if the newly elected metropolitan authority is not aligned with the national government.

Conclusions

This paper has addressed the consequences of political factors in the distribution of local investment from the central government to the municipalities of the Santiago Metropolitan Area. Considering one decentralized urban investment program mediated by municipal governments and another one that transfers resources directly to self-organized citizen committees, the paper has shed light on how fund distribution follows partisan criteria to favor aligned areas against foes. The electoral tactic of the central disburser is to over finance loyal municipalities where competition is stronger, that is, riskier areas that are likely to swing in the next presidential race.

We believe our research contributes in four major ways to a better understanding of governance processes. In the first place, there is scant evidence on how partisan alignment shapes the distribution of funds across city areas, in spite of the implications it has for

urban governance. This piece of work has bridge this gap in the literature showing that accountability problems do not circumscribe to intergovernmental relations within a country, but also hold on a city scale. We believe understanding the redistributive consequences of political discretion deserves further research. If goods are not allocated in an equitable manner but instead particular areas get excessive shares, the urban policy aim of reducing territorial imbalances is certainly undermined. While being a general concern, this issue is particularly pressing in cities of the Global South characterized by strong socio-spatial disparities.

A second lesson to be learned is how political pressure is exercised in the distributive game. The central government benefits loyal areas looking for its own electoral returns, a result consistent with the prevailing assumption of a top-down agency to increase the re-election intentions of the central disburser. However, several-times elected mayors lobby to attract funds supported by their political experience, whereas long-lasting rival mayors are punished. This bottom-up influence helps explaining why decentralized investment is rather subject to political interferences, whereas there is no meddling when grants are administered to beneficiaries.

A third interesting result is the potential benefits of community-based organizations reducing the margin for a politically motivated, discretionary distribution of intergovernmental transfers. As discussed throughout the paper, the literature on participatory governance has signalled the benefits of civic engagement over the democratic process, the performance of public services and the responsiveness and accountability of local governments, although it also involves threats to local governance associated with the risk of capture by specific-purpose associations. Our analysis suggests no sign of appropriation, hence, social capital is able to act as a control mechanism to confine the influence of local governments over an arbitrary spatial allocation of funds. We believe the latter is a contribution to the academic literature since, to the best of our knowledge, no research has determined the potential role of the local social capital limiting pork barrelling. This outcome also opens a productive venue for future research: what institutional conditions allow citizen participation to strengthen government accountability?

Finally, the paper has approached the implications for the governance of the metropolitan area, discussing the benefits of a two-tier governance system. The actual scenario has to come across important planning and accountability problems because the regional governor is politically biased. Although not completely free from political leanings, a system made of a metropolitan authority and a network of local governments is likely to improve metropolitan governance by taking advantage of economies of scale in urban service provision, retaining the benefits of a decentralized system and reducing the margin for partisanship in the distribution of intergovernmental transfers. A two-tier scheme also encounters several bottlenecks, particularly when the two government levels are in gridlock or the upper tier cannot co-ordinate efficiently local authorities. Nonetheless, an elected metropolitan body will improve democratic practices while introducing a counterweight between mayors and the central legislator.

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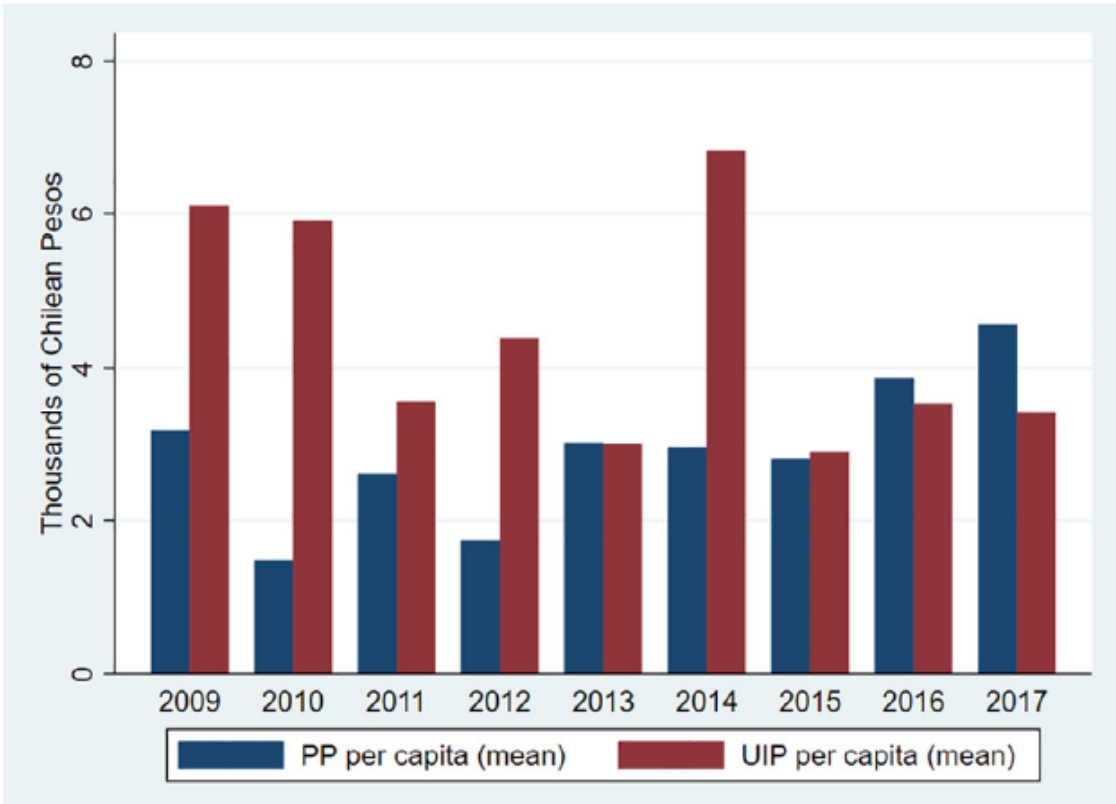
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Annexes

Annex 1 UIP and PP per capita



Annex 2. FE estimations for associational density equal or below 20%

	UIP per capita (ln)		PP per capita (ln)	
	Model 1	Model 2	Model 3	Model 4
Intendente (Dummy)	0.6640** (0.23)	0.4210 (0.56)	-0.0076 (0.14)	0.3311 (0.25)
Period	-0.2685** (0.09)	-0.3614** (0.11)	-0.0395 (0.07)	0.0039 (0.08)
Margin municipal election (%)	0.0032 (0.01)	-0.0007 (0.01)	-0.0007 (0.01)	0.0005 (0.01)
Margin presidential election (%)	0.0113 (0.01)	0.0198 (0.01)	0.0004 (0.00)	-0.0011 (0.00)
Intendente x Period		0.3294* (0.15)		-0.1324 (0.09)
Intendete x Margin_municipal		-0.0039 (0.02)		-0.0063 (0.01)
Intendente x Margin_presidential		-0.0325* (0.01)		0.0077 (0.01)
Crime rate (per 100,000 inhabitants)	-0.0001 (0.00)	-0.0001 (0.00)	0.0003 (0.00)	0.0003 (0.00)
Homicide rate (per 100,000 inhabitants)	0.0288 (0.03)	0.0220 (0.03)	-0.0049 (0.03)	0.0004 (0.03)
Associations (Dummy P20)	-0.1573 (0.23)	-0.1615 (0.20)	-0.0578 (0.25)	-0.0099 (0.27)
Neighbourhood associations (Dummy P20)	0.2261 (0.15)	0.3328 (0.18)	0.0436 (0.19)	0.0191 (0.17)
New Housing Space	0.0177 (0.07)	-0.0167 (0.06)	0.0017 (0.05)	0.0101 (0.05)
Municipal revenues per capita (ln)	-0.1098 (0.42)	-0.0994 (0.42)	0.3105 (0.27)	0.2422 (0.26)
Professionals per capita (ln)	-0.0416 (0.08)	-0.0095 (0.08)	-0.0786* (0.04)	-0.1081* (0.04)
Poverty (ln)	0.5736* (0.25)	0.5810* (0.25)	0.3674 (0.19)	0.3500 (0.18)
_cons	-0.6893 (2.67)	0.0093 (2.71)	1.0545 (2.24)	0.2878 (2.20)
N	466	466	280	280
R-Squared	0.2241	0.2533	0.2921	0.3049
Number of id	52	52	43	43
FE Municipalities	YES	YES	YES	YES
FE Year	YES	YES	YES	YES

Note: Standard errors, clustered by municipality, reported in brackets. ***p < 0.001, **p < 0.01, *p < 0.05.

Annex 3. FE estimations for associational density equal or below 40%

	UIP per capita (ln)		PP per capita (ln)	
	Model 1	Model 2	Model 3	Model 4
Intendente (Dummy)	0.6705** (0.23)	0.4053 (0.55)	-0.0105 (0.14)	0.3195 (0.24)
Period	-0.2667** (0.09)	-0.3552** (0.11)	-0.0420 (0.07)	0.0028 (0.08)
Margin municipal election (%)	0.0038 (0.01)	-0.0002 (0.01)	-0.0008 (0.01)	0.0004 (0.01)
Margin presidential election (%)	0.0114 (0.01)	0.0196 (0.01)	0.0006 (0.00)	-0.0011 (0.00)
Intendente x Period		0.3195* (0.15)		-0.1342 (0.09)
Intendete x Margin_municipal		-0.0022 (0.02)		-0.0059 (0.01)
Intendente x Margin_presidential		-0.0319* (0.01)		0.0079 (0.01)
Crime rate (per 100,000 inhabitants)	-0.0001 (0.00)	-0.0001 (0.00)	0.0003 (0.00)	0.0003 (0.00)
Homicide rate (per 100,000 inhabitants)	0.0297 (0.03)	0.0229 (0.03)	-0.0045 (0.03)	0.0009 (0.03)
Associations (Dummy P40)	0.0498 (0.25)	0.0483 (0.26)	-0.0321 (0.11)	-0.0391 (0.12)
Neighbourhood associations (Dummy P40)	-0.1885 (0.23)	-0.1749 (0.25)	-0.0545 (0.20)	-0.0425 (0.21)
New Housing Space	0.0150 (0.07)	-0.0202 (0.06)	0.0018 (0.05)	0.0101 (0.05)
Municipal revenues per capita (ln)	-0.1591 (0.43)	-0.1695 (0.43)	0.2775 (0.29)	0.2148 (0.28)
Professionals per capita (ln)	-0.0415 (0.08)	-0.0085 (0.09)	-0.0768* (0.04)	-0.1058* (0.04)
Poverty (ln)	0.5818* (0.25)	0.5927* (0.25)	0.3683 (0.19)	0.3513 (0.18)
_cons	-0.9912 (2.67)	-0.4277 (2.66)	0.8321 (2.39)	0.1139 (2.33)
N	466	466	280	280
R-Squared	0.2238	0.2521	0.2925	0.3055
Number of id	52	52	43	43
FE Municipalities	YES	YES	YES	YES
FE Year	YES	YES	YES	YES

Note: Standard errors, clustered by municipality, reported in brackets. ***p < 0.001, **p < 0.01, *p < 0.05.

Annex 4. FE estimations for associational density equal or below 60%

	UIP per capita (ln)		PP per capita (ln)	
	Model 1	Model 2	Model 3	Model 4
Intendente (Dummy)	0.6680** (0.23)	0.4141 (0.55)	-0.0057 (0.14)	0.3417 (0.24)
Period	-0.2672** (0.10)	-0.3559** (0.11)	-0.0448 (0.07)	-0.0032 (0.08)
Margin municipal election (%)	0.0036 (0.01)	-0.0003 (0.01)	-0.0008 (0.01)	0.0006 (0.01)
Margin presidential election (%)	0.0110 (0.01)	0.0193 (0.01)	0.0001 (0.00)	-0.0014 (0.00)
Intendente x Period		0.3201* (0.15)		-0.1269 (0.09)
Intendete x Margin_municipal		-0.0029 (0.02)		-0.0075 (0.01)
Intendente x Margin_presidential		-0.0319* (0.01)		0.0078 (0.01)
Crime rate (per 100,000 inhabitants)	-0.0001 (0.00)	-0.0001 (0.00)	0.0003 (0.00)	0.0003 (0.00)
Homicide rate (per 100,000 inhabitants)	0.0282 (0.03)	0.0218 (0.03)	-0.0046 (0.03)	0.0007 (0.03)
Associations (Dummy P60)	-0.0160 (0.15)	-0.0169 (0.16)	-0.1307 (0.19)	-0.1344 (0.19)
Neighbourhood associations (Dummy P60)	0.1496 (0.36)	0.0908 (0.36)	0.0537 (0.11)	0.0447 (0.12)
New Housing Space	0.0145 (0.07)	-0.0195 (0.06)	0.0027 (0.05)	0.0111 (0.05)
Municipal revenues per capita (ln)	-0.1129 (0.43)	-0.1333 (0.42)	0.2726 (0.29)	0.2041 (0.27)
Professionals per capita (ln)	-0.0409 (0.08)	-0.0076 (0.08)	-0.0743* (0.03)	-0.1028* (0.04)
Poverty (ln)	0.5759* (0.25)	0.5856* (0.25)	0.3695 (0.19)	0.3494 (0.18)
_cons	-0.8058 (2.63)	-0.2677 (2.61)	0.8052 (2.35)	0.0494 (2.28)
N	466	466	280	280
R-Squared	0.2233	0.2516	0.2949	0.3080
Number of id	52	52	43	43
FE Municipalities	YES	YES	YES	YES
FE Year	YES	YES	YES	YES

Note: Standard errors, clustered by municipality, reported in brackets. ***p < 0.001, **p < 0.01, *p < 0.05.

Annex 5. FE estimations for associational density equal or below 80%

	UIP per capita (ln)		PP per capita (ln)	
	Model 1	Model 2	Model 3	Model 4
Intendente (Dummy)	0.6629** (0.23)	0.4283 (0.55)	0.0083 (0.14)	0.3407 (0.24)
Period	-0.2687** (0.09)	-0.3548** (0.11)	-0.0353 (0.07)	0.0041 (0.08)
Margin municipal election (%)	0.0038 (0.01)	-0.0002 (0.01)	-0.0008 (0.01)	0.0007 (0.01)
Margin presidential election (%)	0.0111 (0.01)	0.0195 (0.01)	0.0004 (0.00)	-0.0012 (0.00)
Intendente x Period		0.3085* (0.15)		-0.1198 (0.09)
Intendete x Margin_municipal		-0.0024 (0.02)		-0.0077 (0.01)
Intendente x Margin_presidential		-0.0321* (0.01)		0.0080 (0.01)
Crime rate (per 100,000 inhabitants)	-0.0001 (0.00)	-0.0001 (0.00)	0.0003 (0.00)	0.0003 (0.00)
Homicide rate (per 100,000 inhabitants)	0.0287 (0.03)	0.0221 (0.03)	-0.0051 (0.03)	-0.0001 (0.03)
Associations (Dummy P80)	0.2749 (0.19)	0.2574 (0.19)	-0.1690 (0.26)	-0.1751 (0.26)
Neighbourhood associations (Dummy P80)	-0.5198* (0.21)	-0.4453 (0.24)	0.3641 (0.25)	0.3422 (0.24)
New Housing Space	-0.1175 (0.41)	-0.1293 (0.40)	0.2763 (0.28)	0.2102 (0.27)
Municipal revenues per capita (ln)	0.0214 (0.06)	-0.0139 (0.06)	0.0002 (0.05)	0.0085 (0.05)
Professionals per capita (ln)	-0.0605 (0.08)	-0.0265 (0.09)	-0.0685 (0.03)	-0.0967* (0.04)
Poverty (ln)	0.5759* (0.25)	0.5880* (0.25)	0.3713 (0.18)	0.3501 (0.18)
_cons	-0.6289 (2.58)	-0.1311 (2.59)	0.6704 (2.27)	-0.0461 (2.21)
N	466	466	280	280
R-Squared	0.2261	0.2539	0.2991	0.3117
Number of id	52	52	43	43
FE Municipalities	YES	YES	YES	YES
FE Year	YES	YES	YES	YES

Note: Standard errors, clustered by municipality, reported in brackets. ***p < 0.001, **p < 0.01, *p < 0.05.

Chapter 6: Conclusions

Throughout this Thesis Project, we have developed four investigations to analyze elements of political economy that affect territorial inequality. Inequality has many dimensions, and one of them arises from an asymmetric distribution of public goods, which ultimately results in an uneven distribution of social opportunities. In some cases, this asymmetry is the result of historical and geographical processes, whereas in other cases, it is a consequence of the interaction between social groups, governments and public policies, that is, political economy.

This research, structured in four chapters, evaluated two hypotheses that relate political economy to territorial inequality. Chapters 2 and 3 assessed whether the way in which human activities are organized in highly unequal cities is related to the distribution of public assets and social opportunities. Meanwhile, Chapters 4 and 5 addressed whether politicians, motivated by their desire to maintain power, distribute public goods with the aim of maximizing their re-election options, affecting the alleged equity of territorial policies.

In what follows, we summarize the main conclusions of this Thesis.

Hypothesis 1. The way in which human activities are organized in highly unequal cities is related to the distribution of public goods and the social opportunities of residents

Chapters 2 and 3 have corroborated this hypothesis. In highly unequal cities, the distribution of public goods and social opportunities are related, among other issues, to the organization of urban space.

From this general hypothesis, three specific hypotheses were raised.

Hypothesis 1.1. There is a relationship between the characteristics of urban form and inequality in the SMA.

Although one of the most studied elements in planning is the relationship between urban form and sustainability, the discussion has focused on the benefits and costs of the compact city versus the dispersed city. Besides, much of the literature refers to developed countries where inequality is not as dramatic as in Latin American cities. Going beyond the traditional discussion, Chapters 2 and 3 have demonstrated there is a relationship between urban form and inequality in the Santiago Metropolitan Area (SMA), verifying Hypothesis 1.1. Specifically, Chapter 2 deals with urban form and mobility to show that the accelerated growth of the last decades has been spatially and socially uneven, affecting mobility patterns. Meanwhile, Chapter 3 describes the contradictions of urban form in the SMA, questioning the benefits of densification in a socio-economically polarized city.

Along chapters 2 and 3, the monocentric nature of SMA has been revealed. Over the past decades, the city has grown mainly horizontally, which has led to a commuting pattern from the periphery to the center. It is in the center where most of the economic activities are located, industrial activities remain in the first ring, financial services are even more centralized, whereas commercial activities are increasingly decentralized. On the other hand, the SMA continues to grow horizontally, unlike many cities in Europe and North America. Consequently, the distance of daily commuting is increasing as well as the associated environmental costs.

Urban growth in Santiago has been socially and spatially unequal due to two simultaneous phenomena. Firstly, horizontal growth has been the result of irregular urban expansion driven by low-density suburban residential development. Secondly, the national government promoted a housing policy that sought to reduce the quantitative deficit, without considering other planning elements. This led to a policy that systematically located lower-income population in high-density areas of the periphery. As a result, the peripheral rings combine low-density residential areas (north-eastern areas), and high-density areas with low-income populations (southern and western areas). In sharp contrast,

the dense city center has experienced low population growth, much lower than the periphery. In short, like in other cities in Santiago, density decreases with the distance from the city center, although less acutely due to housing policy and suburban growth. This spatial organization of economic activity and housing has reinforced socio-spatial inequality.

Hypothesis 1.2. The urban form of SMA affects mobility patterns and access to public goods, affecting the social opportunities of residents.

In chapters 2 and 3, we have analyzed the relationship between urban form, mobility and access to public goods. These chapters described how the metropolis has faced a rapid urbanization process, with strong socio-economic disparities and large differences in residential density, expressed in a pattern of unequal mobility and differentiated access to public goods. Therefore, the spatial organization influences mobility patterns and the uneven access of public goods and the social opportunities of residents, which corroborates Hypothesis 1.2.

In fact, since the SMA is a monocentric city, a large part of employment is located in the center of the city, while lower-income workers live mainly in the periphery of the city. As a result, the distance and time of journey to work for this population group is usually higher. Additionally, suburban residential development for high-income segments has generated a decentralization of low-skilled employment (housework, personal services, etc.), thereby increasing the imbalance between the location of low-income households and low qualification employment.

Accessibility is also dependent on the level of income. The new low-density suburbs of the upper classes on the periphery are located around central transport hubs, especially highways and roads. Meanwhile, low-class neighborhoods with high density are located in areas of low accessibility. A major conclusion in this regards is that in the SMA, commuting time is a source of inequality, mainly for those workers who have to travel from the periphery to the city center or from low-income areas to high-income areas.

From an environmental perspective, distance and travel time has effects on pollution, but the transport mode has a greater effect. Access to private transport is correlated to income levels, i.e., car usage is a matter of social status. The different motorization rates across city areas result in unequal access to the social opportunities that the city offers. In turn, the accelerated motorization of recent decades has increased traffic congestion and pollution. Last, public transport is less competitive than private transport.

In this regards, two phenomena that affect lower income groups were identified. First, there is a negative relationship between the competitiveness of public transport and its use, i.e., public transport is more competitive in those areas where it is less used. Second, public transport is mostly used in the periphery, an area where the lowest income population is located. The latter is contrary to the situation of cities in Europe and North America, where longer trips are made frequently by car. Consequently, improving the transport network would have limited effects, insofar as the urban growth pattern and social conditions are not addressed.

Regarding the distribution of public goods, the amount of social infrastructure is positively correlated with residential density, which is an expected result because planning takes the distribution of population into account. However, differences in the quality of infrastructure and equipment between city areas have been identified. These are associated with the average income of the commune. If we turn into environmental infrastructure, the scenario is even more unequal, with a negative relationship between income and urban vegetation. The five richest communes comprise 34% of the total area, while the five communes with the lowest income barely exceed 8%.

Hypothesis 1.3. Sub-optimal metropolitan planning plays an important role in the unequal provision of public goods.

The results of chapters 2 and 3 showed that the city experienced irregular growth due to limited planning. This has had significant implications for the provision of public goods,

corroborating Hypothesis 1.3. The general recommendation is that metropolitan planning should reorient individual preferences and correct the housing policies in order to improve social and environmental performance. The main challenges that planning must address in this realm are suburban expansion, transportation, and infrastructure distribution.

The first task is to contain the expansion of the city, and above all, not to locate lower income groups in the periphery. Compact areas could also be developed where residential and economic activities are combined, in order to generate shorter displacements and to reduce socio-spatial segregation if the new employment is located closed to low-income areas. In a short-term scenario, the planning authority should calculate the availability of vacant land and promote redevelopment programs in these areas. A densification policy can have a marginal effect if it does not consider other dimensions such as transportation, the quality of infrastructure, land use planning and the protection of natural resources.

Improving transportation is key for reducing inequalities in mobility and accessibility. Planning should promote the decentralization of some economic activities, in order to obtain a spatial balance between employment and housing. International evidence suggests that densification favors a more environmentally friendly travel pattern due to wider use of public transport. However, in the SMA we have identified low competition of public transport and dense areas in the periphery of the city, where there is a wide use of public transport. Therefore, metropolitan planning should promote rational transportation options, reducing density at the periphery and encouraging densification in areas near the city center or around transportation axes.

Regarding the distribution of green areas, planning instruments should reduce the current unequal distribution, considering that the SMA has serious pollution problems. This implies that the current planning instrument must be corrected, as it favors the proliferation of green areas in low-density settlements, setting different standards for low and high density settlements. In the former, the minimum green area is 10 m² per inhabitant, while in the high-density communes where social housing is located, the average green area is 1.3 to 3.5 m² per inhabitant. Additionally, the regulation does not define a minimum size of green

area. As a result, there is a dispersion of small areas at the expense of large parks, which best fulfill the social and ecological functions of green areas.

Finally, the SMA requires a new institutionality. Currently, the SMA does not have financial autonomy and the governor is appointed by the president. Municipalities have legal autonomy, but in practice, it is limited due to budgetary restrictions. This is particularly serious in those districts of the periphery where social housing is located, because the main source of financing is territorial taxes, which means that municipalities that concentrate social housing collect less. Although there are complementary sources, these fail to compensate for the disparities in municipal income. The result is a mechanism that increases socio-spatial inequalities in which richer municipalities can provide better public goods and attract dynamic activities.

Well-designed instruments run by independent entities could be implemented to redistribute wealth. However, we deem necessary a major institutional reform to create an elected metropolitan authority. This government authority could adopt fiscal instruments to reduce socio-spatial disparities across territories and foster cooperation between municipalities. On a metropolitan scale, it could also provide a comprehensive approach to urban planning, facing the challenges of urban expansion, transport and infrastructure distribution.

Hypothesis 2: Politicians, motivated by their desire to maintain power, distribute public goods with the object of maximizing their reelection options, which affects the equity of territorial policies.

Chapters 4 and 5 have corroborated Hypothesis 2, that is, politicians influence the distribution of public goods in order to maximize their re-election options, which affect territorial development.

From this general hypothesis, three specific hypotheses were raised.

Hypothesis 2.1. There is electoral influence in the distribution of public goods among the municipalities of a region and among the different areas that make up the SMA.

In recent decades, several studies have documented how politicians use their control over intergovernmental transfers to strengthen their electoral perspectives. Chapters 4 and 5 have analyzed the existence of political influence in the distribution of investments from the central government to the municipalities of Chile, verifying Hypothesis 2.1. Particularly, Chapter 4 analyzed the distribution of the National Regional Development Fund (FNDR) at the national level. The FNDR is a social cohesion fund, which aims to reduce territorial inequality. The results show that transfers vary in time according to the electoral cycle, both for the mayors of the government coalition, and rival mayors. There is a political bias because resources increase in those municipalities where the mayor belongs to the coalition and also, the greater the margin of victory in the municipal elections, the greater the allocation perceived by the commune. Finally, we found that the allocation of the FNDR is related to the electoral results of the municipal elections and not to national elections, in spite of top-down distribution criteria. This latter result would be indicative of the strong influence of local actors.

Chapter 5 analyzed the political influence in the distribution of two urban development programs for vulnerable groups. The first is a centralized fund (Participatory Paving), in which the Ministry of Housing and Urban Planning and self-organized committees participate. The second is a decentralized fund (Urban Improvement Program), where the metropolitan government and the mayors participate. The comparative analysis showed there is partisan influence in the allocation of public goods when the program is mediated by the mayor, the experience of the mayor being a key element to attract resources. Our exercise leads us to maintain that decentralized investment is subject to political interference, while there is no political influence when the organized community actively participates in this process. This seems to indicate that social capital acts as a control mechanism that can limit partisan influence in the discretionary distribution of benefits.

Our results contributed to the academic discussion, supporting the argument that, at the local level, it is possible to identify a electoral distortions since resources are distributed unevenly over time and space. Our results from Chapter 4 set aside with international evidence, showing the existence of a time cycle in the distribution of transfers. Likewise, they align with the academic discussion that supports a tactical distribution in favor of core voters.

Chapter 5 also provided a contribution to the academic literature. It has been made clear that a partisan bias emerges when resources are mediated by the mayor, whereas if citizen participation acts as a control mechanism, such bias vanishes. On the other hand, municipalities are over-funded where the mayor has long experience and belongs to the governor's political party. In this case, electoral competition in presidential elections is a key element in the allocation of the decentralized fund, while the municipal election has no impact. The results are consistent with previous research that reports a tactical distribution to favor swing voters. Finally, both chapters engaged in the debate by generating new evidence regarding the influence of local actors in top-down investment programs.

In short, the results corroborate the hypothesis that politicians have electoral objectives when they assign collective goods. They use resources to improve their reputation in order to increase party's or government coalition's expectations in national elections. Hence, the political credit is shared by mayors and the national government. In this context, it is worth understanding how political pressure is exerted in the distributive game, considering the influence of local leaders on national policy making.

Hypothesis 2.2. Electoral influence in the provision of public goods has implications for the development of metropolises and regions.

To understand whether political bias has implications for territorial development, it is important to describe the institutional framework. Vertical transfers are integrated into the communal budget and municipalities hold strong dependence of from senior level transfers. Institutionality works mainly on two levels (national and local) since the regional or

metropolitan government does not have autonomy, represents the interests of the national government and does not have revenue raising capacity. At the local level, the communes are legally autonomous, but in practice they have limited capacity to make decisions because they are highly dependent on the resources that come from the national level.

Chapter 4 corroborated Hypothesis 2.2. This chapter analyzed the distribution of the FNDR, which is a social cohesion fund that seeks to reduce territorial disparities. The results show that, keeping constant the political variables, municipal income and personnel expenditure is positively correlated with FNDR. The social cohesion fund results therefore in a regressive territorial policy, since it favors those municipalities that are in a better relative position.

We were also able to identified three mechanisms that could reduce discretionality in the design of the fund. First, the project approval criterion implies that all projects are evaluated under cost-benefit analysis, whereby those territories that are relatively richer or concentrate a larger population tend to obtain more investment. Second, municipalities with higher income and professionals can present more projects or better quality proposals, so small and lagging municipalities are at a disadvantage. Third, since the fund is non-programmatic, the regional government is responsible for defining the projects' portfolio to be sent to the National Investment System, and this entity can select initiatives according to their electoral performance. Indeed, given that the regional government and the National Investment System are appointed by the central government, there is ample scope to allocate funds for electoral reasons.

The FNDR allocation scheme creates difficulties for local autonomy. Because the approved projects must match the guidelines defined by the national level, municipalities cannot receive funds if the proposal is not aligned with the priorities of the National Budget Office. Besides, given the shortages of municipal revenues, there is a high dependence on intergovernmental transfers. Currently, the FNDR has become a source for financing operational expenses, despite being intended to finance investment projects. The results indicate that the political bias in the distribution of benefits has implications for territorial

development, considering that Chile registers the second highest level of territorial disparity among OECD countries.

The challenge is to accelerate the decentralization process, empowering regional and local governments in the provision of benefits. This institutional change would raise questions associated with the distribution of responsibilities between different levels of government and the appropriate financial architecture. Although greater local and regional autonomy can provide flexible ways of services and infrastructure provision, there are risks that must be addressed. Each local government, by pursuing its own electoral objectives in the distribution of public goods, can affect metropolitan planning; hence, a global vision to solve common problems such as transportation, urban expansion and distribution of public goods is needed. There is also a risk in the design of intergovernmental transfers to complement municipal revenues, since these transfers constitute a powerful political instrument to gain, or retain, power. Lastly, given a scenario of greater local autonomy, lobbying could be increased where strong mayors and larger local bureaucratic structures have greater capacity to put pressure on the metropolitan authority, at the expense of lagging territories.

Hypothesis 2.3. There are institutional mechanisms that can reduce partisan bias in the distribution of public goods.

Political bias in the allocation of benefits is a constitutive element of the distributive game because politicians are motivated by their results in the polls and the electorate enjoys particularistic benefits, even at the expense of the inefficiencies that this concentration can generate for the majority of the population. Consequently, there is no silver bullet that completely eliminates electoral influence. However, empirical evidence indicates that there are institutional mechanisms that can reduce partisan bias, which corroborates Hypothesis 2.3.

An adequate institutional response to reduce partisan influence requires two complementary measures. The first is the implementation of public policies associated with the distribution

of resources. The second is the development of a metropolitan governance scheme that holds democratic legitimacy.

In this regards, the available literature has identified the following public policy recommendations. Firstly, programmatic vertical transfers are less akin to political interference because they are based on an agreed formula. Regarding non-programmatic assignments, the recommendation is to increase transparency and improve accountability. Secondly, vertical transfers should not be allocated to operational expenses as they increase dependence between different levels of government. These transfers should encourage the development of strategic projects that seek to reverse territorial disparities. Thirdly, the entity in charge of carrying out the territorial plan must be autonomous to reduce political influence and distribute resources bearing in mind a strategic perspective. Fourthly, the implementation of multiannual budgets could contribute to setting aside parochialism while providing certainty to local government. Deferring the budget period from the electoral political cycle would also help reducing the partisan influence. Fifthly, it is advisable to improve local financing to tackle territorial inequality, mainly, increasing horizontal transfers in magnitude. The additional resources that lagged municipalities would obtain should be directed towards improving local planning and management capacities. Sixthly, developing temporary association of municipalities can be a complementary instrument to improve the quality of projects in lagging municipalities. These collaborations can help developing local technical skills, increase efficiency by economies of scale, and prioritize strategic investments, over smaller initiatives.

From the governance perspective, two elements should be jointly developed: strengthening community organizations, and a encouraging an institutional reform to elect a metropolitan authority in competitive elections.

In the first case, the empowerment of local governments must be accompanied by participatory reforms to include citizens in decision-making; citizen participation deepens democracy and improves the quality, responsibility and flexibility of services because it increases control over public goods. At the local level, better synergies are obtained

between citizen organizations and the government. This local synergy allows organizations to develop capacities to address social problems, defining better users' preferences and reducing production costs. Local governments also improve responsiveness and accountability.

On the other hand, it is essential to advance in political decentralization through the democratic election of authority at the subnational level. One of the main problems that has been identified throughout the research is that the SMA is managed by a fragmented political geography, where mayors are democratically elected but have limited financial autonomy, while the metropolitan authority has no autonomy and is designated by the central government. In this institutional scenario there is ample space for sub-optimal planning and political favoritism.

Our recommendation is that the SMA should move towards a two-level governance framework, composed of a metropolitan authority and democratically elected local governments. This two-level governance scheme raises some questions about the distribution of responsibilities and the provision of public goods. However, if responsibilities are clearly demarcated and specified between different levels of government, this scheme is likely to have economies of scale and flexibility in the provision of local services. With respect to the distribution of public goods, this scheme would reduce political influence on the distribution of resources, as it would introduce another mechanism of checks and balances between the national and the local levels.

Annex 1. Environment and Planning B, 2013, vol. 40, 507-522

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Urban form and the environmental impact of commuting in a segregated city, Santiago de Chile

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Abstract. The literature on the relationship between the built environment and travel has identified population density and the mix of land uses as key characteristics of the urban form that affect travel patterns. However, in cities with strong sociospatial disparities it is not clear if these characteristics apply in the same way. In this paper we use regression analysis to estimate the influence of the spatial growth pattern of Santiago, Chile, on the environmental impact of commuting. Our findings can be summarized in three points: the travel impact increases as the city spreads out because of the monocentric nature of Santiago; the environmental impact of commuting could be reduced by containing commuters within the area where they live; and the use of public transport reduces the impact, but the modal choice depends not only on the effectiveness of the transport system but also on the characteristics of the urban form and other socioeconomic determinants. Consequently, we propose to reorient the growth pattern in three ways: redirecting land-use policy to promote development within the already built area, developing compact areas where residential and economic activities are mixed, and facing sociospatial disparities as a way to encourage the use of public transport. This would reduce the environmental impact of commuting while, at the same time, tackling sociospatial segregation.

Keywords: urban form, sustainable travel, sociospatial segregation, Latin America

1 Introduction

In recent years there has been an intense debate about the relationship between the urban form and travel (Banister et al, 1997; Crane, 2000; Ewing and Cervero, 2010; Rickwood et al, 2008). The way human activities are organized in urban space affects travel and associated energy use, since the structure of the city influences the modal choice, the time spent travelling, and the distance travelled. Urban sprawl increases the length of daily trips and encourages the use of private transport, because lower population densities make widespread public transportation networks unprofitable. By contrast, in densely populated and multifunctional areas where complementary land uses are closer the trip distance is usually shorter and the number of people using mass transit or walking is greater (Frank and Pivo, 1994). Therefore, the spatial growth (the distance) and the specific features of the urban form (the density, the functional diversity) seem to be the key issues when analyzing sustainable travel patterns.

Our aim is to estimate the effects of the spatial form of Santiago de Chile (Santiago), on the environmental impact of commuting. Much of the studies regarding travel and the urban form have focused on the US and, to a lesser extent, Europe, where sprawling forms of suburban development are blamed for increased car use (Cervero, 1996; Ewing, 1997; Giuliano and Narayan, 2003; Glaeser and Kahn, 2003; Handy et al, 2005; Schwanen et al, 2004; van de Coevering and Schwanen, 2006), but empirical analysis for Latin American cities is very rare.

Article

Understanding Density in an Uneven City, Santiago de Chile: Implications for Social and Environmental Sustainability

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Abstract: Efforts to promote infill development and to raise densities are growing in many cities around the world as a way to encourage urban sustainability. However, in cities polarized along socio-economic lines, the benefits of densification are not so evident. The aim of this paper is to discuss some of the contradictions of densification in Santiago de Chile, a city characterized by socio-spatial disparities. To that end, we first use regression analysis to explain differences in density rates within the city. The regression analysis shows that dwelling density depends on the distance from the city center, socioeconomic conditions, and the availability of urban attributes in the area. After understanding the density profile, we discuss the implications for travel and the distribution of social infrastructures and the environmental services provided by green areas. While, at the metropolitan scale, densification may favor a more sustainable travel pattern, it should be achieved by balancing density rates and addressing spatial differences in the provision of social services and environmental amenities. We believe a metropolitan approach is essential to correct these spatial imbalances and to promote a more sustainable and socially cohesive growth pattern.

Keywords: density; urban sustainability; socio-spatial segregation; travel; social services; green areas; Santiago de Chile

Annex 3. Regional Studies, vol. 52(3), 403-415.



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Distributive politics and spatial equity: the allocation of public investment in Chile

Felipe Livert & Xabier Gainza

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Paving the electoral way: Urban infrastructure, partisan politics and civic engagement



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ABSTRACT

This paper analyses the incidence of political factors and social capital on the allocation of public investment in the Santiago Metropolitan Area, Chile. Considering panel data on a decentralized investment program distributed through local governments and a program that is geared directly to citizen organizations, the paper explores whether investment is equally subject to electoral concerns and rent seeking under different program designs. Our estimations show that decentralized investment favours aligned municipalities where competition is stronger, but long-lasting local leaders also seek their own benefits. By contrast, transfers directly channelled to beneficiaries are free from political clout and, additionally, there is no sign of capture by organized interests. Based on these results, the paper discusses the implications for metropolitan governance, highlighting the potential role of the local social capital and a two-tier governance scheme to retain the gains from decentralization, acquire economies of scale in metropolitan service provision and reduce the margin for pork barrelling.

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1. Introduction

The allocation of public resources within different city areas is a key question for urban governance because it affects the provision of local infrastructure and shapes the urban growth pattern. General explanations place this issue somewhere between the metropolitan governance structure, the ideology of incumbents and technical considerations imposed by bureaucratic decision standards, but different social and political factors may mediate investment decisions. The recent wave of decentralization has strengthened the role of local governments as service providers, introducing questions about the distribution of responsibilities between different government tiers and the adequate transfer system to finance urban infrastructure. Decentralization favors flexible ways of providing services (Ahmad & Brosio, 2009); yet, local governments may pursue their own electoral aims in the distribution of public goods (Livert & Gainza, 2018). As the literature on distributive politics stresses, since politicians are motivated by their wish to retain public office (Golden & Min, 2013), local governments may allocate urban infrastructure bearing in mind their re-election chances.

In a similar vein, the delegation of powers to local authorities has motivated participatory reforms to include citizens in decision-making. Civic engagement in public affairs is a quest for deepening democracy and improving the quality, accountability and flexibility of services because social capital increases citizen control over public goods (Gaventa & Barrett, 2012). However, associations can also capture local resources if organized groups free ride the public good for their own advantage (Platteau, 2004).

This paper explores the influence of political factors and social capital in the allocation of investment from the central government to the municipalities of the Santiago Metropolitan Area (Chile), and its impact on the urban dynamic. The paper focuses on three potential determinants for urban investment distribution. First, we analyze if partisanship mediates intergovernmental transfers, in particular, if distribution favors areas ruled by mayors aligned with the central government. The aim is not only to test the existence of 'pork-barrel' politics, but also to understand the sources of such a political bias. Theoretically, distribution could be driven by the electoral aspirations of the national government or, instead, may be due to the capacity of municipal governments to put pressure on central policymaking, encouraged by their electoral results. Second, we examine the role of social capital interceding in grant allocations. As mentioned, the participation of community organizations in urban governance can improve responsiveness and accountability by reducing the margin for pork barrelling. However,

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