An Empirical Analysis of Land Use Regulation Determinants

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Abstract

To deepen the understanding of the economics of land regulation and its determinants we test several alternative explanations of the sources of municipal variation on the stringency of the regulatory environment in Argentina. Land use regulation is measured by a new aggregate index of local regulatory restrictiveness—the CIPUV Land Policy Index (CILP)—which comprises diverse sub-indexes that summarize information on the different aspects of the local regulatory environment. We use less-conventional sources of empirical data on regulation, such as a broad database of land cover metrics derived from satellite images for over a hundred municipalities that form part of metropolitan areas of Argentina, and link these metrics with National Population's Census Data to construct our explanatory variables. Our results, based on OLS and IV estimations suggest weak or no support for the most common hypotheses of the determinants of land use regulation, namely those based on correction of externalities or reflecting the wishes of the majority of (formal) landowners. Our findings might provide support to the exclusionary hypothesis which states that heterogeneous municipalities with higher rates of both educational attainment and share of disadvantaged population tend to practice more restrictive residential zoning. We find that, as population gets denser the stringency of residential land use regulation is less related to welfare economics considerations. Neither is it affected by land-based interests but rather by mild exclusionary aims. When spatially tested, we find some interesting correlations as we analyze the exclusionary hypothesis: jurisdictions in Buenos Aires where the share of families with unsatisfied basic needs is higher are systematically surrounded by municipalities with stringent policies regarding infrastructure provision. This result is not observed for the rest of municipalities in Argentina, implying that different mechanisms might be in place in different regions of the country.

Keywords: Argentina, urban agglomerates, urban economics, land use regulation, growth controls, growth management, satellite imagery metrics, local government, regulatory regimes, public policy, urban development, zoning, land market regulation.

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Conceptual Issues on Land Use Determinants: Literature Review

Whether called ‘planning’ or ‘zoning,’ land markets are regulated in cities and countries all over the world. The regulation of land markets is not in itself exceptional but in certain jurisdictions can be exceptional in its tightness. What economists call ‘land market regulation’ however, most people—including those who practice it—refer to it as land use ‘zoning’ or ‘planning.’ This is definitely a form of regulation; since it is intended to determine the use of a resource according to rules and norms by which planning decisions and urban development aspirations are prescribed. These interventions ensure the provision of certain amenities but researchers are increasingly becoming aware of the repercussions regulations have on land and housing markets, as well as on other segments of the economy.

Academic research has developed different theoretical and empirical work focused on analyzing what determinants are behind the adoption of particular land use regulatory environments.[1] In this section we review part of the academic literature on regulation determinants. Although not exhaustive, the review is intended to examine a selection of different approaches and hypotheses that have been tested related to this subject. In particular, the review focuses on two main aspects: first, we present a summary of some of the main theoretical motivations associated with land use regulation. Second, we review different empirical strategies by scope and unit of analysis, extending the estimations from metropolitan areas (known in Argentina as big urban agglomerates—BUAs) to municipal jurisdictions.

Theoretical approach to land use regulation

The rationale for land use regulation falls into three broad categories, which can be summarized into the following groups:

i. The welfare economics approach: land regulation serves to correct agglomeration externalities;

ii. The ‘influential landowner’/ ‘home-voter’ hypothesis: political economy view in which regulation stringency is explained by stakeholders’ influence motivated by fiscal aims;

iii. The exclusionary purpose: land policy act to exclude certain groups of potential residents.

The welfare economics approach

A powerful economic justification for local governments to regulate land use lies in the idea that such regulations are designed to manage externalities requiring some mechanism for dispute resolution, especially in densely populated areas. In densely populated areas, the market does not price many of the costs and benefits associated with urban life. Among costs, agglomeration is coupled with more expensive dwellings, higher poverty and crime rates, traffic congestion and longer commutes times. Among the benefits arising from agglomeration economies, knowledge spillovers or labor market matching have been acknowledged in the literature (Rossi-Hansberg 2004). Therefore, from the welfare economics approach, land use regulation could internalize some of this positive and negative effects associated with the urban life and therefore correct the presumed inefficient market allocation of land.

In this type of analysis, zoning is the regulatory measure that has been most studied. Zoning regulates the range of uses (commercial, industrial, residential) and the intensity of each use (e.g. by floor-to-area ratio—FAR) and can therefore alter city growth or densification. It can also provide public goods such as parks or pedestrian roads. In all, from a welfare economic perspective land use regulation that corrects for agglomeration externalities and provides otherwise inexistent public goods should achieve efficiency and therefore raise real incomes.

In our study, the CILP Index certainly includes zoning restrictiveness measurement, which is synthesized in a Building Restriction Indicator (BRI) and its sub-indexes.[2]

Nevertheless, more recent academic work has drawn attention to land use regulation that arises not as a mechanism to correct for market failures, but because of the exercise of monopoly power by pre-existing owners. These studies hypothesize that owners of existing property will have financial incentives to search very carefully for external effects in urban land use patterns, so that restrictive regulation—reducing the land and housing supply—will appear to be welfare enhancing rather than welfare reducing (White 1975; Hamilton 1975; Fischel 1980 and 1985; Quigley 2007). This theoretical basis for land use regulation leads to the second category of studies that are focused on the political economy view of land use regulation.

The political economy view/the ‘home-voter’ hypothesis

A profuse theoretical literature in urban economics has developed which argues that the tightness of land use regulation is adopted for the benefit of the owners of existing property in the jurisdiction (Ellickson 1977). This political economy approach to government regulation originated with several seminal works such Downs (1957), Ellickson (1977), Madison (1972) and Fischel (2001), among others.

The rationale that drives this view is that homeowners are the most sensitive players in local politics, an issue that is not true at the state or national level (i.e. they vote in elections for local leaders whose actions in the territory are carefully scrutinized). This fact is especially true for land use regulations since local planning boards and legislative bodies whose members are elected by local residents determine it. In view of that, the dominant political economics view suggests that regulation relates to the *aspirations* of a majority of voters (Fischel 2001; Ortalo-Magné and Prat 2007; Hilber and Nicaud 2010).

Political economy models provide different explanations for the influence of homeowners in establishing growth controls, creation of amenities and open space as well as restriction to the supply of housing, related to capitalization. This means that, given the fact that homeowners cannot diversify their assets adequately, they are motivated to be ‘home voters;’ meaning that

[2] See Goytia et al. (2014) for further explanation on this topic.

their voting and other political activities are mainly guided by their concerns about home values (Fischel 2001). Therefore, the prospect of capital gains and losses to homeowners is a consistent motivator of local government activity (and planning), due to the fact that the great part of residents' wealth is tied up in their homes (Fischel 2001). One key issue in this type of analysis is that it assumes municipal voters are conscious participants in governance, not merely passive receptors of decisions by government officials. Importantly, this might be an unrealistic assumption when taking into consideration issues of information asymmetry. In particular, this view assumes local voters and their elected officials understand the relationships between zoning, spending, taxation and property values (Lenon and Heffley 1996), aspects that are sometimes blurred in cities of developing countries, such as the ones in our Argentina's analysis.

As stated by Quigley (2007), restrictive land use regulation and zoning, which reduce the supply of developable land or available dwellings, may confer a particular benefit on pre-existing owners as the values of their dwellings increase due to scarcity created by regulatory constrains. This suggests that owners of existing properties and developed land might have a monetary interest in restricting growth. Therefore, in this view, land use regulation has primary fiscal motives.

The group of home-voters may be homogenous, with a prevalence of homeowners, or can be very heterogeneous and include renters and a large proportion of informal owners, such as is observed in most cities in developing countries. Nevertheless, there is mixed evidence in the literature regarding the relation between land use restrictiveness and population size and socio-economic homogeneity/heterogeneity.

On the one side, there is evidence from empirical studies suggesting that home-voters are influential in regulating land use locally for small, homogeneous, suburban jurisdictions (e.g. Dehring et al. 2008) and less influential in wider metropolitan areas or rural areas with large and heterogeneous population. On the other side, some models of political influences, in which special interests may define the outcomes, are more likely to prevail as the electorate increases in size and issues become more numerous. Ellickson and Tarlock (1981), for example, reached the conclusion that the land-use agenda is more likely to be 'captured' by development interests in the larger, more heterogeneous jurisdiction, or in large and complex places where many renters live. From the studies of Ellickson (1977) and McDonald and McMillen (2004), it is feasible to suggest that in developing countries cities, there might be less interest in development controls among low-income homeowners located in poorer suburbs, those located in older and declining suburbs, or jurisdictions with a larger share of informal owners.

This political economy approach to land use regulation, regardless of the literature dispute on its association with agglomeration and population homogeneity, is of particular interest in the case of Argentina. In many cities densification proposals have been slowed down or totally banned through democratic instruments for public consultation or public mobilization. This scenario might be related to the home-voter hypothesis in the same fashion that has been observed in developed countries. It could, however, result from neighborhood aspirations to *preserving the status quo* or excluding particular groups from settling in their vicinity. This hypothesis leads to the last approach to land use regulation: the exclusionary motives which we briefly describe below.

The exclusionary approach

Development control or zoning may act to exclude certain groups of potential residents such as the poor or minorities. Therefore, a third land use regulation motive considered in the literature is the use of zoning and other land use regulations to maintain community homogeneity or to keep out particular population groups. Although the composition of the tax base is considered (fiscal), it is the exclusionary aim that prevails. A recent review in the USA by Inhanfeldt (2004) argues that there is insufficient evidence to impute a primary desire to exclude poor households or minorities separate from financial issues. Rather homeowners' desire to preserve property values is of fundamental importance motivating exclusionary regulations. The evidence gathered is usually consistent with a fiscal motivation, which reflects both a desire for value preservation by owners of developed land (since net fiscal benefits are capitalized into property values) as well as a desire on the part of homeowners to maximize the net benefits they receive from their local government.

Empirical studies on the determinants of land use regulation

In this section we present a brief review of studies assessing cross sectional variation in land use regulation across metropolitan areas. The scarcity of evidence on the issue in developing countries provides a strong motivation for our study.

Methodologically, the empirical studies that assess the determinants of land use regulation adopt one of four different research strategies based on scope (geographical unit of analysis) and type of land use regulation measures that are involved. In combination they suggest different paths for research that are often affected by comparable data availability of land use regulation at different geographical levels of disaggregation. These four research strategies are the combination of two analytical variables that in turn give two possible choices:

1. The definition of regulation to be explained: aggregated measure of the regulatory environment or a single characteristic of regulation

2. The geographical scope of analysis: variation between or within regions or metropolitan areas

First, based on the definition of regulation to be econometrically explained, researchers' interest can be directed to the whole regulatory environment—captured by an aggregate indicator of land stringency—or to a single regulatory measure, such as zoning or minimum lot size or other sub-indexes focused on particular aspects of land use environment such as gated urbanizations rules (GUR), costs and times of planning approvals, etcetera.[3]

3 For example, Evenson and Wheaton (2003) and Glaeser and Ward (2009) regress measures of various types of land use regulations on historical and other characteristics of Massachusetts's towns. Whereas Evenson and Wheaton (2003, p. 223) conclude that zoning seems to follow the current market, Glaeser and Ward (2009, p. 266) conclude that "the bulk of these rules seem moderately random and unrelated to the most obvious explanatory variables."

Furthermore, the land use regulation environment may be measured by regulatory indicators that provide information for a large sample of communities, such as the Wharton Residential Urban Land Regulation Index (WRLURI) created by Gyourko, Saiz, and Summers (2008). This index is constructed to capture the stringency of residential growth controls across jurisdictions within metropolitan statistical areas (MSA) in the USA. Another indicator, created by Saks (2006), uses the simple average of six independent surveys conducted during the 1970s and the 1980s and has a very large coverage (95 MSAs). Importantly, other indicators, which sometimes provide more detailed information, have a limited regional scope, since each focus on a single region or state. For example, the Pioneer Institute's Housing Regulation Database for Massachusetts Municipalities contains data supplemented with the Mass GIS system information for the time period 1999–2000 about minimum lot size requirements across the state.[4] Other sets of indexes on residential use and minimum lot size can be found in Cho and Linneman (1993).

Second, research studies are mainly divided into two different scopes of analysis. Some focus on the regional scope and analyze differences across metropolitan areas, while others use a large group of communities or municipalities within a region or metropolitan area to estimate intraregional variation in the regulatory environment or in a particular regulatory measure.[5] The first group takes advantage of the substantial variation in regulatory regimes across metropolitan areas to provide evidence of the diversity of local housing markets.[6] Among others, Glaeser and Ward (2009)[7] and Hilber and Nicoud (2013) are two of the most recent studies that run theoretical models to estimate land regulation at the MSA level.[8] However, these studies neglect variation in regulatory regimes within metropolitan areas.[9] The other group of studies that examines the determinants of land use regulation focuses on data for communities or towns within a single state. Studies that examine one or a few jurisdictions, such as early studies by Pollakowski and Wachter (2000), Green (1999) and McDonald and McMillan (2004), not only address but actually take advantage of the richness of within-market variation, though questions can be raised about their potential to be generalized. Therefore, in our study we start considering variation at metropolitan area level but due to the few units of analysis (less than 30), our estimations become more robust when municipalities within metropolitan areas are used as units of analysis in the estimations.

It is important to note that available information from satellite images and GIS data are now providing additional sources of information to complement this type of analysis of the determinants of land use regulation. For example, the amount of developable land has been introduced in recent studies in different ways. Saiz (2010) builds a measure of developable land for each MSA and regresses WRLURI on this measure. His findings suggest that cities with a

[4] Our study reproduces this GIS analysis to obtain information on the remarkable array of land use regulations in 190 municipalities (its main cities and towns) within the country, as we describe later in this paper.

[5] See also Gyourko et al. (2008) and Saiz (2010) on the merits of using MSA aggregates.

[6] See for example, Glaeser, Gyourko, and Saks (2005a and 2005b); Green, Malpezzi, and Mayo 2005; Gyourko, Saiz, and Summers 2008; Hwang and Quigley 2006; Linneman et al. 1990; Mayer and Somerville 2000; Quigley and Raphael 2005; Quigley, Raphael, and Rosenthal 2004; and others reviewed in Quigley and Rosenthal 2005.

[7] Using land use regulation data from the Pioneer Institute's Housing Regulation Database for Massachusetts Municipalities supplemented with data from the Mass GIS system detailing the minimum lot size requirements across the state, and permit and demographic data from the Census.

[8] See also Gyourko et al. (2008) and Saiz (2010) on the merits of using MSA aggregates.

[9] Such a critique is provided by Ihlanfeldt (2007).

relatively small fraction of developable land are more regulated. Emphasizing political economy mechanisms, Hilber and Nicoud (2010) complement this study, by creating a measure of developed land (SDL) that has developable land at the denominator in order to understand how the fraction of land actually developed influences regulation.

Regulatory Environment for Land Use in Cities of Developing Countries: The Aspiration Side of Regulation

Empirical evidence on the determinants and impacts of stringent land use regulations (on the price of land and housing markets) has been growing in the last decade, yet most studies that we have already reviewed were carried out in countries where ordinances are effectively enforced. It is easy to imagine that when enforcement is not strict, the eventual impact of a stricter regulatory environment on urban development is certainly very unclear. These facts have been documented in Goytia and Pasquini (2011), Monkkonen and Ronconi (2013), and Goytia et al. (2014). The latter shows how the regulatory environment of municipalities in Argentina strongly differs from what occurs in practice. In fact, the effective enforcement of value capture measures or the implementation of policy instruments related to access to land, which are part of the local regulatory environment, are seldom or never enforced. Therefore, less strict enforcement as well as lower levels of compliance with planning rules turn land use regulation into an 'aspiration' for urban development and growth, an ambition which is not absolutely correlated with those practical matters that occur in cities and metropolitan areas of Latin America, and those in Argentina are not exceptional.

The 'aspiration' condition of land use regulation is very well exemplified when informal urbanization and housing is considered. As a vivid example, informal urbanization and housing provide evidence that these 'aspirations' for urban development, carefully compiled in land use regulation measures and instruments, are of very low concern relative to current trend and needs of a large share of the urban population who are left aside of land and housing markets due to regulatory failures and tight land use standards and requirements (Goytia and Pasquini 2011), as well as imperfections in financial markets affecting the lower income households.[10]

Smolka and Biderman (2011) have highlighted the failure of conventional models to address conditions in Third World cities where large segments of the urban population cannot bid competitively for land in the formal market. Particularly, the main policy challenge in mitigating informality is to improve the affordability of serviced land for lower-income households without placing undue pressure on land prices, searching for new ways to apply conventional land policy instruments to achieve this goal, including transportation, property taxes, value capture, and regulation.

Furthermore, many authors have underscored that not only the poor bypass land use regulation to satisfy their housing needs (by means of developing informal settlements and increasing density in 'urban *villas miseria,*' '*asentamientos,*' '*favelas*' or '*barrio de ranchos*'), but higher income developments, such as gated urbanization may not comply with land use regulation. Moukkonen

[10] Much of the Latin American urban academic literature stresses this fact (see Fernandez and Smolka 2007, Henderson and Feler 2011, and Biderman 2008).

and Ronconi (2013) show that municipalities with higher levels of regulation have lower rates of compliance with property laws. Therefore, it is plausible to consider that the association between regulation and growth (the shares of developed and developable land) is surpassed by other externalities, which in turn lead to the aspiration role of regulation and its further effects.

Empirical Analysis

The main purpose of this study is to explore what determines land policy, and particularly land use regulatory environment in Argentina's municipalities. Most research on the subject has focused on the context of cities in the developed world and therefore, our empirical contribution comes to fill a gap that will shed light on regulation determinants in the context of cities in a developing country. As mentioned before, the theoretical basis for analyzing land policy in the academic scholarship can be grouped into three categories: i) regulation as a means to correct for agglomeration externalities, ii) regulation as a consequence of political power of homeowners and finally, iii) regulation for exclusionary purposes. We intend to provide evidence on these hypotheses for the case of a cross-section of regulatory environments of municipalities in Argentina. In what follows we elaborate on the data sources we use for the analysis and the theoretical basis for the econometric specification.

Description of data

In order to estimate the determinants of land use regulation, we built a unique data set which has municipalities as unit of analysis, and which is derived from three sources of information: i) land use regulation data compiled in the CIPUV—Land Policy Index (CILP), ii) the National Housing and Population Census (INDEC), and iii) land cover metrics obtained from satellite images circa 1990, 2000 and 2010 for all municipalities in metropolitan areas in Argentina[11] (following Angel et al. 2010 methodology).

First, we built the database on Argentine municipalities´ regulatory environment, compiled in the Municipal Land Use Regulation Survey from year 2011, that collected information on different dimensions of land regulation instruments and their enforcement.[12] Using this rich set of unique data, we created a summary measure of the stringency of the local regulatory environment—the CIPUV Land Policy Index (CILP) (Goytia et al. 2014). The CILP documents how regulation of residential building varies across space and provides evidence on what a typical degree of local regulation stringency entails, and how this stringency varies across municipalities.

This aggregate measure comprises diverse sub-indexes, summarizing information on the different aspects of the regulatory environment, including the existence of provincial and local land use laws and plans, projects approval process, their costs and delays, and other norms on local residential land use regulation, such as community involvement, the presence of building restrictions (e.g. FAR, open space dedications, or minimum lot size requirements), affordable housing requirements, and requirements to pay for infrastructure. By design, these indexes are

[11] See Goytia and Pasquini (2013a) for more details on methodology and results.

[12] The complete explanation is provided in Goytia and Pasquini (2013a).

normally distributed with a mean of zero and a standard deviation of one.[13] Table 1A in Appendix A gives a brief description of each sub-index. The CILP and its sub-indexes are the dependent variables in our estimation models.

The National Census provided by National Statistics Office is another of our sources of information. From it, we obtain the following variables: percentage of formal owners, urban density, average educational level attained by the population over 18 years, unemployment rate and percentage of households with Unmet Basic Needs (UBN),[14] among others.[15] These data are geo-referenced by ARCGIS at census track level. Therefore, the combination of geo-referenced census data and regulatory information provides detailed spatial description of both that is used in the spatial models we estimate in this study.

Finally, a unique data base on land cover metrics, obtained from satellite images (circa 1990, 2000 and 2010), at both metropolitan and municipal level has been assembled, providing several metrics on urban expansion. These metrics enable us to visualize and quantify how much municipalities have grown in terms of urban or suburban built-ups and footprints. The Centro de Política Urbana y de Vivienda (CIPUV) at Torcuato Di Tella University developed a Web tool called the CIPUV Atlas of Urban Expansion[16] were these data can be visualized interactively and users may analyze 20 years of urban growth in over 130 municipalities.

After merging the different sources of data, we obtained complete information for 92 municipalities.

To sum up, table A2 in Appendix A provides summary statistics for all the variables used in the different estimations. The units of analysis are the municipalities. We use our models to estimate the determinants for the overall stringency index (CILP) and its sub-indexes.

Theoretical basis for analysis and explanatory variables

The key variable explained by this empirical analysis is the overall stringency indicator (CIPUV Index of Land Policy, hereafter CILP). This aggregate index captures the overall regulatory environment in the municipalities located in the metropolitan areas in Argentina.[17] Additionally, we estimate the model having as dependent variable a selection of the sub-indexes that compose

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[13] Further details about the index can be found in Goytia, et al (2014).

[14] The percentage of population with at least one unmet basic need, according to the unmet basic needs indicator (i.e., *Índice de Necesidades Básicas Insatisfechas*) that includes access to infrastructure in the dwelling, the quality of it, housing overcrowding and the dependency ratio for a lower-educated household head.

[15] When official results at municipal level from 2010 National Population and Housing Census data are not available, we alternatively use 2001 data.

[16] We followed Angel, Civco and Parent (2010) in their methodology for the classification of satellite images pixels and in their construction of land cover metrics. Images for BUA agglomerates, comprising 130 municipal jurisdictions, circa 1990, 2001 and 2010 were collected and processed, allowing the analysis of developments occurring during that period. Through this process we obtained metrics of, for example, the extent of built-up surfaces and its composition (distinguishing between urban, suburban and rural built-up), the extent of new developments and its composition (distinguishing between infill, extension and leapfrog developments) as well as a number of built-up fragmentation indicators (i.e., the fragmentation of built-up regions by open space under different scales of analysis). These measures allow rigorous quantitative assessment of urban spatial structure and its changes over time, at CIPUV Atlas of Urban Extension (2013) http://atlasurbano.herokuapp.com/#/

[17] Can be taken as the regulatory tax, as in (Glaeser et al. 2005a).

the CILP.[18] Among these sub-indexes we include proxies for regulation stringency, such as the Zoning and Residential Projects Approval Indicator (ZRPI), the GIS corrected Building Restriction Indicator (BRI), and specific regulation indicators such as the Infrastructure Provision Indicator (IPI) or the Restriction to Gated Urbanization Development (GUR).[19]

Our goal of identifying empirically the specific motivations behind the adoption of regulations benefits from the considerable degree of variation among these land use regulation indicators between municipalities in Argentina providing for a rich econometric analysis. We regress the CILP Index and selected sub-indexes on variables that attempt to proxy for each of the different motivations identified in the literature, mostly for regulation in developed countries. As described in previous sections, the potential motivations identified are:

i. The welfare economics approach: land regulation serves to mitigate negative externality effects that arise from incompatible land uses and agglomeration;

ii. The 'home-voter'/ 'fiscal' aim hypothesis: a political economy view expressing the desire of existing residents to maximize the net benefit they receive from the public services/taxes package provided by their local government; and

iii. The exclusionary purpose: land policy acts to exclude certain groups of potential residents, expressing a deliberate desire to exclude lower income and/or minority households from the jurisdiction in an attempt to preserve homogeneity or status quo.

In what follows we explain how we incorporate these hypotheses in our econometric analysis.

Welfare economics hypothesis

In order to capture the degree of regulation that arises as a mechanism to correct for agglomeration externalities and costs, we incorporate population density (PD) as a regressor. The motivation for including this proxy is that authorities in densely populated municipalities may impose more stringent regulation in an attempt to internalize agglomeration externalities. We therefore calculate density as the population divided by the sum of urban built-ups, suburban built-ups and the urban open spaces. Rural open spaces and rural built-ups are excluded from the density calculation in order to capture just urban density.

We follow Hilber and Robert-Nicoud (2013) in incorporating this variable as a way of capturing the welfare economics approach to land regulation.

[18] For more information on determination of CILP and it components, please refer to: The CIPUV Residential Land Use Regulatory Index: A Measure of the Local Regulatory Environment for Land and Housing Markets in Argentina's Municipalities (Goytia et al. 2014).

[19] For example, when incorporating informality into the framework, several issues should be taken into consideration. The existence of vacant land (pvacantland in the equations below) or—as it is measured in our land cover assessment—the existence of open space, for example, are necessary condition for the creation of a new *villa* or *asentamiento* (slum). Therefore we must incorporate a measure of the percentage of developable land that is vacant as a control variable is order to avoid miss-specification of the model.

$$Population\ Density = \frac{Population}{Urban + SubUrban + Captured\ Urban\ Open\ spaces}$$

We are certainly aware of issues of reverse causation: land use regulation (e.g. minimum lot size restrictions) differentially affects population density (PD). We therefore instrument PD in our econometric specification. The choice of instrument is discussed in the next section of this paper.

Figure 1 presents the results from processing the Urban Area of four selected jurisdictions. As seen in the figure, rural built-up is insignificant for the analysis.

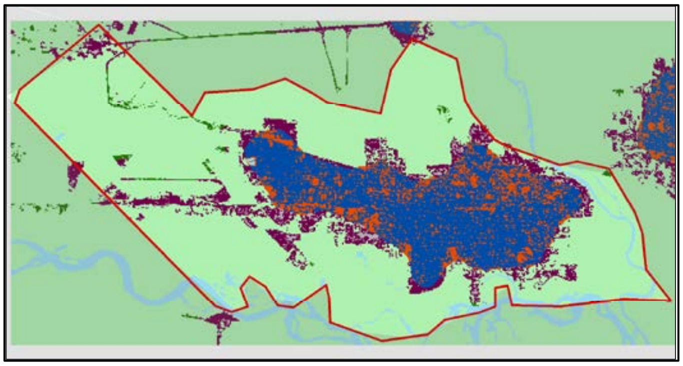
‘Home-voter’/‘influential landowner’ hypothesis

Concisely, the ‘home-voter hypothesis,’ based on Fischel 2001, argues that places with higher homeownership rates tend to be more regulated. The argument arises from a stylize fact observed in the US where more developed areas tend to have regulatory environments that are more stringent than a welfare economic approach to regulation would demand (Glaeser *et al.* 2005a, Cheshire and Hilber 2008). We follow the empirical contribution in Hilber and Nicoud (2010)[20] and incorporate the share of developed land to address this hypothesis. In what follows we present the theoretical framework used by these authors and explain its applicability to the Argentina context.

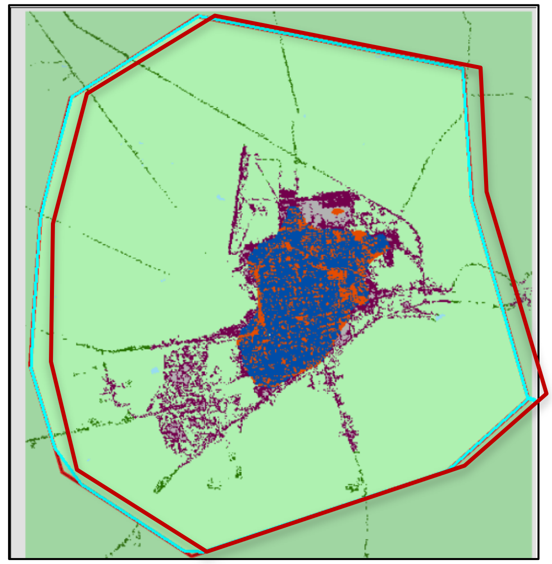
[20] In their empirical contribution the authors identify the origins of cross-sectional variation on land use regulation across metropolitan areas in the USA, rather than in a single MSA area and, like Glaeser and Ward (2009), the authors use aggregate indices, rather than various measures of different types of land use regulation to capture the overall regulatory environment.

Figure 1. Urban Areas for selected municipalities (year 2000)

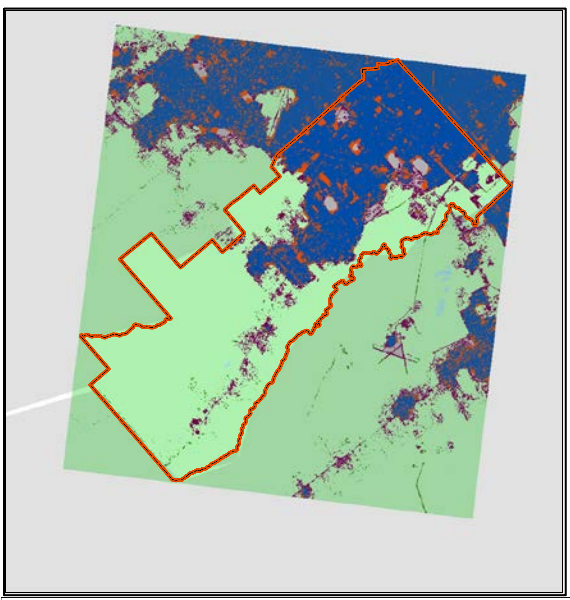
Municipality of Neuquén, Neuquén Province



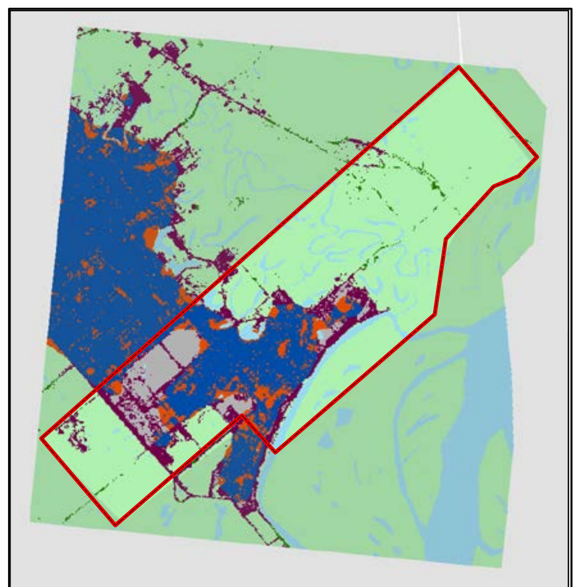
Municipality of San Luis, San Luis Province



Municipality of La Matanza, Buenos Aires Province



Municipality of Barranqueras, Chaco Province



Source: Authors' elaboration from CIPUV Atlas of Urban Expansion (2013).

Hilber and Nicoud (2010) present a theoretical model where a population of mobile households with heterogeneous preferences over a set of cities, chose where to settle given desirable amenities and the level of land use regulation in the city, also referred to as 'regulatory taxes.' Local planning boards choose these 'regulatory taxes,' which have the particularity of being directly capitalized in the value of developed land, therefore benefitting homeowners or landowners. Land use constraints benefit the former group via increasing property prices but hurt owners of undeveloped land via increasing development costs. In this setting, more desirable locations are more developed and, as a consequence of political economy forces, more regulated.

The authors assume that as regulation gets tighter, the greater the benefit is for landowners in the developed area of the city. In their analysis, they develop a sub-game perfect equilibrium model for residential land use constraints as the outcome of a political economy game between owners of developed and owners of undeveloped land, where landowners of developed land lobby for more stringent regulations while land developers and owners of undeveloped land push for less regulation (i.e. that will allow further development and extension).

In this context, a variable that captures the share of developed to developable land (hereafter SDL) captures the 'influential landowner hypothesis,' as the authors coined the argument. Their findings support this hypothesis: in their empirical approach, only SDL has the expected sign and is statistically significant. The study also takes into consideration the possible endogeneity of residential development and the regulatory environment. If SDL is endogenously determined, the estimation of the coefficients for the landowner hypothesis will be biased downwards (as long as regulation works as an impediment to development). The issue is addressed by instrumenting SDL by a set of exogenous regressors. Their results endorse the presence of a downward bias in the OLS specification and reinforce the influential landowner hypothesis by finding a positive, statistically significant and larger than the OLS coefficient for SDL.

Following this theoretical framework we include the share of developed land (SDL) in our determination model of land use regulation in Argentina's municipalities. We also instrument it in order to account for plausible reverser causation. The choice of instrument is discussed in the next section where we present our econometric specification.

In Hilber and Nicoud (2010), SDL is calculated as the share of developed to developable residential land. They define developable residential land area as the total land area minus the surface area that is covered by 'non-developable' land uses, which they define as areas with higher than 15 to 30 degree slope. We follow a similar approach for calculating SDL in Argentina's municipalities. Our satellite imagery provides us with information on the share of urban area to total municipal area, excluding water.[21] We define SDL as follows[22]:

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[21] We also have information on the share of land in the municipality with slope below 15 degrees. However, we chose not to use this measure as our denominator for SDL because for virtually all municipalities the share of land with less than 15 degree slope exceeds 99 percent of the territory. For this reason we found no benefit in excluding these small 'non developable' areas. Moreover, we do not have information on this slope for the entire sample, and losing observations was not worth the slight gain in the precision of the SDL definition.

[22] As a second approach we incorporate the estimations of local planning professionals on the extent on vacant land, and disaggregate it by share of (vacant) public—municipal, provincial and national—and (vacant) privately owned land. This information is available in ERUS, our Survey to municipal land officials in Argentina (2011).

$$SDL = \frac{Footprint\ builtup\ Area}{Municipality´s\ buildable\ area}$$

As mentioned before, we gathered and classified satellite imagery for the years 1990, 2001 and 2010. Any of these time periods could be used to calculate SDL. However, one of our main empirical contributions is to understand the causal relationship between the political power of homeowners and the land use regulatory environment. For this reason, we assume that the level of development in the past, rather than the most recent one, could have affected the current level of regulation. Thus, we decided to use satellite imagery from 2001 to construct our SDL variable.

<u>The 'exclusionary' motivation</u>

The exclusionary aim proxy is the presence of formal homeowners. This ratio of formal homeowners (RFHO) represents the percentage of households within the municipality that declare to be owners of the dwelling and of land they occupy, as measured by National Statistics Office (INDEC).[23] As it was already explained in previous sections, one may expect that greater presence of homeowners will support more tight regulatory environment or development controls to exclude certain groups of potential residents such as the poor or minorities.

Moreover, additional variables might play a significant role in the definition of regulation, particularly in the context of a developing country. In order to control for the relative expected wealth of the jurisdiction, we use the average number of years of education. Incorporating this variable allows us to control for the possibility that income sorting drives the findings.
As mentioned before, applying this model in the context of a developing country implies accounting for social and economic phenomena particular to the developing world where tenure formality is a relevant departure from the literature that arises from evidence from the United States. Informal tenure—a negligible phenomenon in developed countries' land markets—might influence the political agenda of municipalities, though only in some cases. For example, slums generally have a large share of migrants, both national and international, who might not necessarily participate in the local electoral process. In order to account for this, we incorporate variables that can proxy segregation and inequality since they are theoretically linked to the generation of exclusionary regulation. The variables that we use as proxies are the share of families in the municipality that have at least one indicator of unsatisfied basic needs as measured by INDEC and the share of international immigrants from bordering countries, since, as several recent studies indicate, migrant origin strongly affect the probability that a household can satisfy their needs for both land and housing in the informal market (Di Virgilio et al. 2011, Goytia and Pasquini 2013). We also include regional dummies to control for possible territorial regularities. We categorized municipalities into five regions of Argentina: The Northeastern Region (NEA), the Northwestern Region (NOA), Cuyo, The Pampeana Region and Patagonia (INDEC 1998).

<u>The Fiscal Capacity Indicator and control variables</u>

[23] In the context of a developing country, where households underreport ownership informality, it would be prudent to accommodate the definition as a mixture of tenure status declaration and some measure of the physical setting, like living in emergency or informal settlements, and/or lack of all basic infrastructure services, as explained in Henderson and Feler (2011), Biderman (2008) and Goytia and Pasquini (2011). However, because census information is aggregated at the municipal level we are unable to distinguish the particular situation of individual families.

We incorporate a Fiscal Capacity Indicator that captures the degree in which the municipality can seize local resources based on property. By construction, a higher value of this indicator indicates a greater ability of local governments to raise revenues from their own sources. We use as proxy an index build upon the percentage of the municipal property tax that is collected or received by each jurisdiction, either directly or through provincial co-participatory rules. This measure should reflect the municipalities' financial autonomy and effectiveness in its taxes/fees collecting function. A less restrictive regulation (on new housing) may be expected if it generates the revenues necessary to balance the municipal budget.

Econometric Specification

We estimate the following theoretical model:

$$I_i = \beta_0 + \beta_1 SDL_i + \beta_2 RFHO_i + \beta_3 PD + \beta_4 FI_i + \sum_h \beta_h \mathbf{controls}_i^h + \varepsilon_i \quad (1)$$

Where *I* stands for an indicator measuring the degree of stringency of regulation of municipality *i*. As noted before, we estimate the model for different specifications of stringency including both the overall stringency index (CILP) and it sub-components. coefficients capture the causal relationship between our main explanatory variables and the degree of regulatory stringency. These main explanatory variables are the share of developed land (SDL), the rate of formal homeowners (RFHO), the municipal urban population density (PD) and our measure of fiscal capacity autonomy (FI). We are controlling for both socio-economic and regional variables (controls) and we assume that the model is subject to exogenous and random shocks captured by the disturbance term ε.

In its simplest version this model could be estimated by OLS. We do this in the next section in order to gain insights on the relationships that could be determining land regulation stringency. We call this our baseline empirical specification and present the results in table 1B in Appendix B. However, we are cautions in analyzing the results since there are possible sources of reverse causation for our main explanatory variables. We address this potential endogeneity by implementing an IV approach. Following Hilber and Robert-Nicoud (2009) we instrument two of our main explanatory variables: the share of developed to developable land (SDL) and the rate of formal home-owners (RFHO).

The variables used as sources of exogenous variability, our valid excluded instruments are: provincial average maximum and minimum temperatures in the last decade, distance to the main costal area, and provincial population density as of 1895. Our identifying assumptions for these sources of exogenous variation of SDL are that:

1. People, holding other things constant, will prefer mild climates to extreme ones and that climate is not directly related to the regulatory environment of urban agglomerates.

2. Proximity to the main costal area can influence where people want to live, therefore increasing the share of developed to developable land. Moreover, we assume that such

distance is not directly related to the regulatory stringency of agglomerates, but only through its correlation with the share of developed land.

3. Population density in the far away past (we collected data published by INDEC for estimated provincial' population in the year 1895), is correlated with today's share of developed land but cannot explain current regulatory stringency. Historical population density can be used as proxy of land characteristics that make areas more desirable to settlers before the urban political life incorporated land use regulations. The rationale for using the historical density from 1893 as an instrument is that it captures the entire unobserved and time-invariant amenity and cost factors not already included in our set of amenity instruments that lead people to settle in a specific place. It also captures historic amenity and cost factors that were important a long time ago and which started the dynamic development process of cities. These factors may no longer be important nowadays, yet they remain relevant because of inertia, durable housing, or the generation of agglomeration forces (Hilber and Robert-Nicoud 2009).

The second endogeneity concern relates to the homeownership variable (RFHO). The estimation of our model may be biased if there are omitted variables that are correlated with RFHO or if land use regulation influences systematically the incentive to own one's home. We use the UBA's share of households that consist of informal workers and the share of unemployed as sources of exogenous variation of RFHO in order to improve the identification of its effect on CILP. Formal labor market status makes workers more likely to overcome liquidity and down-payment constraints and thus eases attaining formal homeownership. For both of these labor conditions we assume that there is a strong correlation with the RFHO but no direct source of causality between them and municipalities' land use regulation.

Model specification and estimation results

The main objective of this empirical approach is to shed light on the possible determinants of the differences in land use regulation stringency across Argentine municipalities. In order to do so, we first run a simple OLS model, as specified in equation (1). Results are presented in table B1 of Appendix B.

What first needs to be noted is that the model is accounting for a third of the variability in indexes. For instance, regressors can explain 32 percent of the variability in our overall stringency indicator (CILP)[24] and 28 percent of the variability in our GIS adjusted building restriction index (BRI). The model has the least predictive power when the regular zoning approval indicator (ZRPI) is explained (R-squared 0.1). This last result seem plausible since the stringency of ZRPI (i.e. the authorities involved and the frequency in which they are active on planning approvals) may be part of a political process of jurisdictions that is not totally captured by our model.

However, as mentioned earlier, we should be cautions when analyzing the results from this model since there are sources of reverse causality that could be biasing the estimation. In table B2 of Appendix B we present the results for the instrumented version of the model. Columns (1)

[24] A result that is similar to Hilber and Robert-Nicoud (2013).

and (2) are the IV first stage and columns (3) to (12) are the IV second stage for the different categories of land regulatory stringency.

From table B3 in Appendix B we can see that the instruments we chose explain roughly 50 percent of the variability in the endogenous regressors (R-squares of 0.48 and 0.74 for SDL and RFHO, respectively). This first stage model exhibits enough variation in the endogenous variables, making the chosen exogenous variables good instrumental observations. That these instruments are not related to regulation but through their effect on SDL and RFHO is the identifying assumption we need to make in order to have causation in our estimation.[25]

In what follows we present the results for each of the components of land use stringency analyzed. We first analyze the simple version of the model specification (OLS) and then assess the differences that appear once we instrument the potentially endogenous explanatory variables.

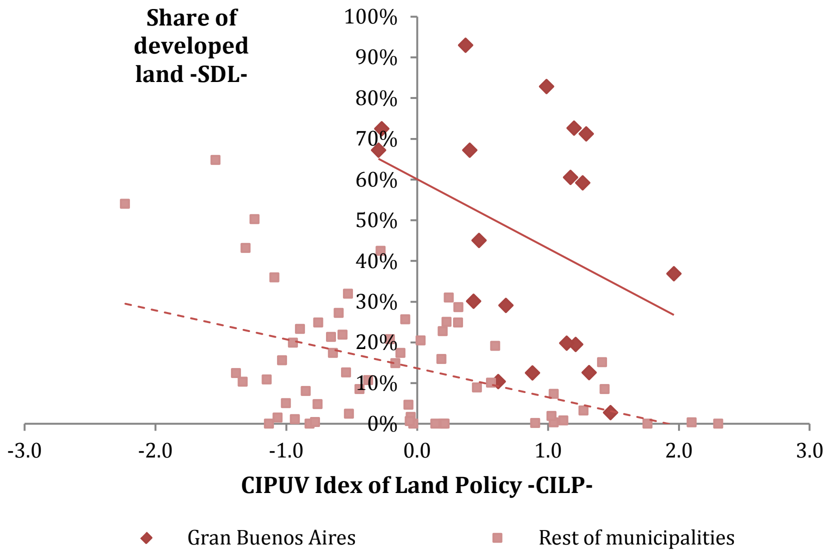
Results for the Overall Stringency Indicator (CILP)

In our baseline (OLS) empirical specification (table B1, column 1 in Appendix B) we can see that, none of our main explanatory variables show a statistically significant association with CILP. Though with some statistically significant coefficients for the IV version of models (tables B2 and B3, column 1 in Appendix B), we find no robust results that support the three main theories the academic literature has associated to regulatory environments.

Our proxy for the influential landowner hypothesis (SDL) is negatively associated with land use stringency, though this association is not statistically different from zero. This might come at odds with the literature reviewed on the subject. There are two main reasons we find that support this finding. First, we have already mentioned how the influential landowner hypothesis arises from the stylized fact that more regulated cities are also those that are more developed. This empirical regularity is not verified in the case of the municipalities in Argentina where the relationship is negative, if any. In other words, less developed cities tend to be more regulated that their more developed pairs. Secondly, reverse causation could be biasing downward results. It is highly plausible to assume that as land regulation gets tighter, development becomes more difficult. If this source of causation is the prominent one, then we should observe a negative sign in our estimations of the controlled correlation.

[25] As is well known, there is no methodological way of testing this exogeneity assumption and therefore its basis is purely theoretical. Please refer to the previous section for a discussion on the plausibility of the exogenous assumption of selected instruments.

Graph 1. Share of Developed Land (SDL)



Source: Authors' elaboration from CIPUV Atlas of Urban Expansion data.

As mentioned earlier in this paper, using share of developed land as a proxy for the political economy hypothesis of regulation (power of owners of developed land) has serious endogeneity issues. Once we account for this source of reverse causation and estimate the IV version of the model (table B2 in Appendix B), we find an interesting result. In this case, the relationship between SDL and CILP Index becomes positive and statistically significant. In particular, we find that there is almost proportional relationship between the two: a one standard deviation increase in the share of developed land is associated with a 0.85 standard deviation in CILP. The fact that the coefficients on SDL are now positive and statistically significant is indicative of a slight downward bias induced by the endogeneity of SDL to regulatory restrictiveness.

However, this result is not robust to other model specifications: once we further account for issues of reverse causation and instrument the variable that represents the welfare side— population density, [26] the statistical significance of SDL no longer holds (table B2 in Appendix B).

To sum up, it is relevant to underscore that no robust support is found for political economy forces acting through the influential landowner hypothesis in the case of municipalities in Argentina. The restrictiveness of land use regulation is not associated to the share of developed land used as proxy for the fiscal benefits arising for land value capitalization of land use constrains.

Furthermore, our results do not provide support for the alternative determinants of regulation (the welfare economics view and the exclusionary approach): the coefficients for contemporaneous population density (PD) and for the formal homeownership rate (RFHO) are not statistically different from zero in the baseline empirical specification (table B1, column 1 in Appendix B)

[26] It is very likely that there is some source of reverse causation between population density and land use stringency since, as land regulation gets stringent, population density is affected.

and in the IV versions of models. First, the OLS specification indicates that the controlled association between CILP and the regressors RFHO and PD is not statistically different from zero. Once we control for possible reverse causation, these findings are unaltered for the RFHO, though for PD there is a positive and statistically significant effect (table B2, column 1 in Appendix B), that reverts to zero with alternative instrumentations (table B3, column 1 in Appendix B).

However, two socioeconomic controls—that may also be proxies for exclusionary aims—the share of families with unsatisfied basic needs and the average educational attainment of heads of households are highly correlated with the regulatory environment of municipalities. In both cases, the relationship, holding other things constant, is positive and statistically significant, implying that in municipalities that have greater shares of educated heads of household and more people living in poverty, the overall regulatory environment becomes more stringent. The results might provide some preliminary support to the exclusionary hypothesis in which heterogeneous municipalities with high average of both educational attainment and share of disadvantaged population tend to practice more restrictive residential zoning.

Results for sub-components of CILP

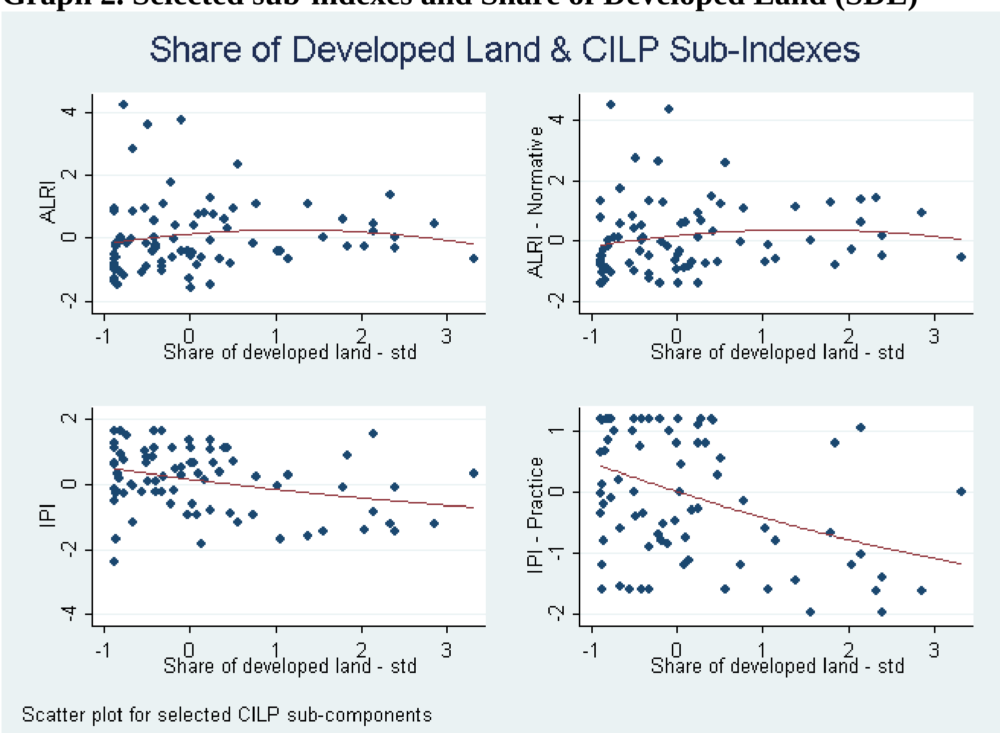
Following the exact methodology used to explain the stringency of the CILP Index this section focuses on describing the results obtained for the different CILP sub-components. Results are presented in table B1 in the Appendix B. As before, three models were specified. In the first table an OLS robust estimation is presented, in the second the SDL (share of developed land) and homeownership ratio are instrumented, due to reverse causality issues, and in the last model the same strategy is replicated, with municipal population density instrumenting a first stage (IV) estimation.

First, the results show no clear evidence for supporting that as the share of developed land increases so does the stringency of the municipal regulatory environment. Moreover, results for the OLS model (in table B1 line 1) display negative coefficients for the variable that captures the share of developed to developable land (SDL) in eight cases, although statistically significant in only three of them. The highest (negative) and significant coefficient for the standard deviation of SDL is for the Infrastructure Provision Index estimation (IPI) (-0.40), followed by the Building Restriction Index (BRI) (-0.33). This means that for an increase on 1 standard deviation in the SDL (share of developed land) reduces these indexes by 0.4 or 0.3, respectively. Infrastructure provision requirements seems reasonable to be lower as the share of developed land increases, taking into consideration that there are many developed jurisdictions where infrastructure services coverage is almost complete while those that are under developed, as measured by lower share of SDL, are still required to finance new urbanization. It follows that fiscal issues associated to new development are more at stake when SDL is low (rather than high), implying that more stringent regulation in terms of service provision is set to avoid local residents having to finance the costs of development and infrastructure extension.

It is important to underscore that results on BRI provide support to the notion that those jurisdictions that are more developed, as measured by SDL, are also less stringent in terms of building restriction parameters (such as FAR or FOS), as they allow residential and mixed-use zones at greater density than those where the undeveloped land represents a greater share of the territory. The BRI index captures the relation that exists between three concepts related to restrictions in the supply of residential buildings: Maximum Total Building Potential in floor to area ratio (FAR), Maximum Land Occupancy Factor (LOF known in Spanish as FOS—*Factor de Ocupación*—which indicates the share of the plot that can be built on), and lot size restrictions (minimum lot size). As will be analyzed in section 6, more developed areas (in 1990) are the ones that grew faster, where greater share of developed land in 1990 is associated with higher growth changes from 1990 to 2010.

On the other side, the negative and significant coefficient for SDL for the estimation of Access to Land Regulation Indicator (ALRI) indicates that lower enactment and enforcement of land policy instruments that favor access to land and housing for lower income households prevail as SDL increases. To illustrate these facts, graph 2 below exhibits the relationship between ALRI stringency and the standardized SDL. The results show that the relationship between the share of developed land (SDL) and the stringency of the municipal regulatory environment is not always straightforward in the municipalities of Argentina (see section 6 for an extended analysis on the association between SDL and CIPL Indexes).

Graph 2. Selected sub-indexes and Share of Developed Land (SDL)



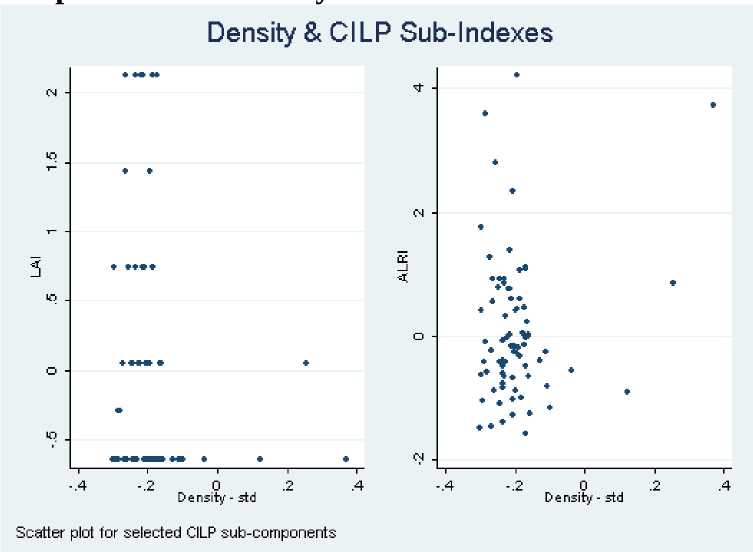
Source: Authors' elaboration from CIPUV Atlas of Urban Expansion data.

Importantly, the sign of the coefficient on RFHO (the rate of formal homeowners) is statistically insignificant in over half of the specifications, except for the indicator of restriction on gated urbanizations (GUR in table B1, where the coefficient is positive and significant (0.21) for the regulatory stringency related to gated urbanizations. It is only in this sub-index that higher share of formal owners to informal ones will support more stringent GUR regulatory environment. One plausible explanation is that a higher share of formal homeowners—those with establish property-rights in their municipality's location advantages and amenities—provide greater incentives to maximize the value of their homes by discouraging GUR, by imposing higher infrastructure contributions from private sector and less dependency on public finance. In particular, the model indicates that the higher the rate of formal homeowners the more regulated the municipality with respect to gated urbanizations, banning its development or, when development is allowed, requiring a great share of infrastructure costs from developers. All else equal, the jurisdictions with lower share of formal owners, lower average education and greater presence of minorities, may be the ones that have greater incentives to allow gated urbanization which can provide a new fiscal economic base by the introduction of higher or median income groups. This result is aligned with qualitative insights from Buenos Aires Metropolitan Area explained in Libertum de Duren 2006, 2009.

Notably, this sub-component is the one with the greatest number of explanatory variables that are statistically significant in accounting for its stringency. Nevertheless, when looking for evidence for land use regulation exclusionary motivation in this case, it is important to highlight that given the fact that homeownership rate in municipalities is high (over 80 percent of households hold formal ownership rights), the average level of educational attainment becomes relevant. So, the coefficient for head of household's educational attainment, negative and strongly significant (p value >0.01), may suggest that keeping other things constant, jurisdictions where average educational level is higher are more sympathetic and less restrictive with respect to gated urbanization zoning and development. In contrast, they favor much more restrictive normative, land plans and costs of development, as indicated by the Building Restriction's Indicator (BRI), Local Plan Indicator (LPI) and Approval Cost Indicator (ACI) positive and significant coefficients (-0.37, 0.32 and 0.35 respectively).

Finally, when testing for the welfare economics theory which views regulation as a way to correct for market failures and externalities derived from agglomeration, looking at the coefficients of population density (PD) we find in six estimations that the values are positive and significant. The strongest effect occurs with the Local Approval Index (LPI) suggesting that as more dense a jurisdiction is, the more developed in terms of a broader set of Local Authorities involved in land use regulatory environment. Furthermore, in those jurisdictions, Citizen Participation instruments are included (and enforced) in the municipal normative framework. The next positive effect occurs with Access to Land Regulation (ALRI) (0.15), followed by the Infrastructure Provision Index (IPI) (0.08). Yet, we also found a negative and statistically significant coefficient when estimating the Land Plan Index (-0.13), which suggests that the greater existence of plans and norms will not be strictly associated to density but to more complex or political motivations. Graph 3 below shows the relationship between these indexes and the standard deviation of municipal density.

Graph 3. Urban Density and CILP sub-indexes



Source: Authors' elaboration from CIPUV data.

It is important to highlight the fact that in all 14 estimations, the R^2 and Adjusted R^2 are low. To be more specific, the most variation is explained by the LPI (34 percent), followed by the LAI (29 percent) and BRI (28 percent). As explained in earlier sections, we know that our models have a reverse causality problem due to the fact that regulation also determines the SDL, the ratio of formal owners and the urban density. Consequently, we instrumented these variables with exogenous variables. Results are presented in tables B2 and B3 in Appendix B. Table B2 shows model estimations in which SDL and RFHO are instrumented.

From the first instrumented set of regressions (SDL and RFHO) we can see that some of the above conclusions change. To start with, the significance for SDL is lost when estimating ALRI and BRI, but the estimation for gated urbanization (GUR) in now significant with a confidence of 99 percent and with an effect of 0.86. Moreover the IPI remains statistically significant and negatively associated with SDL, whereas the ZRPI, changes signs from negative (-0.03) to (0.55) though not significant and statistically different from zero.

Furthermore, in these first instrumented regressions, significance of the ratio of homeowners is lost in all the estimations. What still gives some support to the exclusionary motivations are the positive and significant coefficients for the average level of educational attainment on BRI, IPI and ACI (table B2). Adding to that, the coefficients for the share of households with unsatisfied basic needs (UBN), suggest a tighter regulatory environment for building restrictions (BRI) and costs (ACI) as basic needs increase.

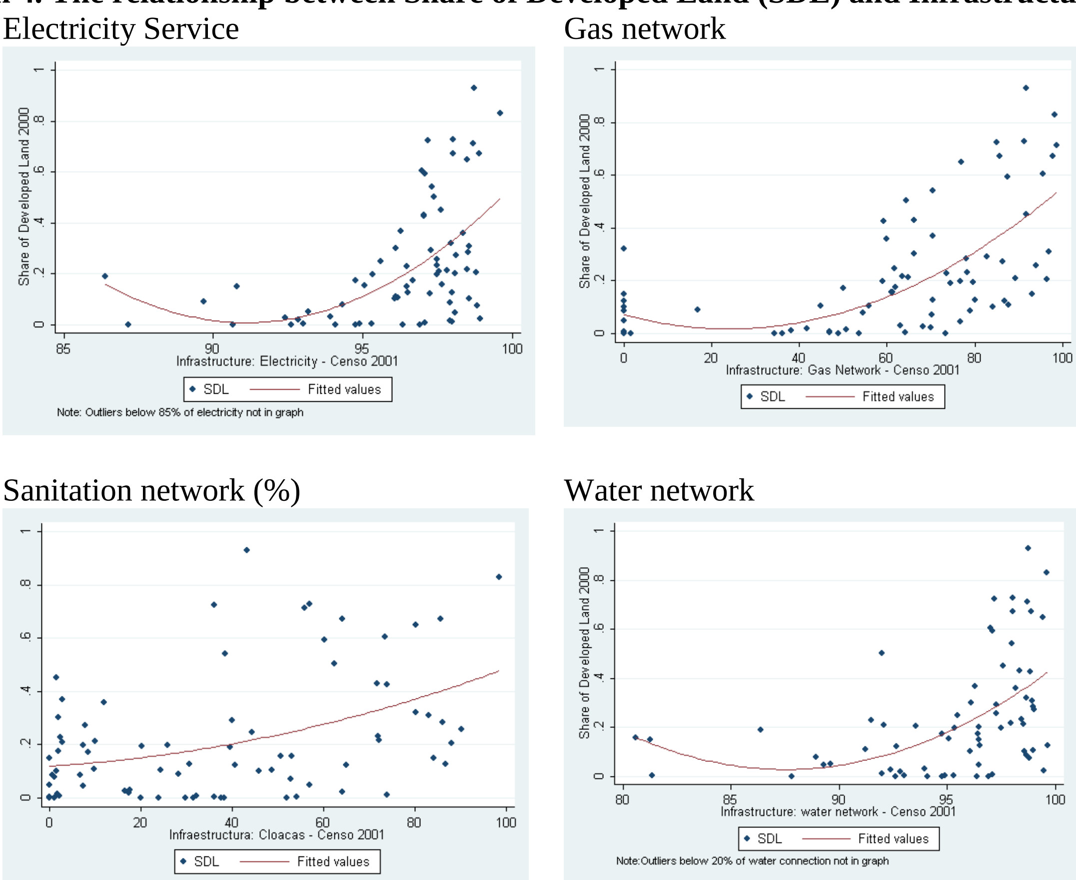
Finally, it is interesting to highlight that all the significant coefficients of density are positive. The biggest effect is found when estimating the LAI (Local Assembly Indicator) (0.4), followed by the ALRI (Access to Land Related Instruments Indicator) (0.16) and BRI (Building Restrictions Index) (0.15), although these are not significant in the OLS version. The results suggest that, as density increases, it is associated to greater restrictiveness of such indicators.

Results are sensitive to model specification as can be seen from changes in sign and significance of relevant coefficients in the set of estimations presented in table B3 in Appendix B. As mentioned above, these models are IV estimations where SDL, RFHO and population density are instrumented using exogenous variables. The most relevant change observed across models is that once population density is instrumented, its positive association with many sub-components becomes statistically not different from zero. This result indicates that if there is a relationship between density and components of land use regulation, it is not causal. Regulatory instruments do not seem to get tighter as population gets denser. As mentioned when analyzing the overall stringency indicator (CILP), the analysis of its sub-components arrives at a similar conclusion: the tightness of residential land use regulation is less related to welfare economics considerations and more affected by land-based interests and some exclusionary motivations.

When all three variables are instrumented, SDL becomes more negative when estimating the LPI; and it becomes significant and positive when estimating the ALRI. In this model specification, the density coefficient also has a positive effect in estimating ALRI, and this variable seems to be significant for LAI.

Infrastructure provision

Graph 4. The relationship between Share of Developed Land (SDL) and Infrastructure



Source: Authors' elaboration from CIPUV Atlas of Urban Expansion data.

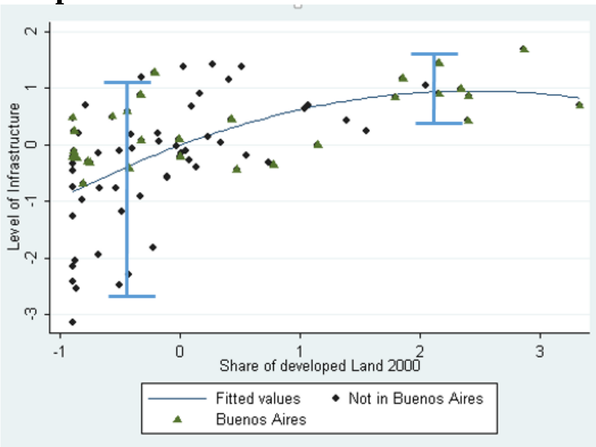
Following the methodology used in the previous section, we explore if the level of infrastructure coverage is relevant for having a more stringent regulatory environment or not. Our database contains information about the percentage of households with (i) Water access from network, (ii) Electricity, (iii) Gas connection and, (iv) Sewer connection. In order to test if the coverage of infrastructure is relevant in determining the infrastructure regulatory stringency, we constructed a variable that synthesizes these four infrastructure variables. To make the value of coefficients easy to interpret, this variable was standardized. Municipal Infrastructure is defined as:

$$Municipal\ Infrastructure = STD\left\{\frac{\%\ of\ Electricty\ coverage + \%\ of\ Sewage\ coverage + \%\ of\ Water\ connection + \%\ Gas\ connection}{400\%}\right\}$$

In the following graph 5, the level of infrastructure in the year 2001 is plotted against the standardized share of developed land (SDL) in year 2000. The quadratic line of fit shows a positive relation between these two variables. Municipalities with larger share of developed land, have a better provision of infrastructure. It is important to notice that municipalities with low share of developed land are more heterogeneous in terms of infrastructure provision. For instance, places with a share of developed land of around +2 standard deviations, have a level of infrastructure that range between 0 and +1 standard deviations; most of these municipalities belong to Buenos Aires Province. But jurisdictions with a standard deviation of the share of developed land of -0.5, experience a level of infrastructure that are between -2.52 and +1 standard deviations.

The next three models reproduce the basic methodological approach previously used: first using an OLS with robust standard errors and then, to overcome the endogenity issues, two stages estimations with instrumented Share of Developed Land (SDL), Formal Ownership Rate (RFHO) and Population Density (PD). For all of them, the level of infrastructure is included as control variable. Importantly, by including the level of infrastructure as a control variable the R-squared increases from 0.23 to 0.29. Results are displayed on table B4 of Appendix B.

Graph 5. CILP Index and Level of Infrastructure



Source: Authors' elaboration from CIPUV Atlas of Urban Expansion data.

The OLS results (first column of table B4 in Appendix B) indicate, as before, that the share of developed land in 2000 is negative and significant at a 5 percent confidence level. The value of the coefficient for this variable is -0.4 as in the other model. Interestingly, while including infrastructure as an explanatory variable, the externality aim of regulation (for which density is the proxy) loses significance and the exclusionary aim (for which the formal ownership ratio is the proxy) becomes significant and with a positive effect of 0.4, although infrastructure level is not a significant variable in this model.

To address the problems of reverse causality, discussed in previous sections, we estimate the second stage (instrumented) regressions that are reported in columns 3, 4 and 5 of table B4. As expected, the coefficient of the share of developed land is still a significant and it becomes even more negative falling from -0.4 to -0.6. The level of infrastructure coefficient is positive and significant. But neither the formal ownership ratio nor population density variables are significant in this model. However, as explained in previous description of CILP and sub-indexes models, the percentage of people with complete secondary education seems to increase the stringency of infrastructure regulations, and the significance of this variable holds when performing the second instrumented regressions.

Finally, when the share of developed land (SDL) in 2000 is instrumented, second stage results reported in columns 6 to 9 of table B4 in Appendix B, support previous results that indicate that when the share of developed to develop land increases, the provision of infrastructure became less stringent.

To conclude this section, we can say that we found opposite evidence about the fact that more developed areas tend to have more stringent regulatory environments, at least in terms of infrastructure requirements. As shown by the graph 5, where the level of infrastructure in the year 2001 is plotted against the standardized share of developed land in 2000, if there is (causal) relationship between share of developed land and infrastructure regulation stringency, it must be a negative one. The fitted quadratic line shows a positive relation between these two variables since municipalities with larger share of developed land, have a better provision of infrastructure.

The Spatial Model at Municipal Level Unit of Analysis

The regulatory choices of municipal jurisdictions may spatially depend on other municipalities. In this section we explore the spatial dimension of our analysis of land use regulation using our nation-wide municipal level data. In particular we are interested in learning if there are sources of spatial correlation in our data that could be explaining the observed regulatory environment in municipalities throughout the country.

How do we expect these neighbouring interactions to happen? Our premise is that the generation of certain land use policies, such as exclusionary policies towards lower income groups, in a given jurisdiction might externalize to neighbour jurisdictions where we might see larger shares of these displaced income groups. This issue was well analysed by Rolleston (1987), in her analysis of restrictive land use regulation. This dimension might be particularly important, for example in the case of the analysis of the Access to Land Elements Regulation Indicator (ALRI) or in the case of Infrastructure Provision (IPI),[27] and may be particularly relevant for the analysis of coverage of infrastructure, when incorporated as control.

One main hypotheses is that municipalities practicing exclusionary regulation, be it through externalities or fiscal zoning, attempt to build 'invisible walls' which exclude particular categories of land users, such as low-income and minority groups. Thus, one major objective of our study is to measure the inter-jurisdictional determinants of restrictive zoning by examining the relationship between residential zoning decisions based on characteristics of bordering jurisdictions. In other words, we expect the level of restrictiveness observed in a given jurisdiction to reflect consideration of local and nonlocal characteristics that generate externality, fiscal, and exclusionary zoning incentives.

Estimation of the model described below requires that a number of specific criteria be met with respect to the sample and the study area. The sample must include a large number of contiguous jurisdictions within a single metropolitan area. This requirement is essential to test the hypothesis that communities use zoning in response to both intra- and inter-jurisdictional pressures.

It is important to further test this hypothesis even though our findings suggest that the regulatory environment of a particular municipality is not influenced by the regulation adopted by neighboring municipalities, this is to say that there is no observed clustering of regulation throughout municipalities in Argentina. Nevertheless, we do find supportive evidence for unaccounted sources of regulatory triggers that are moderately related in space. Among these unaccounted sources of spatially dependent variation we might think of sources of connectedness such commuting, regional economies or trade, that could induce neighboring municipalities to adopt complimentary regulations regarding land use. Moreover, as explained in section 2, our analysis suggests that regulation in Argentina is motivated by aspirations rather than pragmatic reasons. Local governments enact land use laws that significantly affect how land is handled. These land use regulations are expressed in local ordinances, higher-level legislation, discretionary governmental decisions, administrative regulations, judicial opinions, and private agreements that finally affect urban development and growth patterns. If this is the case, then it is plausible to assume that neighboring experiences will influence own regulatory decisions while enforcement patterns should be locally determined.

In what follows, we show why we reject the spatial dependence for the land use regulation in Argentina and what motivates our analysis of unaccounted sources of regulatory triggers which are spatially related. We present the model specification and conduct an exploratory analysis of the relationship between the spatially lagged versions of our main explanatory variables and land policy indicators to shed some light on possible sources of interdependence between municipalities.

Spatial specification

The first step in analyzing the spatial dependence of urban regulation is to determine the criteria to define 'neighbors.' There are several different ways in which we could decide the relational

[27] As mentioned in section 1, the provision of infrastructure has been considered in the literature as an indirect exclusionary (inclusionary) policy.

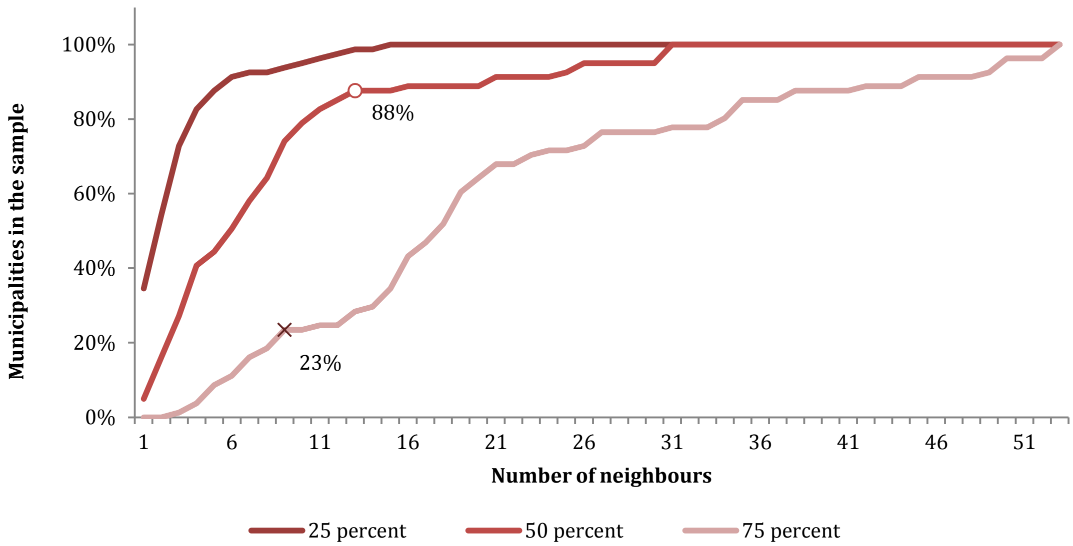
matrix that makes some municipalities to be related to one another. We could use polygon contiguity and consider neighbors only those who share a political border; we could use a fixed number of neighbors, say four, and consider only the closest four municipalities as neighbors or we could use distance as a weighting variable and consider that every municipality influences every other but this influence is inversely related to the distance that separates them.

There is no rule of thumb or methodological guidance to choose one way over the other, the decision depends on the rationale we have for the choice. Given the sparse nature of our data, we could not use the adjacent polygon approach since this would leave to several 'islands' (municipalities with no neighbors) and because of the estimation procedure in spatially dependent models these islands need to be removed from the sample. Choosing a fixed number of neighbors doesn't seem as a good alternative in such a diverse territory where some municipalities are very close to one another and others appear quite isolated. The inverse distance approach seems most useful for our case since it captures territorial diversity, enabling very crowded places to have many municipalities exercising great impact in the weighted average that comprises the neighbor lag, while other municipalities with only few neighbors, have each a great share in the weighted average, while all other municipalities will be low weighted. [28]

Graph 6 shows the number of neighbors that accumulate the 25, 50 or 75 percent of the spatial weight for each municipality. The x-axis shows the number of municipalities that account for a share of these spatial weights and the y axis represents the percentage of the sample that with 25, 50 or 75 percent of the spatial weight given certain number of observations. As we can see, as the percentage of spatial weight increases from 25 to 75 percent, more units are involved. In order to guide the interpretation of this graph, we have marked two points on the graph. The circle indicates that 88 percent of municipalities have 13 or fewer neighbors that account for 50 percent of the weight. The rest of municipalities, which account for the reimaging 50 percent, are more distant in space than these 13. The cross indicates that 23 percent of municipalities have 9 or fewer neighbors that account for 75 percent of the spatial lag weight.

[28] Based on Charlton and Fortheringham (2009).

Graph 6. Number of closest neighbors that account for 25, 50 and 75 percent of the spatial weighting matrix. Cumulative graph for municipalities in the sample



Source: Authors' elaboration from CIPUV Atlas of Urban Expansion data.

After defining the spatial weighting matrix, and therefore, the relational way municipalities are connected, we proceed to select the functional form that can best explain the observed patterns and relations in space for our data. There are two distinct models widely explored in the spatial econometrics literature: the spatial lag model and the spatial error model.

In the spatial lag model the spatially lagged dependent variable (CILP Index in our case) is used as a regressor, implying that neighboring values of the dependent variable exert a direct effect on the dependent variable itself. In other worlds, we test whether the level of CILP Index in neighboring jurisdictions exert any effect on the local adoption of certain level of regulatory stringency.

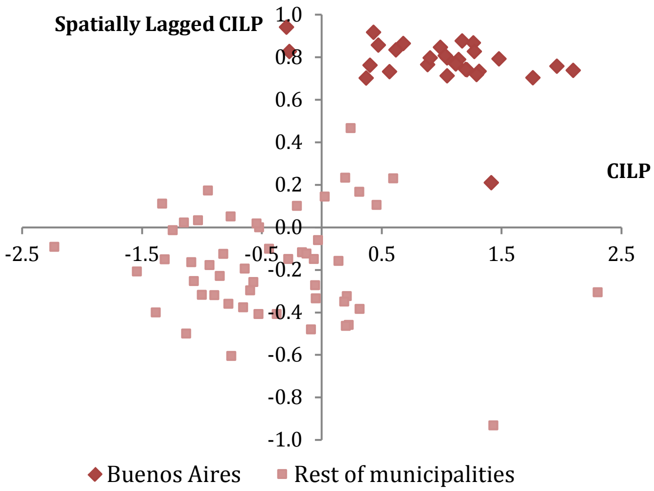
In the spatial error model, the motivation is that it is not the spatial lag of the dependent variable that impacts the dependent variable, meaning the levels of regulation externalities, but instead, there is some spatially clustered feature that has been omitted from the analysis and that is influencing both the municipality and its neighbors.

A spatial lag specification would be useful for our analysis if we thought that the regulatory environment of neighbors influences the level of land use stringency in a given municipality. There might be good reasons to believe this a priori, as indicated by Rolleston (1987) measuring the restrictiveness of local residential regulatory instruments by ad hoc weighted average of neighbors. If this were the case, we would expect spatial clustering of similar levels of land use stringency over the territory. However, our data do not support this assertion. When we explore the spatial correlation of CILP values, we can see that two important things are happening:

1. Municipalities in the province of Buenos Aires and municipalities in the rest of the country have clearly well differentiated levels of CILP, with Buenos Aires being more tightly regulated;

2. Within these two large groups, there is no spatial clustering of levels of regulation. In graph 7 these facts become very clear. We plot, in the X axis the levels of CILP for every municipality, and in the Y axis the level of CILP as a weighted average for neighbors (spatial lag of CILP). This evidence does not support a spatial lag specification.

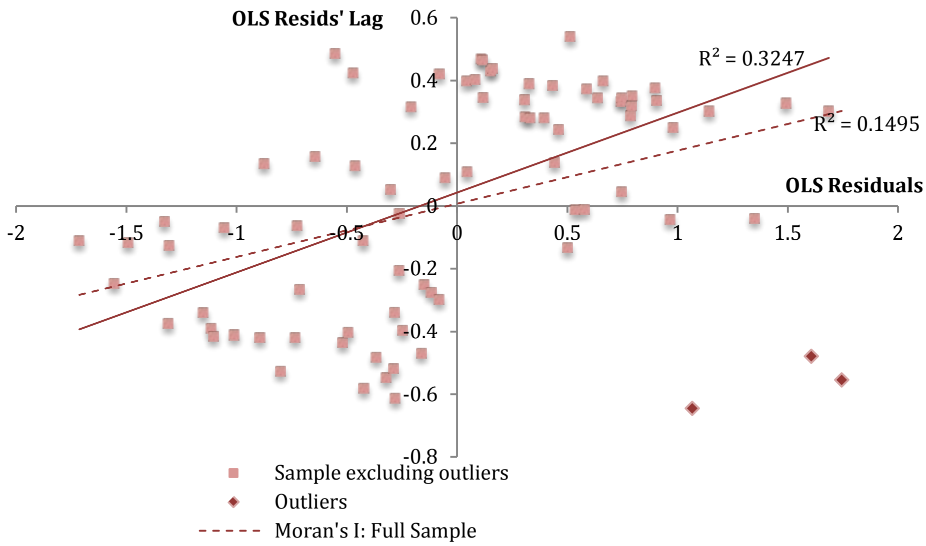
Graph 7. Spatially Lagged CILP



Source: Authors' elaboration from CIPUV data.

As mentioned before, a spatial error model assumes that there are unaccounted factors correlated in space, that affect CILP. In order to assess the relevance of a spatial error specification, we analyze the residuals from the OLS model we have presented earlier. Mapping errors enables us to visually explore the presence of clusters of where the model shows over and under representation (i.e. places where the model systematically predicts higher/ lower levels of land use restriction); these residual clustering, if existent, support the idea that there is some spatially related variable that may not so far been accounted for. In the graph below, we show the spatial correlation of OLS residuals. We can see that there is important clustering of data (Moran's I is 0.32 when excluding 3 outliers). The spatial clustering of model errors indicates that the model itself may be miss-specified and that a spatial pattern needs to be incorporated. We have ruled out the spatial lag specification and concluded that a spatial error model seems the best fit.

Graph 8. OLS Residuals Lag



Source: Authors' elaboration from CIPUV data.

In order to account for the unobserved factors, the spatial error model assumes spatial correlation in the error term. Formally, we will be estimating a model which diverges from the model in (1) because of the functional form in μ.

$$I_i = \beta_0 + \beta_1 SDL_i + \beta_2 RFHO_i + \beta_3 PD + \beta_4 FI_i + \sum_h \beta_h \text{controls}_i^h + u_i$$
$$u_i = \rho \sum_{j=1}^{k} m_{ij} u_j + \varepsilon_i \qquad (2)$$

Where the parameters are the same as for the general model.

The functional form in can be compactly expressed as $\mathbf{u} = \rho \mathbf{M}\mathbf{u} + \mathbf{e}$, where M is the k × k spatial-weighting matrices (with zero diagonal elements); Mu is the k × 1 vector typically referred to as spatial lag; is the corresponding scalar parameter typically referred to as spatial-autoregressive parameters, and an k × 1 vector of innovations. Note that if there is no spatial correlation in the error term then will be zero and the model reduces to the OLS we have analyzed before where municipalities are not spatially dependent.

In modeling the outcome for each municipality as dependent on a weighted average of the outcomes of other municipalities, the spatial error model determines outcomes simultaneously. This simultaneity implies that the ordinary least squares (OLS) estimator will not be consistent (Anselin 1988). We therefore apply a generalized spatial two-stage least-squares (GS2SLS) estimator for the parameters. The GS2SLS estimator produces consistent estimates, under the assumption the innovations ε_i are independent and identically distributed (IID) or independent but heteroskedastically distributed, where the heteroskedasticity is of unknown form. For a discussion of the estimation theory for the implemented GS2SLS estimator see Arraiz et al. (2010) and Drukker et al. (2011), that build on Kelejian and Prucha (1998, 1999, 2010).

We have already discussed the possible sources of reverse causation that could be affecting our results. In order to account for this endogeneity we also incorporate the IV version in the spatial error model. This model specification allows for right hand side endogenous regressors, as analyzed in the previous section but adds the spatial functional form to the error term. The estimation procedure of this IV spatial error model uses the GMM/IV estimation strategy discussed in Arraiz et al. (2010) and Drukker et al. (2011). This estimation procedure builds on Kelejian and Prucha (1998, 1999, 2004 and 2010) and the literature cited therein.

Results from the spatial error model

We first analyze the difference that arises as we compare the OLS representing our baseline empirical estimation and the spatial error model (SEM) that models the spatial dependence in the error term. We then analyze how the IV specification changes as we explicitly model the spatial error dependence and estimate the IV-SEM.

Table 1 below present a short version of the OLS and SEM output information (full versions are found in Appendix B). As suggested by rho, there is a strong evidence of positive spatial correlation between neighboring municipalities. Moreover, by comparing the OLS and the SEM we can see point estimates changing quite abruptly. For instance, the coefficient of the share of developed land (SDL) almost doubles when the error term is modeled and becomes statistically significant. The share of educated heads of households is positively associated with CILP in the SEM model although in the OLS version it was not statistically significant. However, the association of land use regulation and both the share of poor people and the share of migrants, appear as not statistically different from zero in the SEM version while these relationships were positive and statistically significant in the OLS version of the model.

Table 1. CILP determinants: OLS and SEM results

Variables	OLS	SEM
Share of developed land	-0.18 [0.12]	-0.335*** [0.126]
Formal homeowner ratio	-0.1 [0.16]	-0.13 [0.109]
Population density	-0.01 [0.05]	0.001 [0.065]
Share of heads of households with completed secondary education	-0.24 [0.221]	0.286*** [0.110]
Share of population with UBN	0.35** [0.16]	0.053 [0.134]
Share of foreign migrants	0.27* [0.15]	-0.04 [0.097]
Fiscal Index	-0.07 [0.09]	-0.12 [0.127]
Constant	0.04 [0.44]	-0.177 [0.458]
Rho		**0.706*** [0.119]**
Observations	81	**81**

Notes (table 1):
Standard errors in brackets.
All models include regional dummies and heteroskedastic.

*** p<0.01, **p<0.05, *p<0.1

Table 2 shows the shortlist output information from the IV and IV SEM (full versions in Appendix B). Interestingly, once we instrument endogenous regressors, the spatial correlation between neighboring municipalities—captured in rho—is no longer statistically different from zero. Why might this be so? A possible explanation might come from the selection of instruments we picked. Both average maximum and minimum temperatures in the last decade and population density as of 1895 are considered at the provincial (and not municipal) level of aggregation. If much of the spatial dependence happens at the provincial level, then these instruments might be capturing the interdependence and act as dummy variables that account for province fixed effects.

There are some significant changes once we model spatial dependence including the smaller effect of both SDL and population density, which become statistically not different from zero. In this case, only the level of education of heads of households and the share of the population in the municipality with unsatisfied basic needs are positively associated with a more stringent regulatory environment in the IV-SEM model, giving some support to the exclusionary motivation of the regulatory environment. In all, once spatial dependence and province specific effects are taken into consideration, there is not much more explanatory power in the other alternative hypothesis based on welfare economic approaches—the desire to mitigate negative externality effects derived from agglomeration; or the political economy approach—based on maximizing the capitalization of benefits for owners of developed land and the desire of existing residents to maximize the net benefit they receive from the public services/taxes package provided by their local government.

Table 2. CILP determinants: IV and IV-SEM results

Variables	IV	IV-SEM
Share of developed land	0.85* [0.45]	0.33 [0.22]
Formal homeowner ratio	0.01 [0.56]	0.1 [0.25]
Population density	0.18* [0.01]	0.1 [0.08]
Share of heads of household with completed secondary education	0.15 [0.2]	**0.03**** [0.08]
Share of population with UBN	-0.12 [0.3]	**0.30*** [0.16]
Share of foreign migrants	0.30** [0.15]	0.08 [0.13]
Fiscal Index	0.13 [0.12]	-0.16 [0.12]
Constant	-0.16 [0.36]	-0.15 [0.3]
Rho		**0.3** **[0.28]**
Observations	81	81

Notes:

Standard errors in brackets.
All models include regional dummies and heteroskedastic correction.

***p<0.01, **p<0.05, *p<0.1

IV Fist states not reported in this brief version, please refer to models in Appendix B for full disclosure.

Externalities within neighboring municipalities

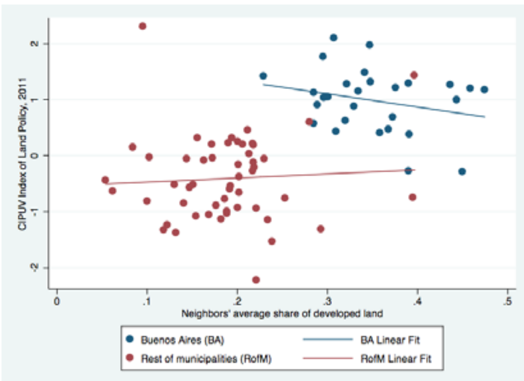
We now explore possible sources of neighboring influence over regulation. In particular, we are interested in analyzing if the level of development or the share of formal homeowners in the vicinity of a municipality relates to its regulatory environment. We do so by analyzing the correlation between the overall stringency indicator (CILP) in the municipality and the spatially lagged versions of our most relevant regressors. We find mild relationships in these simple correlations. In order to assess the causality of such relationships, we explore spatial models in which possible sources of reverse causation are properly accounted for, an issue that still requires further exploration.

Importantly, we test for the exclusionary approach to regulation, i.e. that regulation is used as a mean to build 'invisible walls' that exclude particular groups of land users, for example low-income and minority groups. We find that in municipalities in the province of Buenos Aires there is a strong relationship between higher levels of poverty in jurisdictions that are neighbors of municipalities with stringent regulation regarding infrastructure provision in new developments. This result is not extensive to the rest of municipalities in Argentina, implying that different mechanisms might be in place in different regions of the country.

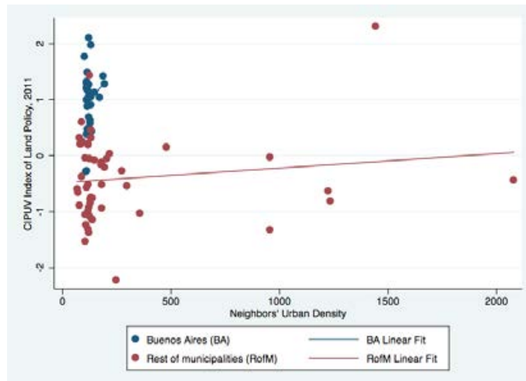
As stated above, we first test for evidence to support neighboring spillover or externality. In the figure 2 below, we plot the relationship between the overall stringency indicator for every municipality in the sample (CILP Index) and the average value of neighboring characteristics (consisting of the spatial lags of regressors). These characteristics include our proxy for urban development (share of developed to developable land or SDL), the ratio of formal homeowners, urban population density, education level of heads of household, share of poor families measured by unsatisfied basic needs (UBN), share of unemployed and migrant heads of household, and the fiscal index.

Figure 2. CIPUV Index of Land Policy (CILP) and characteristics of neighboring municipalities

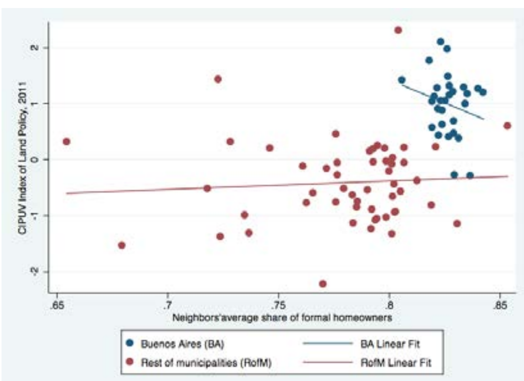
Neighbors' average share of developed land



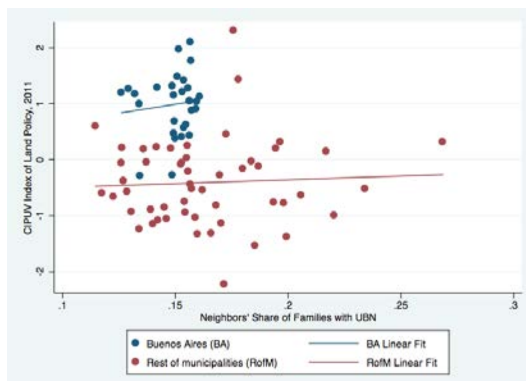
Neighbors' average share of formal homeowners



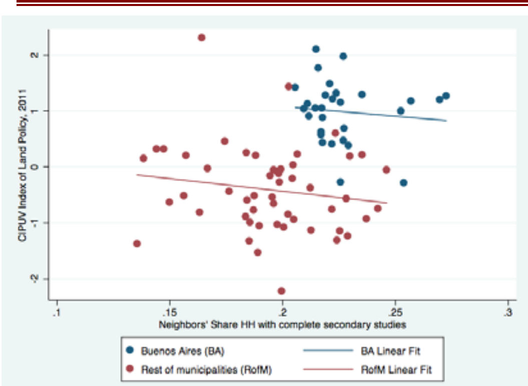
Neighbors' average urban density



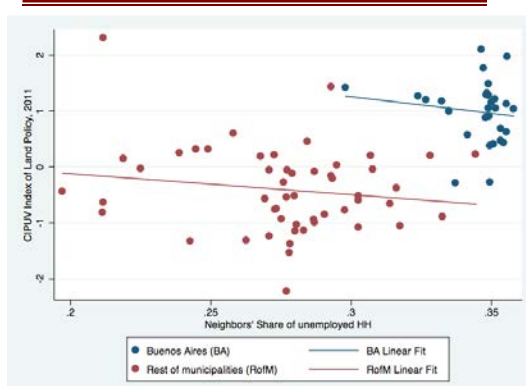
Neighbors' average share of households with UBN



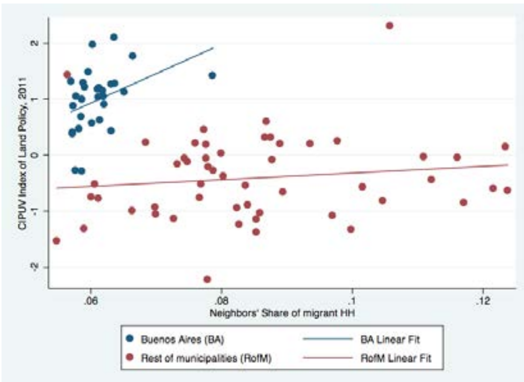
Neighbors' average share of HH with complete secondary



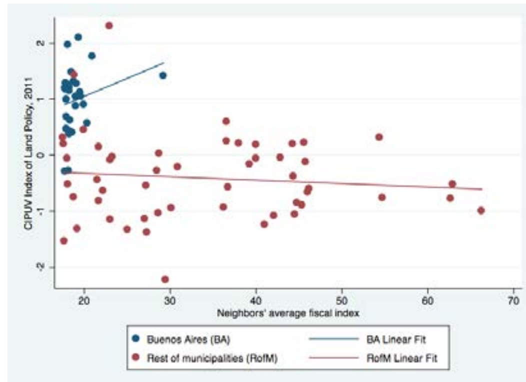
Neighbors' average share of unemployed HH



Neighbors' average share of migrant HH



Neighbors' average value of the fiscal index



Source: Authors' elaboration from CIPUV data.

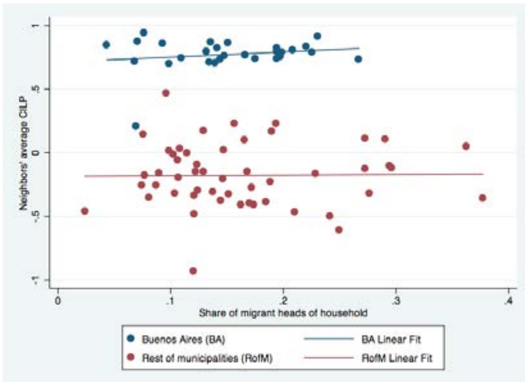
What first should be noted is how different the municipalities in the province of Buenos Aires (blue dots) are as compared to the rest of municipalities (red dots). Once we account for these differences, we can observe that for most of the characteristics analyzed there is not much relationship between spatial lags and CILP. This means that there is no empirical evidence of spillovers of neighboring characteristics associated with different levels of land use regulation. The only association statistically different from zero is between CILP in municipalities in Buenos Aires and the average share of migrant heads of household in neighboring jurisdictions. Once we analyze what component of CILP is positively associated with greater than average share of foreign migrants in neighboring jurisdictions, we find that the Approval Cost Indicator (ACI) is a sub-component that is associated. In this case, a large share of migrants in neighboring jurisdictions is associated to higher approval costs in a given municipality. If the exclusionary hypothesis is responsible for this finding, it is through higher development costs that exclusion works in Buenos Aires jurisdictions.

We also examine possible reverse causality of this exclusionary policy: i.e. that the generation of exclusionary policies towards lower income groups in a certain jurisdiction might externalize to neighboring jurisdictions where we should see higher shares of these displaced groups. By this definition of exclusion, we might expect to see higher than average levels of displaced groups when the surrounding jurisdictions are more stringent in their land policies. In this case, we should look at the association between disadvantaged groups in municipalities and the average level of land policy stringency in neighboring municipalities. This issue was well analyzed by Rolleston (1987) in her analysis of restrictive land use regulation and relations within jurisdictions. This dimension might be particularly important, for example in the case of the analysis of the Infrastructure Provision Index (IPI) or Access to Land Regulation Indicator (ALRI).

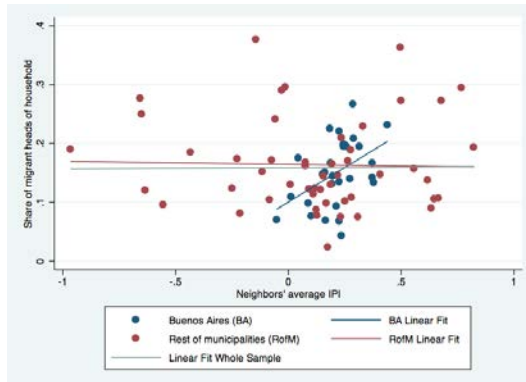
We find some interesting correlations once we analyze the exclusionary hypothesis in this manner: jurisdictions in the province of Buenos Aires—where the share of families with unsatisfied basic needs is higher—are systematically surrounded by municipalities with stringent policies regarding infrastructure provision. Share of migrant families (which we could consider another targeted group) are not affected by this relationship, nor this holds for other sub-components of CILP such as the Access to Land Regulation Indicator.

Figure 3. Minorities and CIPUV neighboring land policy

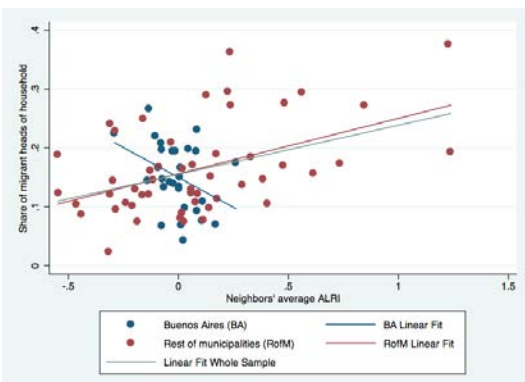
UBN vs Neighbors' average CILP



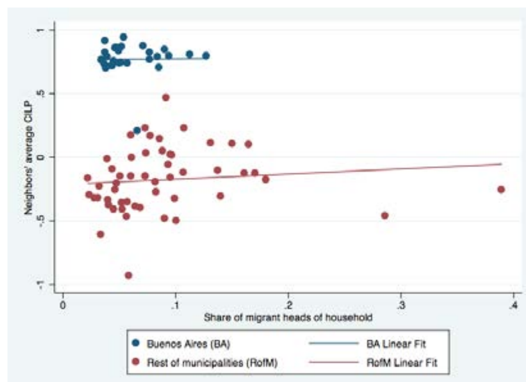
UBN vs. Neighbors average IPI



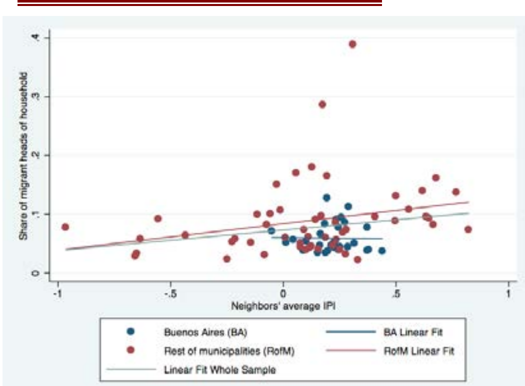
UBN vs. Neighbors' average ALRI



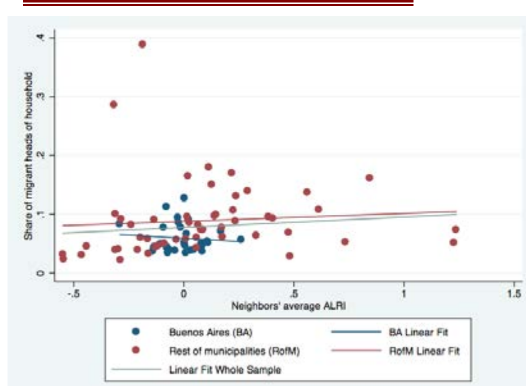
Migrants vs Neighbors' average CILP



Migrants vs Neighbors' average IPI



Migrants vs. Neighbors' average ALRI



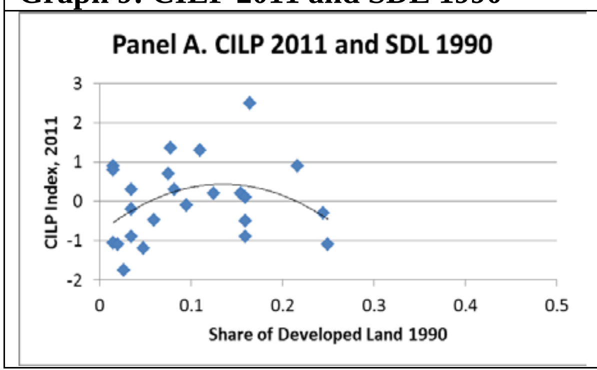
Source: Author's elaboration from CIPUV data.

Metropolitan Urban Growth and CILP Index

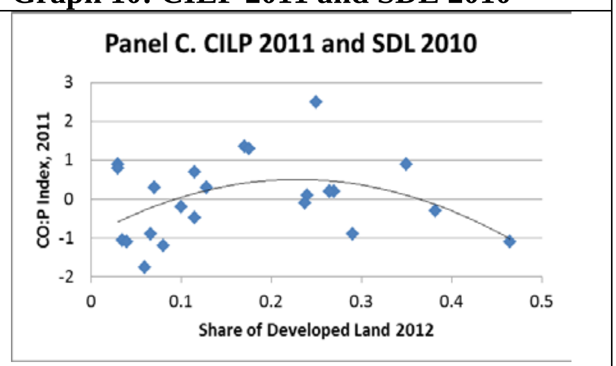
Given the fact that the regulatory environment and urban growth might be both intrinsically associated, in this section we describe this association at both metropolitan and municipal level. [29] To do that we processed satellite images for jurisdictions (circa 1990, 2000, 2010) both at metro and municipal levels[30] and built a large set of metrics from which we take the share of developed to developable land (SDL) to explore whether jurisdictions with less regulation grow faster or vice versa, while changes over time are used to help reveal direction of causation.

Graphs 9 and 10 display the share of developed land (in years 1990 and 2010) and the CILP Index in year 2011 for Metropolitan Areas in Argentina (BUA). The trend lines are second-degree polynomials, not straight lines indicating that the share of developed area grew in all BUAs while the relation with the CILP index is complex. A different presentation of the data in graph 11 shows that the association between regulation and growth is also nonlinear, since the extent of growth varies with regulation strength. The x axis in this case displays information on the absolute change in SDL while the CILP index is presented in the y axis. The graph contributes to underscore that modest regulation does not speed growth of relatively undeveloped BUAs.

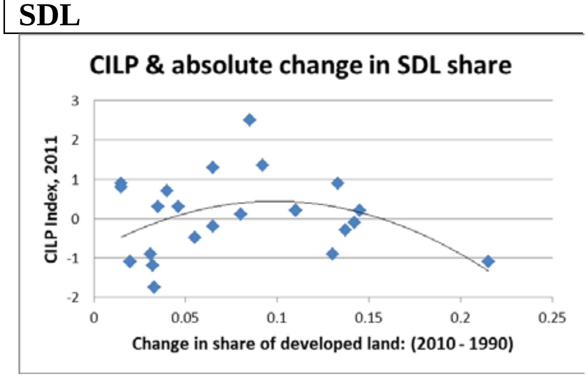
Graph 9: CILP 2011 and SDL 1990



Graph 10: CILP 2011 and SDL 2010



Graph 11. CILP and absolute change in SDL



Source: Authors' elaboration from CIPUV data

[29] We are extremely grateful to G. Ingram insights that helped frame this section of the paper.

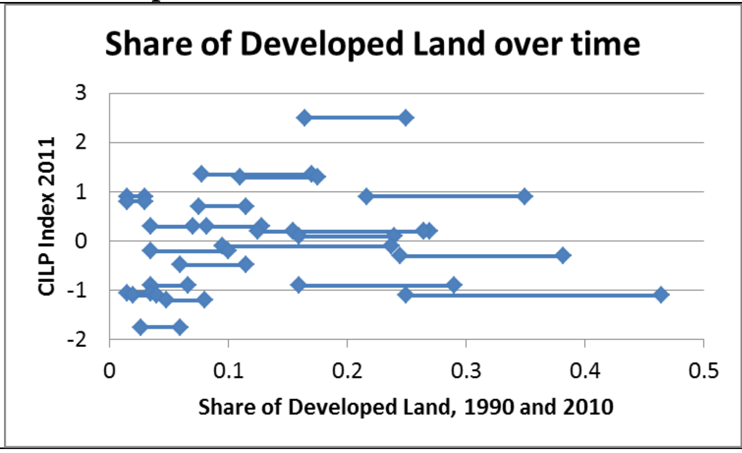
[30] See Goytia and Pasquini (2013a) for more detailed description of procedures and data.

As see in graph 11 the proportion of urban growth provides a more accurate measurement which allows graphing in a simpler way how the association between growth and regulation works. In this case, growth (as a proportion of the base) produces a simpler picture with less regulation associated with growth. In particular, this graph demonstrates that lower values of the CILP Index are associated with greater change in the share of developed land from 1990 to 2010. Still, what is interesting to emphasize is that over 20 years, the growth rates are not small, aligned with Angel, et al. (2011). Our analysis provides some evidence on the association between those growth trends and regulation. Since there is little in the way of planning and preparation for urban growth, authors such as Angel et al. (2011) called particular attention on how cities need to prepare for sustainable growth grounded in four key components: the realistic projections of urban land needs; generous metropolitan limits; selective protection of open space; and an arterial grid of roads spaced one kilometer apart that can support transit.

Graph 12, which displays the share of developed land over time, reports SDL values from 1990 to 2000 on the x axis and CILP Index 2011 values on the y axis. This long time trend highlights some interesting facts. Increases in SDL are larger for BUAs whose developed land share is above about 0.08. Since urban growth is larger when CILP Index is lower for that group, this finding suggests that regulation affects growth when BUAs are over some threshold.

Finally, growth momentum is evident when looking at the scatter plot which provides evidence that developed areas (in 1990) are the ones that grew faster, as indicated by the change in SDL from 1990 to 2010. Greater share of developed land in 1990 is associated with higher growth changes from 1990 to 2010 in BUAs. Examining the national census data from1990 to 2010, we are able to trace the peculiarities of urban and population growth during that period and confirm these facts. Particularly from 2000–2010, larger jurisdictions were the ones where population grew faster; while during 1990–2000, middle size jurisdictions display rapid growth which is then halted in the following decade.

Graph 12. Share of Developed Land over time



Source: Authors' elaboration from CIPUV data

Conclusions

The main purpose of this paper is to explore what determines land policy, and particularly land use regulatory environment in Argentina's municipalities. Most research on the subject has focused on the context of cities in the developed world and therefore, our empirical contribution comes to fill a gap that will shed light on regulation determinants in the context of cities in a developing country. As mentioned before, the theoretical basis for analyzing land policy in the academic scholarship can be grouped into three categories: i) regulation as a means to correct for agglomeration externalities, ii) regulation as a consequence of political power of landowners based on fiscal motivations and home-voters hypothesis and iii) regulation for exclusionary purposes. We intend to provide evidence on these hypotheses for the case of a cross-section of regulatory environments of municipalities in Argentina, based on a rich dataset of land use regulation and urban metrics for years 1990, 2000 and 2010. In what follows we elaborate on the main results arising from the econometric models presented in the paper. These models are OLS and IV estimations coupled with spatial models, where SDL, RFHO and population density are instrumented using exogenous variables. Results are sensitive to model specification as can be seen from changes in sign and significance of relevant coefficients in the set of estimations presented.

To put the issue in a broader development context, there is a first important matter to underscore related to the pattern of development across metropolitan areas in Argentina, since more developed metropolitan jurisdictions (in 1990) are the ones that have grown faster. This means that a greater share of developed to developable land in year 1990 can be associated with higher growth changes from 1990 to 2010.

Several other findings should be highlighted. First, no robust support is found for restrictiveness of land use regulation to be associated to the share of developed land. The results show no clear evidence to support the proposition that as the share of developed land increases so does the stringency of the municipal regulatory environment. Furthermore, results do not provide support for the welfare economics approach as determinant of regulation, since urban population density is not causally associated to higher CILP levels. In fact, the results provide some preliminary support to the exclusionary hypothesis since heterogeneous municipalities, having both high average educational attainment of heads of households and high average share of disadvantaged population tend to have more restrictive residential regulatory environment. In other words, these two socioeconomic indicators are highly correlated with municipalities' stringency of the regulatory environment.

Second, there are a couple of interesting results related to CIPL sub-indexes. One relates to results on Building Restrictions Index (BRI) and provide support to the notion that those jurisdictions that are more developed (as measured by SDL) are also less stringent in terms of building restriction parameters (such as FAR or FOS), as they allow residential and mixed use zoning at greater density than those where undeveloped land represents a greater share of the territory. This finding can contribute to explain why urban growth has been faster in highly-developed jurisdictions.

Furthermore, we found contradictory evidence to the assumption that more developed areas tend to have more stringent regulatory environments, at least in terms of infrastructure requirements. Requests to developers for infrastructure provision (measured by IPI) are lowered when the share of developed land of in the jurisdiction is higher. Municipalities with larger share of developed land have a better provision of infrastructure. Therefore, the strongest regulatory environment in terms of public service provision relates to less developed municipalities. A plausible explanation may be that local inhabitants avoid the impact of financial costs of new development and infrastructure extension on the municipal budget. On the other hand, lower enactment and enforcement of land policy instruments that favor access to land and housing for lower income households prevail as SDL increases.

It is also interesting to highlight that our findings consistently suggest that regulatory instruments do not get tighter as population density increases. For both the overall stringency indicator (CILP) and its sub-components, we arrive at a similar conclusion: results suggest that the tightness of residential land use regulation is less related to welfare economics considerations and more affected by land-based interests and some exclusionary motivations. Importantly—and giving more support to the exclusionary motivations aims—are the positive and significant correlation coefficients between the average level of educational attainment of heads of households and the stringency of BRI, IPI and ACI. Adding to that, the coefficients for the share of households with unsatisfied basic needs (UBN) suggest a tighter regulatory environment (for building restrictions (BRI) and costs (ACI) as UBN increases.

There are some significant changes once we model spatial dependence. Besides the smaller effect of both SDL and population density, only the level of education of heads of household and the share of the population in the municipality living with unsatisfied basic needs are positively associated with a more stringent regulatory environment in the IV-SEM model, giving some support to the exclusionary motivation of the regulatory environment. In all, once spatial dependence and province specific effects are taken into consideration, there is not much more explanatory power in the other alternative hypothesis based on welfare economic approaches or the political economy approach.

We also explore possible sources of neighboring influence over the local regulatory environment. In particular, we are interested in examining if the share of developed land or the share of formal homeowners in the vicinity of a municipality relates to the regulatory environment of neighboring jurisdictions. We test for the exclusionary approach to regulation that implies that regulation is used as a means to build 'invisible walls' that exclude particular groups of land users, for example low-income and minority groups. We find that in the municipalities of the province of Buenos Aires there is a strong relationship between higher levels of poverty in jurisdictions that are neighbors of municipalities with stringent regulation regarding infrastructure provision in new developments. This result is not extensive to the rest of municipalities in Argentina, implying that different mechanisms might be in place in different regions of the country.

There is not much evidence of spillovers of neighboring characteristics associated with different levels of CILP Index. The only statistically significant association is between CILP in municipalities in Buenos Aires and the average share of migrant heads of household in neighboring jurisdictions. When we analyze what component of CILP is positively associated with greater than average share of foreign migrants in neighboring jurisdictions, we find that the Approval Cost Indicator (ACI) is the only sub-component that is associated. In this case, a large share of migrants in neighboring jurisdictions is associated to higher approval costs in a given municipality. In case the exclusionary hypothesis is responsible for this finding, it is through higher development costs that exclusion works in Buenos Aires municipalities.

Finally, we find some interesting correlations when analyzing the exclusionary hypothesis in connection of the provision of infrastructure. The Buenos Aires municipalities, where the share of families with unsatisfied basic needs is higher, are systematically surrounded by municipalities with stringent regulations regarding infrastructure provision. The share of migrant families (which we could consider another targeted group) is not affected by this relationship, nor is it observed in relation to other sub-components of CILP Index.

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Appendix A. Definitions and Summary Statistics

Table A1: Definition of Land Use Regulation indexes

Index Name	Var Name	Description
CIPUV INDEX OF LAND POLICY	CILP	Overall land use regulation index. Takes into account different dimensions of regulation.
Land Use Plan Index	LPI	Captures the availability that local governments have to make use of urban plans and zoning codes
Regular Project Approval Indicator	ZRPI	Capture the involvement of different governmental authorities, in the approval of residential projects. It considers the approval of projects that require zoning changes and those regular projects that do not require any zoning change.
Local Assembly Index	LAI	Captures how direct democracy is instrumented in each Municipality
Access To Land Regulation Indicator	ALRI	Measures the presence of redistributive policy and access to land related elements incorporated in the regulation of use of land.
Approval Cost Indicator	ACI	Captures the costs related to projects registration process.
Public Service Provision Indicator	IPI	Captures the stringency level as a result of the requirements in infrastructure.
Gated Urbanizations Index	GUR	Capture how reluctant municipalities are towards the development of gated urbanizations.
Building Restriction Index	BRU	Captures the relation that exists between three concepts related with restrictions in the supply of residential buildings. Maximum Total Building Potential in floor to area ratio (FAR), maximum Land Occupancy Factor (LOF, or known as FOS –Factor de Occupation- in Spanish, which indicates the share of the plot that can be constructed) and Lot size restrictions (minimum plot size)

Table A2: Summary Statistics for explanatory variables and instruments

Variable	Obs.	Mean	Std. Dev.	Min	Max
Share of developed (urban and suburban built-up) land - (SDL)	81	0.22	0.23	0.00	0.93
Formal homeownership rate - (RFHO)	81	0.79	0.09	0.45	0.91
Population density in developed area, 2000 - (POPD)	81	198.41	659.15	0.36	5003.04
Average head of household's educational attainment	81	0.20	0.08	0.04	0.48
Share of heads of household with U.B.N.	81	0.16	0.08	0.02	0.48
Share of unemployed heads of household	81	0.29	0.08	0.12	0.47
Share of foreign born heads of household	81	0.08	0.06	0.02	0.39
Fiscal capacity Indicator	81	30.70	26.83	0.00	100.00
Cuyo Region	81	0.07	0.26	0.00	1.00
Northeastern Region	81	0.10	0.30	0.00	1.00
Northwestern Region	81	0.11	0.32	0.00	1.00
Pampeana Region	81	0.64	0.48	0.00	1.00
Distance to the port of Buenos Aires (in hundreds of km)	81	489.96	424.33	13.90	1477.60
Average maximum temperatures recorded in the last decade (Celsius)	81	24.43	2.21	19.82	29.80
Average minimum temperatures recoded in the last decade (Celsius)	81	12.71	2.28	7.34	17.00
Population density in developed area, 1895	81	2.56	1.95	0.02	9.58

Table A3: Summary Statistics for Land Use Regulation indexes

Variable	Obs.	Mean	Std. Dev.	Min	Max
CILP	81	0.09	0.96	-2.23	2.30
BRI	81	0.03	0.93	-2.67	2.44
IPI	81	0.16	0.98	-2.37	1.61
ZRPI	81	0.03	0.95	-2.42	1.98
LPI	81	-0.05	0.97	-1.97	0.84
LAI	81	-0.08	0.92	-0.64	3.50
ALRI	81	0.06	1.14	-1.59	4.21
ACI	81	0.17	1.08	-1.24	3.63
GUR	81	0.07	1.09	-2.69	2.13

Table A4: Correlation matrix and significance level between Dependent variables and Regulation indexes

Variable Name	LPI	ZRPI	LAI	ALRI	ACI	IPI	GUR	BRI	CILP
Share of developed (SDL)	**0.2406**	-0.0132	0.1594	0.0661	0.0702	**-0.3255**	-0.0714	-0.2113	-0.0201
	(0.031)	(0.907)	(0.155)	(0.558)	(0.534)	**(0.003)**	(0.527)	(0.058)	(0.859)
Formal homeownership rate - (RFHO)	0.0809	-0.0435	0.1498	-0.0645	**0.2587**	0.1273	0.1507	0.1572	**0.1969**
	(0.473)	(0.7)	(0.182)	(0.567)	**(0.02)**	(0.257)	(0.179)	(0.161)	**(0.078)**
Population density in developed area in year 2000 – (POPD)	-0.1228	0.0056	**0.35**	0.0265	0.0938	**0.1957**	-0.0755	0.1611	0.0707
	(0.275)	(0.961)	**(0.001)**	(0.814)	(0.405)	**(0.08)**	(0.503)	(0.151)	(0.531)

Note: Significance level between parentheses

Appendix B. Regression Results

Table B1. Baseline empirical specification: OLS model for estimating the determinants of land use regulation stringency (N=101)

VARIABLES	CILP	BRI	IPI	ZRPI	LPI	LAI	ALRI	ACI	GUR
Share of developed) land -	-0.18	**-0.33*****	**-0.40****	-0.03	0.09	0.15	**0.25*****	-0.11	-0.13
(SDL)	(0.12)	**(0.12)**	**(0.14)**	(0.10)	(0.11)	(0.11)	**(0.08)**	(0.17)	(0.14)
Formal homeownership rate -	-0.10	-0.05	0.12	-0.10	-0.35*	-0.03	0.13	0.01	**0.21****
(RFHO)	(0.16)	(0.17)	(0.20)	(0.13)	(0.18)	(0.10)	(0.16)	(0.14)	**(0.09)**
Population density in developed	-0.01	0.06	**0.08***	0.00	**-0.13*****	**0.39*****	**0.15*****	0.05	**-0.20****
area, 2000 – (POPD)	(0.05)	(0.04)	**(0.05)**	(0.07)	**(0.04)**	**(0.03)**	**(0.03)**	(0.06)	**(0.08)**
Average head of household's	**0.35****	**0.37*****	0.13	0.23	**0.31***	0.25	-0.02	**0.32***	**-0.35*****
educational attainment	**(0.16)**	**(0.11)**	(0.09)	(0.15)	**(0.16)**	(0.19)	(0.14)	**(0.16)**	**(0.12)**
Share of heads of household with	**0.27***	**0.27***	0.15	**0.25****	0.06	0.13	0.32	0.19	-0.21
U.B.N.	**(0.15)**	**(0.15)**	(0.12)	**(0.12)**	(0.17)	(0.15)	(0.24)	(0.12)	(0.17)
Share of foreign born heads of	-0.07	-0.03	-0.01	0.06	-0.11	-0.01	-0.04	-0.06	**-0.13****
household	(0.09)	(0.09)	(0.06)	(0.06)	(0.10)	(0.05)	(0.09)	(0.08)	**(0.05)**
Fiscal capacity Indicator	-0.24	-0.20	-0.16*	0.02	-0.18	-0.08	**0.24*****	-0.26	-0.18
	(0.22)	(0.12)	(0.09)	(0.15)	(0.14)	(0.10)	**(0.08)**	(0.21)	(0.20)
Cuyo Region	-0.22	**-0.95****	-0.46	0.15	0.21	-0.46	0.64	-0.60	0.69
	(0.63)	**(0.39)**	(0.49)	(0.56)	(0.60)	(0.38)	(0.57)	(0.50)	(0.80)
Northeastern Region	-0.85*	-0.54	-0.75*	-0.68	-0.90*	0.42	0.41	-0.64	0.70
	(0.48)	(0.32)	(0.40)	(0.48)	(0.47)	(0.42)	(0.39)	(0.46)	(0.73)
Northwestern Region	-0.89	**-1.00****	-0.51	-0.30	**-0.90***	-0.60	-0.32	-0.73	0.93
	(0.59)	**(0.43)**	(0.47)	(0.59)	**(0.50)**	(0.49)	(0.40)	(0.50)	(0.79)
Pampeana Region	0.32	-0.03	-0.21	0.24	0.36	-0.44	-0.13	-0.12	1.05
	(0.56)	(0.27)	(0.31)	(0.46)	(0.42)	(0.32)	(0.30)	(0.47)	(0.79)
Constant	0.04	0.26	0.48	-0.08	-0.17	0.22	0.04	0.40	-0.77
	(0.44)	(0.23)	(0.31)	(0.41)	(0.37)	(0.32)	(0.26)	(0.32)	(0.72)
R-squared	0.32	0.28	0.23	0.10	0.34	0.29	0.14	0.17	0.23

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Explanatory variables in standard deviations.

Table B2. IV Model. Corrected empirical specification: IV model for estimating the determinants of land use regulation stringency (N=101)

	First Stage		Second Stage								
VARIABLES	SDL	RFHO	CILP	BRI	IPI	ZRPI	LPI	LAI	ALRI	ACI	GUR
Share of developed) land - (SDL)			**0.85***	0.19	**-0.36****	**0.55****	0.64	0.27	0.23	0.82	**0.86*****
			(0.45)	(0.33)	**(0.18)**	**(0.27)**	(0.44)	(0.31)	(0.22)	(0.71)	**(0.17)**
Formal homeownership rate - (RFHO)			0.01	0.14	0.29	-0.48	-0.09	-0.02	-0.18	0.60	-0.14
			(0.56)	(0.39)	(0.35)	(0.39)	(0.37)	(0.24)	(0.16)	(0.58)	(0.33)
Population density in developed area, 2000 - (POPD)	**-0.14*****	0.06	**0.18***	**0.15****	**0.08****	0.13	-0.03	**0.41*****	**0.16*****	0.21	-0.00
	(0.02)	(0.08)	**(0.10)**	**(0.08)**	**(0.04)**	(0.10)	(0.05)	**(0.05)**	**(0.05)**	(0.13)	(0.10)
Average hh educational attainment	**0.29***	**0.46****	**0.12****	**0.08****	**0.05****	0.12	-0.01	0.19	0.10	**0.29****	**-0.64***
	(0.15)	**(0.19)**	(0.30)	(0.24)	(0.15)	(0.26)	(0.30)	(0.28)	(0.12)	(0.32)	(0.37)
Share of heads of household with U.B.N.	-0.15	**-0.42***	**0.30****	**0.34****	0.22	0.10	0.16	0.13	0.20	**0.41*****	-0.35
	(0.14)	**(0.22)**	**(0.15)**	**(0.14)**	(0.16)	(0.15)	(0.12)	(0.14)	(0.22)	**(0.15)**	(0.34)
Share of foreign born heads of household	-0.19	-0.08	0.13	0.10	0.03	0.08	0.05	0.01	-0.11	0.23	-0.03
	(0.12)	(0.08)	(0.12)	(0.09)	(0.08)	(0.10)	(0.10)	(0.08)	(0.09)	(0.15)	(0.14)
Fiscal capacity Indicator	-0.00	**-0.24***	-0.15	-0.14	-0.14	0.02	-0.11	-0.07	**0.20****	-0.13	-0.14
	(0.07)	**(0.13)**	(0.20)	(0.14)	(0.09)	(0.15)	(0.14)	(0.10)	**(0.09)**	(0.18)	(0.15)
Cuyo Region	-0.55	-0.75	0.21	-0.65	-0.33	0.11	0.58	-0.42	0.43	0.11	0.81
	(0.49)	(0.48)	(0.66)	(0.65)	(0.48)	(0.47)	(0.60)	(0.42)	(0.51)	(0.72)	(0.60)
Northeastern Region	-1.48*	0.11	-0.39	-0.23	-0.64	-0.68	-0.54	0.47	0.22	0.06	0.87
	(0.77)	(0.69)	(0.56)	(0.50)	(0.42)	(0.52)	(0.56)	(0.44)	(0.35)	(0.58)	(0.54)
Northwestern Region	-0.02	-0.42	-1.05	-0.93	-0.33	-0.90	-0.75	-0.62	-0.69*	-0.30	0.26
	(0.75)	(0.56)	(0.98)	(0.67)	(0.61)	(0.74)	(0.70)	(0.55)	(0.39)	(0.88)	(0.66)
Pampeana Region	**-0.84*****	0.45	0.44	0.05	-0.18	0.23	0.46	-0.43	-0.18	0.07	**1.09***
	(0.26)	(0.47)	(0.36)	(0.29)	(0.29)	(0.39)	(0.32)	(0.30)	(0.30)	(0.21)	**(0.56)**
Distance to the port of Buenos	-0.00	0.00									
	(0.00)	(0.00)									
Average maximum temperatures recorded in the last decade (Celsius)	**-0.07***	0.04				1					
	(0.03)	(0.06)									
Average minimum temperatures recoded in the last decade (Celsius)	**0.21****	-0.06									
	(0.10)	(0.07)									
Population density in developed area, 1895	-0.07	**-0.15*****									
	(0.04)	**(0.05)**									
Share of unemployed heads of household	-0.10	**0.36****									
	(0.16)	**(0.14)**									
Constant	0.09	-0.50	-0.16	0.12	0.42	-0.06	-0.34	0.20	0.14	0.06	**-0.84***
	(1.27)	(1.52)	(0.36)	(0.32)	(0.31)	(0.34)	(0.36)	(0.32)	(0.25)	(0.31)	**(0.48)**
R-squared	0.48	0.74									
Test of overidentifying restrictions (Hansen J Statistic)	.	.	3.443	6.351	8.843	2.591	3.349	5.881	1.527	3.393	3.637
P-value of Hansen J Stat.	.	.	0.328	0.0957	0.0315	0.459	0.341	0.118	0.676	0.335	0.303

Notes: Robust standard errors in parentheses.*** p<0.01, ** p<0.05, * p<0.1**. Explanatory variables in standard deviations.**

Table B3: IV model (density instrumented) for estimating the determinants of land use regulation stringency (N=101)

	First Stage			Second Stage								
VARIABLES	SDL	RFHO	POPD	CILP	BRI	IPI	ZRPI	LPI	LAI	ALRI	ACI	GUR
Share of developed) land - (SDL)				0.58	-0.15	**-0.44****	0.35	0.40	0.47	**0.48*****	0.82	**0.73*****
				(0.61)	(0.34)	**(0.21)**	(0.45)	(0.44)	(0.38)	**(0.16)**	(0.82)	**(0.25)**
Formal homeownership rate - (RFHO)				-0.16	-0.07	0.24	**-0.60***	-0.23	0.11	-0.03	0.60	-0.22
				(0.42)	(0.31)	(0.32)	**(0.35)**	(0.31)	(0.22)	(0.21)	(0.46)	(0.31)
Population density in developed area, 2000 – (POPD)				-0.28	-0.45	-0.05	-0.21	-0.45*	**0.77****	**0.59*****	0.21	-0.22
				(0.48)	(0.36)	(0.20)	(0.40)	(0.26)	**(0.37)**	**(0.18)**	(0.58)	(0.42)
Average head of household's educational attainment	**0.34***	**0.44****	-0.23	-0.04	0.19	**0.08****	0.18	**0.06****	0.13	0.02	**0.29****	**-0.60***
	(0.18)	**(0.20)**	(0.22)	(0.27)	(0.23)	(0.15)	(0.24)	(0.29)	(0.28)	(0.13)	(0.31)	**(0.32)**
Share of heads of household with U.B.N.	-0.11	**-0.44***	-0.30	0.13	0.11	0.17	-0.03	0.00	**0.27***	**0.36****	**0.41*****	-0.43
	(0.18)	**(0.22)**	(0.34)	(0.21)	(0.16)	(0.13)	(0.20)	(0.21)	**(0.15)**	**(0.17)**	**(0.13)**	(0.40)
Share of foreign born heads of household	-0.16	-0.09	-0.16	0.06	0.01	0.01	0.03	-0.01	0.07	-0.04	0.23	-0.06
	(0.11)	(0.08)	(0.11)	(0.13)	(0.11)	(0.08)	(0.13)	(0.11)	(0.08)	(0.07)	(0.14)	(0.12)
Fiscal capacity Indicator	0.02	**-0.25***	-0.19	-0.21	-0.22	**-0.16***	-0.02	-0.17	-0.02	**0.27*****	-0.13	-0.17
	(0.06)	**(0.14)**	(0.13)	(0.22)	(0.16)	**(0.09)**	(0.18)	(0.14)	(0.13)	**(0.08)**	(0.17)	(0.17)
Cuyo Region	-0.63	-0.72	0.16	-0.04	**-0.96***	-0.41	-0.07	0.36	-0.23	0.65	0.11	0.70
	(0.50)	(0.47)	(0.21)	(0.68)	**(0.57)**	(0.49)	(0.56)	(0.59)	(0.45)	(0.45)	(0.65)	(0.63)
Northeastern Region	**-1.70****	0.19	1.09	-0.51	-0.39	**-0.68***	-0.77	-0.64	0.56	0.33	0.06	0.82
	(0.74)	(0.69)	(0.69)	(0.59)	(0.48)	**(0.41)**	(0.59)	(0.57)	(0.47)	(0.35)	(0.53)	(0.56)
Northwestern Region	-0.20	-0.36	0.61	-1.05	-0.93	-0.33	-0.90	-0.75	-0.62	-0.69*	-0.30	0.26
	(0.77)	(0.54)	(0.49)	(0.96)	(0.62)	(0.61)	(0.73)	(0.67)	(0.52)	(0.40)	(0.88)	(0.67)
Pampeana Region	**-1.06*****	0.55	**1.59****	0.54	0.18	-0.15	0.30	0.55	-0.50	-0.28	0.07	**1.14***
	(0.28)	(0.43)	**(0.71)**	(0.52)	(0.30)	(0.32)	(0.49)	(0.36)	(0.32)	(0.29)	(0.28)	**(0.64)**
Distance to the port of Buenos Aires (in hundreds of km)	-0.00	0.00	0.00									
	(0.00)	(0.00)	(0.00)									
Average maximum temperatures recorded in the last decade (Celsius)	-0.06	0.04	-0.04									
	(0.04)	(0.06)	(0.05)									
Average minimum temperatures recoded in the last decade (Celsius)	**0.23****	-0.07	-0.04									
	(0.11)	(0.06)	(0.08)									
Population density in developed area, 1895	-0.07	[illegible]	-0.03									
	(0.04)	(0.05)	(0.05)									
Share of unemployed heads of household	-0.04	**0.34****	-0.24									
	(0.13)	**(0.12)**	(0.16)									
Constant	-0.19	-0.43	-0.13	-0.17	0.11	0.42	-0.06	-0.35	0.20	0.15	0.06	**-0.84***
	(1.27)	(1.48)	(1.31)	(0.36)	(0.26)	(0.32)	(0.36)	(0.34)	(0.32)	(0.28)	(0.31)	**(0.50)**
R-squared	0.46	0.74	0.21									
Test of overidentifying restrictions (Hansen J Statistic)	.	.	.	2.978	2.742	7.006	1.905	3.098	2.955	1.589	2.700	3.170
P-value of Hansen J Stat.	.	.	.	0.226	0.254	0.0301	0.386	0.213	0.228	0.452	0.259	0.205

Notes: Robust standard errors in parentheses.*** p<0.01, ** p<0.05, * p<0.1**. Explanatory variables in standard deviations.**

Table B4. Determinants of Local Infrastructure Regulatory Environment (IPI): OLS and IV estimations

	OLS	OLS	IVREG 1			IVREG 2			
VARIABLES	IPI	IPI	SDL	Formal	IPI	SDL	Formal	Density	IPI
SDL[a]	**-0.40****	**-0.39****			**-0.59*****				**-0.63****
	(0.14)	**(0.15)**			**(0.19)**				**(0.28)**
Formal Owners[a]	0.12	**0.42****			0.20				-0.16
	(0.20)	**(0.18)**			(0.39)				(0.42)
Density[a]	**0.08***	0.09	**-0.12*****	-0.01	0.06				-0.47
	(0.05)	(0.05)	**(0.03)**	(0.06)	(0.05)				(0.46)
Level of Infrastructure[a]		-0.02	**0.39****	0.16	0.07	**0.37****	0.16	0.16	0.13
		(0.13)	**(0.16)**	(0.11)	(0.14)	**(0.17)**	(0.11)	(0.20)	(0.18)
Complete Secondary[a]	0.13	**0.19****	0.25	0.05	**0.28***	0.32	0.05	-0.46	0.09
	(0.09)	(0.17)	(0.18)	(0.07)	**(0.16)**	(0.19)	(0.06)	(0.36)	(0.18)
Percentage of HH with U.B.N. [a]	0.15	**0.39***	0.16	**-0.75*****	0.29	0.22	**-0.74*****	-0.43	-0.25
	(0.12)	**(0.22)**	(0.13)	**(0.19)**	(0.34)	(0.16)	**(0.19)**	(0.37)	(0.34)
Percentage of migrants[a]	-0.01	0.13	**-0.45***	**0.20***	0.06	**-0.45***	0.20*	-0.03	0.20
	(0.06)	(0.11)	**(0.23)**	**(0.12)**	(0.15)	**(0.24)**	(0.12)	(0.13)	(0.20)
Fiscal Index[a]	**-0.16***	-0.08	-0.06	-0.05	-0.11	-0.06	-0.05	-0.08	-0.11
	(0.09)	(0.12)	(0.08)	(0.12)	(0.12)	(0.07)	(0.12)	(0.12)	(0.15)
Cuyo	-0.46	-0.14	-0.73	**-0.93*****	-0.33	-0.77	**-0.95*****	0.09	-0.44
	(0.49)	(0.45)	(0.47)	**(0.28)**	(0.54)	(0.48)	**(0.28)**	(0.27)	(0.64)
NEA	**-0.75***	-0.64	**-1.46****	-0.58	**-0.73***	**-1.58*****	-0.60	0.74	-0.51
	(0.40)	(0.43)	**(0.52)**	(0.42)	**(0.39)**	**(0.51)**	(0.43)	(0.68)	(0.38)
NOA	-0.51	-0.60	**-0.79***	-0.35	-0.66	-0.90*	-0.38	0.57	-0.25
	(0.47)	(0.46)	**(0.45)**	(0.45)	(0.44)	(0.48)	(0.45)	(0.56)	(0.46)
Pampeana	-0.21	-0.14	**-0.56***	0.01	-0.12	**-0.73****	0.00	**1.43****	0.40
	(0.31)	(0.37)	**(0.30)**	(0.24)	(0.35)	**(0.29)**	(0.21)	**(0.65)**	(0.34)
Constant	0.48	0.36	-0.77	-2.51*	0.41	-0.73	-2.58*	-1.33	0.16
	(0.31)	(0.33)	(0.85)	(1.45)	(0.32)	(0.81)	(1.38)	(1.93)	(0.31)
Distance to the port of Buenos Aires (in hundreds of km)			0.00	-0.00		0.00	-0.00	0.00	
			(0.00)	(0.00)		(0.00)	(0.00)	(0.00)	
Average maximum temperatures (Celsius)			-0.08	**0.14****		-0.08	**0.14****	0.01	
			(0.05)	**(0.06)**		(0.06)	**(0.05)**	(0.06)	
Average minimum temperatures (Celsius)			**0.27*****	-0.03		**0.27****	-0.02	-0.00	
			(0.09)	(0.04)		**(0.10)**	(0.04)	(0.11)	
Population density in developed area, 1895			-0.06	-0.05		-0.06	-0.05	-0.02	
			(0.05)	(0.04)		(0.06)	(0.04)	(0.05)	
Share of unemployed heads of household			**-0.26***	**0.26***		-0.21	**0.26****	-0.32	
			(0.13)	**(0.13)**		(0.13)	**(0.12)**	(0.23)	
Observations	101	101	101	101	101	101	101	101	101
R-squared	0.23	0.29	0.56	0.82		0.56	0.82	0.24	
Test of overidentifying restrictions (Hansen J Statistic)					8.218				4.047
P-value of Hansen J Stat.					0.0417				0.132

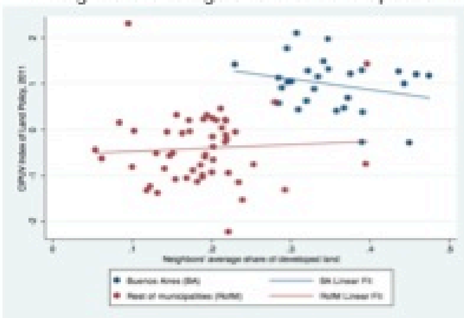
Notes: a Standardized variables. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Explanatory variables in standard deviations.

Table B5: Spatial Models. Determinants of land use regulation stringency (N=101)

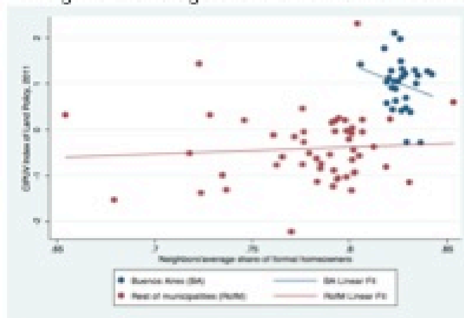
	Dependent Varaible: CILP		
VARIABLES	SEM (1)	IV-SEM (2)	IV - SEM (3)
Share of developed) land - (SDL)	**-0.335*** **	0.33	0.3
	[0.126]	[0.22]	[0.22]
Formal homeownership rate - (RFHO)	-0.13	0.1	0.13
	[0.109]	[0.25]	[0.25]
Population density in developed area, 2000 - (POPD)	0.001	0.1	0
	[0.065]	[0.08]	[0.16]
Average head of household's educational	**0.286*** **	0.03	0.03
	[0.110]	[0.18]	[0.18]
Share of heads of household with U.B.N.	0.053	**0.30***	**0.29***
	[0.134]	**[0.16]**	**[0.16]**
Share of foreign born heads of household	-0.04	0.08	0.08
	[0.097]	[0.13]	[0.12]
Fiscal capacity Indicator	-0.12	-0.16	-0.17
	[0.127]	[0.12]	[0.12]
Cuyo Region	-0.059	0.15	0.13
	[0.555]	[0.41]	[0.42]
Northeastern Region	-0.538	-0.46	-0.46
	[0.463]	[0.34]	[0.35]
Northwestern Region	-0.415	-0.72	-0.67
	[0.711]	[0.69]	[0.69]
Pampeana Region	0.53	0.47	0.48
	[0.467]	[0.33]	[0.33]
Constant	-0.177	-0.15	-0.16
	[0.458]	[0.3]	[0.3]
Rho	**0.706*** **	0.3	0.27
	[0.119]	[0.28]	[0.3]

Notes: Robust standard errors in brackets.*** p<0.01, ** p<0.05, * p<0.1. Column (1) reports results from spreg estimation. Column (2) is the instrumented spatial regression; SDL and RFHO instrumented as ivreg models. Column (3) contains results of the instrumented spatial regression; SDL, RFHO and POPD are instrumented with exogenous variables. **. Explanatory variables in standard deviations.**

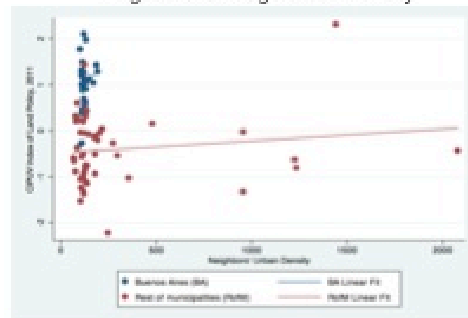
Neighbors' average share of developed land



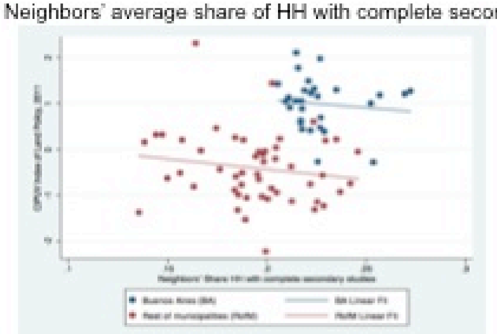
Neighbors' average share of formal homeowners



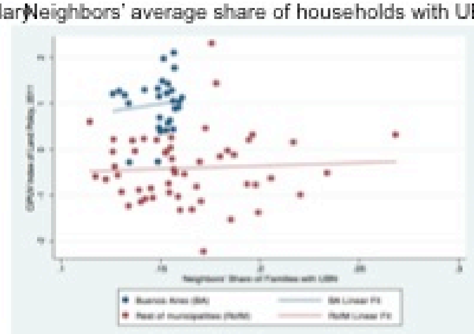
Neighbors' average urban density



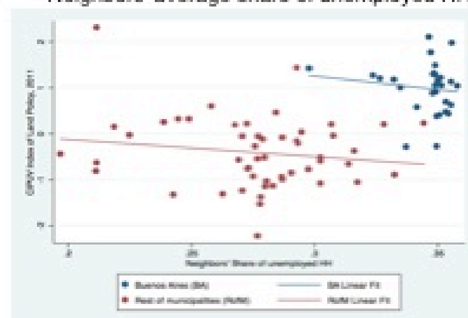
Neighbors' average share of HH with complete secondary



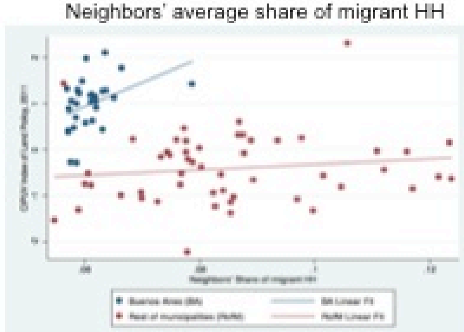
Neighbors' average share of households with UBN



Neighbors' average share of unemployed HH



Neighbors' average share of migrant HH



Neighbors' average value of the fiscal index