AN EMPIRICAL APPROACH TO URBAN LAND MONOPOLY: A CASE STUDY OF THE CITY OF BARANQUILLA, COLOMBIA

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INTRODUCTION

There is a growing awareness in urban social science of the importance of real estate as a medium by which major cities are embedded within global capital networks (Halbert et al., 2014) and a 'rediscovery' of real estate as a topic for critical urban analysis (Christophers, 2010; Gotham, 2006; Lizieri and Pain, 2014) Real estate developers and investors play critical roles in city centre transformations, with that development potentially at conflict with urban planning and the needs of households across the social spectrum in those cities (Lizieri, 2009).

Development in cities requires land that is, outside command economies, generally in private ownership. Thus land owners play a mediating role in shaping urban form – particularly where they hold monopolistic or quasi-monopolistic stakes in a city. Land monopoly was, for long, a major topic of debate in social sciences, given its alleged pervasive influence on socio-economic performance and wealth disparities. Discussions of land were central to the work of 19th century political economists and in analyses of agriculture and poverty in Europe and the USA at the time.

History and sociology rely heavily on land monopoly as a conceptual framework and see it as a deterrent to social change and progressiveness in rural medieval Europe, while dismissing its importance for predominantly urban, contemporary economies. This rural bias in the original land monopoly controversies may have had an impact on the current dearth of analyses (Ward & Aalbers, 2016).

Mainstream economics has essentially remained silent about land monopoly, having moved away from traditional concerns over land ownership, agriculture, and poverty. By contrast, we argue that land monopoly is an important research subject for two reasons: a) detection of land monopoly remains a Marxian urban land economics academic challenge (Ekonomakis, 2003); and b) under land monopoly conditions, landowners' "strikes" are feasible, with the important welfare implication that land taxation will not be neutral (Garza & Lizieri, 2016).

This paper specifies a set of spatial empirical tests of land monopoly in a medium-sized urban economy of a developing country, Barranquilla, Colombia. To do so, Evans's (1991) land

monopoly theory is used, framed within Deng's (2009) taxonomy of cases that solve the Coase (1972) paradox of the impossibility of a durable goods monopoly. We will show that the urban spatial structures that resemble land monopoly conditions in a Coasian perspective, also fulfil the requirements for a spatial urban land monopoly in Marxian terms (Houghton, 1993).

In many economies, large urban land plots are owned by the state or mixed-economy institutions, with implications on real estate markets and planning processes (Haila, 2014). In contrast, our case study offers exceptional conditions for assessment, as the subject city has a high degree of landownership concentration in its highly regulated northern fringe, an area destined for elite residential and commercial development. This landowner is a fully private real estate corporation, in a neoliberal urban policy setting; consequently, we have an almost pure context for land monopoly assessment.

We seek to make two contributions to the urban literature: a) to refocus attention to the importance of land in urban development; and b) to develop and apply a novel analytic approach to land monopoly in an emerging economy where land issues are prominent. This approach echoes Park (2014), spatially testable hypotheses are derived from a workhorse Marxian differential rents theoretical model. Our testable hypotheses separate the effect of a spatial land monopoly from those associated to urban regulation, location, and economic performance.

Following this introduction, section two sets out the conceptual problem involved in the land monopoly question, while producing a set of spatial econometric specifications. In section three, we explain the advantages of the selected case study, and present our data. The fourth section presents empirical results, and section five concludes.

LAND MONOPOLY

Urban economics and land monopoly

Land monopoly has largely disappeared from the urban economics research agenda. Despite the dearth of recent studies, from the existing literature we can infer four broad approaches:

- Land owners are *monopolists as a class*, a statement drawn from classical authors such as Ricardo or Marx;

- Landowners are *site monopolists,* due to the unique location characteristics of each individual plot of land.
- Land use regulation produces land monopolies, in particular the granting of development rights with a spatial schedule (Fischel, 1985);
- Land owners behave as monopolists in the microeconomic sense of the term. Evans (1991) extrapolates this from the Marxian concept of monopoly rent, but asserts that application of microeconomics, even from outside the Marxian tradition, may simplify the concept and its implications[1].

In the last case, surplus is not simply called economic profit but rather (Marxian) monopoly rent since it is imposed by the land seller *over and above* location rents. This means, contrary to criticisms (Foldvary, 1993), that it goes beyond site monopoly.

This paper focuses on this fourth approach but, to enhance Evans's argument, we take into account that land is a durable good and, as such, is limited by the Coase paradox (1972). This paradox can be summarized as an inter-temporal selling dilemma for the owner of all the land in a country or city. If the owner tries to retain some land to increase prices, rational buyers will not buy until all land goes on sale. If some buyers paid for overpriced land in the first period, they would suffer asset losses during the second period devaluation as the monopolist put the remaining land up for sale[2].

The Coase paradox makes sense in an urban land economics context because each plot of land is assumed to be sold at its 'maximum and highest use', where there is no place for a land monopolist. The development potential of each plot of land in a city is determined by its location characteristics, environmental quality, and the regulatory framework (Anas *et al*., 1998).

The non-existence of land monopolies has been challenged by historical experience of landowners' "strikes", although they have not been a long-term strategy (Needham, 1981). This is why Deng (2009) reassesses the Coase paradox when urban land is not just a durable good,

[1] Evans plays down the welfare economic implications of a land monopoly, by stressing that from a planner's point of view it is better to deal with one large landlord-developer than with a myriad of small firms (Evans, 2004).

[2] Even where renting (rather than selling), it is still in the interest of the landlord to rent all of the land in order to achieve maximum income

but a bundle of pure land and a public good that allows it to be used for urban purposes. In his interpretation, there exists a set of cases where the public good can be provided either by the land monopolist or by the local government.

Deng uses a two-period bundle of goods model, in order to derive a taxonomy of cases. Under different assumptions on population distribution and strictness of the regulatory framework, his simulations determine different profit and welfare combinations. The simulations resemble some real life cases in the United States where large suburban real estate developments become local governments in their own right, controlled by "first period" buyers. We retain from Deng's simulations the following set of results:

- More plots of land are allocated when the government has to provide the public good, and profits are higher.
- If a community is predominantly wealthy, more plots are allocated and profit is higher.
- There is a positive relationship between more restrictive zoning and profit, with welfare increasing effects in predominantly wealthy communities.

In other words, land monopoly pricing is more feasible in wealthier neighbourhoods, with public provision of infrastructure, and with stricter urban regulation.

Spatial land monopoly: the search for specification

Evans's analysis of land monopoly relies on the idea that it is mistaken to follow the Ricardian concept of a perfectly inelastic land supply curve. In Evans's (2004) critique, land supply will be perfectly inelastic only when all available land in a region (or an island such as Great Britain as in the classic analysis of Ricardo) has been utilised.

We might argue, against this idea, that the owner of each plot of land is already a site monopolist because of the irreproducibility of its location. Further, even if all available land on an island is used, it may be possible to create more, and the owners of the newly-created locations will still be site monopolists due to the locational characteristics[3]

[3] The possibility of creating new land, as in the Netherlands, challenges Evans's interpretation of Ricardo, but it does not refute the existence of site monopolists (Needham, 1992). The "man-made" islands of Harvey (1974) also fall under this category: landowners influence the planning process in the limited granting of development rights with a spatial agenda.

Even if we question the starting point for Evans' criticisms, his insights are useful for the empirical formulation of a land monopoly test. We must remember that Evans' approach to land monopoly draws from Marxian urban land economics where the existence of absolute urban land rent remains a valid intellectual challenge (Park, 2014; Jaramillo, 2009).

Evans uses a shopping mall as an example, where rental spaces that are in all physical senses equal are, nonetheless, allocated to different uses with different rents. In a competitive context, different tenants would equalize their space demand requirements at the same rental price. In contrast, a central manager would allocate the space discriminating prices between tenants according to their marginal income.

We extrapolate Evans's ideas to the city level by stating that a land monopolist must be able to exploit the different income to land price elasticities of the separate individual demands to be allocated inside its plot of land. The land monopolist would be then able to overprice each subdivision accordingly, and those extra rents are added to what determined by location. Following the Marxian logic of Houghton (1993), land rents could be monopolistic if the landowner zone has exclusive location and regulatory characteristics, which cannot be found anywhere else in the metropolitan region. This situation coincides with our case study zone which satisfies Deng's above-mentioned land monopoly conditions. The detection of these spatial patterns with city level information is the subject of the next section.

Conceptual Structure of the Testing Frameworks

This section presents a spatial econometric structure to be estimated under different specifications to test for the existence of a land monopoly. We consider land rent per square metre in each location and period r_{it}, to be determined by panel variables like property type X_{it}, pure cross-sectional variables like distance to the CBD d_i, and regulatory framework as summarized by height limits h_i. Other determinants are pure time-series variables such as city building output Q_t, and income per capita in each period y_t:

$$r_{it} = (X_{it}, d_i, h_i, Q_t, y_t) \tag{1}$$

Income is a demand side force that increases land rents in the entire city; however, its impact should be different in the land monopolist's zone $(i = A)$, compared to its most comparable neighbours $(i = B)$, and over any other property in the city $(i \neq A, B)$:

$$r_{it} = (X_{it}, d_i, h_i, Q_t, y_t) + y_t[i = A] + y_t[i = B] \quad (2)$$

This is where our testing framework does more than check the higher prices in the land monopoly zone, which could be due to spatial segregation or environmental amenities. In our analysis, the income impact on the different zones should follow a spatial structure as determined by the corresponding spatial weights matrices (W_A) for the land monopolist zone and (W_B) for its neighbours (Lacombe, 2004). Given different observations over time, the estimation framework will be satisfied by Kronecker-expanding these matrices over all periods T (following Anselin *et al.*, 2008).

In equation 2, a pure time-series variable y_t affects the dependent variable r_{it} through its own (W) spatial structure. Specifically, recall that in a cross-sectional framework, a positive sign on the spatial autoregressive parameter means that its spatial distribution clusters high values together: a situation compatible with Evans' land monopolist spatial discrimination, and on a plot of land that has an independent internal spatial structure from the citywide spatial land prices structure (Houghton, 1993)[4].

The impact of income on prices is made of two components: one causes higher land prices in all locations, and the second is local and causes prices changes to be different in each location, as represented in Figure 1.

[Figure 1 about here]

This idea is employed in a panel estimation with the impact of income on land prices divided into two components: $r_{it} = y_t + (I_T \otimes W_N) y_t$. The first is the city income per period t positively related with the land prices in all the locations per period $y_t \rightarrow r_t$. The second

[4] We also tested cubic-spline price functions (Muñiz, et al., 2003), but they did not perform adequately in terms of significance and signs. We ruled them out as our preferred citywide spatial land prices structure.

component is the same income in each of the T periods, weighted by the spatial matrix for $W_{NT}y_T[T=t] \rightarrow r_i[T=t]$ where N is the number of locations.

We cannot separate time and spatial effects in the second component, as time will be pooled over all cross-sectional units in a panel estimation. However, both effects must be positive in order to produce a positive second component. To have positive income to land price elasticity mediated by positive spatial correlation, means that the positive income to land price elasticity is higher in the more expensive locations. This pattern is consistent with a spatial agenda of land price discrimination, as required by our spatial land monopolist process, which goes beyond merely having higher than average prices (Needham et al., 2011)[5]. Figure 1 represents this process.

We perform the same estimation for a control group, the zone immediately neighbouring that of the (potential) land monopolist. If we find the same spatial patterns, we will conclude that a price discriminating land monopoly does not cause it, because that neighbouring zone does not exhibit extreme concentration of land ownership. The estimated parameters are then compared to test whether the spatial income to land price elasticity is higher in the monopolist zone than in its neighbours. This is the Spatially Controlled (SCM) panel to be estimated:

$$lnr_{it} = \alpha + \beta_j(X_{it}, lnd_i, lnh_i, lnQ_t, Z_{it}) + \sigma lny_t + \gamma W_{AT} lny_t + \eta W_{BT} lny_t + \varepsilon_{it} \qquad (3)$$

The variables are introduced as logarithms enabling direct assessment of the parameters as elasticities. We include a set of control variables Z_{it}, and focus in the spatial (γ, η) and non-spatial (σ) income to land price elasticities. ε_{it} are the panel error terms.

We expect the parameter σ to be positive, and γ to be positive and significantly larger than η. These are the conditions for a spatially structured income to land price elasticity in the monopolist zone. If, by contrast, we find that γ is negative or significantly smaller/non-different from η, this would suggest that land concentration does not drive the spatial income to land price elasticity.

[5] In the sense that land monopoly is not just the result (higher prices), but includes the process (spatially differentiated income-to-land-price elasticities) (Park, 2014).

Once we have detected spatially structured and different income to land price elasticities by zone, we assess if the land monopolist zone commands 'over and above' prices. We use two variables to detect this pattern: (a) for the land monopolist zone and (b) for the neighbour. There is overpricing if π is positive and larger than ρ in equation (4):

$$lnr_{it} = \alpha + \beta_j(X_{it}, lnd_i, lnh_i, lnQ_t, Z_{it}) + \sigma lny_t + \pi a + \rho b + \varepsilon_{it} \quad (4)$$

Finally, we use a Spatially Autoregressive component (SAR) to check the required positive spatial autocorrelation of the land prices regardless of city-wide location, in both the land monopolist zone A, and its neighbour B. We do not use the entire city spatial weights matrix, because the neighbouring zone is the most similar to the land monopolist one and, hence, its most appropriate control group:

$$lnr_{it} = \alpha + \beta_j(X_{it}, lnd_i, lnh_i, lnQ_t, Z_{it}) + \sigma lny_t + \delta W_{AT} lnr_{it} + \theta W_{BT} lnr_{it} + \varepsilon_{it} \quad (5)$$

This use of spatial econometrics is not simply exploiting the spatial character of contemporary databases (Gibbons and Overman, 2012). We use spatial econometrics because we are trying to resemble the processes represented in Figure 1, with information from an entire metropolitan area. This is why further explorations in the use of Spatial Error and Spatial Durbin models, popular in recent literature on spatial econometrics, are beyond the requirements of our tests.

In addition, this case study will not have to separate direct and indirect effects of the Spatial Lag component in equation (3) (LeSage & Pace, 2009). The spatial weights do not cover all the area under analysis, nor all the periods of the panel, and consequently, the income parameter is not affecting itself and the dependent variable indirectly (Elhorst, 2014). While we do not have marginal effects, we just need to be sure that the SAR components are positive and significant in equation (5).

A CASE STUDY: BARRANQUILLA, COLOMBIA

The context

Barranquilla, the fourth largest Colombian city, sits between the Magdalena River to the east and the Caribbean Sea to the north. The conurbation includes two municipalities: Barranquilla (population: 1,148,606), and Soledad (503,477). Map 1 shows the two municipalities, with blocks of built environment represented as grey polygons. The historic centre of the city, as represented by the town hall, is presented along with key traditional landmarks: El Prado hotel (built 1930); the Stadium (1985); and the Buena Vista shopping mall (2001). These landmarks are sub-centres in cubic-spline price functions that, however, did not report correct signs and significance in the regression analyses presented below and were thus not explored further in the empirical application. The land owned by a single landowner around Buena Vista mall is represented in Map 1 as a red bounded polygon; it is equivalent to 90% of all the feasible northern urban expansion land, according to the 2001 Master Plan.

[Map 1 about here]

High-income residential and retail neighbourhoods occupy the red bounded polygon and its surroundings. Middle income neighbours are located towards the south and southeast. Industrial zones and low-income neighbourhoods are located on the south and south-western peripheries, typical of Latin American informal urbanization. We note that, despite the informal sector, urban land markets do exist and exhibit an upward price trend (Carazo, 2011).

The landowner of the red polygon in Map 1 was a cement corporation, founded in the 1930s on peripheral land with direct access to mining facilities and a river port. Subsequently, the manufacturing plant closed and city development has reached the outer limits of this large plot of land[6]. The company has transformed into a real estate corporation, which accomplishes the process named 'urbanization' in Colombia: it requests land development permissions from the local authority, adds local connective infrastructure (although not all of it), and then proceeds to sell the land to developers. These, in turn, build elite residential and commercial developments under stricter regulation conditions than in other areas of the city[7]. These characteristics: private ownership, land concentration, upper-class land uses, and stricter

[6] Local analysts have guessed that this company has manipulated the city planning process in order to attract development in the direction of its plot of land (Garza, & Tovar, 2009). A large landowner with strong political influence, but not necessarily the exercise of monopolist market power.

[7] As opposed to the locations where poor inhabitants dwell, where regulation is largely absent, consistent with the typical Latin American pattern of spatial segregation (Alfonso, 2012).

regulation, make this case the most likely land monopolist scenario in above presented Deng's taxonomy.

Land Prices and Database Construction

This research uses appraisal data from the publication "*El Valor del Suelo Urbano en Barranquilla y su Area Metropolitana"* by *Lonja de Propiedad Raiz de Barranquilla*, the local association of real estate professionals in the city of Barranquilla. The publication is the result of a collective effort to use appraisal information to highlight spatial land price structure and trends in the city in the period 2000 – 2010.

Appraisals are carried out on request from involved stakeholders in real estate markets (sellers, buyers, mortgage banks, government, etc.). In Colombia, the professionals associated with the *Lonjas* produce private but regulated appraisals, which are legally examined when considered biased or leading to unsatisfactory business decisions. In general terms, surveying is considered a reasonably competent profession in the country. As a result, the appraisals may be noisy but should not be systematically biased.

The appraisals report land prices for both developed and undeveloped properties, as surveyors use residual valuation techniques to determine pure land value in the case of already developed plots of land. It is important to use land values (as appraised) because our analysis deals with pure land rents as a function of location.

From the dataset, we compiled those observations that had all of the characteristics required for empirical analysis; these were 4,384 independent valuations for the entire period 2000-2010. This information is represented in Map 2 over a background map of the built environment in the Barranquilla-Soledad conurbation.

[Map 2 about here]

In the first panel of Map 2 we present the blocks in Barranquilla and Soledad classified according to their socio-economic status or *estrato*. The *estrato* is a national housing survey spatial classification ranging from 1 (the poorest) to 6 (the wealthiest). As we can see in the

map, Barranquilla contains all 6 *estratos*, while the top *estrato* in Soledad is 3, since it is a smaller and poorer municipality.

In the second panel, we present the appraisals and land prices (2012 constant COP$) in 2010. As expected, most of the observations are in the northern and north-western areas of the city where high income housing and commercial activities are located. In a typical Latin American city, these submarkets are more connected to formal financial mechanisms and the corresponding formal appraisal processes.

We deal with this selection bias in the dataset by aggregating property level information into larger spatial units: the blocks. These are the minimal built environment units surrounded by streets and roads in the background of Map 2. The blocks are spatial units small enough to produce micro-spatial econometric relationships, while diminishing selection bias and the extreme difference in individual appraisals. Barranquilla-Soledad has, in total, 7,224 blocks.

The panel structure is unbalanced since not all blocks have values in all the years of the database. The resulting land prices database per block is depicted in Map 3, where the first panel shows the 1,984 different blocks with information in at least one of the years under analysis. The maps shows 38 blocks located inside the land monopolist area, depicted in yellow. These blocks comprise the land monopolist spatial weights matrix W_A.

[Map 3 about here]

In order to determine the blocks to be included in the neighbours' spatial weights matrix, we averaged the distance between all of the block-observations and used it as a geographical threshold for a spatial buffer departing from each point of the boundary of the land monopolist zone. The threshold thus defined was 6,895 meters: all the 780 blocks fully or partially included are depicted in light red in the first panel of Map 3. These blocks comprise the neighbours' spatial weights matrix W_B, the 'North'.

In order to offer contrast options to the North as neighbours' spatial weights matrix W_B, we take a buffer equivalent to 1/3 of the average distance (2,298 metres) an area that includes 279 blocks identified in red in Map 3. Another contrast matrix was produced with a buffer

equivalent to 1/3 the former distance (766 metres), designated as “Closer Neighbour” and identified in dark red. All the other blocks in the city with information in at least one year are identified in blue in the first panel of Map 3.

The right panel of Map 3 reports land prices per block in 2010. We observe that the extreme values in the classification (the legend) have moderated while retaining the general spatial structure of Map 2. There has been also an upward trend in prices, particularly between 2005-10, as identified by Payares (2012).

Other variables – The variables gathered for each year-block and used in the empirical section are:

- *Estrato*: as above, this is a standardized Colombian geographical classification based on built environment quality and proxies for wealth. This variable is introduced in the estimations as a dummies, with *estratos* 1 and 2 as the baseline. The resulting parameter should be positive and increasing in *estrato* rank.
- Building Output: this is Construction GDP for Atlántico, the province where Barranquilla-Soledad is located. Atlántico has 2,373,550 inhabitants so the city has a disproportionate share in the population (73%) and economy of the province. We could not find more disaggregated information, so this is a pure time-series variable, and it is expected to have a positive effect on land price.
- Height: as determined by city regulations. Theory predicts city-wide land price increases due to height limits, but also lower land prices in the blocks where height is limited (Anas et al., 1998). It is expected to have a positive impact on prices.
- Soledad: this is a dummy variable for all of the blocks in the municipality of Soledad. We expect this to have a negative influence, because the southern municipality is poorer.
- Count: this is the number of appraisals per block-year. It may be positively related to price because when more appraisals are performed on a block, it indicates higher market potential or activity levels and greater informational certainty. This is precisely the selection bias when using individual appraisals and, hence, the use of block averages.

- Euclidean Distance: in metres from the centroid of each block to the Town Hall represented in Map 1. We expect this to show a negative sign, consistent with standard urban economics models[8].
- Income per capita: this is a pure time-series variable (available for Atlántico, the province that contains Barranquilla) and we expect it to be positively related to prices. This variable will also be used in conjunction with the spatial matrices to perform the spatial income-price elasticity tests explained in section 2.
- Property types: dummy variables for each of five property types: Housing, Apartment, Commercial, Industrial and Empty Lot.

A summary of these information sources, adaptation to the block-level panel estimation environment and units of measurement, is presented in Table 1. The corresponding descriptive statistics are reported in Table 2, including information for each of the three candidate neighbour zones. The extended neighbours should be the best control zone because of lower average land price; by contrast, the average price in the closer neighbours is actually higher than in the monopolist zone. This selection process will be further explained in the empirical section below.

Table 1: Summary of information sources, precision, and units of measurement

[8] To calculate in-route distances in the absence of GPS tracked observations would require us to design an optimization algorithm, which will be dependent upon initial assumptions and will not necessarily add too much to the analysis.

Variable	Type	Final Spatial Precision	Original Spatial Precision	Source	Units
Land Price	Unbalanced Panel	Blocks per Year	Property Appraisal	Lonja	2012 constant COP$ per M^2
Building Output	Time-Series	City per Year	City per Year	DANE	Square meters
Estrato	Cross-Section	Block	Block	City Cartography	Dummy
Height	Cross-Section	Block	Block Fractions and/or set of Blocks	City Cartography	Floors
Soledad	Cross-Section	Block	Block	City Cartography	Dummy
Count	Unbalanced Panel	Block	Property Appraisal	Lonja	Count
Distance	Cross-Section	Block Centroid	Block Centroid	City Cartography	Meters
Population	Time-Series	City per Year	City per Year	DANE	Number
Income	Time-Series	City per Year	City per Year	DANE	2012 constant COP$ per M^2
Property types	Unbalanced Panel	Block per Year	Property Appraisal	Lonja	Dummy
Built Price	Unbalanced Panel	Block per Year	Property Appraisal	Lonja	2012 constant COP$ per M^2
Lot Size	Unbalanced Panel	Block per Year	Property Appraisal	Lonja	Square meters

Table 2: Descriptive statistics of the information per blocks (2,987 block-year)

Variable		Mean	Std. Dev.	Max	min
Land price		221,690	164,867	2,035,394	11,200
Intra-monopoly [i = A = 38]	n = 72	300,143	128,975	700,000	20,000
Closer Neighbour [i = B = 53]	n = 104	301,057	165,912	1,034,028	120,000
Neighbours [i = B = 279]	n = 537	259,882	176,558	2,035,394	43,488
North (Extended Neighbour) [i = B = 780]	n = 1,388	221,566	150,595	2,035,394	43,488
Rest of the city [i = B = 1,166]	n = 1,527	101,167	69,769	1,100,000	11,200
Building Output		123,346	48,399	196,187	23,350
Estrato	Estrato 2	0.17	0.38	1	0
	Estrato 3	0.27	0.45	1	0
	Estrato 4	0.16	0.37	1	0
	Estrato 5	0.17	0.38	1	0
	Estrato 6	0.17	0.38	1	0
Height		9.43	3.54	20	1
Soledad		0.06	0.24	1	0
Count		1.75	1.78	27	1
Distance		3,419	1,993	10,005	1
Income		9,417,332	768,287	10,295,983	8,136,945
Property types	Empty Lot	0.02	0.15	1	0
	Residential	0.49	0.49	1	0
	Apartment	0.47	0.49	1	0
	Commercial	0.2	0.38	1	0
	Industrial	0.05	0.19	1	0
Built Price		498,845	364,999	3,125,000	1
Lot Size		915	9,065	241,372	1

EMPIRICAL RESULTS

Land Monopoly Tests

This section uses spatial econometrics, acknowledging the fact that we cannot use panel effects because the spatial weighting process is already functioning as a type of fixed effect, repeated

across cross-sections (La Sage & Pace, 2009). In order to control for endogeneity problems, we use this Pooled FML System version of Equation (3)[9]:

$$\begin{aligned} \underline{lnr_{it}} &= \alpha + \beta_j(X_{it}, lnd_i, lnh_i, lnQ_t, Z_{it}) + \sigma lny_t + \gamma W_{AT} lny_t + \eta W_{BT} lny_t + \varepsilon_{it} \\ lnP_{it} &= \lambda + \chi_j(V_{it}) + \psi \underline{lnr_{it}} + \epsilon_{it} \end{aligned} \quad (6)$$

This System FML estimation has only one source of simultaneity, the effect of the Income to the Land Price mediated by the spatial lag only for the zones A and B: that is, a spatially controlled single equation and then a non-spatially controlled system estimation[10]. Consequently, we do not need to estimate the spatial parameters sequentially (Rey and Boarnet, 2004; Liu and Lee, 2013).

The Built Price P_{it} has its own set of V_{it} explanatory variables and controls (Land Area and Year Dummies), and the r_{it} land price. ϵ_{it} is its vector of panel errors. Results for equation (6) are presented in Table 3. The Table also includes results with SAR and dummies, system versions of equations (4) and (5).

All of the theory variables, property types and *estratos* have their expected signs and are significant in Table 3 (*estratos* also have their expected ordering of the absolute value parameters). The controls Soledad and Count have their expected signs and are significant. This is a well-behaved econometric baseline, on top of which we can perform the spatial land monopoly tests.

The models Sys1 to Sys7 report the results when using just the previously presented Extended Neighbour matrix[11]. Model Sys2 includes the spatial income to land price elasticities, and Sys3 includes SAR components: both were significant, and significantly larger for the land monopolist according to the Wald test. However, a direct assessment of the 'over and above'

[9] Instrumented and non-instrumented results (Limited Maximum Likelihood) were almost identical to the system results presented here, and can be delivered upon request. However, system estimation offers the best possible approach to equations (3), (4) and (5), for two reasons: a) we do not have enough variables to choose from as instruments, but enough to have separate price determinants for land and built environment; and b) the system controls land price endogeneity, which is the estimation problem in the first place.

[10] Equation (6) has different determinants on every equation, except the land price as common endogenous variable.

[11] All the spatial matrices have 4 neighbours, the structure that produced the highest goodness of fit. Different numbers of neighbours and alternative structures (inverse distance and Thiessen Polygons) produced the same signs and significance, but a lower goodness of fit.

condition in equation (4) is performed using dummy variables in models Sys4 to Sys7. The parameter was always positive and significant for the land monopolist zone, but positive and significantly larger for the neighbour (according to the Wald test), refuting the existence of a land monopoly. The most comprehensive model Sys7, also refutes the hypothesis, the neighbours have both significantly higher income-to-land-price-elasticity and over-pricing.

We infer from these results, that the higher prices in the monopolist zone in Table 2, cannot be attributed to land ownership concentration. In fact, the entire northern section of the city has higher than average prices (including the land monopolist zone), possibly due to city-wide patterns of spatial segregation (Garza & Tovar, 2009).

In order to contrast the results obtained when using the Extended Neighbours' spatial matrix, we perform estimations for other two candidate control zones: Neighbour and Closer Neighbour. The results are in models Sys8 to Sys11, where the quality of all the theory and control variables hold. In addition, the land monopolist income-to-land-price elasticity is not significant in the comprehensive models Sys9 and Sys10.

All the regressions have similar Log-Likelihood, Akaike and Schwartz criteria, but the Neighbour and Closer Neighbour regressions have larger Standard Errors than the equivalent Extended Neighbour regressions. We consider this extended zone the most convenient control zone, hence it will be used in the regressions presented in Table 4.

Criticisms can be directed to the selection of this Extended Neighbour as the control zone, because it could be fine-tuned to reject the land monopoly hypothesis; however, we argue that the opposite applies. In the regression results of Table 3, it was this wider zone that almost failed to reject the land monopoly hypothesis (the other two zones clearly rejected it). It is extended and includes low priced central and south-western properties that diminish the value of its dummy parameter. This is evident in its lower land price than the land monopoly zone in Table 2 and, hence, its use makes for a stronger test.

Table 3: System Estimation Land Monopoly Tests (Different Neighbours)

		Extended Neighbour (North)							Closer Neighbour		Neigbhour	
		Sys1	Sys2	Sys3	Sys4	Sys5	Sys6	Sys7	Sys8	Sys9	Sys10	Sys11
Equation One	Constant1	-12.858 ***	-12.679 ***	-12.663 ***	-12.591 ***	-12.437 ***	-12.380 ***	-11.895 ***	-12.137 ***	-12.140 ***	-12.204 ***	-12.226 ***
Theory Variables	Building Output	0.068 ***	0.069 ***	0.069 ***	0.070 ***	0.065 ***	0.066 ***	0.069 ***	0.071 ***	0.070 ***	0.071 ***	0.071 ***
	Height	0.135 ***	0.108 ***	0.108 ***	0.130 ***	0.099 ***	0.094 ***	0.084 ***	0.132 ***	0.130 ***	0.138 ***	0.134 ***
	Income	1.550 ***	1.536 ***	1.535 ***	1.534 ***	1.539 ***	1.537 ***	1.500 ***	1.505 ***	1.507 ***	1.512 ***	1.513 ***
	Distance	-0.169 ***	-0.161 ***	-0.160 ***	-0.170 ***	-0.189 ***	-0.191 ***	-0.181 ***	-0.172 ***	-0.173 ***	-0.180 ***	-0.178 ***
Land Monopoly Tests	Monopoly Income elasticity · (1,000)		1.390 ***					0.663 **	0.534 **	-0.036	0.973 ***	0.253
	Neighbour Income elasticity · (1,000)		1.125 ***					0.777 ***	1.127 ***	1.614 *	0.951 ***	1.689 ***
	Monopoly SAR · (1,000)			1.797 ***								
	Neighbour SAR · (1,000)			1.503 ***								
	Monopoly Dummy				0.092 ***		0.096 ***	0.090 **		0.119 ***		0.148 ***
	Neighbour Dummy					0.246 ***	0.246 ***	0.204 ***		-0.056		-0.112 ***
Property Types	Empty Lot	-0.426 ***	-0.430 ***	-0.429 ***	-0.438 ***	-0.433 ***	-0.438 ***	-0.434 ***	-0.432 ***	-0.437 ***	-0.413 ***	-0.418 ***
	Residential	-0.252 ***	-0.242 ***	-0.242 ***	-0.251 ***	-0.267 ***	-0.267 ***	-0.258 ***	-0.253 ***	-0.252 ***	-0.252 ***	-0.247 ***
	Apartment	0.123 ***	0.104 ***	0.103 ***	0.120 ***	0.115 ***	0.113 ***	0.103 ***	0.117 ***	0.116 ***	0.120 ***	0.115 ***
	Commercial	0.213 ***	0.206 ***	0.206 ***	0.215 ***	0.192 ***	0.193 ***	0.190 ***	0.213 ***	0.215 ***	0.214 ***	0.223 ***
	Industrial	-0.179 ***	-0.198 ***	-0.197 ***	-0.178 ***	-0.197 ***	-0.197 ***	-0.208 ***	-0.183 ***	-0.182 ***	-0.185 ***	-0.179 ***
Controls	Estrato3	-0.025	-0.023	-0.023	-0.024	-0.042 **	-0.041 **	-0.038 *	-0.024	-0.024	-0.027	-0.027
	Estrato4	0.277 ***	0.205 ***	0.205 ***	0.280 ***	0.091 ***	0.094 ***	0.075 ***	0.280 ***	0.281 ***	0.267 ***	0.271 ***
	Estrato5	0.630 ***	0.523 ***	0.520 ***	0.631 ***	0.449 ***	0.450 ***	0.405 ***	0.624 ***	0.623 ***	0.594 ***	0.599 ***
	Estrato6	1.033 ***	0.913 ***	0.909 ***	1.023 ***	0.854 ***	0.845 ***	0.799 ***	0.997 ***	0.993 ***	0.917 ***	0.923 ***
	Soledad	-0.122 ***	-0.121 ***	-0.121 ***	-0.121 ***	-0.074 **	-0.073 **	-0.081 ***	-0.118 ***	-0.118 ***	-0.106 ***	-0.110 ***
	Count	0.016 ***	0.017 ***	0.017 ***	0.016 ***	0.018 ***	0.018 ***	0.018 ***	0.016 ***	0.016 ***	0.015 ***	0.015 ***
Equation Two	Constant2	3.883 ***	3.814 ***	3.821 ***	3.707 ***	3.948 ***	3.902 ***	3.931 ***	3.739 ***	3.700 ***	3.857 ***	3.810 ***
	Land Price	0.885 ***	0.892 ***	0.892 ***	0.902 ***	0.881 ***	0.884 ***	0.882 ***	0.899 ***	0.902 ***	0.888 ***	0.892 ***
	Land Area	-0.311 ***	-0.313 ***	-0.313 ***	-0.313 ***	-0.313 ***	-0.313 ***	-0.313 ***	-0.312 ***	-0.312 ***	-0.312 ***	-0.312 ***
Time Dummies	2001	0.126	0.133	0.121	0.127	0.123	0.137	0.125	0.126	0.125	0.123	0.122
	2002	-0.085	-0.081	-0.093	-0.090	-0.079	-0.068	-0.083	-0.092	-0.092	-0.093	-0.094
	2003	-0.112	-0.109	-0.121	-0.121	-0.108	-0.098	-0.115	-0.122	-0.124	-0.118	-0.121
	2004	-0.264	-0.262	-0.273	-0.273	-0.270	-0.260	-0.273	-0.276	-0.277	-0.275	-0.274
	2005	-0.268	-0.265	-0.277	-0.278	-0.275	-0.264	-0.277	-0.283	-0.284	-0.278	-0.280
	2006	-0.455 *	-0.458 *	-0.470 *	-0.466 *	-0.457 *	-0.446 *	-0.461 *	-0.464 *	-0.465 *	-0.463 *	-0.467 *
	2007	-0.688 ***	-0.692 ***	-0.704 ***	-0.703 ***	-0.687 ***	-0.677 **	-0.689 ***	-0.702 ***	-0.706 ***	-0.693 ***	-0.699 ***
	2008	-0.131	-0.128	-0.140	-0.141	-0.134	-0.124	-0.129	-0.138	-0.140	-0.133	-0.137
	2009	0.165	0.169	0.157	0.158	0.165	0.178	0.169	0.161	0.159	0.165	0.165
	2010	-0.012	-0.001	-0.013	-0.018	0.001	0.013	0.003	-0.017	-0.019	-0.013	-0.015
	Log-likelihood	-7,025.5	-6,991.3	-6,991.3	-7,023.1	-6,976.3	-6,973.7	-6,959.1	-7,014.9	-7,012.6	-7,005.7	-6,996.9
	Akaike	4.723	4.702	4.702	4.723	4.751	4.690	4.682	4.718	4.718	4.712	4.707
	Schwartz	4.782	4.764	4.764	4.783	4.691	4.752	4.748	4.780	4.784	4.774	4.773
	S.E. of Equation 1	0.343	0.340	0.340	0.344	0.338	0.338	0.336	0.343	0.343	0.341	0.341
	S.E. of Equation 2	1.852	1.852	1.852	1.853	1.851	1.852	1.852	1.853	1.853	1.852	1.852
Wald Tests	Income Elasticities		0.000					0.000	0.092	0.064	0.934	0.000
	Spatial Lags			0.000								
	Dummies						0.042	0.049		0.099		0.000

Unbalanced Pooled FML
Maximum Likelihood Estimation – 2987 observations
***Significant at 1%; **Significant at 5%; *Significant at 10%
Wald tests reports the p-value of $H_0: \hat{\beta}_k = \hat{\beta}_l$, of the Income Elasticities, SAR Components, and Dummies

Another source of criticism could be the small number of spatial units comprised in the Land Monopolist zone; however, its SAR component was positive and significant in model Sys3. This last observation is important, as both land monopolist and neighbour zones had positive, significant, and not statistically different SAR parameters, despite the use of a citywide land price gradient. This is a reliability indicator, where both zones have a spatial structure of their own with positive spatial correlation (market organization in the logic of Houghton, 1993).

Possible Monopoly in the Built Environment Market

In this section, we explore if the relationships between income and location are mediated by built environment prices. Once again, we depart from equation (3) as a system:

$$\begin{aligned} \underline{lnr_{it}} &= \alpha + \beta_j(X_{it}, lnd_i, lnh_i, lnQ_t, Z_{it}) + \varepsilon_{it} \\ lnP_{it} &= \lambda + \chi_j(V_{it}) + \psi\underline{lnr_{it}} + \phi lny_t + \vartheta W_{AT} lny_t + \varphi W_{BT} lny_t + \epsilon_{it} \end{aligned} \quad (7)$$

In this case, to the V_{it} set of P_{it} explanatory variables and controls, we add the y_t income per capita, and the corresponding spatially-structured Income–to–Built–Price elasticities in the Land Monopoly Zone $W_{AT} lny_t$ and its neighbours $W_{BT} lny_t$. Results using the above-selected Extended Neighbour control zone, are presented in Table 4.

In Table 4, all the theory variables and controls have their expected signs and are significant. The application of monopoly tests on the Built Price equation always produces non-significant parameters for their elasticities and SAR (Sys13 to Sys15). Furthermore, Income is always non-significant when used in Sys12, Sys13 and Sys19, while the land monopoly dummy is significant only when controlled by the neighbour dummy in Sys18, and even in that case, non-significantly different from the neighbour.

According to the findings in Table 4, the spatial economic structures are defined by the Land Price and *not* by the Built Price, as theoretically expected. The dummies for overpricing were positive, significant and non-different when used together (Sys18), but the monopoly dummy was non-significant when including the income elasticities (Sys19), and the elasticities were never significant (Sys13, Sys14 and Sys19). The reasons for overpricing in the northern zone of the city are not in the built environment market, but in the land market.

According to all the results presented, any land overpricing observed in northern zones of Barranquilla during 2001-2010, does not coincide with higher (and even significant) income-to-land price elasticities. In addition, over-pricing is lower (or equal) in the land monopoly zone than in neighbouring control zones. Consequently, we must reject the existence of a spatial land monopoly in our case study.

We have not found evidence of a land monopoly *à la Evans*, in a case study that satisfies the theoretical requirements for such a behaviour (Deng, 2013; Houghton, 1993). From this, there is an important policy implication: landowners' strikes are not feasible in the long term, land taxation and value capture strategies are market neutral, and cannot be passed forward to final land market users (Garza & Lizieri, 2016).

CONCLUSIONS

In this paper, we have sought to explore the economics of land monopoly in the context of a city in an emerging economy that has undergone significant urban transformation. If landowners with a monopolistic holding of key sites can exploit their ownership, they may be able to capture excess profits, affecting the distribution of the benefits of urban growth and the impact of urban policies like value-capture or land taxes. While there has been a refocusing of attention on the importance of real estate and capital flows into and out of property markets in urban studies, there has been less attention to land and land ownership and we have sought to make a contribution in that area.

According to the Coase paradox, land monopoly is a theoretical impossibility when land is a commodity with its rent purely determined by location; but it becomes feasible if it is bundled with the public goods that make that land suitable for urban uses. In this last case, there will be a higher degree of land monopoly pricing when the government provides the public good, land regulation is strict, and its potential users are wealthy. Land monopoly can be understood as a pricing strategy where the land rents lie 'over and above' what their location permits.

In the particular case of Barranquilla's northern fringe, a single private firm owns more than 90% of all the land, which is destined for high-income housing and commercial developments, with strict urban regulation, and where the government carries the main connectivity expenses. This firm gets urban expansion permissions and then proceeds to sell the land to best-bidder developers. All of these conditions are ideal for land monopoly pricing, and to perform formal spatial tests.

We have designed a spatial land monopoly test that uses a double spatial matrix weighting of the income to land price elasticities, and dummy variables to identify overpricing. We applied the test by using many different spatial econometric specifications, but none of these suggested

the existence of a land monopoly in the candidate zone, in spite of its high prices and extreme concentration of land ownership.

Table 4: System Estimation Monopoly tests on Built Prices (Extended Neighbour)

			Sys12	Sys13	Sys14	Sys15	Sys16	Sys17	Sys18	Sys19
Equation 1		Constant1	10.517 ***	10.664 ***	10.380 ***	-8.870 ***	-3.117 **	-4.536 ***	-5.940 ***	10.506 ***
	Theory Variables	Building Output	0.203 ***	0.188 ***	0.211 ***	0.091 ***	0.122 ***	0.114 ***	0.104 ***	0.205 ***
		Height	0.155 ***	0.186 ***	0.140 ***	0.137 ***	0.136 ***	0.140 ***	0.141 ***	0.149 ***
		Distance	-0.174 ***	-0.183 ***	-0.167 ***	1.287 ***	0.907 ***	1.002 ***	1.097 ***	-0.174 ***
		Income				-0.170 ***	-0.173 ***	-0.174 ***	-0.175 ***	
	Property Types	Empty Lot	-0.465 ***	-0.455 ***	-0.547 ***	-0.413 ***	-0.437 ***	-0.377 ***	-0.349 ***	-0.398 ***
		Residential	-0.271 ***	-0.288 ***	-0.253 ***	-0.256 ***	-0.257 ***	-0.263 ***	-0.264 ***	-0.268 ***
		Apartment	0.108 ***	0.122 ***	0.110 ***	0.121 ***	0.118 ***	0.120 ***	0.121 ***	0.113 ***
		Commercial	0.166 ***	0.166 ***	0.181 ***	0.207 ***	0.195 ***	0.198 ***	0.200 ***	0.178 ***
		Industrial	-0.268 ***	-0.251 ***	-0.227 ***	-0.196 ***	-0.212 ***	-0.219 ***	-0.220 ***	-0.261 ***
	Controls	Estrato3	-0.033	0.004	-0.027	-0.027	-0.029	-0.030	-0.031	-0.032
		Estrato4	0.259 ***	0.299 ***	0.268 ***	0.273 ***	0.271 ***	0.263 ***	0.263 ***	0.255 ***
		Estrato5	0.604 ***	0.644 ***	0.606 ***	0.626 ***	0.622 ***	0.617 ***	0.618 ***	0.601 ***
		Estrato6	1.006 ***	1.056 ***	1.004 ***	1.029 ***	1.025 ***	1.025 ***	1.027 ***	1.009 ***
		Soledad	-0.114 ***	-0.080 **	-0.129 ***	-0.123 ***	-0.124 ***	-0.123 ***	-0.123 ***	-0.128 ***
		Count	0.012 ***	0.012 ***	0.014 ***	0.015 ***	0.015 ***	0.015 ***	0.015 ***	0.013 ***
Equation 2		Constant2	0.047	0.373	2.269 *	4.758 ***	3.806 ***	6.405 ***	7.141 ***	-112.42
	Determinants	Land Price	0.892 ***	0.852	1.049 ***	0.806 ***	0.893 ***	0.656 ***	0.588 ***	0.651 ***
		Land Area	-0.318 ***	-0.309 ***	-0.325 ***	-0.308 ***	-0.309 ***	-0.310 ***	-0.303 ***	-0.306 ***
		Income	0.234	0.251						7.445
	Monopoly tests	Monopoly Income elasticity · (1,000)		2.040	0.944					1.531
		Neighbour Income elasticity · (1,000)		0.344	-0.269					-0.306
		Monopoly SAR · (1,000)				2.867				
		Neighbour SAR · (1,000)				0.698				
		Monopoly Dummy					0.194		0.513 **	0.025
		Neighbour Dummy						0.276 ***	0.302 ***	0.301 ***
	Time Dummies	2001	0.310	-0.013	0.009	0.117	0.111	0.101	0.084	0.320
		2002	-0.081	-0.321	-0.379	-0.119	-0.157	-0.134	-0.141	0.142
		2003	-0.166	-0.469	-0.589 **	-0.156	-0.236	-0.188	-0.176	0.104
		2004	-0.319	-0.555	-0.678 **	-0.293	-0.362	-0.304	-0.293	-0.286
		2005	-0.383	-0.557	-0.777 ***	-0.293	-0.380	-0.298	-0.268	-0.609
		2006	-0.373	-0.639	-0.743 ***	-0.450 *	-0.499 *	-0.411	-0.392	-1.052
		2007	-0.555	-0.789	-0.913 ***	-0.653 **	-0.697 ***	-0.577 **	-0.545 **	-1.829
		2008	0.083	-0.135	-0.193	-0.083	-0.092	-0.015	-0.004	-1.283
		2009	0.343	0.096	0.028	0.199	0.178	0.244	0.261	-0.827
		2010	0.082	-0.154	-0.224	0.006	-0.038	0.050	0.057	-0.927
		Log-Likelihood	-7136	-7143	-7134	-7027	-7043	-7034	-7029	-7,129
		Akaike	4.798	4.803	4.796	4.726	4.736	4.730	4.727	4.795
		Schwartz	4.856	4.865	4.857	4.788	4.796	4.790	4.790	4.861
		S.E. of Equation 1	0.356	0.357	0.359	0.343	0.346	0.344	0.343	0.355
		S.E of Equation 2	1.857	1.854	1.874	1.846	1.853	1.835	1.831	1.838
	Wald Tests	Income Elasticities		0.466	0.599					0.588
		Spatial Lags				0.474				
		Dummies							0.320	0.417

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Wald tests reports the p-value of H_0: $\hat{\beta}_k = \hat{\beta}_l$, of the Income Elasticities, SAR Components, and Dummies

Our analysis is restricted by paucity of spatial information, which, in turn, affected modelling possibilities. The unbalanced structure of the panel information constrains our ability to produce more robust results, a problem that might be overcome by re-aggregating information

into larger spatial units (although this approach is not without its disadvantages with the larger units masking micro-level spatial effects). Regardless of these constraints, the results hold consistently for a variety of specifications, while the spatial land monopoly test is innovative and potentially replicable in other cities.

The absence of evidence of land monopoly is a valuable result for policy making, as it is the land monopoly what guarantees the possibility of long term landowners' strikes, frustrating land use regulation, planning and taxation policies. Our results imply that landowners do not have strategic behaviour, and land value capture or other exactions cannot be avoided or brought forward in the price to be paid by final land users.

Even though land monopoly pricing was not detected, the displacement of highly priced developments further north may not be a desirable result for Barranquilla. The traditional downtown is more accessible to lower income workers from the south of the city and mass public transit has yet to reach the northern area to any great extent. Moreover, as a monopolist land-market structure has not been detected, all of the welfare implications for the northern fringe development must be 'urban planning' related rather than 'market concentration' related. In this sense, even if pricing over and above location rents is not detected, the political influence of the land monopolist firm may still constitute an important source of inefficiencies and concern for an urban research agenda. By implication, the interaction between land ownership, political influence and economic power becomes a key focus for future research on urban development in growing cities.

REFERENCES

Alfonso, O. (2012), *Bogotá Segmentada: Reconstrucción histórico-social de la estructuración residencial de una metrópoli latinoamericana*. Universidad Externado de Colombia, Bogotá.

Anas, A; R. Arnot and K. Small (1998), Urban spatial structure. *Journal of Economic Literature* 36–3, 1426-1464.

Anselin, L.; J. Le Gallo and H. Jayet (2008), Spatial panel econometrics. In L. Matyas, and P. Sevestre (eds), *The Econometrics of Panel Data: Fundamentals and Recent Developments in Theory and Practice*. Springer-Verlag Heidelberg, Berlin

Carazo, C. (2011), Regulación urbana, precio e informalidad de la vivienda en Cartagena de Indias. *Revista de Economía del Caribe* 8, 167-201.

Christophers, B., (2010). On voodoo economics: theorising relations of property, value and contemporary capitalism. Trans. Inst. Br. Geogr. 35, 94–108.

Coase, R. (1972), Monopoly and durability. *Journal of Law and Economics* 15, 143-49.

Deng, F. (2009), Comparative urban institutions and intertemporal externality: a revisit of the Coase conjecture. *Journal of Institutional Economics* 5, 225-250

Ekonomakis, G. (2003), On absolute rent: theoretical remarks on Marx's analysis. *Science & Society* 67(3), 339-348

Elhorst, P. (2014), *Spatial Econometrics: From Cross-Sectional Data to Spatial Panels*. Springer Briefs in Regional Science.

Evans, A. (2004), *Economics and Land Use Planning*. Blackwell Publishing, Oxford.

Evans, A. (1991), On land monopoly rent. *Land Economics* 67 – 1, 1-14.

Fischel, W. (1985), *The economics of zoning laws*. The John Hopkins University, Baltimore MD.

Foldvary, F. (1993), On monopoly rent: comment. *Land Economics* 69 – 1, February, 108-110.

Garza, N. & C. Lizieri (2016), A spatial-temporal assessment of the Land Value Development Tax. *Land Use Policy* 50, 449-460.

Garza, N. & R. Tovar (2009), El mercado de vivienda en Barranquilla y el sector externo de la economía. *Revista de Economía del Caribe* 4, 181-209.

Gibbons, S. and M. Overman (2012), Mostly pointless spatial econometrics. *Journal of Regional Science* 52 – 2, 172-191.

Gotham, K.F., (2006). The secondary circuit of capital reconsidered: globalization and the U.S. real estate sector. *American Journal of Sociology* 112, 231–275.

Haila, A. (2016), *Urban Land Rent: Singapore as a Property State*. Wiley Blackwell, Oxford

Halbert, L., J. Henneberry and F. Mouzakis (2014) The financialization of business property and what it means for cities and regions. *Regional Studies* 48, 547–550

Harvey, D. (1974), Absolute rent and the structuring of space by governmental and financial institutions. *Antipode* 6(1), 22-36.

Houghton, T. (1993), On the nature of real estate, monopoly and the fallacies of "monopoly rent". *International Journal of urban and Regional Research* 17(2), 260-273.

Jaramillo, S. (2009), *Hacia una Teoría de la Renta del Suelo Urbano*. CEDE – Universidad de los Andes, Bogota, Colombia.

Lacombe, D. (2004), Does econometric methodology matter? An analysis of public policy using spatial econometric techniques. *Geographical Analysis* 36(2), 105-118.

Le Sage, J. and K. Pace (2009), *Introduction to Spatial Econometrics*. CRC Press – Taylor and Francis Group, Boca Raton FL.

Liu, X. and L. Lee (2013), Two-stage least squares estimation of spatial autoregressive models with endogenous regressors and many instruments. *Econometric Reviews*, 32 – 5, 734-753.

Lizieri, C. (2009) *Towers of Capital.* Blackwell-Wiley, Oxford

Lizieri, C. and K. Pain, (2014). International office investment in global cities: the production of financial space and systemic risk. *Regional Studies* 48, 439–455.

Muñiz, I.; A. Galindo & M. García (2003), Cubic-spline population density functions and satellite city delimitation: the case of Barcelona. *Urban Studies* 40(7), 1303-1321.

Needham, B. (1992), A theory of land prices when land is supplied publicly: the case of the Netherlands. *Urban Studies* 29 – 5, 669-686.

Needham, B. (1981), A neo-classical supply-based approach to land prices. *Urban Studies* 18 – 1, 91-104.

Needham, B.; A. Segeren & E. Buitelaar (2011), Institutions in theories of land markets: illustrated by the Dutch market for agricultural land. *Urban Studies* 48(1), 161-176.

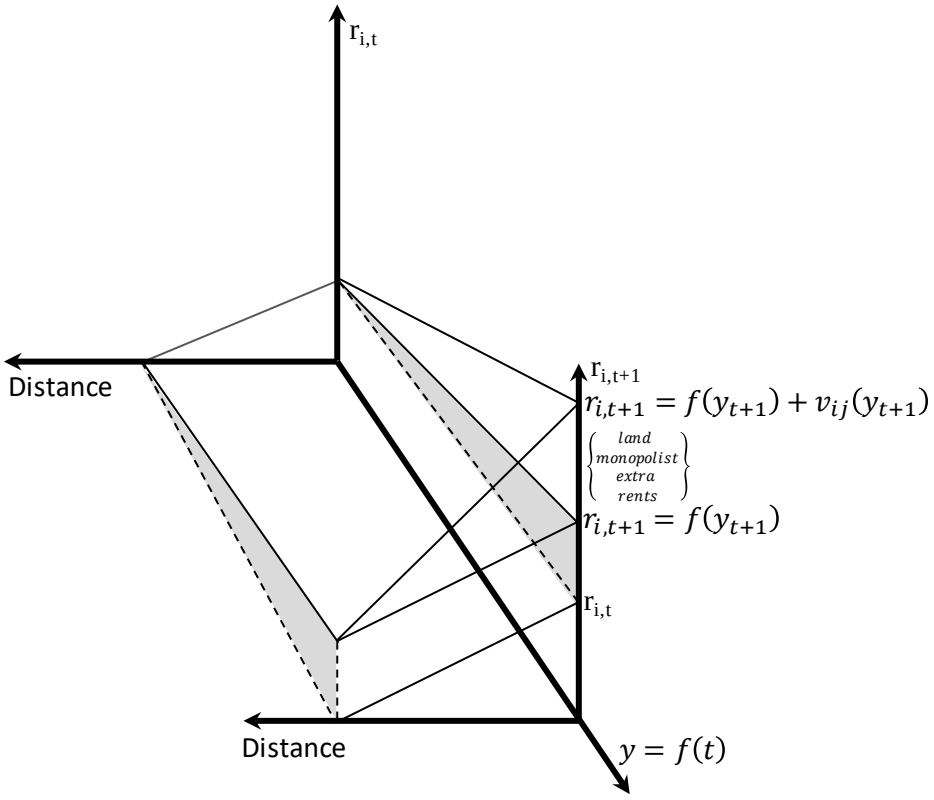
Park, J. (2014), Land rent theory revisited. *Science & Society* 78 – 1, 88-109.

Payares, D. (2012), Estimación del potencial de valorización del suelo en Barranquilla en el periodo 2001–2011: estimación de efectos fijos en datos de panel. *Revista de Economía Del Caribe* 10, 65-91.

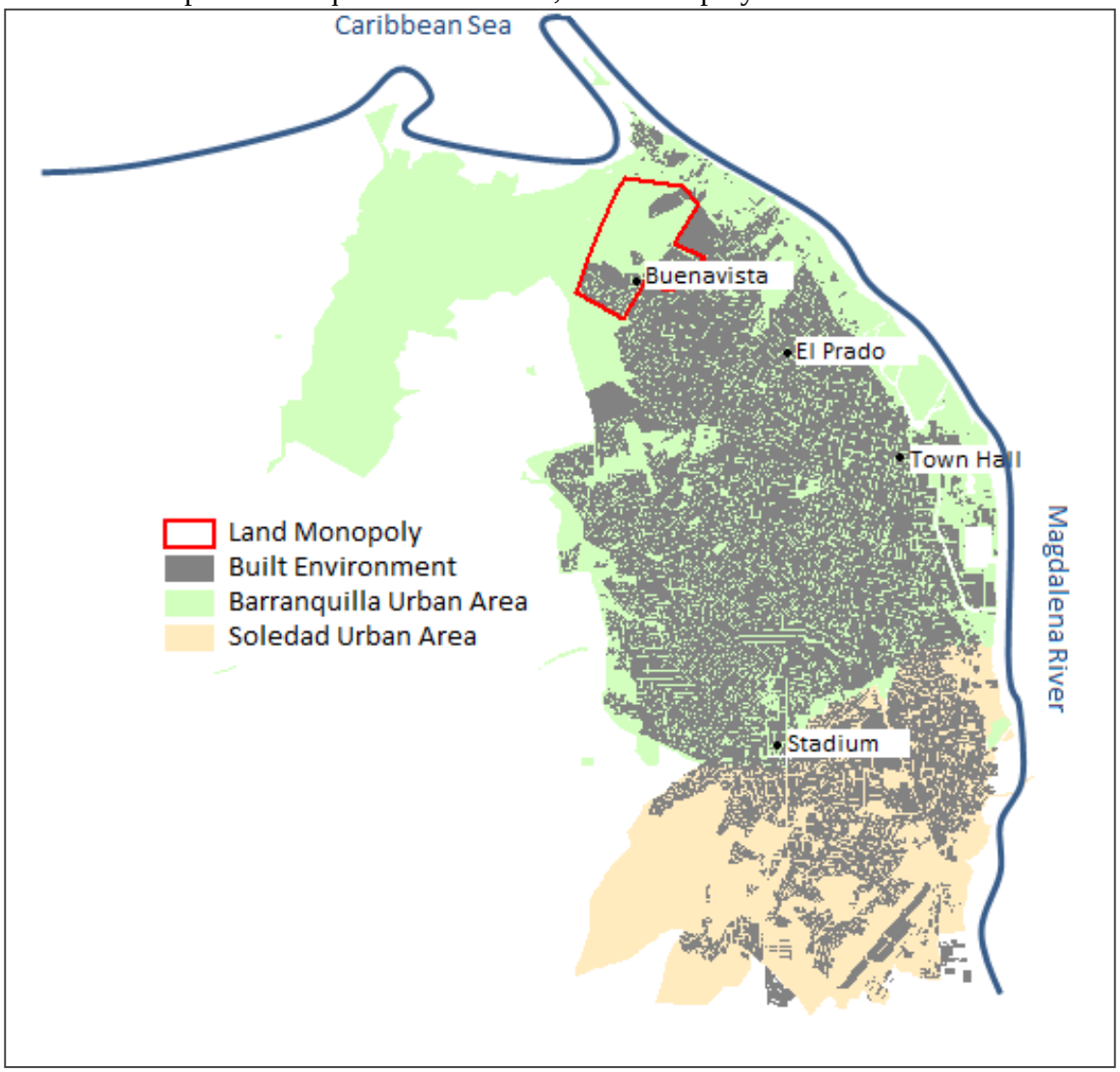
Rey, S. & M. Boarnet (2004), A taxonomy of spatial econometric models for simultaneous equations systems. in L. Anselin, et al. (eds), *Advances in Spatial Econometrics: Methodology, Tools and Applications*. Advances in Spatial Science – Springer-Verlag, Berlin.

Ward, C. & M. Aalbers (2016), Virtual special issue editorial essay: 'the shitty rent business': What is the point of land rent theory? *Urban Studies* 53(9), 1760-1783.

Figure 1: Spatial Income-to-Land-Price elasticity



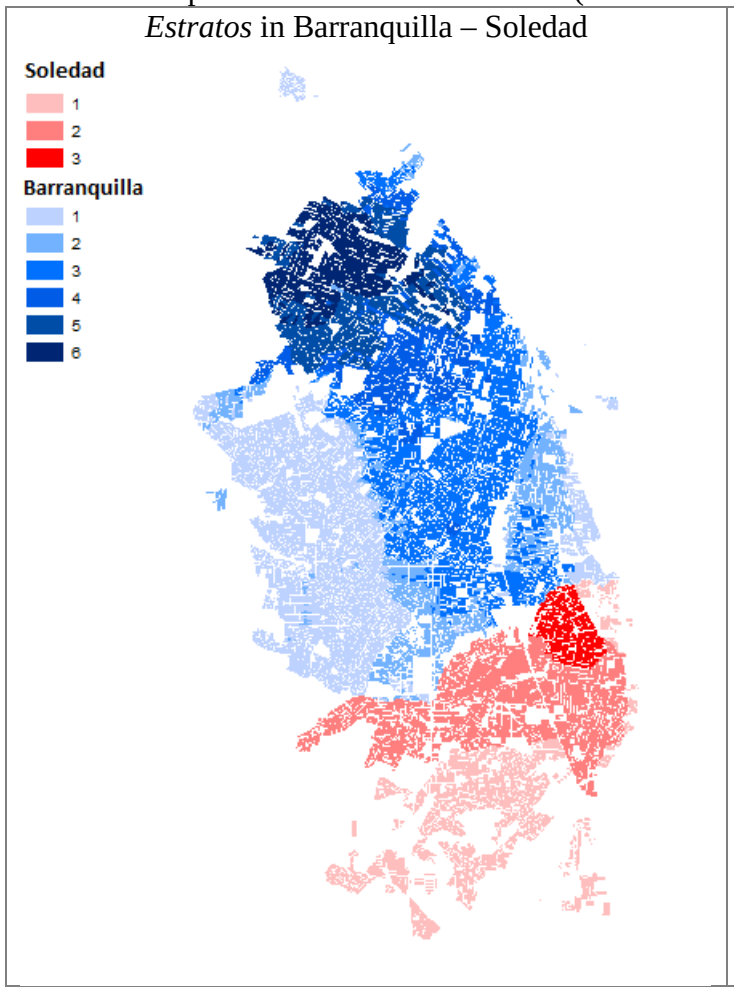
Map 1: Barranquilla and Soledad, land monopoly zone and sub-centres



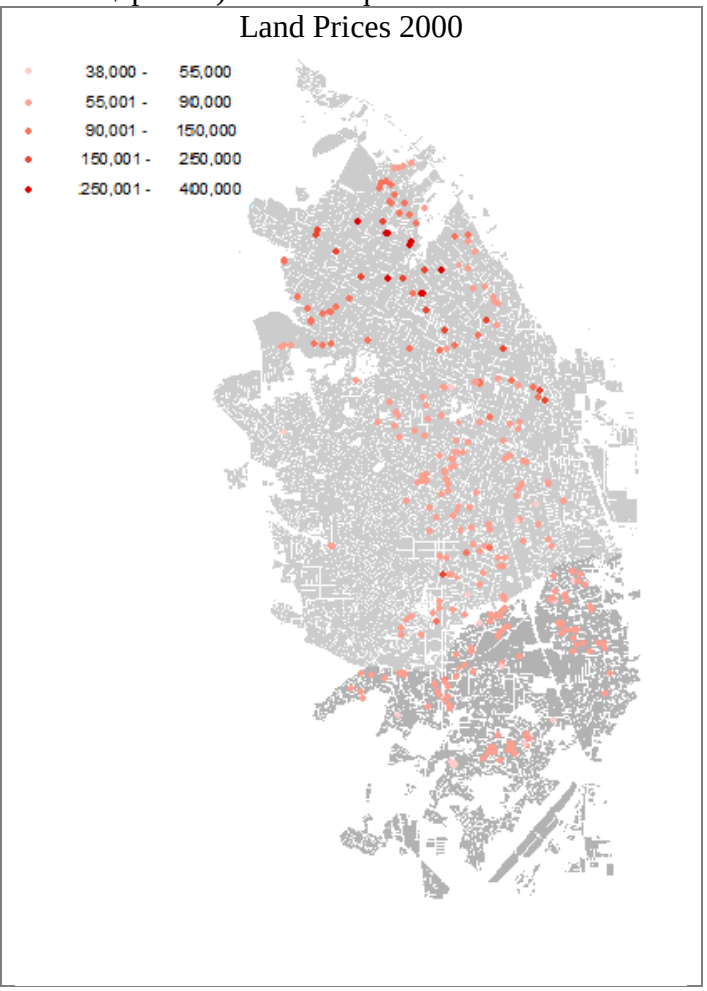
Source: Own elaboration using city cartography block level

Map 2: *Estratos* and Land Prices (2012 constant COP$ per m^2) in Barranquilla – Soledad

Estratos in Barranquilla – Soledad

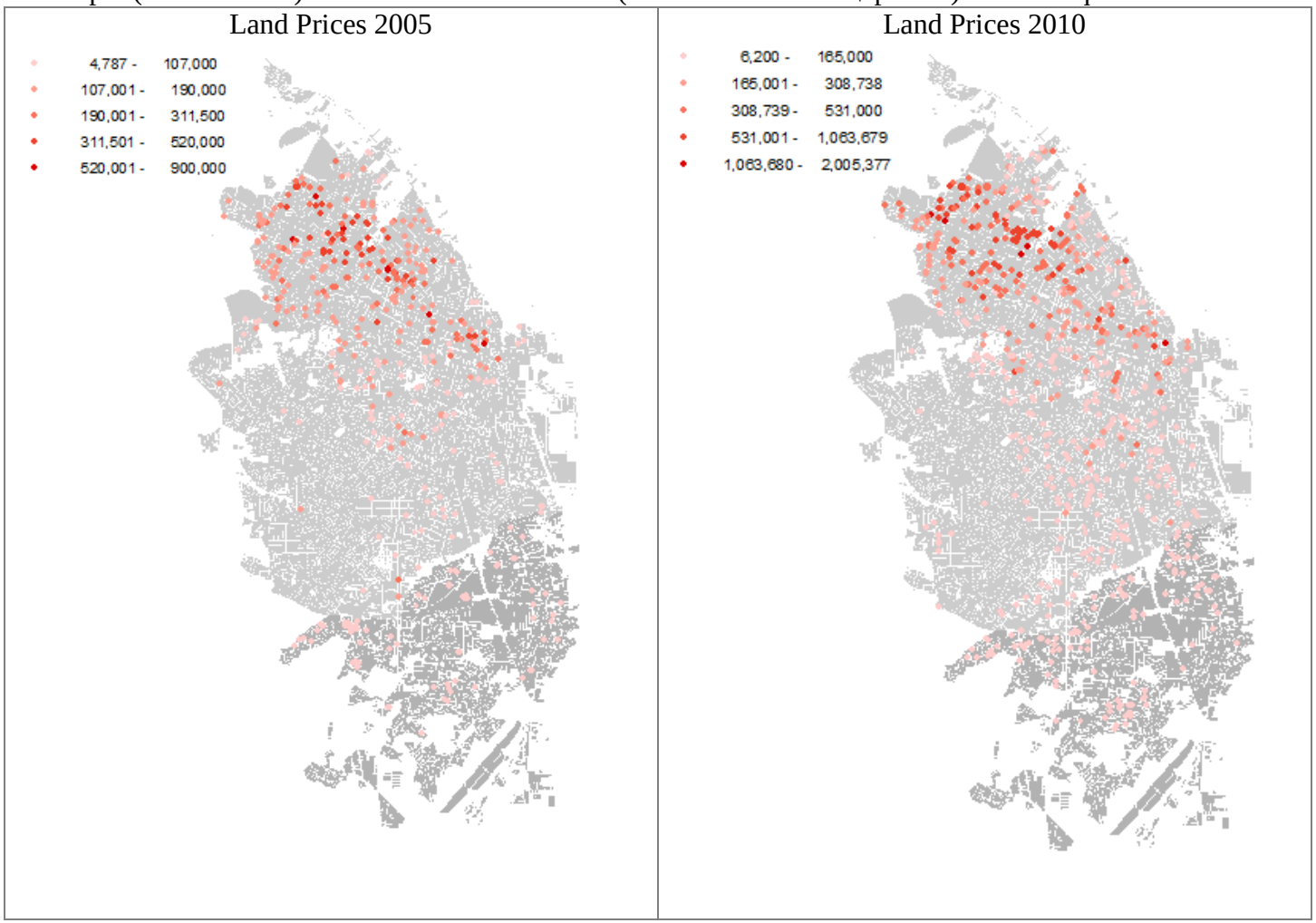


Land Prices 2000



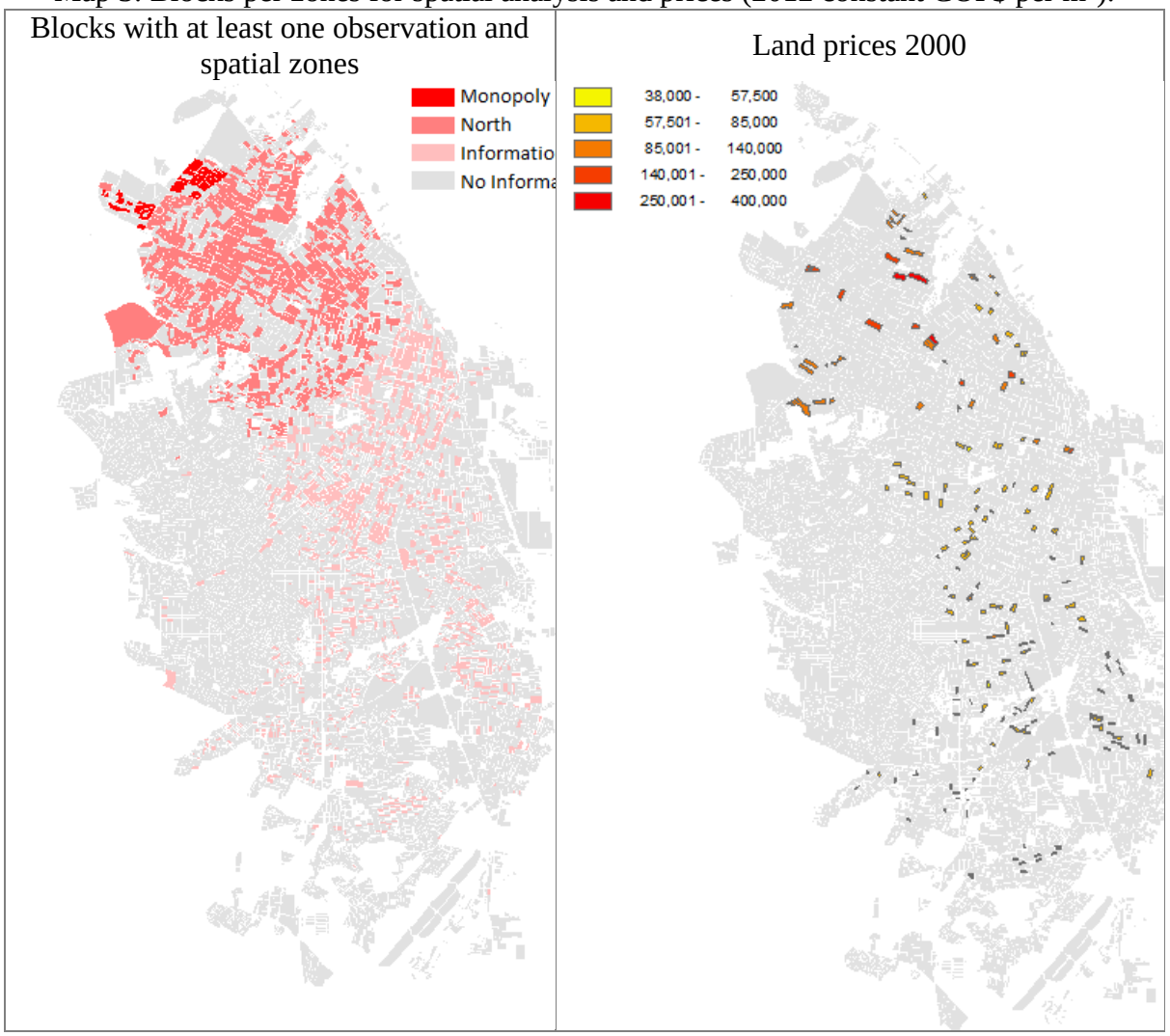
Source: Own elaboration using city cartography block level and *Lonja* appraisals

Map 2 (Continuation): *Estratos* and Land Prices (2012 constant COP$ per m^2) in Barranquilla – Soledad



Source: Own elaboration using city cartography block level and *Lonja* appraisals

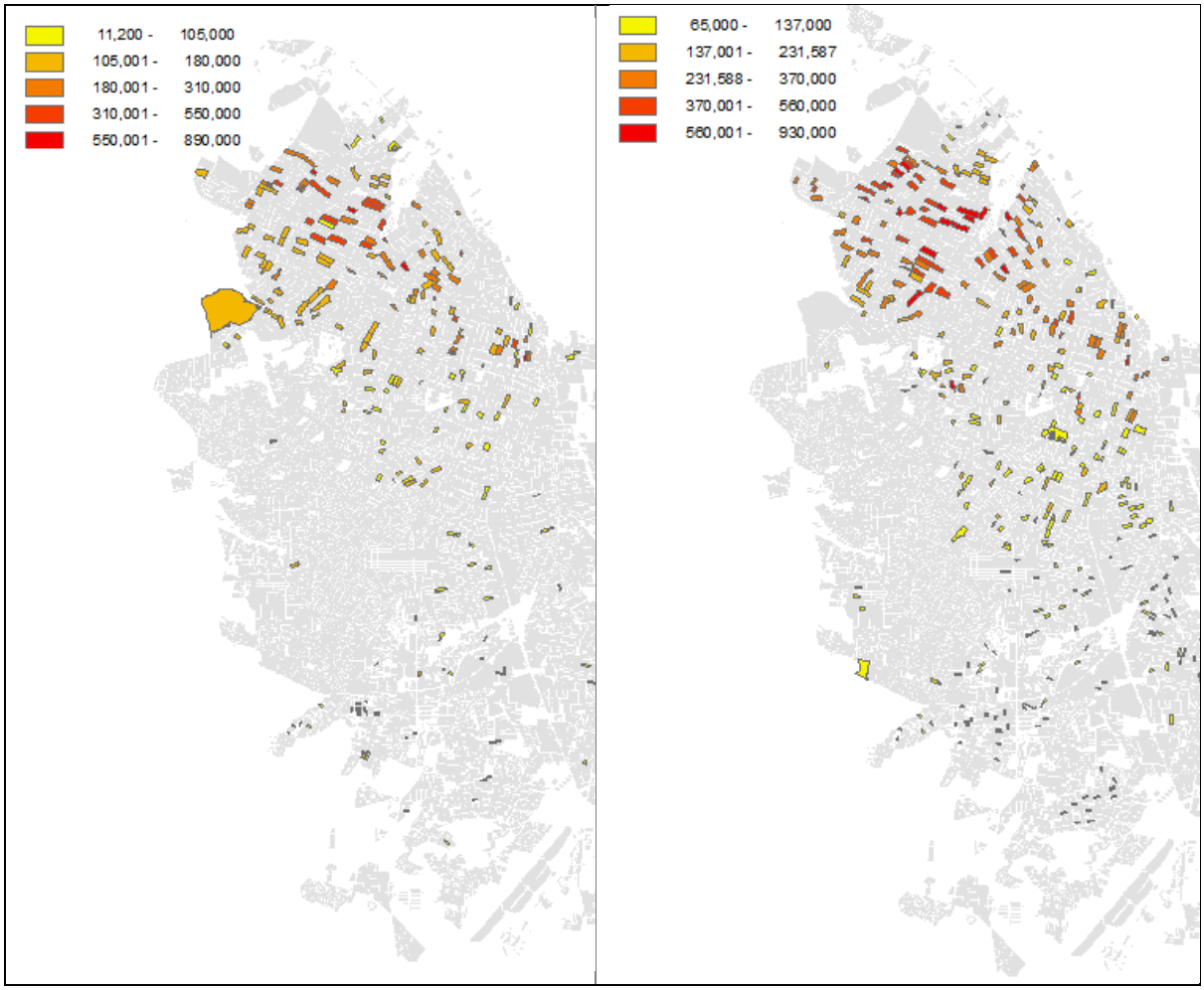
Map 3: Blocks per zones for spatial analysis and prices (2012 constant COP$ per m^2).



Source: Own elaboration using city cartography block level

Map 3: (continuation): Blocks per zones for spatial analysis and prices (2012 constant COP$ per m^2).

Land Prices 2005	Land Prices 2010



Source: own elaboration using city cartography block level