

Soccer stadiums and the property values in the city of Buenos Aires

A research study by Federico Catalano

Abstract

Buenos Aires is one of the cities with the highest number of professional soccer stadiums in the world. Located in residential areas, the massive events that take place there arouse certain debate. The inconveniences that they generate for the inhabitants of the surrounding areas are usually interpreted as a negative factor.

Therefore, the main objective of this study was to evaluate whether the proximity to a soccer stadium is an attribute that does or does not depreciate the economic value of properties for sale.

The study was carried out using an original database created using web scraping techniques, including approximately 10,000 ads of properties for sale: houses, apartments, house-type apartments (PH) and lots.

Results show that distance to a soccer stadium is not statistically significant in the conformation of properties' sale prices. On the other hand, other factors of the urban environment where they were located were identified as relevant.

Among properties' characteristics that most influenced the price structures were the level of provision of urban services and the constructive quality of the surrounding homes.

Finally, this study suggests an alternative vision regarding stadiums, emphasizing on the recreational activities they offer and the possibility of enhancing the social role of clubs in local communities.

1. Introduction

Many times, the idea that soccer stadiums depreciate the economic value of properties is often fallen back on. A test case of this issue is the recently raised debate from the "Nuevo Gasómetro"¹ project in the Boedo neighborhood.

In spite of this, we must not forget that a stadium is both a space for the development of sports events as well as the headquarters of an institution with a strong local anchor that promotes the development of different types of social activities and community integration.

Likewise, the impact of the stadiums is directly linked to the environment that contains them and their planning in project terms (that is, as individual and urban projects). Thus, it is clear that a soccer stadium does not necessarily generate negative externalities. To demonstrate this, we refer to what occurred with the urban properties located in the vicinity of the soccer stadiums of the English Premier League².

Therefore, the way in which a stadium impacts on the value of properties will depend on how modern it is, the area in which it is located and the role that the institution plays within the local community.

1.1. Can the economic effects of a stadium be estimated?

As the specialized literature suggests, the construction of a soccer stadium is primarily an urban project.

As such, it is expected that the effects will not occur in isolation but rather by modifying the functioning of the urban system as a whole. In other words, if the price of properties is affected by this type of project, it is because they generate some impact on mobility, security or the supply of services in the area in question.

Therefore, before analyzing the impact that a stadium could have, we should probably take into account the previous state of the factors which that project eventually modified or could modify. That is, the main characteristics of the urban context in which it is located.

In any case, it is important to recognize that the stadiums are located in specific zones. If, for example, we were to compare the value of the square meter in the vicinity of the River and Boca

¹In December 2016, San Lorenzo signed the contract note for the sale of the lot located on Avenida La Plata 1700, an area where its former stadium was previously located.

²According to a study carried out by the Halifax consultancy agency in 2012, the properties located near the 20 stadiums that make up the English first division league saw their value rise by 137% between 2002 and the reference year of the study.

stadiums (which can be comparable as regards the attendance of fans) we could hardly establish that the differences in prices are due to the distance between the properties and the stadiums³.

Therefore, *is the proximity to a stadium the aspect that can have the greatest influence on the valuation mechanisms of a property? Or perhaps these are influenced by a series of broader factors that, as a whole, make up the surrounding urban environment?*

To answer this question, it is necessary to define a set of variables that serve to estimate a description of the urban context that characterizes the vicinity of a soccer stadium in the City of Buenos Aires.

2. The impact on prices, a question of environment?

2.1. Study Hypothesis

This article suggests that the distance to a soccer stadium cannot be a negative impact factor on the value of properties and urban land. In other words, being in its vicinity is not the main factor by which the value of a property could depreciate.

In any case, a soccer stadium is one more component of the urban landscape delimited by its location. Therefore, the value of land or of an urban property is determined by its location and the services and amenities that this brings. This is due to the urban context where it is located.

2.2. Analysis Methodology

The concept of "urban environment" was elaborated to develop this idea. Some variables were included to differentiate between the areas in which the 18 soccer stadiums of the City of Buenos Aires are located.

Considering that "these structures constitute spaces of unusual dimensions" (Rioja Marcos, 2004, p.409), the areas where they are located can be distinguished from the rest of the city in terms of their urban integration level.

In other words, the extension of the areas where soccer stadiums are located can have an impact on the level of urban services provision, on the number of passable roads, open spaces and habitable dwellings or even on the population density. That is, at urban consolidation level.

To characterize the environments in each of the areas of influence, the constructive quality of the dwellings, the number of inhabitants per hectare, the diversity of urban services and the distance to the stadiums were considered. With these elements, a socio-spatial segregation index and an

³According to a study recently published in the *Properati* blog, within a radius of 900mts to the Boca Juniors stadium, the value of the square meter decreased by 21% with respect to the properties that were located outside this circumference. The opposite happened in the Núñez neighborhood, where this value amounted to 35% in the vicinity of the River Stadium. Available at <http://blog.properati.com.ar/como-impactan-los-estadios-en-el-precio-de-las-propiedades>.

urban infrastructure index were designed to characterize the behavior of the properties and lots offered in the 18 areas of interest. Likewise, each variable was tested in a regression model to analyze the impact of the stadiums on the price formation mechanisms.

The construction of the indexes considered an influence buffer of 800m to a soccer stadium while for the regression analysis, the relationship between the properties offered in said buffer and another of shorter distance (450m) was considered, with the aim of verifying the property values as they got closer to the stadium⁴.

The first factor, the constructive quality of the houses, was designed by grouping the last two categories of the "*Quality of materials (Calmat*⁵)" indicator prepared by the National Statistics and Census Institute during the last population census⁶. These include homes with "weak and low resistance materials" (Quality III) and "low quality" (Quality IV) in both the roof and floors⁷. The sum of both types is used to characterize housing conditions of the different areas of influence to a stadium.

Intuitively, the supply of urban lots and properties could be affected by a greater concentration of housing with deficient materials. If the distribution of the supply varies considerably from one area to another, it could be concluded that the constructive quality in the vicinity of the stadiums may be an explanation with respect to the price levels.

The population density of each area was also incorporated: the number of inhabitants per hectare was considered for this variable. It is worth clarifying that in this calculation the population value was taken by census tract and its size⁸. In this sense, it is expected that at a higher density, the stadium will be located in central areas (or at least not exclusively residential) with higher real estate values.

Lastly, the level of urban infrastructure provision was taken into account. This indicator was constructed in two levels, both for the polygon corresponding to the census radius where the property for sale was located as well as for the influence buffer of the stadiums. This measure attempts to identify not only the intensity of services but also their diversity. A higher level of services could be biased by the concentration of a specific factor. Therefore, it is not only important

⁴Only these properties were taken to diminish undesired effects of cases that could capture the influence of areas too far away or that had little to do with the phenomenon analyzed.

⁵'Calmat' is the abbreviation for 'Calidad de los materiales'. This term refers to the constructive quality of the houses.

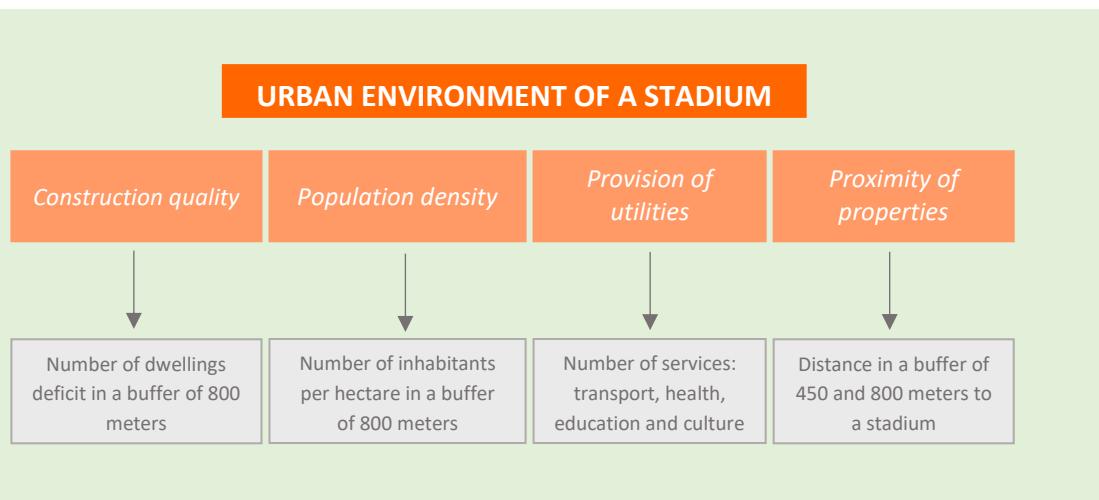
⁶As well as the level of provision of urban services such as running water and sewage, this indicator measures structural situations that vary little with time.

⁷National Institute of Statistics and Censuses (INDEC), National Population, Household and Housing Census 2010. Definitions of the REDATAM database. April 2013.

⁸For the regression model, the properties assumed the value of deficient housing and population density of the census tract where they were located. The calculation of the segregation and infrastructure indices contemplated the sum of the values of the census tracts selected in an area of 800m to the stadium.

to incorporate the quantity but also the way in which urban services are composed. That is, how much and what is in the area.

TABLE N°1 Operationalization Scheme and Definition of the Variables



2.2.1. Database construction

In order to evaluate the impact of soccer stadiums on the value of properties and urban land, a database composed of 10,759 properties for sale throughout the city was built. Among them, 4957 apartments were surveyed, 2408 house-type apartments (PH), 1914 houses and 1480 lots, all published during the third week of the month of January of the current year on the *argenprop* site.

The database was built using web-scraping techniques, computing the address, the price, the covered and uncovered surfaces, the neighborhood, the ad text and the URL for each property type.

The cartographic annex shows the territorial distribution patterns for the four types of supply. Each of these was included in the calculation of the square meter value.

The decision to combine the different property types was made with the intention of increasing the number of cases and making the price averages more robust.

In addition, the zones of influence of the stadiums concentrate specific typologies depending on the area of the city. To name just one example, it is common to find more houses and fewer apartments in Mataderos than in Caballito neighborhood. Therefore, by including all types, a greater level of representativeness in the estimates is guaranteed.

3. The supply of urban properties

3.1. Global price description: the value of the square meter from a comparative perspective

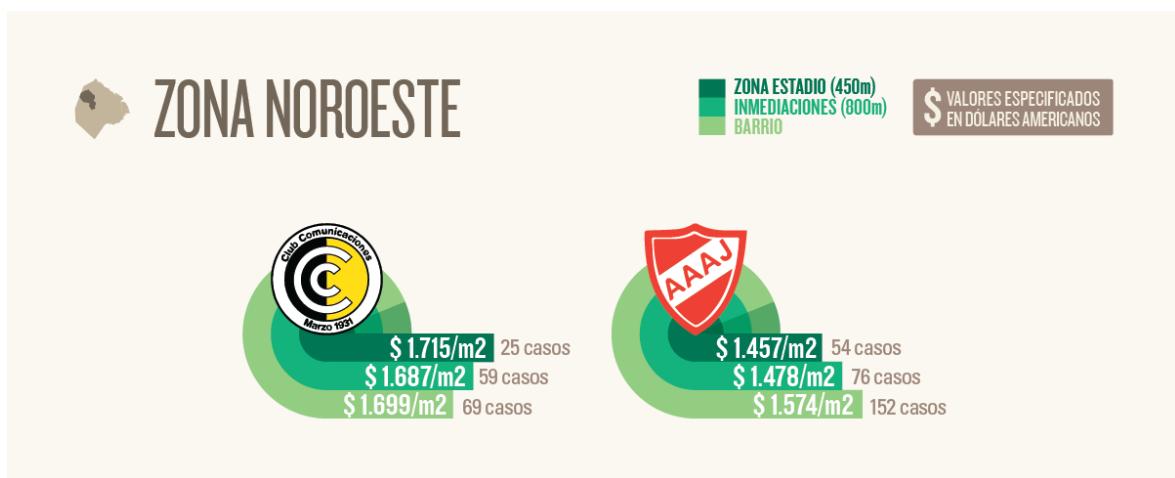
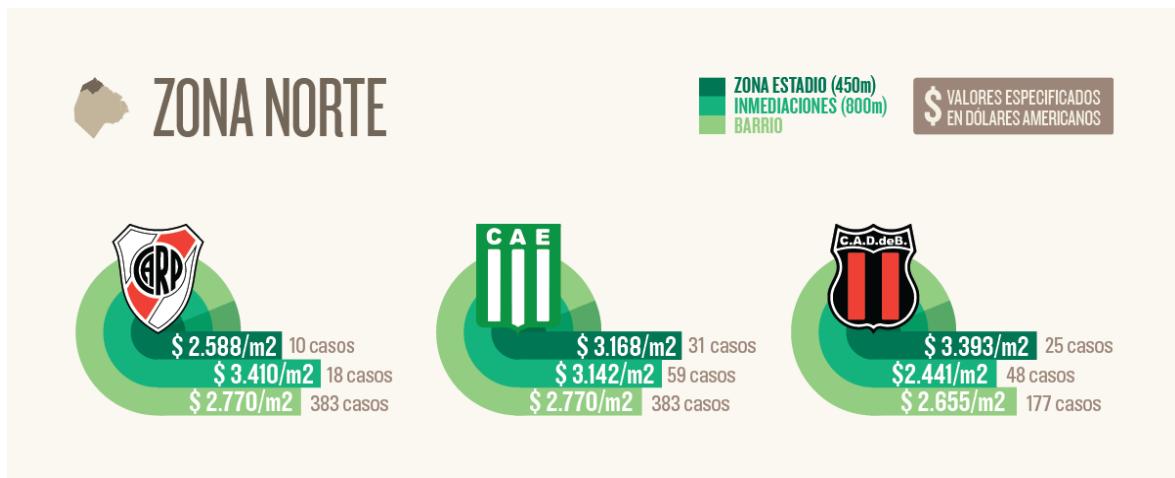
In this section we will analyze the behavior of prices comparing the average values of the square meter in three areas: in a radius of 450 m, another of 800 m⁹ and in the neighborhood where the stadium is located.

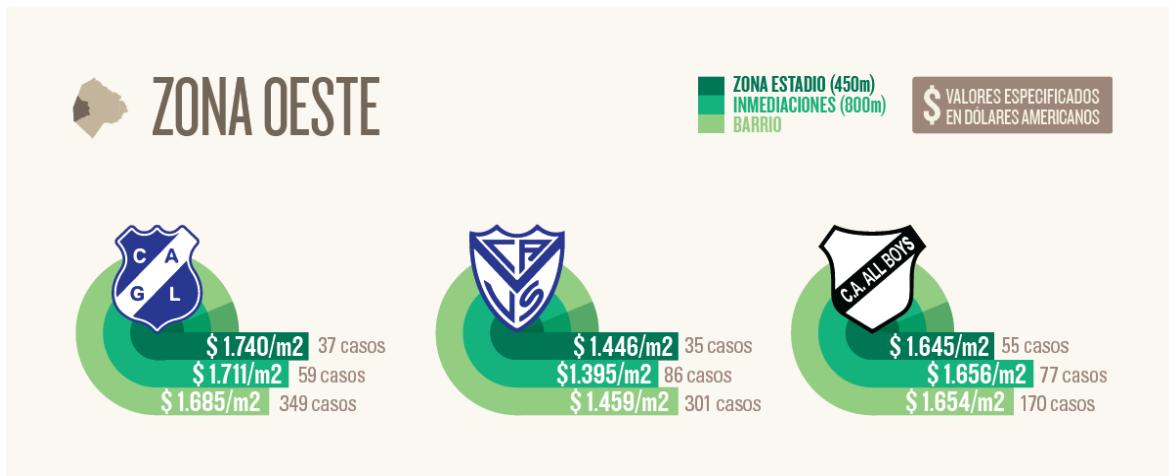
TABLE N°2 *Summary of prices for sale of properties and urban lots. January 2017.*

Team/Stadium	Neighborhood		Stadium area (450 m)		Surrounding area (800 m)	
	Usd/sqm	Cases	Usd/sqm	Cases	Usd/sqm	Cases
All Boys	1.654	170	1.645	55	1.656	77
Argentinos Juniors	1.574	152	1.457	54	1.479	76
Atlanta	2.135	489	1.915	62	2.009	158
Barracas Central	1.631	286	1.000	1	1.351	5
Boca Juniors	1.203	130	1.094	50	1.490	80
Comunicaciones	1.699	69	1.715	25	1.687	59
Defensores de Belgrano	2.655	177	3.393	25	2.441	48
Deportivo Español	1.300	182	974	3	756	4
Excursionistas	2.770	383	3.168	31	3.142	59
Ferrocarril Oeste	2.292	786	2.006	65	2.172	103
General Lamadrid	1.685	349	1.740	37	1.711	59
Huracán	1.575	195	1.025	11	1.402	21
Nueva Chicago	1.353	314	905	15	1.108	20
Riestra	709	17	0	0	499	1
River Plate	2.770	383	2.588	10	3.410	18
Sacachispas	709	17	0	0	877	3
San Lorenzo	1.736	532	0	0	755	3
Vélez Sarsfield	1.459	301	1.446	35	1.395	86

Source: own elaboration based on web-scraping over argenprop.com

⁸The limit of 800 m was established considering that the area of influence should not capture external effects. That is, they were not associated with the stadium. In turn, a larger size was assigned to the first buffer since near the stadium the volume of cases is smaller. Given the extension of the area, it is expected that properties begin to be offered only in more remote areas. By increasing the first buffer an additional 50 m, the surfaces offered are expected to agglomerate a similar number of cases.





As seen in the infographics, the square meter presents different values depending on the area of analysis. However, these differences do not seem to be too great.

While in twelve of the eighteen stadiums the price is higher outside the 450m limit, in most of these cases the distance is not significant. Among them we can mention the All Boys, Argentinos Juniors or Atlanta stadiums, among others.

In turn, it is interesting to see that the value of the square meter does not overly contrast in relation to the average price of the neighborhood. With few exceptions, the offer in the vicinity of the stadiums behaves similarly.

In contrast, if we focus on those cases where values do begin to show a greater disparity, it is interesting to note how they all share the same location. This relationship can be seen more clearly in the Boca Juniors, Barracas Central, Huracan, Riestra, Sacachispas or San Lorenzo stadiums. All of them in the south of the city.

It can also be seen that the offer volume is lower in the stadium areas than in its surrounding area¹⁰. This tendency is verified in most of the stadiums, being also more acute in the south of the city. Thus, it seems to be clear that as the distance with respect to stadiums increases, the offer volume grows.

3.2. Price estimation: The behaviour of the square meter towards the interior of the áreas of influence

Beyond the average prices, the value of the square meter can vary within the buffer of influence of the stadiums. That is, we can recognize areas where it is higher or lower.

In this sense, it is important to determine whether or not these areas are related to soccer stadiums. In other words, if the value of the square meter is exclusively lower near them.

For this, a process known as estimation of statistical surfaces was carried out¹¹. Briefly, this consists of extrapolating a value from a certain agglomeration of points (in our case, the offer of lots and properties).

Thus, we take the price of a square meter measured in dollars to the polygons of influence of the stadiums (a buffer of 800 m). Thus, different areas were discriminated based on said parameter to verify if there is a clear depreciation pattern near the stadiums.

The interpolation method used to define these patterns was the inverse distance weighting (IDW). Through it, the agglomeration of apartments, houses, PH and lots was taken as sampling points and a weighting coefficient was applied. The interpolation of these points was done by assigning weights to the environment data in inverse function of the distance that separated them. That is, the influence of one property in relation to another diminished with distance¹². The further away two points were, the greater the difference of the estimated values.

⁹The radios delimited for 450 m and 800 m to a stadium are different rings. The properties analyzed in the second do not include those incorporated in the calculation of the first.

¹⁰For a more detailed approach to this technique, you can review the following documentation:

www.um.es/geograf/sigmur/sigpdf/temario_6.pdf

¹¹ This operation considers the proximity of the points included in the weighting from the following formula:

As seen in the first map, the stadiums located in the areas of greatest value in the city are Defensores de Belgrano, Excursionistas, River Plate and Ferrocarril Oeste (North and Center - North).

Another interesting aspect is the distance between the price surfaces in some areas. In the south of the city, for example, a series of targets where the estimates are weakest appear. This is explained, initially, because the estimates need a certain number of points to ensure robust expected values. In other words, having a lower relative offer, the price estimate is weak.

Such is the case of Deportivo Español, Sacachispas, Riestra, San Lorenzo and Barracas Central stadiums. Although the price surfaces seem to be those with the highest rank, we should not lose sight of the fact that, given the volume of supply, the estimate is not significant. Due to the general area conditions, the value of the square meter is not only lower but there is also a smaller amount of properties for sale.

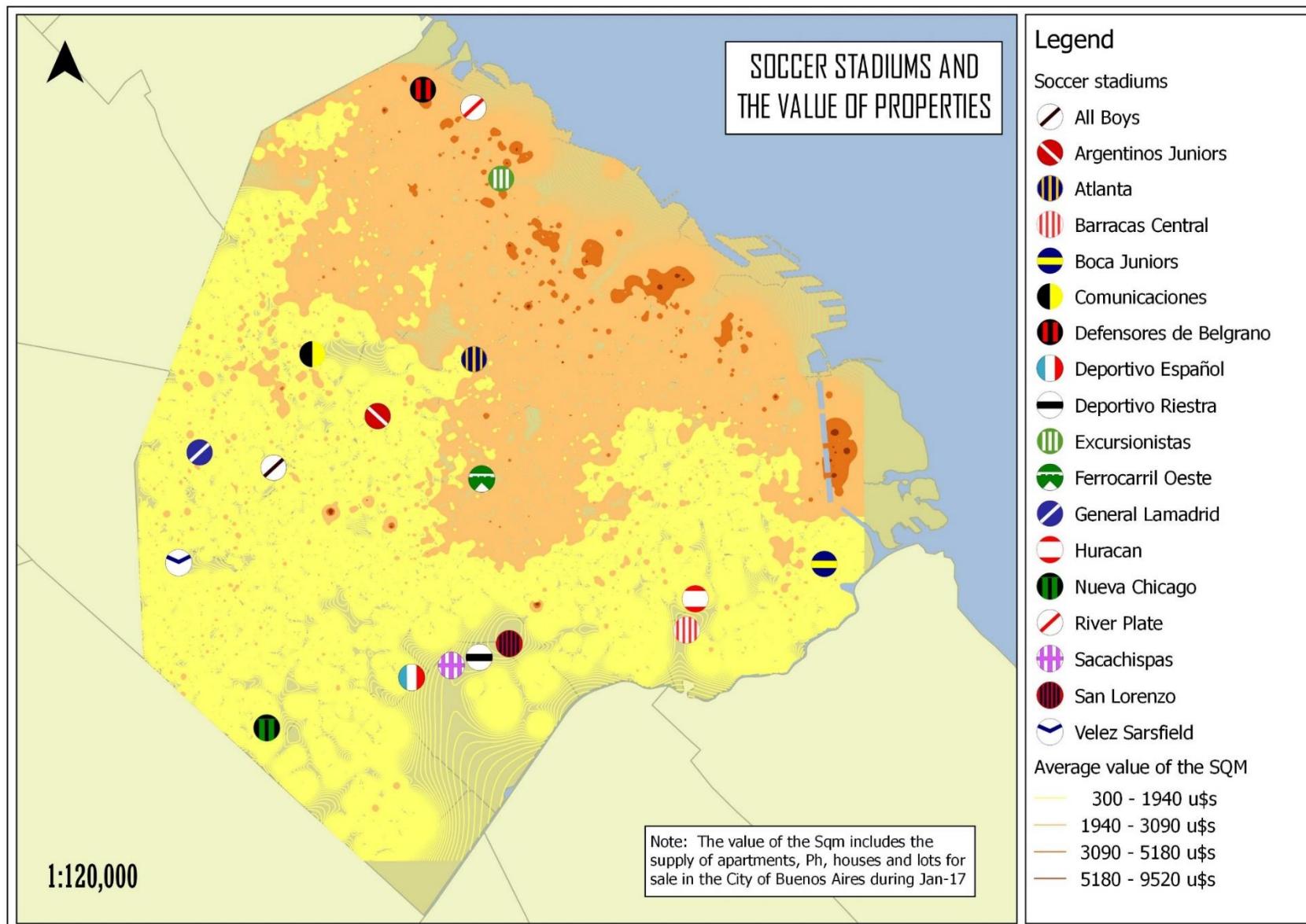
We must remember that the calculation of the extrapolation of points considers the weighted inverse distance. That is, the values of the estimated square meter grow as the distance of the point taken as reference increases. This can be deceptive for some areas. However, we must emphasize that in these cases the stadium is located in an area where open spaces predominate and, for that reason, there is a low or almost null amount of properties offered. This is replicated seen in the case of Comunicaciones or River. Green spaces predominate or there simply is no offer in some areas of these stadiums.

Beyond this, in none of the analyzed cases would there seem to be a clear depreciation pattern within the influence buffer. The stadiums can be located in more expensive areas than others, but in none of the cases would these appear to be the main cause of depreciation. In short, the price estimates make it clear that there are areas with different morphologies. That is, stadiums located in open areas with few properties for sale or in residential areas. In none of the cases these seem to be depreciation factors.

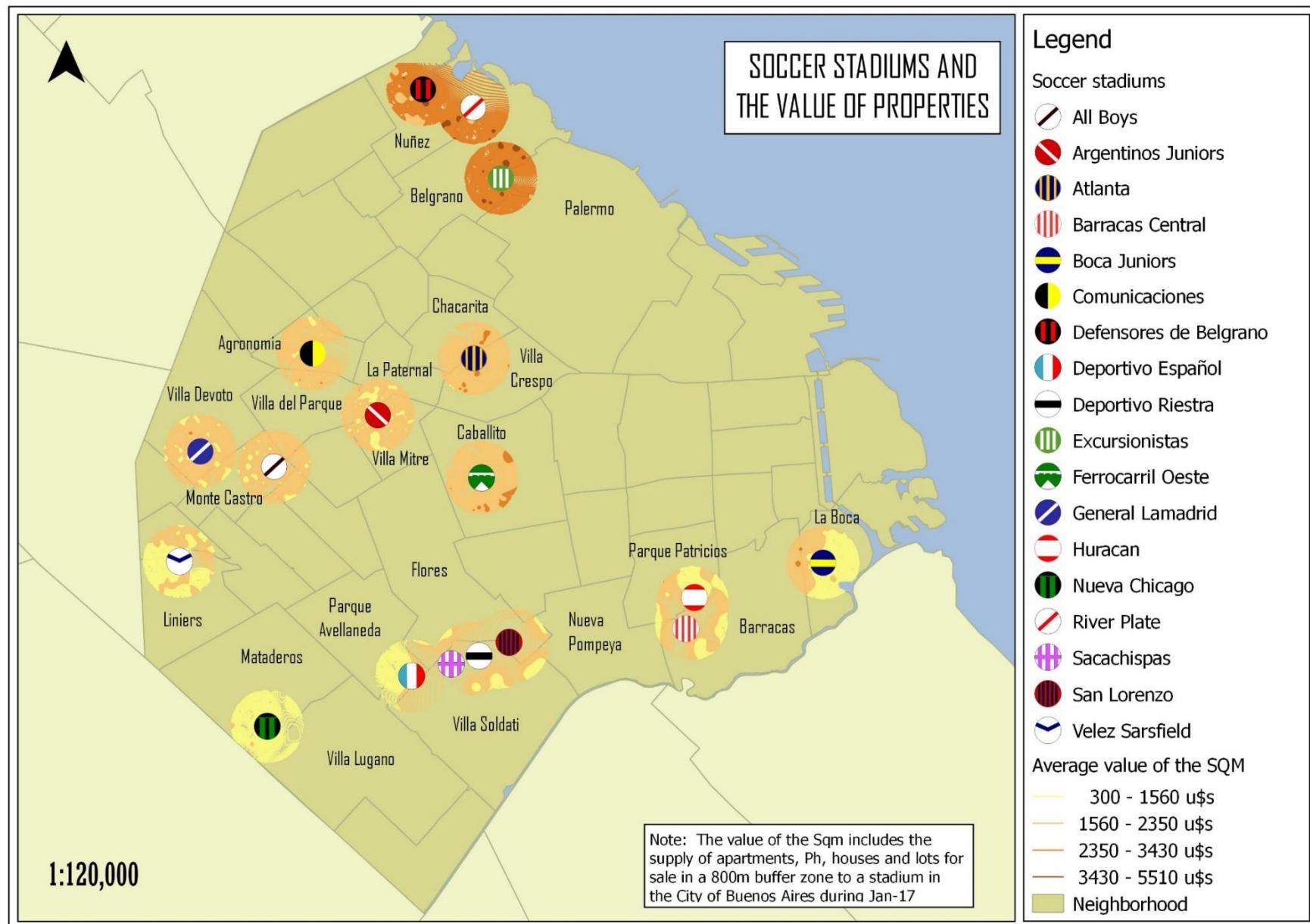
$$\hat{z}_j = \sum_{i=1}^n k_{ij} \cdot z_i$$

Where, \hat{z}_j is the estimation of a value for the point j , n is the total points used in the interpolation (in our case 10,759), z_i is the value of point i -nth and k_{ij} the weight associated to i in the node calculation j .

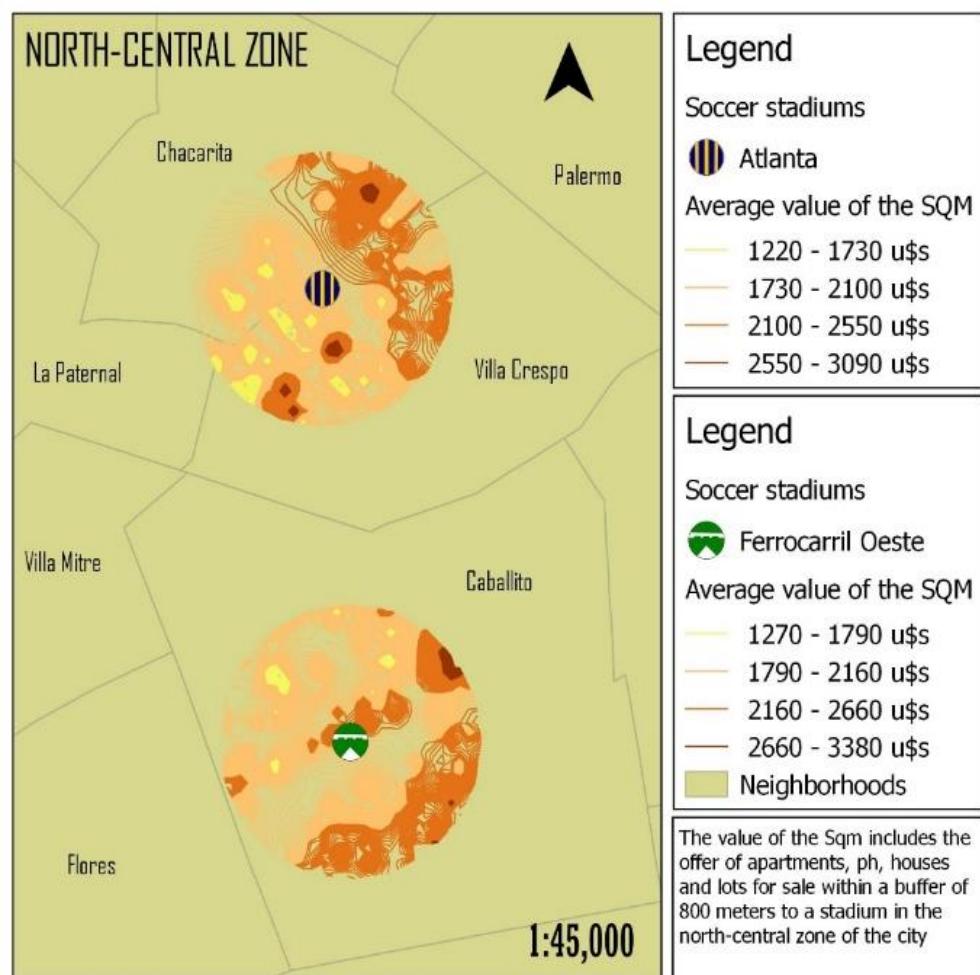
MAP N°1 Estimation of statistical surfaces: average value of the square meter in the city of Buenos Aires. January 2017



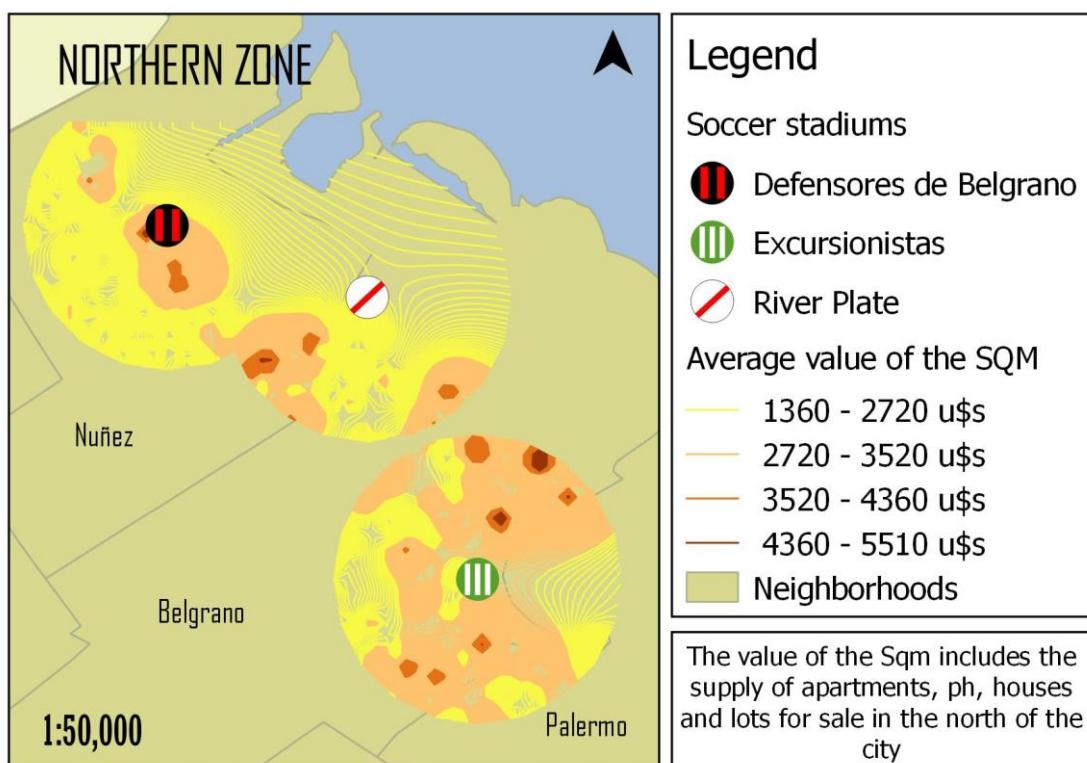
MAP N°2 Estimation of statistical surfaces: average value of the square meter in a buffer zone of 800 m to a stadium in the city of Buenos Aires. January 2017



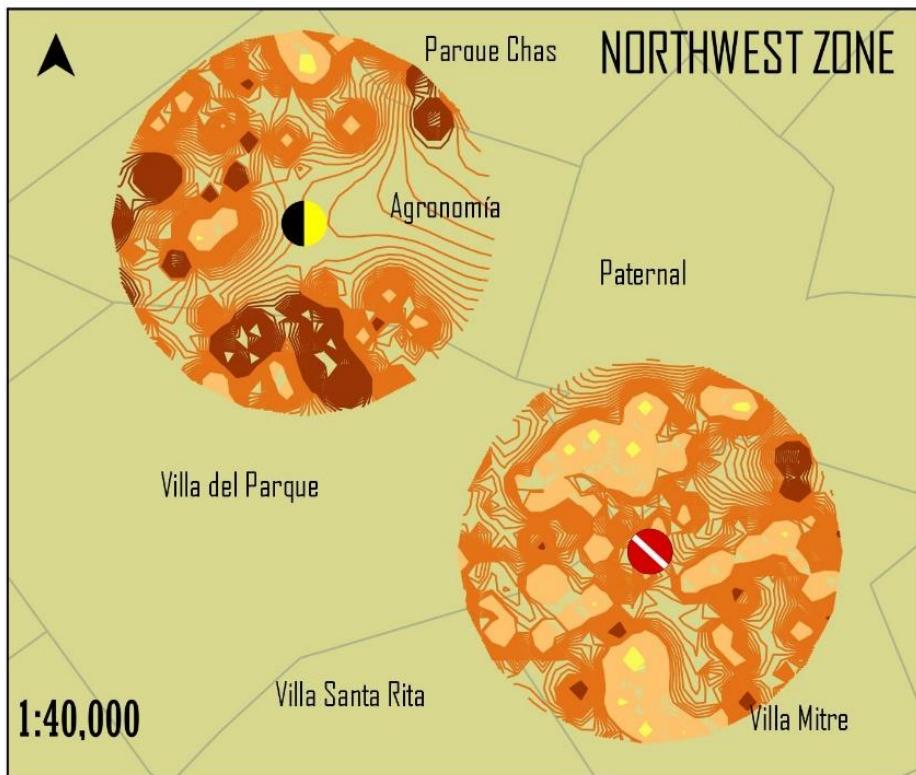
MAP N°3 Average value of the square meter in a buffer zone of 800 m to a stadium in the center-north of the city. January 2017.



MAP N°4 Average value of the square meter in a buffer zone of 800 m to a stadium in the north of the city. January 2017.



MAP N°5 Average value of the square meter in a buffer zone of 800 m to a stadium in the north-west of the city. January 2017.



Legend

Soccer stadiums

- Argentinos Juniors (Red)
- Comunicaciones (Yellow)

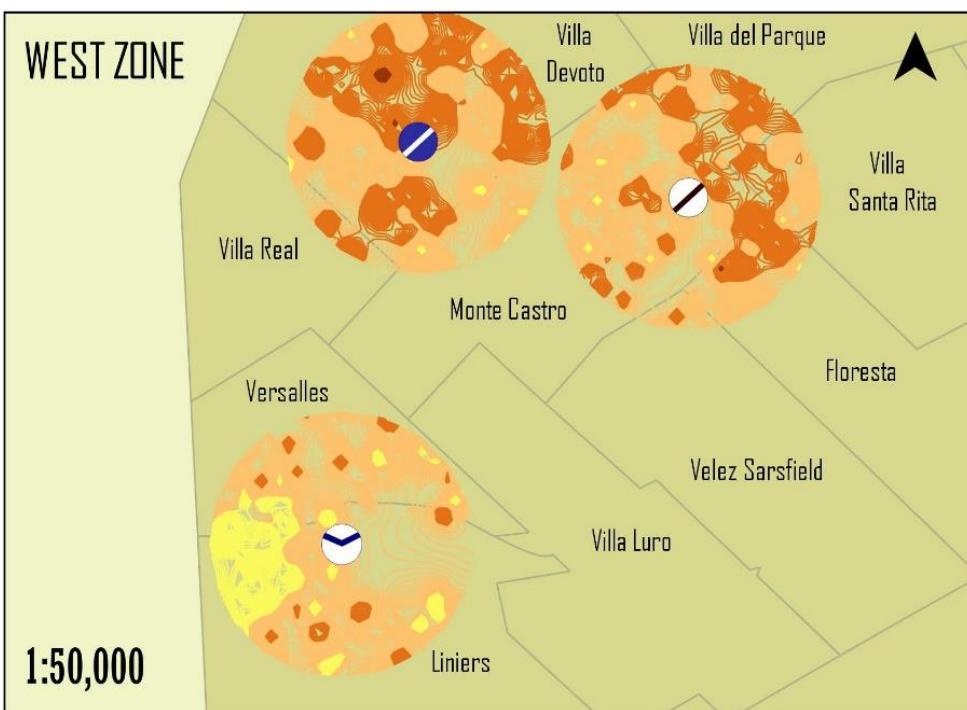
Average value of the SQM

- 800 - 1300 u\$s
- 1300 - 1600 u\$s
- 1600 - 1890 u\$s
- 1890 - 2470 u\$s

Neighborhood

The value of the Sqm includes the supply of apartments, ph, houses and lots for sale in a buffer of 800mts to a stadium in the northwest of the city

MAP N°6 Average value of the square meter in a buffer zone of 800 m to a stadium in the west of the city. January 2017.



Legend

Soccer stadiums

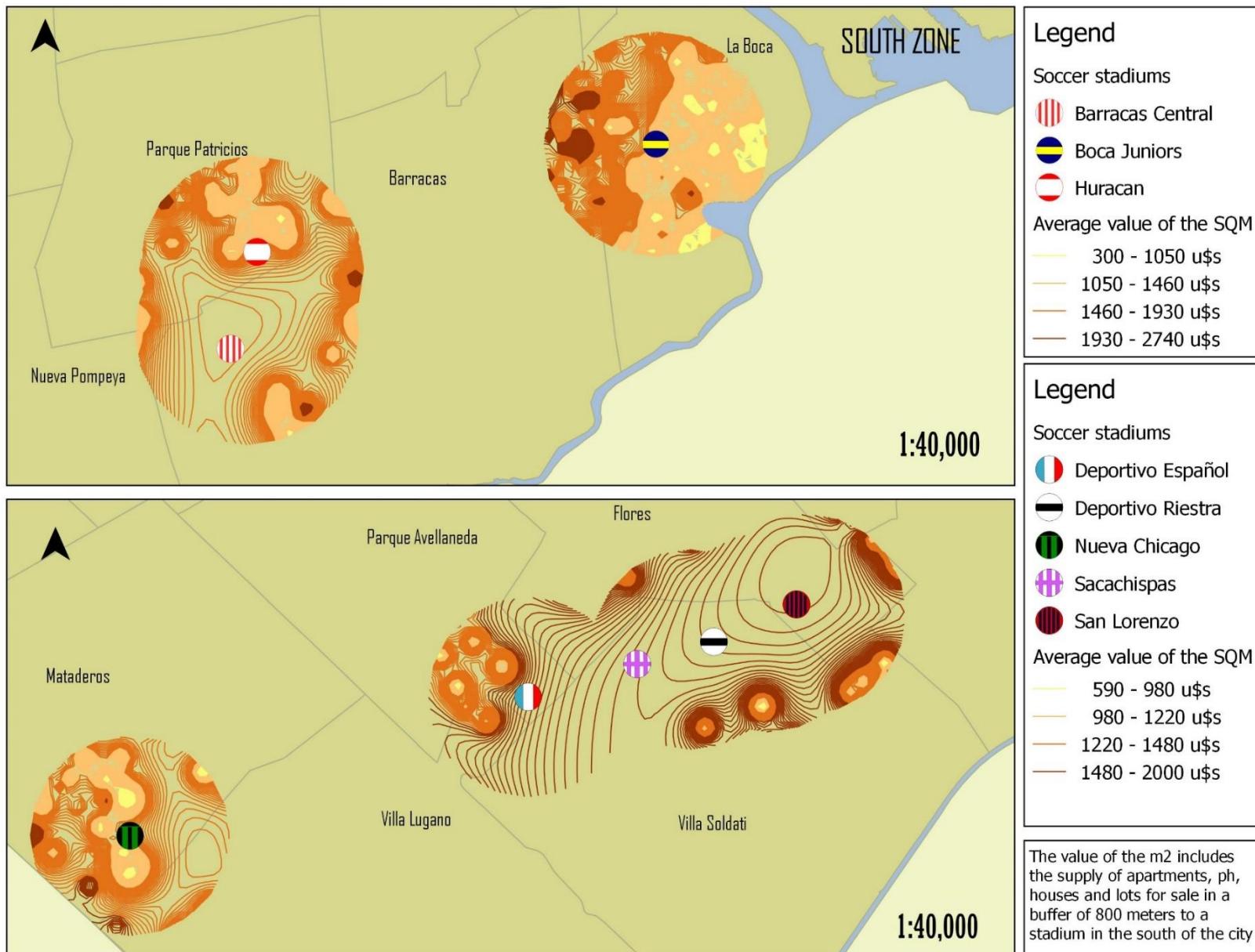
- All Boys (White with diagonal lines)
- General Lamadrid (Blue)
- Velez Sarsfield (White with chevron)

Average value of the SQM

- 870 - 1390 u\$s
- 1390 - 1720 u\$s
- 1720 - 2200 u\$s
- 2200 - 3000 u\$s

The value of the Sqm includes the supply of apartments, ph, houses and lots for sale within a radius of 800 meters to a stadium in the west of the city

MAP N°7 Average value of the square meter in a buffer zone of 800 m to a stadium in the south of the city. January 2017..



4. Prices determinants

4.1. Urban segregation and provision of utilities

As we mentioned in the methodological section, we designed the segregation and prvision indices to explain the behavior of prices in the stadiums areas. The first one describes the distribution of houses with low-quality materials within a radius of 800 meters to a stadium through the following formula:

$$Segregation = \left[\frac{Calmat5_r}{Calmat5_b} \right] / \left[\frac{Calmat6_r}{\left(\frac{Calmat6_b}{Calmat5_b} \right)} \right]$$

...where

"*Calmat5_r*" represents the amount of houses with Calmat III and IV in the census tract

"*Calmat5_b*" represents the amount of houses with Calmat III and IV in a 800m buffer.

"*Calmat6_r*" represents the amount of houses with Calmat I and II in the census tract.

"*Calmat6_b*" represents the amount of houses with Calmat I and II in a 800m buffer .

This index contrasts the population of a minority group (dwellings with poor construction quality) in a census tract, against the total population of the same minority group in a larger area of analysis . Thus, the segregation is expressed as the number of dwellings that dont have low quality materials for each house with Calmat III and IV in a buffer zone of 800m to a stadium. For its part, the level of urban equipment provision in the vicinity of the stadiums was estimated as follows:

$$Utilities = - \sum_{i=1}^S p_i \log_2 p_i$$

...where

"*S*" represents the amount of urban equipment categories considered.

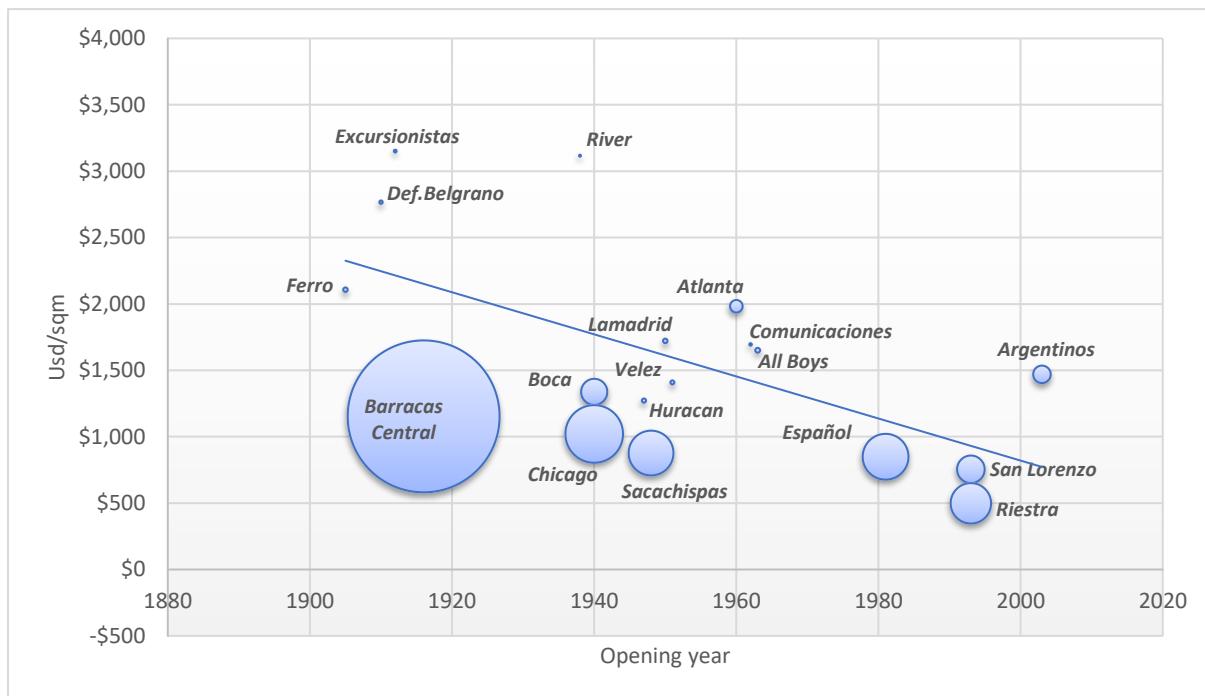
"*p_i*" represents the portion of each category in the total buffer equipment.

The urban provision considers both the quantity of equipment and its composition. The index starts at zero and has no limit, thus expressing how many equipment categories are registered in the area (diversity¹³) and the number of cases grouped by each one.

¹³ This index is known as the Shannon diversity index and is often used in ecology or environmental sciences to analyze biodiversity in natural and artificial ecosystems.

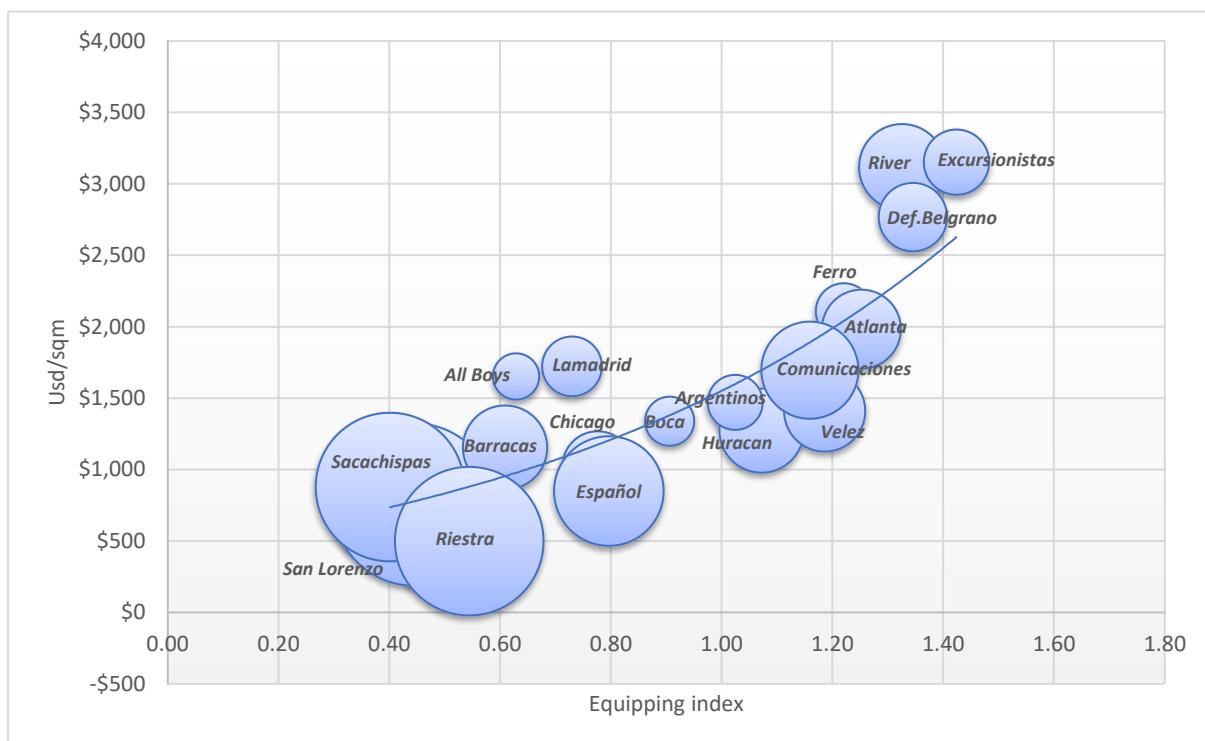
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GRAPH N°1 Average Price per square meter according to the opening year of the stadiums



Note: The size of the spheres representing soccer stadiums is proportional to the urban segregation index calculated for a radius of 800 meters. For the price per square meter the same limit is also considered.

GRAPH N°2 Price per square meter according to the equipment provision level



Note: The size of the spheres representing soccer stadiums is proportional to the minimum distance of a property within a 800-meter buffer. For the price per square meter the same limit is also considered.

Graphs 1 and 2 show the behavior of the square meter in the surrounding areas of the stadiums for the two indices. The first one reflects how beyond the antiquity of the stadiums; the price of properties and urban lots depends on two closely related factors: location and level of residential segregation.

This graph shows that the square meter is cheaper where the level of segregation is higher but, coincidentally, in stadiums located in the south of the city. The exception here is the case of Huracan. Although it is relevant to clarify that, given its proximity to the Barracas Stadium, the largest distribution of deficit housing was had by the latter.

Urban segregation shows how this type of housing is not distributed homogeneously. At higher values of the index, we can observe a tendency for deficit dwellings to cluster in a specific section of the stadium.

This is clearly seen in the case of Nueva Chicago, Barracas Central, Deportivo Español, Riestra, Sacachispas and San Lorenzo. Likewise, it can be observed that in those areas where housing with Calmat III and IV is greater, the offer of properties decreases (see Map No. 7).

In the same way, Graph 2 shows a close relationship between the price per square meter and the level of urban equipment provision. Again, the stadiums with the lowest prices are those where the provision and diversity of services is the least intense¹⁴.

Likewise, a certain relationship can be observed with the minimum distance that the properties keep. That is, the vicinity of the stadiums in the south is not only the least expensive but also where segregation is greater and the supply of properties is smaller. In other words, where the distance of the first property offered is comparatively greater than that of the rest of the stadiums in the city.

This has to do with the type of areas in which the southern stadiums are located. Given its morphology, the level of urban integration is lower.

Undoubtedly, this is the factor that has the most impact on the price level. The main difference that exists between soccer stadiums is not given exclusively as regards the value of the areas where they are located. Although there are more expensive areas than others, we could anticipate that the influence of a stadium on the price of the square meter is low. On the other hand, the quality of the urban environment can explain when and why prices fall or rise.

¹⁴ Recall that the number of train, subway, pre-metro and metro-bus stations were computed to calculate the equipping index; the number of schools and universities, hospitals and private health centers and different types of cultural dependencies such as cinemas, theaters, cultural centers, etc. This being the case, it is expected that the stadiums in the south of the city are the worst provided or those that are located in less consolidated areas in terms of urban quality.

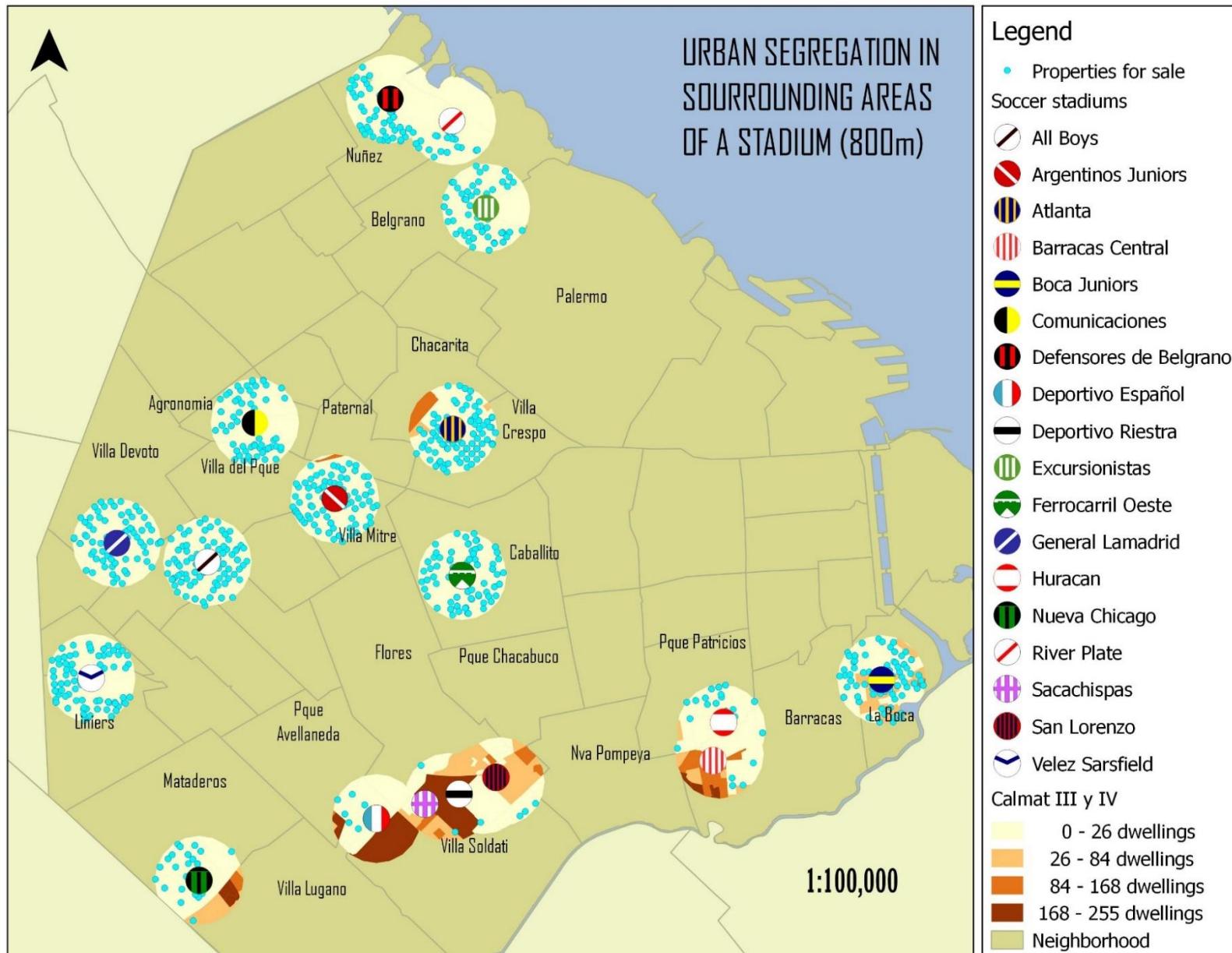
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TABLE N°3 Summary of indicators for a buffer zone of 800 m to a soccer stadium. January 2017.

Team/Stadium	Opening year	Age	Usd/sqm	Cases	Average distance	Minimum distance	Hectares	Density (Inhab/Ha)	Calmat (III y IV)	Equipping	Segregation
Boca Juniors	1940	77	1.338	130	513	68	5	248	1.096	0,91	0,0083
Huracán	1949	68	1.273	32	577	193	16	135	794	1,07	0,0001
San Lorenzo	1993	24	755	3	720	702	9	482	1.763	0,45	0,0091
Vélez Sarsfield	1951	66	1.409	121	574	180	9	111	80	1,19	0,0004
Argentinos Juniors	2003	14	1.470	130	522	84	6	169	326	1,02	0,0040
All Boys	1963	54	1.651	132	500	60	7	141	131	0,63	0,0005
Nueva Chicago	1940	77	1.021	35	511	136	12	186	1.165	0,78	0,0370
River Plate	1938	79	3.117	28	553	202	41	107	33	1,33	0,0002
Ferrocarril Oeste	1905	112	2.108	168	515	88	4	336	110	1,22	0,0004
General Lamadrid	1950	67	1.722	96	539	99	7	128	103	0,73	0,0004
Sacachispas	1948	69	877	3	661	589	15	434	1.285	0,40	0,0228
Atlanta	1960	57	1.983	220	604	170	8	220	454	1,25	0,0022
Barracas Central	1916	101	1.154	14	437	193	14	238	2.489	0,61	0,2464
Comunicaciones	1962	55	1.695	84	574	255	8	158	47	1,16	0,0002
Defensores de Belgrano	1910	107	2.767	73	541	129	18	185	83	1,35	0,0003
Riestra	1993	24	499	1	589	589	12	527	1.143	0,54	0,0187
Deportivo Español	1981	36	849	7	499	323	19	272	1.217	0,80	0,0238
Excursionistas	1912	105	3.151	90	549	118	16	330	68	1,42	0,0002

Note: "Hectares" computes the average value of a census radius in a buffer zone of 800m to a stadium. On the other hand, the distances compute the average and minimum

MAP N°8 Supply of properties on sale and urban segregation level in a buffer zone of 800 m to a stadium. January 2017.

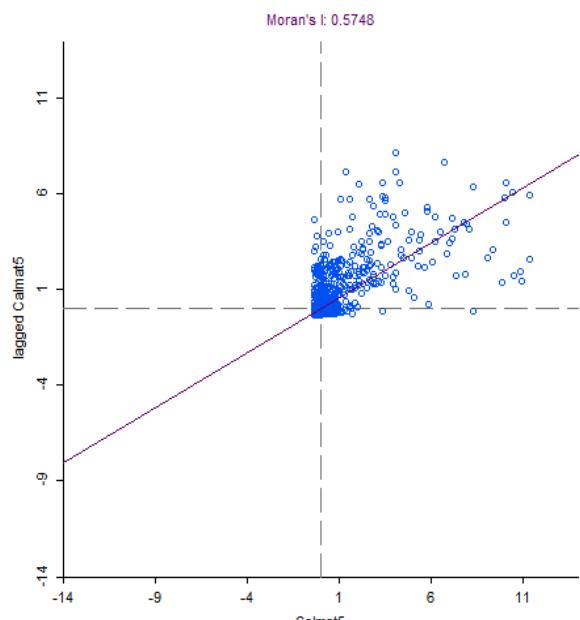


4.2. Spatial autocorrelation. Spatial distribution of déficit housing

The fact that soccer stadiums located in the south of the city show the lowest prices is not accidental. The quality of their urban environments is comparatively worse, which can be seen in the high level of concentration of housing with Calmat III and IV.

Analysis of spatial autocorrelation provided by the Moran Index shows the degree of association between the census tract and their neighbors, based on the constructive quality.

GRAPH N°3 Number of census radius according to Calmat III & IV

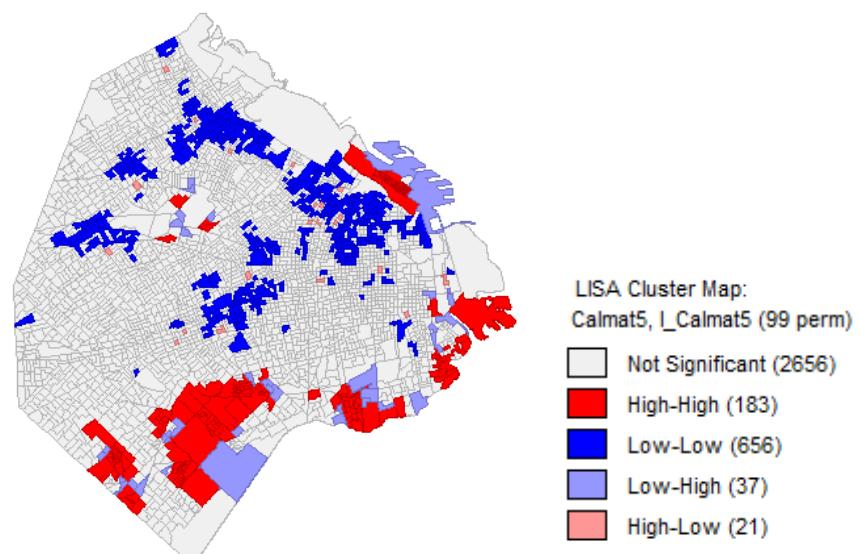


A value of 0.57 for the Moran Index indicates that there is a high probability that houses with low constructive quality were distributed with a specific spatial criterion.

The graph shows a positive relationship between the number of dwellings with Calmat III and IV and their lagged or neighboring variable. The relation between constructive quality and spatiality is not random.

As the number of this type of housing increases by radio on the X axis, the average of Calmat III and IV for the neighboring (lagged) radios does the same on the Y axis.

MAP N°9 Low quality construction housing (Calmat III y IV). Spatial correlation – Anselin
Local Moran's. CNPHV 2010



The location of these houses shows that the most affected areas of the city are located in the south. Therefore, it could be said that in this part of the city, the urban environment of the stadiums is characterized by a greater number of deficit dwellings.

4.2.1. Explanatory models: main Price determinants

Next, we evaluated two specific models to determine the impact of the stadiums and the environment variables on the value of the square meter. This assumes the following form:

$$\text{Log}(Usd/m^2) = \beta_0 + \beta_1 * \text{Superficie} + \beta_2 * \text{Densidad} + \beta_3 * \text{Calmat III y IV} + \beta_4 * \text{Dotación} + \beta_5 * \text{Estadios} + \varepsilon$$

TABLE N°4 Correlation coefficients between pairs of model variables

	Surface (sqm)	Density (Inh./Ha)	Calmat 5 houses	Urban services	Stadium distance	Buffer stadium
Surface (sqm)	1	-	-	-	-	-
Density (inh./Ha)	-0,09	1	-	-	-	-
Calmat 5 houses	0,07	-0,02	1	-	-	-
Urban services	0,04	0,19	-0,04	1	-	-
Stadium distance	-0,01	0,01	0,08	-0,16	1	-
Buffer stadium	0,02	-0,01	-0,12	0,18	-0,86	1

TABLE N°5 Regression models for the testing of the impact of stadiums

	Model 1		Model 2	
	Distance to stadium	Áreas of influence		
Surface (sqm)	B -.0004192	p-value 0.000	B -.0004196	p-value 0.000
Density (inh./Ha)	B 0.000624	p-value 0.000	B 0.000628	p-value 0.000
Calmat 5 houses	B -.0125491	p-value 0.000	B -.011053	p-value 0.000
Urban services	B .2171246	p-value 0.000	B .2126832	p-value 0.000
Distancia_Estadio	B -.0000308	p-value 0.641*	B -	p-value -
Stadium distance	B -	p-value -	B -.0070701	p-value 0.775*
Constant	B 7.23848	p-value 0.000	B 7.228054	p-value 0.000
N		B 1352		B 1352
R2		B 0.2204		B 0.2203
R2 Adj.		B 0.2175		B 0.2174

*p>0.1

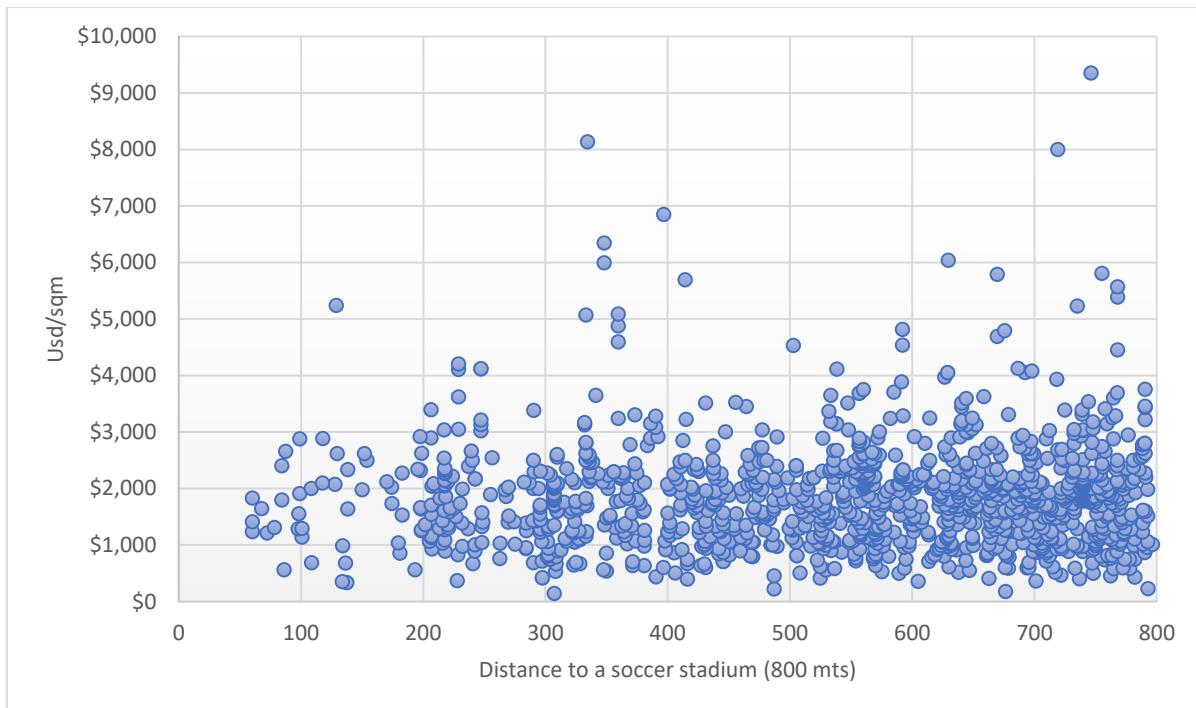
Both models confirm a clear impact of urban environment variables¹⁵. In the first place, it can be seen that the greater the offer, the prices fall. That is, for each square meter that increases the census radius where the property for sale is located, the price falls by 0.004%.

This may mean that in open or larger areas, it is likely that there will be more urban empty spaces or unused areas that affect the value of the square meter.

In line with this is the population density. For each additional inhabitant per hectare, the price increases by 0.006%. Undoubtedly, the most populated areas reflect a higher level of urban integration and, therefore, the offer of properties. In these cases, it is expected that prices will be higher.

It can also be observed that houses with poor construction qualities depreciate the value of the square meter. Specifically, for each additional dwelling of these characteristics that are in the vicinity of the stadiums, the price drops by up to 0.13% (which when dealing with a hundred additional dwellings, for example, reflects an approximate depreciation of 13%).

GRAPH N°4 Price per square meter according to the distance to a stadium



¹⁵The error distribution for the same model presented in linear terms showed a clear bias to the left. Since this does not follow a normal distribution, a logarithmic relationship between the dependent variable and its explanatory variables was considered. The graphs for the distribution of the error can be found in the statistical annex.

Among the variables analyzed, the provision of utilities level was the one with the greatest explanatory power. Table N°5 shows that for each point that this index rises, the value of the square meter can increase by 22%. This helps to understand that a property increases its value when the environment provides a greater number of amenities. That is, if they are located in areas with a higher level of urban consolidation and integration, their sale price will be higher.

Finally, evidence shows that the soccer stadiums were not significant. While model 1 incorporates the distance in meters of a property to the stadium, the second one compares the prices between the two buffers (450 and 800m¹⁵). In neither case the regression coefficient was significant.

This seems reasonable if we evaluate the behavior of the value of the square meter in Graph No. 4. Although the properties and lots supply volume grows as the distance to a stadium increases, the same does not happen with the price level. It is not clear that there is a direct relationship between distance and the value of the square meter.

5. Conclusions

Throughout the present study an attempt was made to analyze the impact of soccer stadiums on the price levels of urban properties and lots.

The different strategies deployed allow affirming that there is not enough statistical evidence to determine that stadiums necessarily reduce the value of the square meter of sale in the City of Buenos Aires.

However, the areas where they are located may vary in relation to some characteristics. Urban environments in the vicinity of a stadium have different levels of urban integration.

In this sense, these areas may vary in terms of the supply of services such as transport, education and health or population density, construction characteristics, etc., and this will not depend exclusively on the stadium itself.

Simply stated, the surrounding areas of a stadium assumes certain urban characteristics not because it is located near them but because of the place they occupy within the city.

In an area with high sales value, the square meter is hardly depreciated by proximity to a stadium. In a market as particular as real estate, where properties are not always governed by supply and demand, prices are usually defined by a set of characteristics and not by one in particular.

¹⁵In model two, a dummy variable was constructed for the properties that were within a radius of 450m. Thus, we sought to measure whether the properties in said buffer zone had a lower price than those of the 800m buffer. This, with the intention of evaluating if the price falls in the vicinity of the stadiums.

Therefore, it is expected that the value of the square meter responds to the general characteristics of the area where the property is located. Thus, we may conclude that soccer stadiums are not cause but effect of the general state of said area.

6. Statistical annex

TABLE N°6 Summary of prices of apartments for sale. Argenprop - January 2017

Team/Satium	Neighborhood				Stadium area (450 mts)				Surrounding areas (800 mts)			
	Usd	Usd/sqm	Sup	Apts	Usd	Usd/sqm	Sup	Apts	Usd	Usd/sqm	Sup	Apts
All Boys	97.714	1.984	52	28	82.857	1.957	43	14	115.686	1.808	66	7
Argentinos Juniors	114.219	1.818	65	27	106.044	1.796	62	9	101.525	1.789	60	8
Atlanta	127.539	2.187	61	304	111.405	2.083	70	23	98.283	2.023	51	112
Barracas Central	152.437	2.082	77	118	0	0	0	0	0	0	0	0
Boca Juniors	119.820	1.874	67	34	86.778	1.499	55	9	140.955	2.064	76	31
Comunicaciones	133.444	1.990	76	18	156.098	1.978	90	10	139.519	2.039	82	17
Def. de Belgrano	236.381	2.871	79	97	238.111	3.380	68	18	207.169	2.656	82	22
Español	90.832	1.667	56	19	62.000	1.069	58	1	63.000	1.125	56	1
Excursionistas	260.833	2.806	89	272	410.114	3.104	128	23	567.898	3.306	164	49
Ferrocarril Oeste	171.825	2.402	72	596	101.233	2.063	51	43	176.636	2.291	79	70
General Lamadrid	164.105	2.029	77	63	189.359	2.567	71	3	108.723	1.993	56	7
Huracan	122.617	1.850	71	72	0	0	0	0	0	0	0	0
Nueva Chicago	109.709	1.648	76	49	90.000	750	120	1	105.000	808	130	1
Riestra	45.000	900	50	1	0	0	0	0	0	0	0	0
River Plate	260.833	2.806	89	272	0	0	0	0	676.929	4.310	135	7
Sacachispas	45.000	900	50	1	0	0	0	0	55.000	1.100	50	1
San Lorenzo	128.764	1.898	72	193	0	0	0	0	0	0	0	0
Velez Sarsfield	108.858	1.694	70	60	104.000	1.490	88	8	99.947	1.623	63	19

TABLE N°7 Summary of prices of house-type apartments (Ph) for sale. Argenprop - January 2017

Team/Stadium	Neighborhood				Stadium area (450 mts)				Surrounding areas (800 mts)			
	Usd	Usd/sqm	Sup	Ph	Usd	Usd/sqm	Sup	Ph	Usd	Usd/sqm	Sup	Ph
All Boys	162.530	1.808	100	54	141.613	1.829	81	16	149.759	1.869	86	34
Argentinos Juniors	155.226	1.554	108	47	142.412	1.567	102	17	158.948	1.625	103	29
Atlanta	166.472	1.872	98	61	153.954	1.838	91	13	139.143	1.629	96	14
Barracas Central	155.134	1.387	122	74	0	0	0	0	79.000	1.013	78	1
Boca Juniors	129.719	1.236	123	36	129.176	1.258	123	17	135.909	1.387	112	23
Comunicaciones	156.241	1.817	100	29	160.857	1.820	97	7	158.600	1.719	106	20
Def. de Belgrano	270.226	2.418	112	31	219.333	3.384	63	3	231.423	2.438	98	13
Español	136.916	1.345	117	72	0	0	0	0	90.000	789	114	1
Excursionistas	229.108	2.197	113	37	330.000	2.391	138	1	165.750	1.945	83	4
Ferrocarril Oeste	197.897	1.691	125	74	224.075	1.738	140	12	215.467	1.661	145	15
General Lamadrid	170.031	1.764	113	111	140.304	1.771	91	23	180.805	1.933	105	21
Huracan	115.939	1.516	86	38	106.500	1.452	97	2	132.500	1.508	107	4
Nueva Chicago	115.713	1.422	95	122	94.714	1.061	102	7	106.445	1.159	104	11
Riestra	128.580	1.060	116	5	0	0	0	0	0	0	0	0
River Plate	229.108	2.197	113	37	0	0	0	0	455.000	2.800	148	5
Sacachispas	128.580	1.060	116	5	0	0	0	0	124.000	1.033	120	1
San Lorenzo	147.939	1.610	106	120	0	0	0	0	77.900	866	90	1
Velez Sarsfield	135.626	1.493	104	104	144.667	1.542	100	6	132.511	1.334	112	27

Soccer stadiums and the property values in the city of Buenos Aires

TABLE N°8 Summary of prices of houses for sale. Argenprop - January 2017

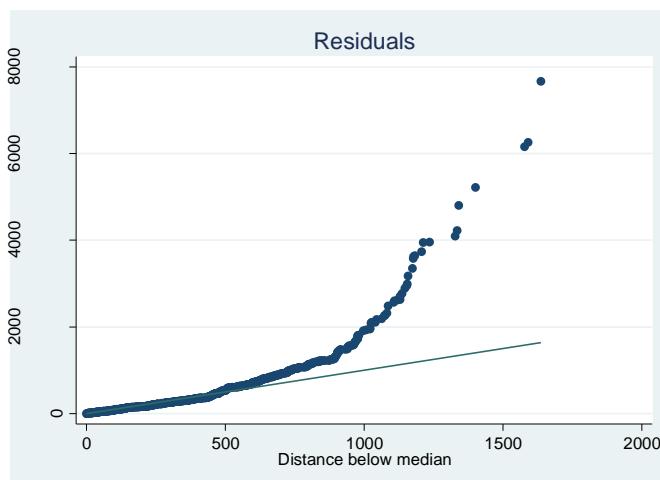
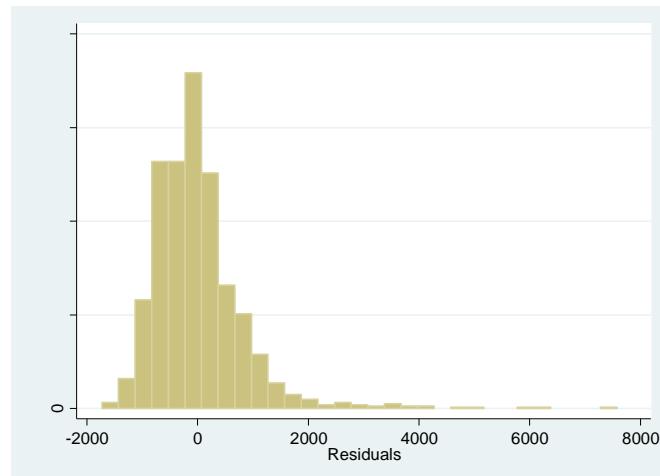
Team/Stadium	Neighborhood				Stadium area (450 mts)				Surrounding areas (800 mts)			
	Usd	Usd/sqm	Sup	Houses	Usd	Usd/sqm	Sup	Houses	Usd	Usd/sqm	Sup	Houses
All Boys	291.060	1.511	209	50	302.778	1.474	230	9	284.929	1.478	214	21
Argentinos Juniors	339.974	1.599	253	38	302.529	1.453	237	17	320.211	1.345	256	19
Atlanta	427.995	1.714	276	44	323.488	1.536	222	8	216.271	1.393	182	7
Barracas Central	309.123	1.356	270	57	160.000	1.000	160	1	214.500	1.436	169	4
Boca Juniors	206.452	834	313	31	249.833	847	385	12	317.273	1.016	393	11
Comunicaciones	334.200	1.486	252	15	358.600	1.434	258	5	305.400	1.566	234	10
Def. de Belgrano	579.393	2.177	286	28	485.000	2.425	200	1	567.500	2.192	285	8
Español	255.174	1.130	239	68	132.500	927	164	2	219.000	554	405	2
Excursionistas	864.160	2.526	354	50	1.586.667	3.928	357	3	696.667	2.602	284	6
Ferrocarril Oeste	485.521	1.850	273	48	385.000	2.255	171	4	403.667	1.741	234	9
General Lamadrid	474.011	1.530	330	133	277.800	1.695	212	5	377.208	1.584	243	24
Huracan	301.407	1.362	242	27	130.000	667	195	1	219.167	1.527	152	6
Nueva Chicago	252.514	1.244	223	109	143.600	790	184	5	295.800	1.378	281	5
Riestra	179.167	644	290	6	0	0	0	0	180.000	499	361	1
River Plate	864.160	2.526	354	50	557.222	2.115	273	9	765.000	2.230	451	3
Sacachispas	179.167	644	290	6	0	0	0	0	180.000	499	361	1
San Lorenzo	353.300	1.384	266	122	0	0	0	0	180.000	900	200	1

TABLE N°9 Summary of prices of lots for sale. Argenprop - January 2017

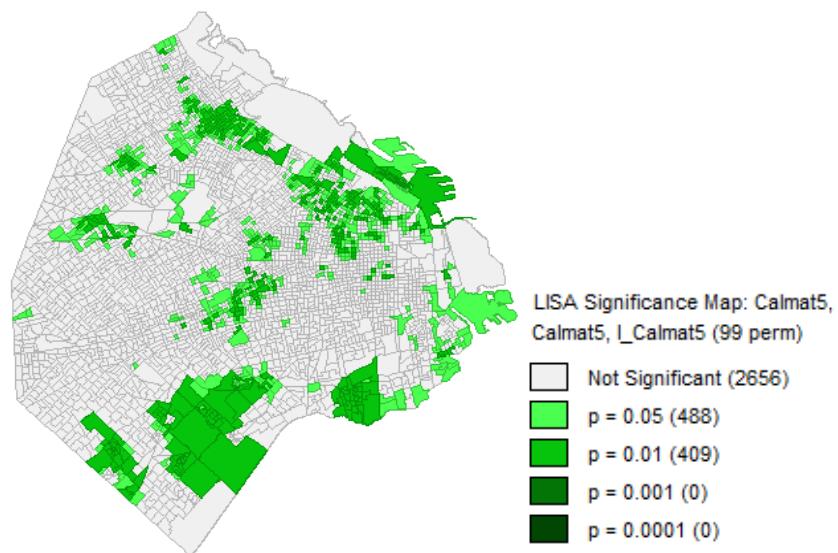
Team/Stadium	Neighborhood				Stadium area (450 mts)				Surrounding areas (800 mts)			
	Usd	Usd/sqm	Sup	Lots	Usd	Usd/sqm	Sup	Lots	Usd	Usd/sqm	Sup	Lots
All Boys	530.100	1.352	402	15	604.931	1.285	482	16	530.100	1.352	402	15
Argentinos Juniors	615.950	1.271	425	20	295.364	1.017	303	11	615.950	1.271	425	20
Atlanta	1.054.520	2.333	493	25	546.494	1.926	293	18	1.054.520	2.333	493	25
Barracas Central	0	0	0	0	0	0	0	0	0	0	0	0
Boca Juniors	770.200	812	782	15	253.333	805	345	12	770.200	812	782	15
Comunicaciones	800.000	1.236	882	12	400.000	1.064	376	3	800.000	1.236	882	12
Def. de Belgrano	746.000	1.902	364	5	823.333	3.801	377	3	746.000	1.902	364	5
Español	0	0	0	0	0	0	0	0	0	0	0	0
Excursionistas	0	0	0	0	2.550.000	3.162	807	4	0	0	0	0
Ferrocarril Oeste	1.523.889	2.532	595	9	885.833	1.961	457	6	1.523.889	2.532	595	9
General Lamadrid	510.000	1.197	447	7	528.333	1.241	358	6	510.000	1.197	447	7
Huracan	768.636	1.295	536	11	651.125	964	688	8	768.636	1.295	536	11
Nueva Chicago	149.667	574	250	3	234.500	725	453	2	149.667	574	250	3
Riestra	0	0	0	0	0	0	0	0	0	0	0	0
River Plate	1.150.000	3.510	308	3	1.000.000	6.849	146	1	1.150.000	3.510	308	3
Sacachispas	0	0	0	0	0	0	0	0	0	0	0	0
San Lorenzo	170.000	499	341	1	0	0	0	0	170.000	499	341	1
Velez Sarsfield	549.000	1.299	516	10	520.000	1.652	348	7	549.000	1.299	516	10

Soccer stadiums and the property values in the city of Buenos Aires

GRAPHS N°5 y 6 *Error Distribution for Linear Models.*



MAP N°10 Statistical significance for Moran's Index (MAP N°9)

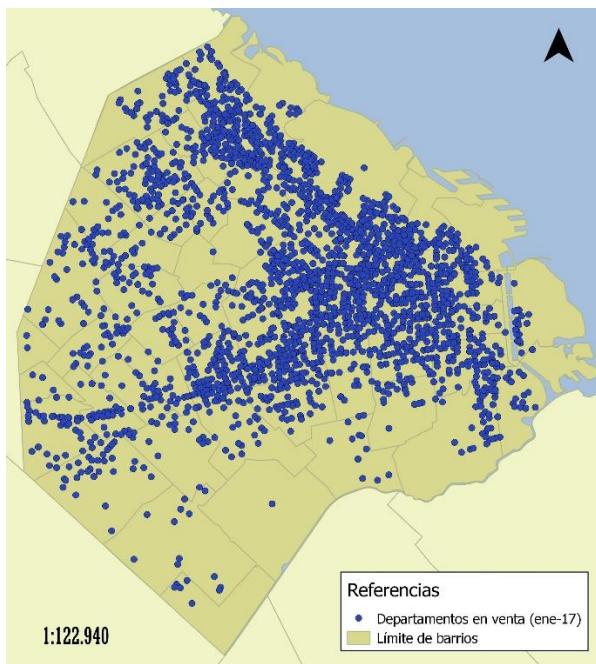


7. Cartographic annex

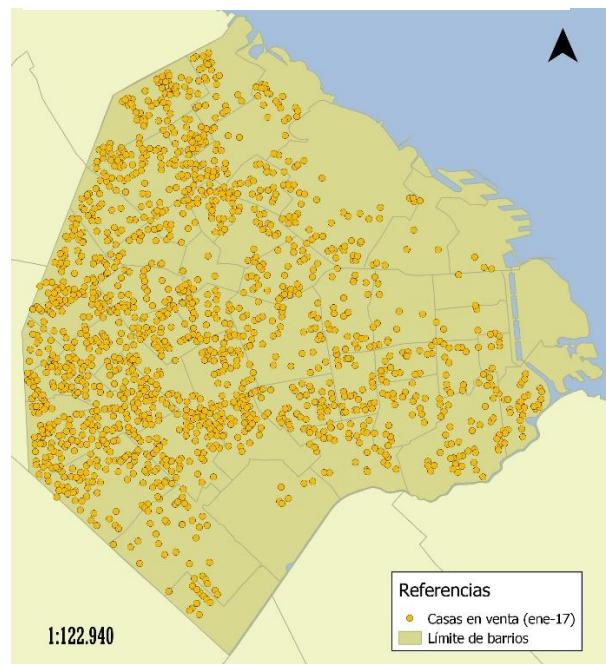
We can recognize two well marked patterns of territorial distribution. On the one hand, the apartments and on the other, the rest of the properties.

The first tend to concentrate in central areas and follow the route of the main roads. On the other hand, it is observed how the lots, houses and PHs tend not to concentrate, but rather move away towards the edge of the city.

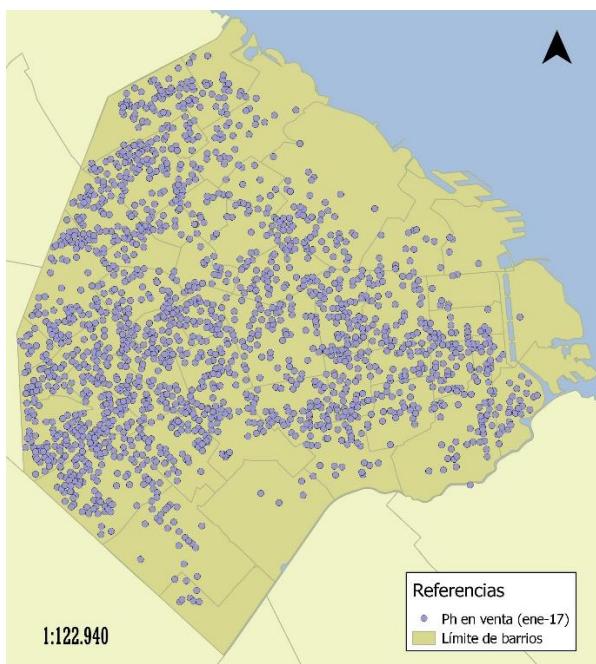
MAP N°11 Supply of Apartments. January 2017



MAP N°12 Supply of Houses. January 2017



MAP N°13 Supply of PH. January 2017



MAP N°14 Supply of Lots. January 2017

