Wp

WORKING PAPERS

WHAT IS THE ROLE OFURBAN GROWTH ON INEQUALITY, AND SEGREGATION?
THE CASE OF URBAN ARGENTINA´S URBAN AGGLOMERATIONS
11/2016
N° 2016/12

WHAT IS THE ROLE OF URBAN GROWTH ON INEQUALITY, AND SEGREGATION? THE CASE OF URBAN ARGENTINA´S URBAN AGGLOMERATIONS

Goytia, Cynthia
Dorna, Guadalupe

DEVELOPMENT BANK OF LATIN AMERICA

Wp

WORKING PAPERS

DEVELOPMENT BANK OF LATIN AMERICA

WHAT IS THE ROLE OF URBAN GROWTH ON INEQUALITY, AND SEGREGATION? THE CASE OF URBAN ARGENTINA´S URBAN AGGLOMERATIONS

Goytia, Cynthia
Dorna, Guadalupe

CAF – Working paper N° 2016/12
11/2016

ABSTRACT

We analyze the relationship between urban sprawl and changing patterns of inequality and segregation in metropolitan areas of Argentina. The existing literature has endeavored to study the determinants of the expansion of cities, but less attention has been placed in understanding the effects of this sprawl on the livelihood of the people that live in them. Understanding whether different patterns of urban extension determine both segregation and inequality is extremely relevant in the context of fast growing urban agglomerates of Latin American countries. Among other findings, we provide evidence that there is segregation of the poor and not of the rich in all urban agglomerates but in Greater Buenos Aires, where segregation of the affluent, not the poor, prevails in the areas of greater informal urban expansion, measured by the extension of informal settlements. Yet, not all the patterns of urban development and built-up growth have the same effect. More leapfrog appears to explain greater segregation -particularly of the poor- while both infill and extension are positively related to more homogeneous urban agglomerations. This means that the most disadvantaged are more evenly distributed in agglomerations that have not seen much of their sprawl due to discontinue urban expansion of their borders. Finally, we also find a positive association between more unequal municipalities and greater slum expansions. The causality of this relationship is unclear and further analysis could be promising. It might be the case that more unequal municipalities allow for institutional environments in which slums can grow faster. Or it might well be that places which have experienced more accelerated slum growth have become more unequal because of the arrival of new families that accentuates such disparities.

Wp

WORKING PAPERS

¿CUÁL ES EL ROL DEL CRECIMIENTO URBANO EN LA DESIGUALDAD Y LA SEGREGACIÓN? LA EXPERIENCIA EN LOS AGLOMERADOS URBANOS DE ARGENTINA

Goytia, Cynthia
Dorna, Guadalupe

CAF - Documento de trabajo N° 2016/12
11/2016

RESUMEN

Las ciudades de América Latina crecen con rapidez. Entender en qué medida las diferentes formas en que se extiende el territorio de las ciudades afecta los niveles de segregación y desigualdad es entonces sumamente relevante. Si bien la literatura académica ha analizado los determinantes de la expansión y sprawl de las ciudades, muy poca atención se ha dedicado aun al análisis de los efectos causales de esta dinámica en las condiciones de vida de los hogares. Este estudio analiza la relación causal entre el crecimiento urbano –sprawl– y las condiciones de desigualdad y segregación en las áreas metropolitanas de Argentina. Para ello, genera una original base de datos que combina información de imágenes satelitales junto con información censal y de encuestas de hogares a nivel de radio censal, construyendo indicadores de desigualdad de ingresos, de bienestar y segregación. La evidencia indica que hay segregación de los hogares más pobres, y no de los más ricos, en todas las áreas urbanas menos en Gran Buenos Aires. En esta, la segregación de los hogares de mayores ingresos –y no de los más pobres-, es la que prevalece y más aún, en las áreas que presentan mayor crecimiento de los asentamientos informales. Sin embargo, no todos los patrones de crecimiento urbano tienen el mismo efecto. A mayor nivel de desarrollo discontinuo, existe mayor segregación, particularmente de los más pobres, mientras que tanto el completamiento o densificación del área existente y la extensión continua, explican áreas urbanas más inclusivas. Más aun, existe una asociación positiva entre municipios más desiguales y mayor expansión de los asentamientos informales. La relación de causalidad en esta asociación no es clara y constituirá un prometedor tema de análisis futuro para entender si las ciudades más desiguales presentan contextos institucionales en los cuales los barrios informales pueden expandirse más; o es que las desigualdades se acentúan en las ciudades que presentan un crecimiento más acelerado de los asentamientos informales.

What is the role of urban growth on inequality, and segregation?
The case of urban Argentina´s urban agglomerations

Cynthia Goytia [1] and Guadalupe Dorna[2]

Centro de Investigaciones de Políticas Urbanas y de Vivienda (CIPUV)
Universidad Torcuato Di Tella

This version: November 1th, 2016

[1] Corresponding author: Cynthia Goytia. Head of the Master Program on Urban Economics at Universidad Torcuato Di Tella and Chair of the Research Center on Urban Policies and Housing (CIPUV). cgoytia@utdt.edu

[2] Head of Master Program on Public Policy at Universidad Torcuato Di Tella. and Senior researcher at Research Center on Urban Policies and Housing (CIPUV).

We gratefully acknowledge funding from CAF. We thank participants at the CAF Habitat and Urban Development Workshop for helpful comments and suggestions. Ramiro Mosterin and Jonathan Cohen provided excellent research assistance. The remaining errors are the sole responsibility of the authors.

Abstract

We analyze the relationship between urban sprawl and changing patterns of inequality and segregation in metropolitan areas of Argentina. The existing literature has endeavored to study the determinants of the expansion of cities, but less attention has been placed in understanding the effects of this sprawl on the livelihood of the people that live in them. Understanding whether different patterns of urban extension determine both segregation and inequality is extremely relevant in the context of fast growing urban agglomerates of Latin American countries. Among other findings, we provide evidence that there is segregation of the poor and not of the rich in all urban agglomerates but in Greater Buenos Aires, where segregation of the affluent, not the poor, prevails in the areas of greater informal urban expansion, measured by the extension of informal settlements. Yet, not all the patterns of urban development and built-up growth have the same effect. More leapfrog appears to explain greater segregation -particularly of the poor- while both infill and extension are positively related to more homogeneous urban agglomerations. This means that the most disadvantaged are more evenly distributed in agglomerations that have not seen much of their sprawl due to discontinue urban expansion of their borders. Finally, we also find a positive association between more unequal municipalities and greater slum expansions. The causality of this relationship is unclear and further analysis could be promising. It might be the case that more unequal municipalities allow for institutional environments in which slums can grow faster. Or it might well be that places which have experienced more accelerated slum growth have become more unequal because of the arrival of new families that accentuates such disparities.

Key words: income inequality, welfare inequality, segregation, sprawl, infill, leapfrog, extension, Latin America.

1. Introduction

It has been widely documented that, over the 2000's income inequality has diminished in Latin American countries, however it has also been discussed that this fall inequality is not based on strong fundamental and therefore could be a fragile tendency (Gasparini et al. 2011). Moreover, while income inequality might be diminishing, segregation might not. At a local level, the accelerated expansion of urban areas might be responsible for increases in segregation and welfare inequality.

In Argentina, as in many other Latin American countries, these two trends have dominated the evolution of metropolitan areas. First, metropolitan areas have experienced rapid development in their outer suburban rings. Second, the majority of the cities still experience high levels of inequalities, not only related to income but also related to their welfare - such as deficient access to basic services and infrastructure (Goytia et al., 2015). These two central facts, in themselves, are uncontroversial. Nevertheless, there is a lively debate about the association of this trends and their association to segregation.

In this study we analyze the relationship between urban sprawl and changing patterns of inequality and segregation in metropolitan areas of Argentina. The bulk of the research on inequality has focused on inequality at the national level. Yet in most Latin American countries, such as Argentina, most people live in cities (92% of the population) and their experience of inequality is shaped by their cities environment, which involves location within the functional urban area and the opportunities (access to labor markets, public goods, services and infrastructure, among others) that their specific location allows them to enjoy. This fact indicates the need to research inequality in the urban agglomerates, which cover over 70% of the urban population in the country.

Argentina is composed by 32 urban agglomerates that range in size from the one of the biggest metropolitan areas of the world, Buenos Aires, to minor cities with less than 50 thousand inhabitants. Urban agglomerates differ not only in their size but also in their level and type of development and institutional fragmentation –i.e. the number of jurisdictions that compose the agglomerate. These differences might play an interesting role in allowing for differing patters in the correlation of sprawl and both inequality and segregation.

We intend to analyze these correlations and their relationship with different characteristics that the expansion of urban agglomerates in Argentina presents. The existing literature has endeavored to study the determinants of the expansion of cities, but less attention has been placed in understanding the effects of this sprawl on the livelihood of the people that live in

them. Understanding whether different patterns of urban extension determine both segregation and inequality is a relevant issue on its one, but even more so in the context of Latin American countries and, in particular, in the fast growing urban agglomerates of Argentina.

The relevance of fostering scholarship on the nexus between sprawl and both inequality and segregation is noteworthy because, while local governments have little direct control over an issue like income inequality, planning and land use regulation and local investments are one of the major powers held by local governments in most federal countries, such as Argentina. If public investments -or better planning for land use- can improve welfare equality within regions, it is vital that policymakers know specifically what modifications should be made to foster it. Therefore, an analysis of these topics may be extremely useful to inform urban policy making.

We find that there is segregation of the poor and not of the rich in all urban agglomerates but in Greater Buenos Aires, where the rich- rather than the poor- appear to be the segregated group. In this metropolitan area, segregation of the affluent, not the poor, prevails in the areas of greater informal urban expansion, measured by the extension of informal settlements.

Yet, not all the patterns of urban development and built-up growth have the same effect. More leapfrog appears to explain greater segregation -particularly of the poor- while both infill and extension are positively related to more homogeneous urban agglomerations. This means that the most disadvantaged are more evenly distributed in agglomerations that have not seen much of their sprawl due to discontinue urban expansion of their borders.

Finally, we also find a positive association between more unequal municipalities and greater slum expansions. The causal mechanism tying this relationship is unclear. It might be the case that more unequal municipalities allow for institutional environments in which slums can grow faster. Or it might well be in place the opposite mechanism, that places which have experienced more accelerated slum growth have become more unequal because of the arrival of new families that accentuates such disparities. The causality of this relationship is unclear and further analysis could be promising.

An important part of this study compromises the need to generate a homogenized database for the urban agglomerates of Argentina since the data comes from different sources and need to be geo-referenced into a computational environment. We describe below the methodology and treatment given to the innovative data collected for this study, which include Satellite data

matched with census and households' survey information from National Statistics, as well as slum information provided from TECHO[3].

The report is organized as follows. Here, we first discuss the mechanisms through which urban sprawl is thought to be associated to inequality and segregation and summarize relevant empirical research on the topic. Section three describes the methodology and data collected and generated for the study. Section four provides the main results that relate to urban agglomerations of Argentina that have expanded over the decade 2001-2010. In section five we take a closer look at the urban agglomeration of Buenos Aires and study the relationship between urban expansion, inequality and segregation in the presence of informal settlements. In section six we conclude. Finally, all the relevant statistical and geographical complementary information and the estimation of income inequality –complementing the analysis of our measure of welfare inequality- are included in the Appendix.

[3] Catastro de Asentamientos in Argentina (TECHO, 2011)

2. Literature Review and conceptual framework

To begin, one important contribution from the field of urban economics is the theoretical insight that residential location is determined through a competitive bidding process for land for housing, and thus land markets play an important role in the distribution of different socioeconomic groups (Mills and Hamilton, 1994). Baum-Snow's (2007b) finding of a relative decline in central city population in response to lower commuting costs is consistent with the monocentric model. As cities grow, land values become increasingly differentiated due to differences in commuting costs and increasing differences in the mix of public services and natural amenities provided in different locations due to decentralization. This leads to a greater differentiation of residential neighborhoods. Margo (1992) studies the contribution of rising incomes to suburbanization. Yet, the forces highlighted by the monocentric model are arguably not the only ones. In addition to falling commuting costs and rising incomes, a number of different explanations have been proposed for the suburbanization of population, worrying about the limited success of the literature at explaining patterns of location choices by income.

Besides the decentralization of residential population, one central aspect of urban sprawl, which is of relevance for cities is the fragmentation of residential development, studied by Burchfield, Overman, Puga, and Turner (2006). The most commonly emphasized characteristics of urban sprawl are low density spread-out development and scattered development (Galster, Hanson, Ratcliffe, Wolman, Coleman, and Freihage, 2001). Burchfield et al., 2006 confirm that development is more scattered in cities built around the automobile. Ortalo-Magné and Prat (2011) and Hilber and Robert-Nicoud (2013) use political economy arguments to indicate that overly restrictive regulations in developed areas would be a powerful force explaining excessive urban sprawl in undeveloped areas.

Our main concern in this paper is whether such sprawl in undeveloped areas is associated to segregation and inequalities. The recent urban expansion may simply be a manifestation of growth, rising incomes and increased land and housing consumption, coupled with a general preference for suburban living. An alternative explanation considers that extension, particularly leapfrog development, is associated to income segregation of the poor -or the reach- although the paths will be different in each case.

There are two primary explanations for income segregation, or the tendency of households with similar levels of income to live near one another. These arguments come from developed countries, particularly USA, where some scholars argue that income segregation results from an efficient sorting process: Households move into neighborhoods that offer them the best combination of housing and local amenities that they can afford (Oates, 1981; Tiebout, 1956).

Yet, other scholars argue that segregation (by race or income) also arises from policies and collective efforts to exclude certain groups— low-income or minority households, for example—from areas preferred by those with the power to do so. Although this structural source of racial segregation is well documented (Massey & Denton, 1993; Pendall, 2000), there are few empirical studies on income segregation. Yang and Jargowsky (2006) show that decentralized development patterns and sprawl encourage income segregation in USA metropolitan areas, and the growth rate of a metropolitan area help explain the extent to which income segregation occurs: there is more segregation by income when metropolitan areas are either stagnant or fast growing (Watson et al., 2006), but no consideration is due to the type of growth (eg. Leapfrog or infill).

In fact, this relationship between urban form and income segregation is even more complex, because certain types of urban form, in particular low-density development patterns and leapfrog, can contribute to income segregation. The most recent literature on exclusive land use regulation for Brazil or Argentina (Feler and Herdenson, 2009; Goytia and Pasquini,2010) points to the local nature of planning and the greater pressure from multiple local interest groups on residential development that exacerbates the tendency to segregate by income while at the same time it denies the provision of services to newcomers (informal) residents, increasing the extension of informal settlements. One underlying assumption is that land use regulations reduce housing options for low-income households who cannot afford large single-family homes. This makes some cities and neighborhoods unaffordable for lower- and middle-income households, leading to greater neighborhood homogeneity and higher metropolitan income segregation (Ihlanfeldt, 2004, Pendall, 2000). Higher population densities and infill development, in contrast, could lead to greater integration if neighborhoods include more multifamily and smaller housing units.

Yet, the phenomenon of segregation can involve a particular socioeconomic group. A number of studies have shown that income inequality, positively associated with income segregation across cities in USA (Reardon & Bischoff, 2011; Watson, 2009; Watson, Carlino, & Ellen, 2006), seems to have increased the segregation of affluence, but not of poverty in metropolitan areas (Reardon and Bischoff, 2011).

Last, metropolitan fragmentation is also thought to contribute to income segregation. The U.S. system of multiple incorporated counties in each metropolitan area can have dozens or even hundreds of separate jurisdictions, each of which have control over their land use. Given that many suburban jurisdictions are created to cater to households with similar tax and spending preferences (Oates, 1981; Tiebout, 1956), it follows that fragmentation would lead to relatively homogenous communities. Empirical research confirms this. For example, Yang and Jargowsky

(2006) find that the number of governments per 100,000 persons in a metropolitan area is positively associated with income segregation.

3. Methodology and data

In this study we analyze the correlation between patterns of urban sprawl and both inequality and segregation, firstly, for the complete set of urban agglomerates and, secondly, for groups of urban agglomerations that share similarities. Between the set of characteristics in which we group urban agglomerates are:

- Regions within the country
- Size of the urban agglomeration
- Level of institutional fragmentation
- Degree of development measured in terms of aggregated indexes of prosperity and livability

We describe below the sources of information and the methodology we applied in generating the database.

a. Satellite images and sprawl

Sprawl studies (e.g., Burchfield et al. 2006) and land-cover studies (e.g., Angel et al., 2005, 2010, 2011) have significantly been benefited by the availability of these new types of data. Our classification of satellite images (Landsat5 imagery with resolution of 30x30 meters, Angel 2011) identifies areas with different land permeability from which land is classified in terms of its uses between urban, suburban, captured open spaces and rural areas. In turn, by comparing these digitally processed images in two or more periods, growths patterns can be detected and therefore urban sprawl can be dimensioned and classified. The classification of the types of expansion of the urban area is: expansion by means of the completion of the urban fabric (infill), growth by extension of the urban area (extension) or sprawl as the disconnected extension of the urban belt (leapfrog). We have already compiled information on urban sprawl for the 1990-2000 and the 2000-2010 decades for more than 30 urban agglomerates in Argentina including the metropolitan region of Buenos Aires. We have made this information available to the public trough the CIPUV Atlas of Urban Growth, accessible at http://www.utdt.edu/ver_contenido.php?id_contenido=9267&id_item_menu=18003.

By using satellite images, we can detect and distinguish surfaces that characterize built-up areas from those non-built open spaces in and around them. The images were initially coded into maps of pixels, where each pixel is classified as built-up, open space, or water. We used Landsat 5-satellite images with a 30-meter pixel resolution. Once the images were classified, we obtained all our metrics by closely following the methodology of Angel, Parent, and Civco (2010).

The main input for the all measurements is the grid of classified pixels covering all the analysis area. Then all the indicators are calculated on the basis of their relative location.
Built-up Area is the area that is occupied by all built up pixels. An Urban pixel was defined as a built-up pixel that had a majority of built-up pixels in its immediate neighborhood, that neighborhood defined as a circle 1 km2 in area about the center of that pixel. A Suburban built-up pixel was defined earlier as a built-up pixel had more than 10 and less than 50 percent of its immediate neighborhood occupied by built-up pixels; and a rural built-up pixel was defined as a built-up pixel had less than 10 percent of its immediate neighborhood occupied by built- up pixels. All open space pixels that were more than 100 meters away from urban or suburban built-up pixels.

Urban agglomerations have expanded their built up urban areas by 36%, or equivalently, at a rate of 3.5% annually, incorporating a total of 1,023 sq. km. of urban built-up land. On average, territorial expansion of the urban agglomerations was 2.9 times higher than population growth (1.2% annually) for the period 2001- 10. The territorial expansion of the urban built-up areas is higher than the expansion experienced in the previous decade (1990-2000) when the physical increase was 27% (2.4% annually).

Yet, there are important variations in the extent of territorial expansion across agglomerations and within regions. The urban built-up area of Buenos Aires has grown by 38% in the 2001-2010 period, equivalent to an annual increase of 3.7%, above the average annual growth of 3.5% for the other urban agglomerations. The agglomerations that experienced the most significant expansion in their urban built-up areas are located in the Northwest region – Catamarca experienced the most significant annual growth in urban built-up area (7.0%), followed by San Salvador de Jujuy (6.1%) and La Rioja (5.4%) over the 2001-2010 period.[4]

Our measure of urban extension considers the type of total new developments 2001-2010 (which are obtained by comparison of built-up pixels between the two mentioned periods). It is decomposed into three measures: infill, extension, and leapfrog developments: i) *Infill* is defined as consisting of all new development that occurred within the interior open space, set of all fringe open space pixels that were more than 100 meters away from rural open space in 2001. Ii) *Extension* is defined as consisting of all new development that occurred in contiguous clusters that occupied exterior open space in full or in part, and were not infill. Exterior open space is defined as the set of all fringe open space pixels that were less than 100 meters away

[4] See Appendix 1 for average annual urban built-up area and population growth rate, 2001-2010 in urban agglomerates.

from rural open space in 2001. Finally, *iii) Leapfrog* is defined as consisting of all new development that occurred entirely within rural open space, defined as the set of all open space pixels that were more than 100 meters away from urban or suburban built-up pixels in 2001.

These measures are extremely relevant since there is great variability within urban agglomerates. In Santa Fe, 45 % of new development was due to leapfrog and less than 10 % to infill, while in Corrientes 55 % of new development during the decade was due to infill and leapfrog almost imperceptible (see Table in the Appendix).

b. Socio-economic information

Census data in its more disaggregated level (census tract) can be spatially combined with the urban sprawl information. However, a limitation of census data is the lack of geo-referenced information on family earnings that prevents the analysis of the causes and consequences of urban expansion on income segregation patterns. We propose an innovative way to approximate income information based on matching census socio-demographic information -which does not survey incomes- to household survey data -which does survey families' incomes.

For doing so we use a rich set of socio-demographic data to generate proxy indicators of income. The same socio-economic variables are collected in both census data and in household surveys. As mentioned, household surveys do collect income information disaggregated for each urban agglomeration in Argentina but cannot be spatially located, while census data that is spatially located does not gather income information. Therefore, we match socio-demographic indicators in the census database and the household in order to have income information that could be spatially located based on the geographical location of census tracts.
The selected socio-demographic variables need some adjustments prior to the matching. Though the same variables are collected in each database, the households' survey present data disaggregated at the household level while census data provides information for all the households that fall within the boundaries of the census tract but individual families cannot be identified. Therefore, for the census database, the following indicators are constructed as an average indicator for all the households in each tract. These average indicators are used to match individual households from the household survey. Formulas below show these averages.

- Construction materials quality: proportion of households with good quality of materials, where we consider two medium quality households as one with good quality. Low quality households do not add to the proportion.
  There are 4 quality categories for the household:
  -Quality 1: resistant and solid housing materials, both in floor and roof. Has ceiling
  -Quality 2: Roof without ceiling or lower quality materials in floors.
  -Quality 3: little resistant and solid housing materials, both in floor and roof.
  -Quality 4: low quality materials in floors and roof.

Then, the indicator is given by:

$$\frac{Quality1 * 1 + Quality2 * 0.5}{Number\ of\ households}$$

- Basic services connection quality: proportion of households with satisfactory quality. Basic quality households are considered a half of satisfactory quality households
  There are 3 services connection categories:
  -Satisfactory quality: households with water and sewage network.
  -Basic quality: households with water network and drain well with septic tank.
  -Insufficient quality: households that do not meet any of the above conditions.

  Then, the indicator is given by:

$$\frac{Satisfactory\ quality * 1 + Basic\ quality * 0.5}{Number\ of\ households}$$

- Tenure condition: proportion of households where both house and land are owned. Rents add half as much to the proportion.
  There are 4 tenure categories of interest:
  -Owner of the house and the parcel
  -Owner of the house and not the parcel
  -Tenant
  -Occupant

  Then, the indicator is given by:

$$\frac{Owner\ of\ house\ and\ land * 1 + Tenant * 0.5}{Number\ of\ households}$$

- Overcrowding: households up to 2 people per room are not considered overcrowded, between 2 and 3 overcrowded, and more than 3 fully overcrowded.

Then, the indicator is given by:

$$\frac{Up\ to\ 2\ people\ per\ room * 1 + Between\ 2\ and\ 3 * .25}{Number\ of\ households}$$

- Education of the head of household: level of education adds gradually to the indicator including primary, secondary, superior, undergraduate and graduate.
  Then, the indicator is given by:

$$\frac{Primary * .2 + Secondary * .4 + Superior * .6 + Undergraduate * .8 + Graduate * 1}{Number\ of\ head\ of\ households}$$

- Education level of spouse: level of education adds gradually to the indicator including primary, secondary, superior, undergraduate and graduate.
  Then, the indicator is given by:

$$\frac{Primary * .2 + Secondary * .4 + Superior * .6 + Undergraduate * .8 + Graduate * 1}{Number\ of\ spouses}$$

The corresponding denominator in each formula above corresponds to the total of all categories considered in each indicator with available data (excluding missing data and non-relevant categories).

In order to minimize the differences in matched and actual income distributions, for each urban agglomeration, we proceed as follows:

- We conduct the matching technique iteratively modifying the number of closest matches (neighbors); selecting, in each iteration, a different number of neighbors between 1 to 20.
- In each iteration, we compare the resulting difference in mean from both distributions, i.e. the actual one as obtained from households' surveys and the estimated one imputed to census tracts. And for each iteration we calculate the minimum distance between matches
- We select the matching distance that minimizes the difference between the means and impute income values accordingly

Even after approximating distributions by their means, an issue that needs to be stated involves the differences in deviation between distributions. This issue is attributable the difference in measuring units between databases. As mentioned before, while the household survey has families as its units, the census presents census tracts as its most disaggregated level.

Therefore, when we find a match for the census tract we are finding a household (or group of households) that can mimic the *average* income of that tract. As a result, we hardly obtain extreme values for both income and socio-economic proxy indicators, obtaining a less dispersed distribution than it is actually observed in the household survey.

Below we show the income distribution for the actual and estimated income series for a selection of urban agglomerates. As mentioned, the estimated series is more concentrated around average values than the actual series.
We display below the maps that show estimated income for these agglomerates.

Figure 1. Income distribution for selected agglomerates

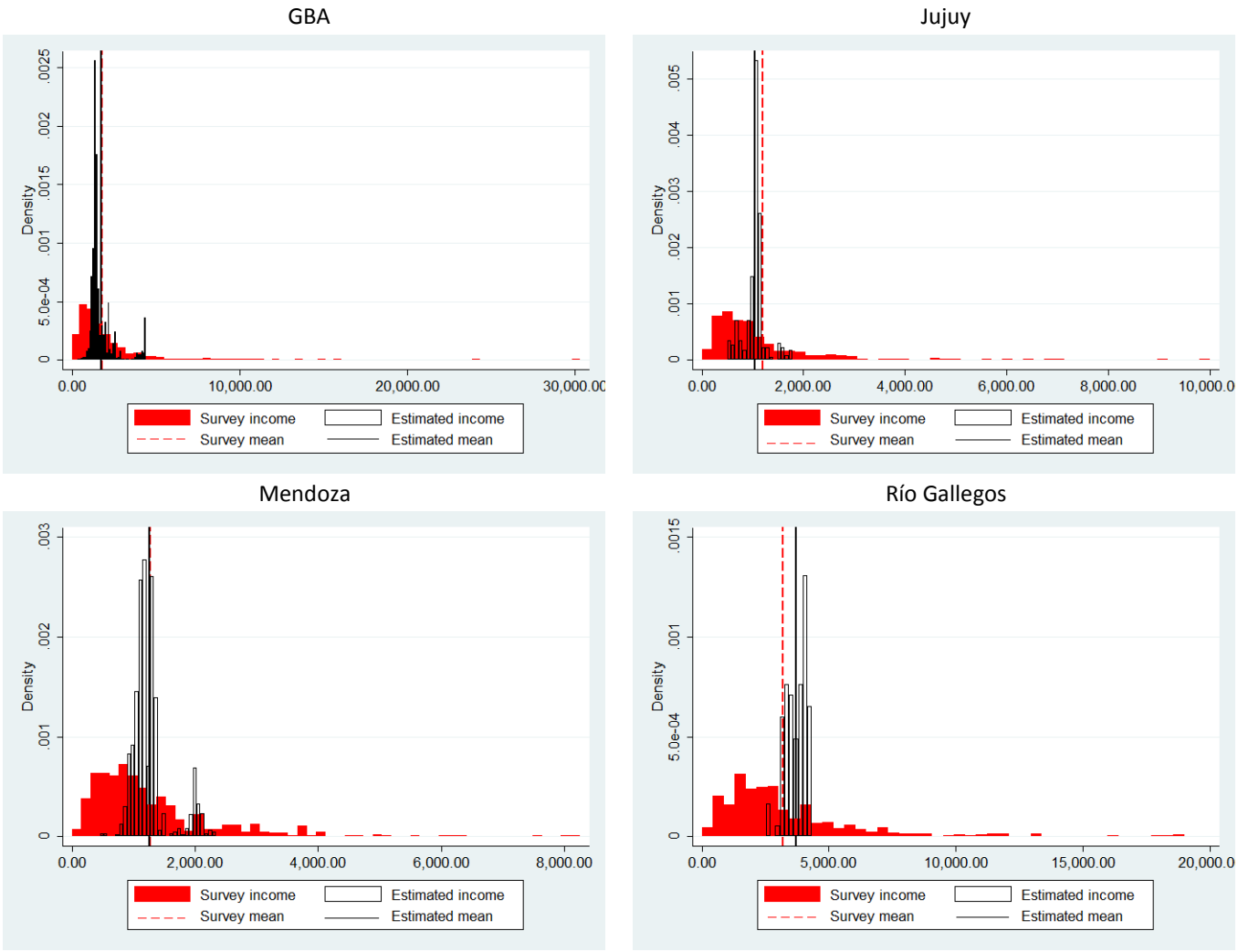
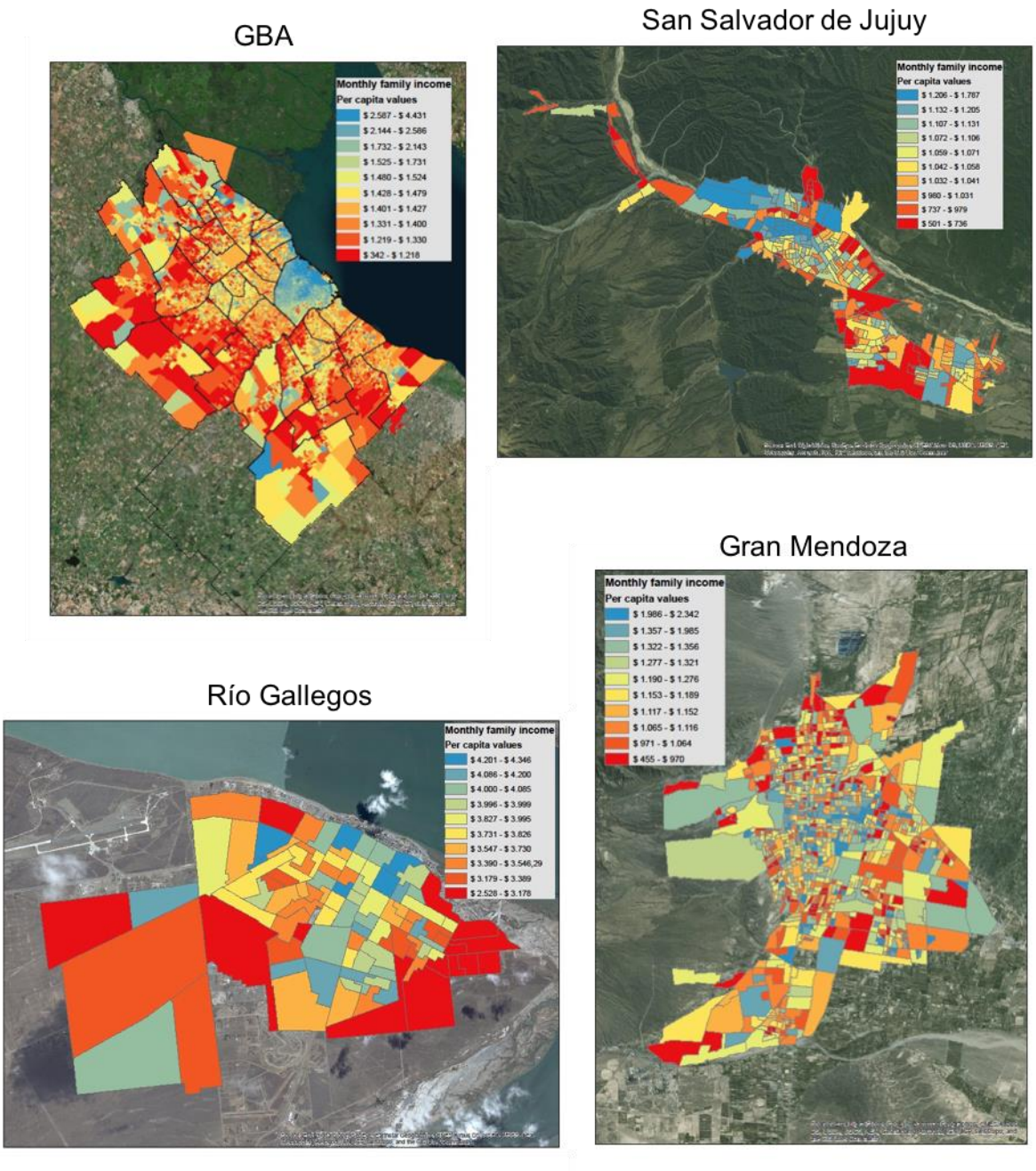


Figure 2. Estimated income maps



Source: CIPUV based on data from National Census (2010) and National Households Survey (INDEC)

Once we obtain an average income for each census tract, we can calculate our measures of inequality and segregation. Traditionally, they are based on income differences. However, we generate an indicator where income is part of the components but not the only one and call

this indicator the Welfare Index. We include the socio-economic indicators from census data already described. We substitute the Basic services connection quality indicator for 3 more disaggregated services indicators: water network connection, gas network, and sewage network. Together with income, these variables allow us to generate a better picture of socio demographic characteristics. By means of principal component analysis, we generate the Welfare Index normalized in the interval [0;1].

Below we show mean and standard deviation of the welfare indicator for each urban agglomeration.

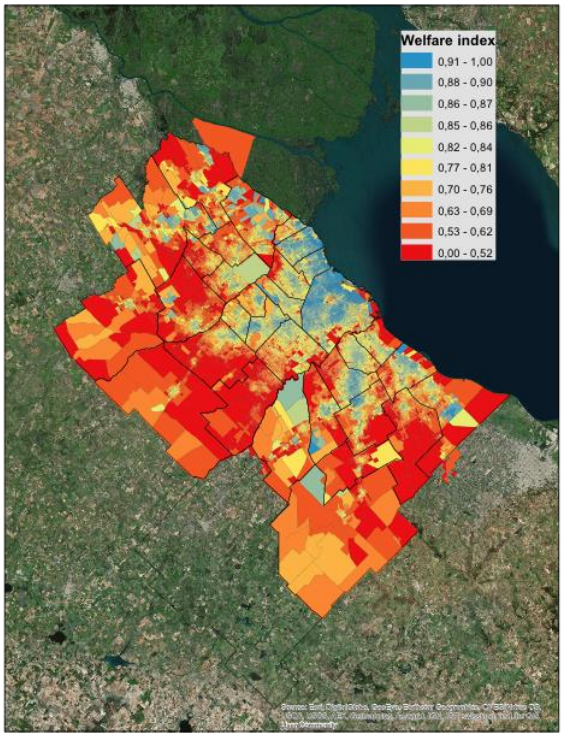
Table 1. Welfare indicator

WELFARE INDEX		
Agglomerate	Mean	Std. Dev.
Gran La Plata	0.79	0.14
Bahia Blanca - Cerri	0.82	0.09
Gran Rosario	0.77	0.13
Gran Santa Fe	0.73	0.15
Gran Parana	0.73	0.12
Gran Posadas	0.75	0.13
Gran Resistencia	0.71	0.14
Comodoro Rivadavia - Rada Tilly	0.83	0.09
Gran Mendoza	0.78	0.10
Gran Corrientes	0.75	0.12
Gran Cordoba	0.76	0.12
Concordia	0.67	0.14
Formosa	0.68	0.17
Neuquen - Plottier - Cipolletti	0.76	0.15
Santiago Del Estero - La Banda	0.68	0.15
Gran San Salvador De Jujuy	0.65	0.15
Rio Gallegos	0.89	0.07
Gran San Fernando Del Valle De Catamarca	0.70	0.12
Gran Salta	0.67	0.18
La Rioja	0.66	0.12
Gran San Luis	0.77	0.11
Gran San Juan	0.71	0.14
Gran Tucuman - Tafi Viejo	0.70	0.17
Gran Santa Rosa	0.83	0.07
Ushuaia - Rio Grande	0.83	0.10
Caba	0.87	0.10
Gba	0.72	0.15
Mar Del Plata - Batan	0.80	0.11
Gran Rio Cuarto	0.77	0.09

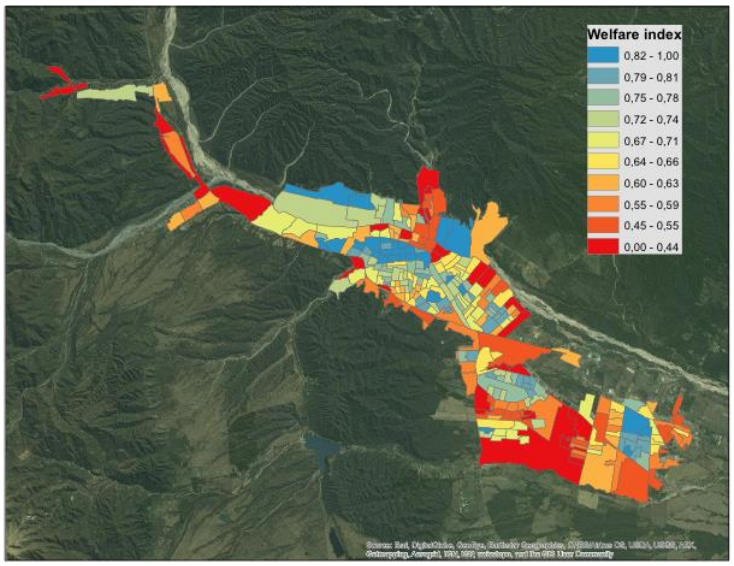
San Nicolas - Villa Constitucion	0.77	0.12
Rawson - Trelew	0.81	0.08
Viedma - Carmen De Patagones	0.81	0.13

Figure 3. Welfare indicator maps

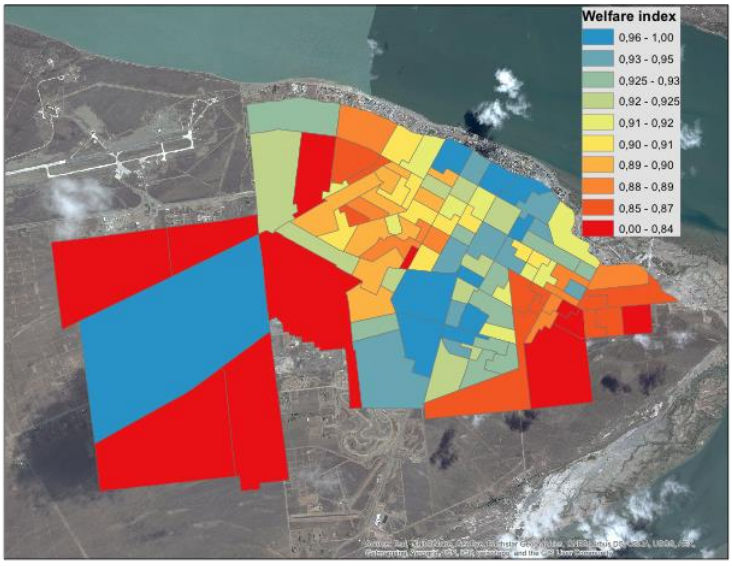
GBA



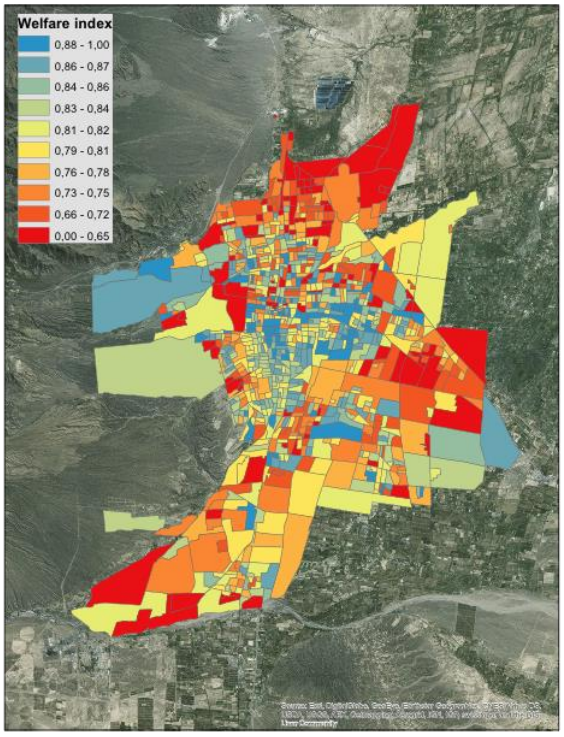
San Salvador de Jujuy



Río Gallegos



Mendoza



Source: CIPUV based on data from National Census (2010) and National Households Survey (INDEC)

Now we can proceed to generate the aforementioned measures of inequality and segregation based on the Welfare Index.

c. Indicator of socio-economic segregation

We follow the recent literature to assess socio-economic segregation -Rearon (2006), Rearon and Bischoff (2011) and Lee et al. (2008). This methodology is invariant to income levels (approximated by socio-demographic characteristics) or distribution patterns since it is constructed solely from information on percentiles of this distribution. In turn, this segregation information has the advantage of permitting the differentiation of segregation patters of different socio-economic groups that allows us to understand, for instance, if lower-income families are the ones that are isolated from other households or if the higher income are the segregated ones.

Reardon (2006) generates an ordinal information theory index as an ordinal generalization of the categorical information theory index H. He then proposes a modification introducing a rank-order measure which has the properties and advantages stated above. However, this is done because they use U.S. census data base which has income information distribution per census tract in a given set of thresholds.

Since we only have average income per census tract, we do not have this problem, although some others arise which need to be addressed. After making some adjustments to our database –explained in what follows- we use the ordinal information theory index which, for our purpose, is equivalent to the rank-order information theory index that constitutes the subject of the paper of reference.

First, as for inequality, we use our constructed Welfare Index instead of income as the argument of the segregation indicator. Conceptually, this segregation measure compares the distribution of the Welfare Index in the agglomerate to that of each census tract. If the distribution inside the tract emulates that of the agglomerate, then that unit is considered to have no segregation. This is done for each tract and weighted proportionally by number of households. Segregation occurs when a given percentile of the distribution is concentrated in some tracts instead of evenly distributed among them. For e.g. if we only consider two groups

divided by the median of the distribution, then if each census tract contains half of this this groups, then there is no segregation, while if one group is totally concentrated in one tract, then the agglomerate will be totally segregated.
It is important to highlight that the measure of segregation differs from that of inequality in that the former compares a given distribution between units of a set (census tracts) and the set (agglomerate) regardless of how even or uneven that distribution is while the later deals with this.

Since we only have average information per census tract we do not have variability to compare the distribution *within* the census tract to that of the agglomerate. Therefore, we adjust our database with the following procedure. We find for each census tract the closest 10 units and call these its neighbors. Each census tract and its neighbors will be considered as a neighborhood. For each of these neighborhoods we compute the deciles of the distribution of the Welfare indicator taking into consideration the total number of households that fall within it. Neighborhoods do overlap since, as mentioned before, we construct a different neighborhood for each census tract. We take into account this overlapping of neighborhoods once we compute the deciles of the distribution of the Welfare Index for the agglomerate[5] (i.e.).
To calculate the segregation index, we first need to calculate the index of ordinal entropy, a form of variation measure.

This is given by

$$E_0 = \frac{-1}{K-1}\sum_{k=1}^{K-1}[c_k log_2(c_k) + (1-c_k) log_2(1-c_k)]$$

Where $K: number\ of\ categories\ (10\ deciles)$
$c_k: cumulative\ proportion\ of\ the\ sample\ with\ values\ in\ category\ k\ or\ below$

This is calculated once for each agglomerate where the proportions are the defined deciles, and for each unit, where the proportions might or not be equal to these established deciles.
Then, the segregation index is given by

$$H_0 = \sum_{j=1}^{J}\frac{t_j}{TE_0}(E_0 - E_{0j})$$

Where

[5] We consider the total number of households as the sum of the households in each neighborhood, therefore if a single household falls in two distinct neighborhoods then these household is counted twice in the overall segregation index. We have computed the overall segregation index without duplicating the number of households and found no significant differences in our conclusions.

$j = 1, \dots, J$ *is the unit* $(neighbors)$
t_j: *number of households in unit* j
T: *total number of households* $(considered\ the\ augmented\ database)$

The graphs below show the cumulative distribution of the socioeconomic index for each census tract and its corresponding neighbors. The closer these are to the 45 degree line, the more homogeneous the urban agglomeration is. We display the graphs for two urban agglomerations: Concordia which is among the most homogeneous and Rawson which is among the least.

Figure 4. Concordia

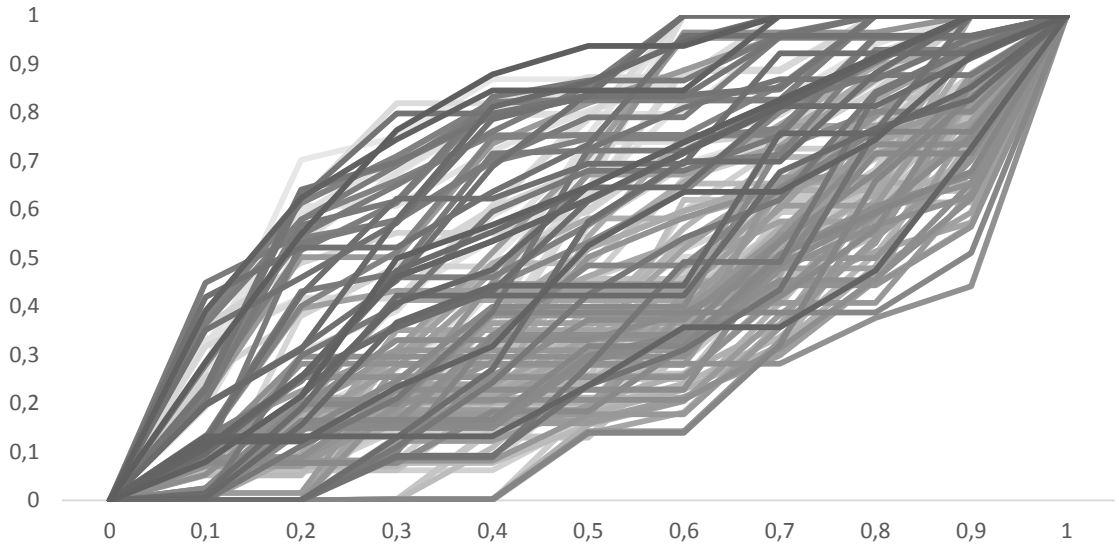
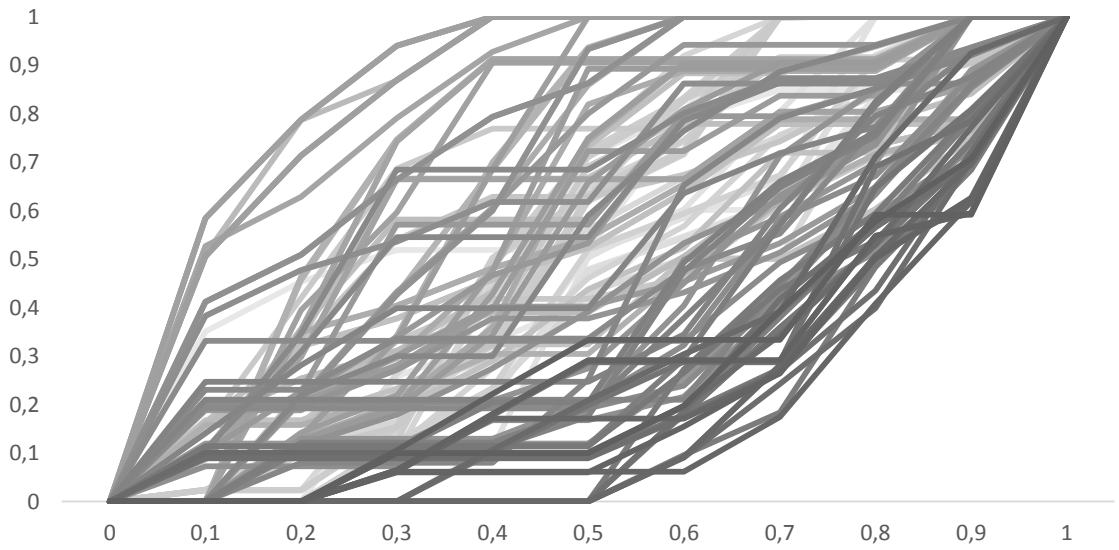


Figure 5. Rawson-Trelew



The index compares the deviation from the variation measure between units and the agglomerate. It considers different groups in a dichotomous manner, i.e. segregation is calculated for the groups below and above each percentile, and then added across groups. However, each iteration is given a different weight according to the entropy index, where for e.g. it is maximized when considering the groups given by the median of the distribution. Here we consider 10 groups given by the deciles of the distribution, and the application of the formula above gives the resulting index for each agglomerate.

However, segregation can also be calculated between groups of specified interest. Beyond the general indicator, we also report segregation for two groups: the lowest and highest 20th percentiles. In this way we can see if those with lower socio economic indicators are more or less segregated than those with the highest measures, and also with respect to the general index where all the distribution is considered.

To this, we use the same formula for the index, except that entropy index is calculated for only one category.

$$E_0 = \frac{-1}{K-1}\sum_{k=1}^{K-1}[c_k log_2(c_k) + (1-c_k) log_2(1-c_k)]$$

Using $c_k = .2$ or $c_k = .8$ for the lowest and highest percentiles, respectively.

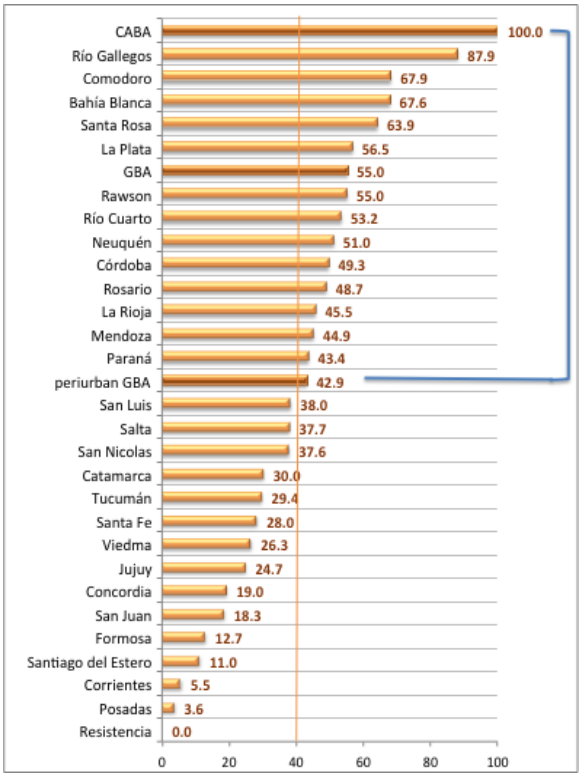
Finally, as we did for the Gini coefficient, we use the categories derived from the information about new developments in each census tract and obtain segregation measures of each group.

d. Prosperity and Livability indexes

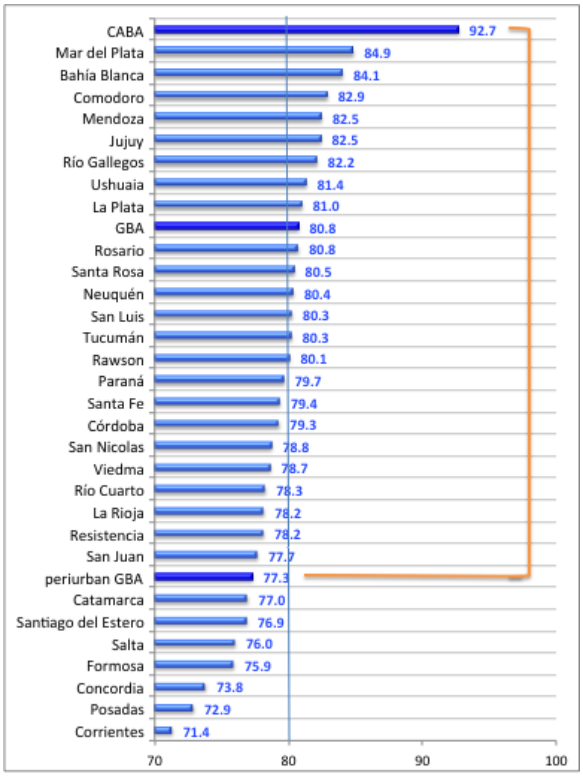
In order to measure prosperity and livability we have developed two complementary metrics of city performance based on publicly available data: the prosperity index and the livability index. The prosperity index is a multi-dimensional metric measuring economic performance of agglomerations that captures a city's success in generating prosperity for its inhabitants. More precisely, it measures success in achieving high productivity, strong dynamism and low level of poverty. The livability index is a multi-dimensional metrics to measure quality of life of agglomerations. The index captures multiple components of a city's livability affecting quality of life in a city along the following dimensions: public services, housing, transport, health, education, social inclusion and resilience.

Figure 6. Metrics of city performance

Prosperity ranking



Livability ranking



Source: Own elaboration based on data from INDEC (2010a, 2010b, 2010c, 2012, and 2014); Government of Argentina, Ministry of Interior and Transport (2013); Ministry of Health (2010a and 2010b).

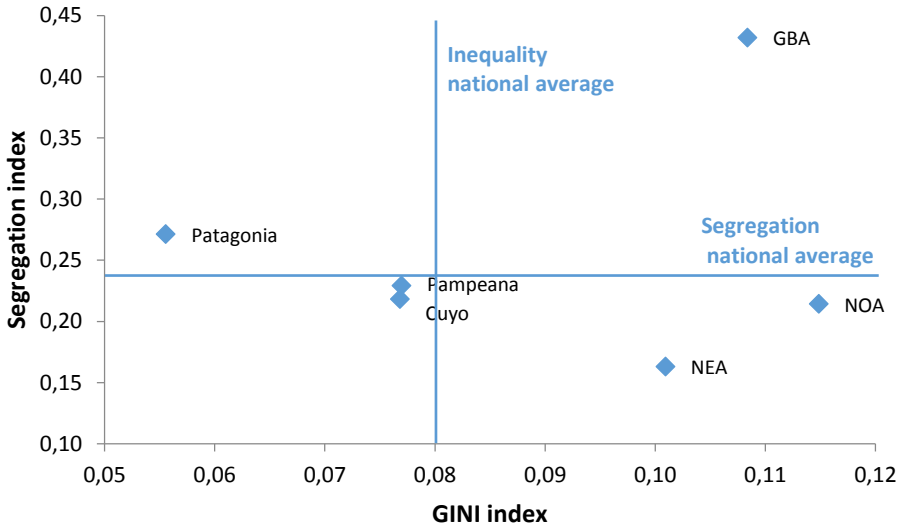
4. Preliminary results related to inequality and segregation

We have firstly studied the differences in terms of both segregation and inequality that arise in the very different geographical regions of Argentina. The six main regions of the country are: the Northwest region (NOA), the Northeast region (NEA), the Pampeana region, the Cuyo region, the Greater Buenos Aires region (GBA) and the Patagonia region.

Regions differ widely in their level development: while the North (NOA and NEA) are by far the poorest regions in the country, the regions of the south -Patagonia and to a lesser extent Cuyo- enjoy higher levels of both per capita income and access to public services. In the middle between these extremes lie the central regions. Of these, GBA is of primmest importance because of its size both in terms of geographical extent and in terms of its population. GBA has historically attracted population because of its opulence and labor possibilities. In the last decades, though, it has become a very unequal region that hosts both the richest and some of the poorest families in the country. This broad characterization of regions can be better understood once the inequality and segregation indexes are analyzed. The chart below depicts this situation.

While the poor regions of the country and GBA present the highest GINI coefficients (i.e. highest inequality), the region of Patagonia in the south has the lowest indicator among regions. However, the most equal of regions, Patagonia is among the most segregated together with GBA.

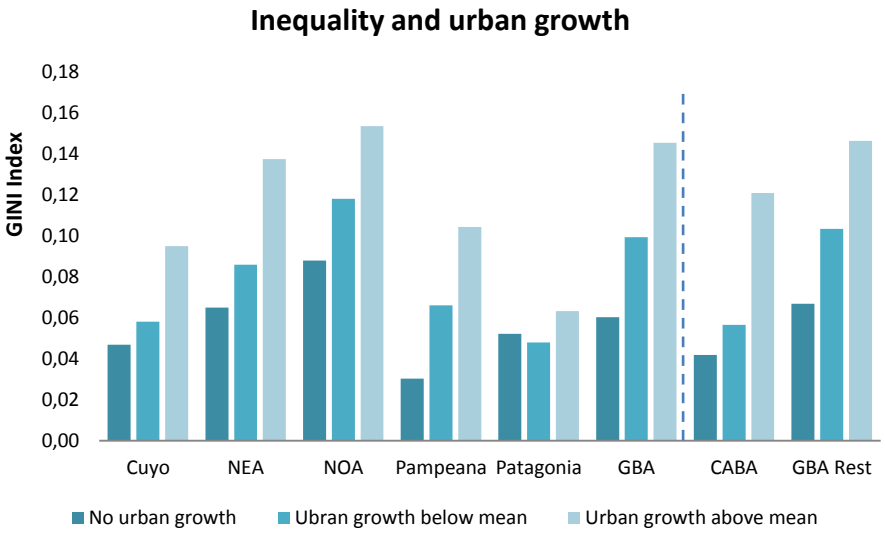
Figure 7. Gini and Segregation by region



In order to have a closer picture to inequality we have analyzed the differences that arise once we consider different patterns of urban growth. As already mentioned we have analyzed satellite images that enabled us to locally measure the area that has expanded over the last decade (2001-2010). We therefore measured the hectares of urban expansion that each census tract in each urban agglomeration has experienced and have categorized these into three categories: areas of no urban growth, areas that have expanded less than the average value for the agglomeration and areas that have done so surpassing the agglomeration average. We have calculated GINI indexes for each of these areas and for each of our urban agglomeration. The average result for the geographic regions is presented below.

There is a clear pattern between inequality and urban growth: areas that have experienced greater urban expansion are also more unequal. This is particularly true in the City of Buenos Aires, where the difference in inequality is almost doubled between areas that have not grown in the last decade and those that have done so above average. The case of Patagonia is interesting since it is the only region in the country where this empirical regularity is not seen.

Figure 8



We have performed the same exercise and analyzed the differences in segregation between areas of differing urban growth patterns and, interestingly, we have found no observables differences for any of the regions.

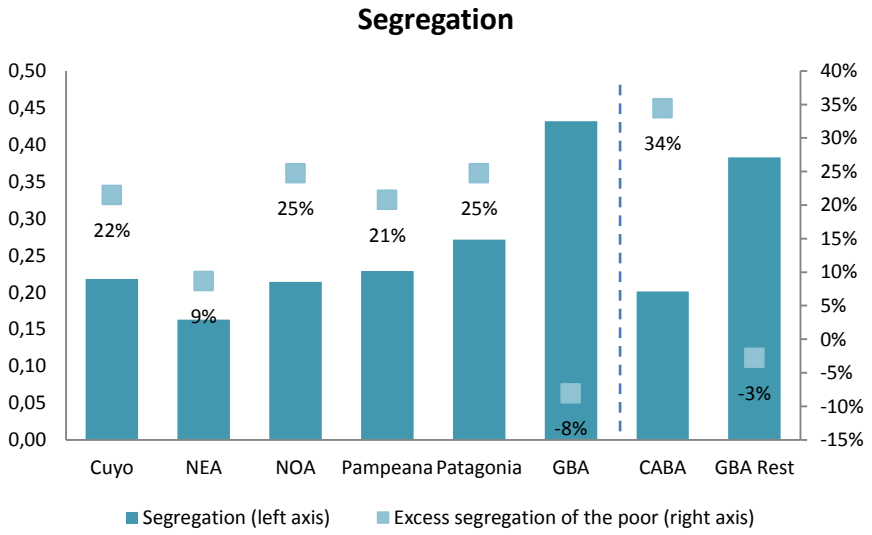
We have, however, performed a different analysis of segregation that provides a clearer picture of the type of exclusion present in the regions of the country. As mentioned in the methodological section, we have calculated the segregation index that the bottom quintile and top quintile present, respectively. These indexes, once compared, allow us to understand if the

poor or the rich are the isolated group that account for the overall segregation pattern observed.

Once again there is an empirical regularity in the data: we observe that there is segregation of the poor and not of the rich in all urban agglomerates but in GBA where the rich rather than the poor appear to be the segregated group. In most of the urban agglomerates, the segregation of the poor result is probably reflecting the fact that poor households live in areas where land is cheap and affordable –which in developing countries cities usually means the lack –or deficitary condition- of public infrastructure services and restricted accessibility to major employment areas. Moreover, housing policies that locate large social housing projects in the urban periphery in order to save in land prices and build more units. Most of the literature concerned with social housing policies point out the risk of settling poor households into remote areas (Habitat-UN, 2016), which is coincident with the spatial mismatch hypothesis, first proposed by Kain (1968). This policy may house a lot of low income households but it may be reinforcing their economic condition helping to trap those families in the vicious cycle of poverty. In other words, it often creates neighborhoods besieged by crime and severely limits life chances in schooling, employment, health, intergenerational mobility, and other vital outcomes (Lens & Monkkonen, 2016).

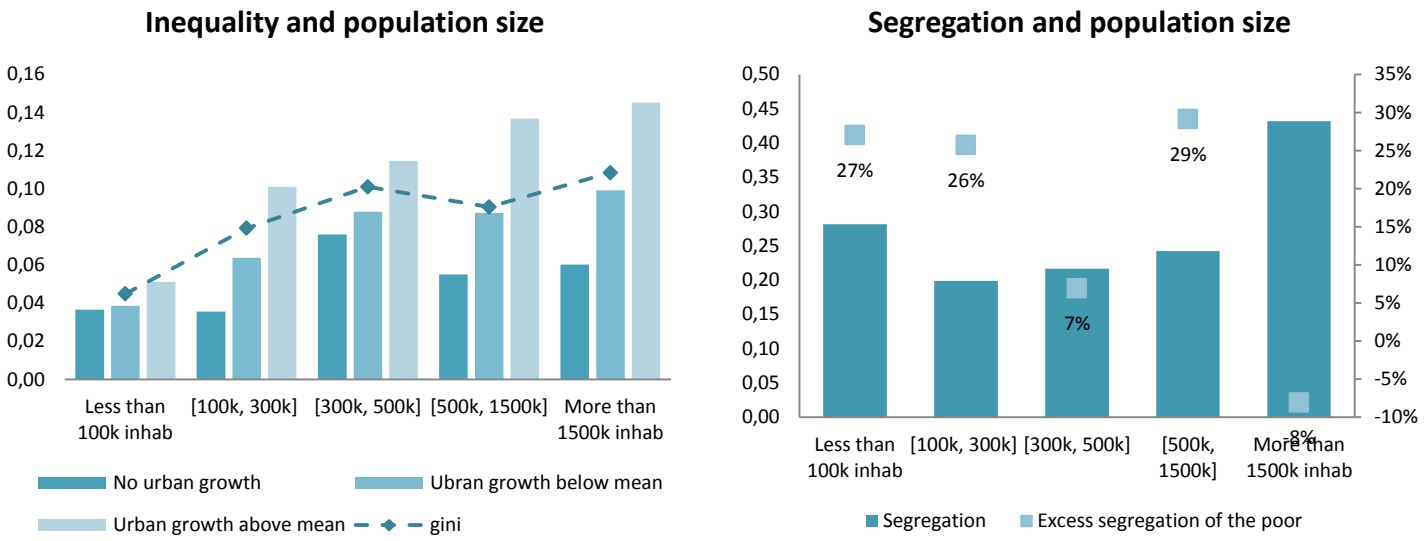
In contrast, in GBA, higher income households decide to locate in remote areas as do want to be isolated for example, in gated communities, a significant trend that has increase from the decade of 1990 until the present (Goytia and Lanfranchi, 2009)

Figure 9



If we look at urban agglomerations and divide them in terms of its population size we can also depict an empirical regularity: the bigger the agglomeration the more unequal it appears and this is particularly true for areas that have experiences higher than average urban expansions. However, the patterns of overall segregation and isolation of both poor and rich does not seem particularly related to agglomeration size.

Figure 10. Inequality and Segregation and Population Size



We have constructed OLS models to test the statistical significance of these findings. In these, the unit is the urban agglomeration and we are studying association but not causation. We will devote another chapter to causality once we analyze the relationship between urban sprawl and both inequality and segregation.

For testing the statistical significance of the regularity observed in the data we have ran a robust OLS regression that sequentially adds co-variables. It starts by simply regressing different measures of inequality and segregation with the categorical variable that divides urban agglomerates with respect to their population size. Subsequently, we include regions fixed effects. In a third step we add average socioeconomic characteristics observed in the urban agglomerate that we construct using household survey information. We include the following socioeconomic information:

- Average adult equivalent family income,
- average educational level of the head of household,
- share of informal head of household workers to total workforce,

- share of unemployed heads of household and share of immigrants in the urban agglomeration.

Table 2. GINI INDEX and Population Size

GINI and POPULATION SIZE

	OVERALL GINI			GINI IN AREAS OF NO SPRAWL			GINI IN AREAS OF BELOW MEAN SPRWAL			GINI AREAS OF ABOVE MEAN SPRAWL		
	0.006*	0.004	0.002	0.006**	0.012**	0.009	0.009***	0.008**	0.003	0.015***	0.012*	0.002
	(0.003)	(0.004)	(0.004)	(0.003)	(0.006)	(0.007)	(0.003)	-(0.003)	(0.004)	(0.005)	(0.006)	(0.011)
Observations	33	33	25	28	28	22	28	28	22	28	28	22
R-squared	0.099	0.577	0.704	0.071	0.501	0.768	0.228	0.759	0.829	0.241	0.5	0.622
Regions Fixed effects	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Socioeconomic controls	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 3. Segregation and Population Size

SEGREGATION and POPULATION SIZE

	OVERALL SEGREGATION			SEGREGATION OF THE POOR			SEGREGATION OF THE RICH		
	0.016	0.017***	0.007	0.01	0.017**	-0.003	0.020**	0.023***	0.019
	(0.01)	(0.006)	(0.01)	(0.008)	(0.008)	(0.013)	(0.01)	(0.007)	(0.011)
Observations	32	32	24	32	32	24	32	32	24
R-squared	0.108	0.713	0.734	0.044	0.549	0.71	0.148	0.656	0.782
Regions Fixed effects	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Socioeconomic controls	No	No	Yes	No	No	Yes	No	No	Yes

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

The results from the regression analysis partly confirm the observational correlation results: the greater the size of the urban agglomeration in terms of its population the greater the inequality and the segregation. However, none of the correlations is statistically significant once we account for socioeconomic characteristics. As Glaeser et al., 2009 explained, income inequality across space can be explained by differences in the skill distribution across metropolitan areas, particularly abundant college graduates and high school dropouts are areas that are particularly unequal.

Another interesting correlation to be analyzed arises once we account for institutional fragmentation of urban agglomerations. In Argentina there is great diversity in terms administrative fragmentation. Only 10 out of the 31 big urban agglomerates are completely contained within the same administrative area, the remaining 21 have more than one administrative unit within its borders. GBA is the most fragmented urban agglomeration completely containing the city of Buenos Aires and 14 municipalities and partially including 18 municipalities more.

Table 4. Number of municipalities in each urban agglomeration

1 Municipality	Between 2 y 5 Munis	More than 5 Municipalities
Bahía Blanca	Gran La Plata	Gran Buenos Aires
Concordia	Comodoro Rivadavia	Gran Mendoza
Formosa	Ushuaia	Gran Rosario
Corrientes	Gran Córdoba	Gran San Juan
La Rioja	Gran Santa Fe	Gran Tucumán-Tafí Viejo
Mar del Plata-Batan	Gran Paraná	
Río Gallegos	Posadas	
	Gran Resistencia	
	Rio Cuarto	
	Salta	
	Gran Catamarca	
	San Luis-El Chorrillo	
	Jujuy-Palpalá	
	Santa Rosa-Toay	
	Neuquen - Plottier- Cipolletti	
	San Nicolas –Villa Constitucion	
	Santiago Del Estero - La Banda	
	Rawson-Trelew	
	Viedma - Carmen de Patagones	

The number of municipalities is most likely related to the number of inhabitants in the urban agglomeration and in consequence institutional fragmentation needs to take this into account. We therefore construct an index of institutional fragmentation that indicates the number of municipalities per 100 thousand inhabitants and classify agglomerations into three categories:

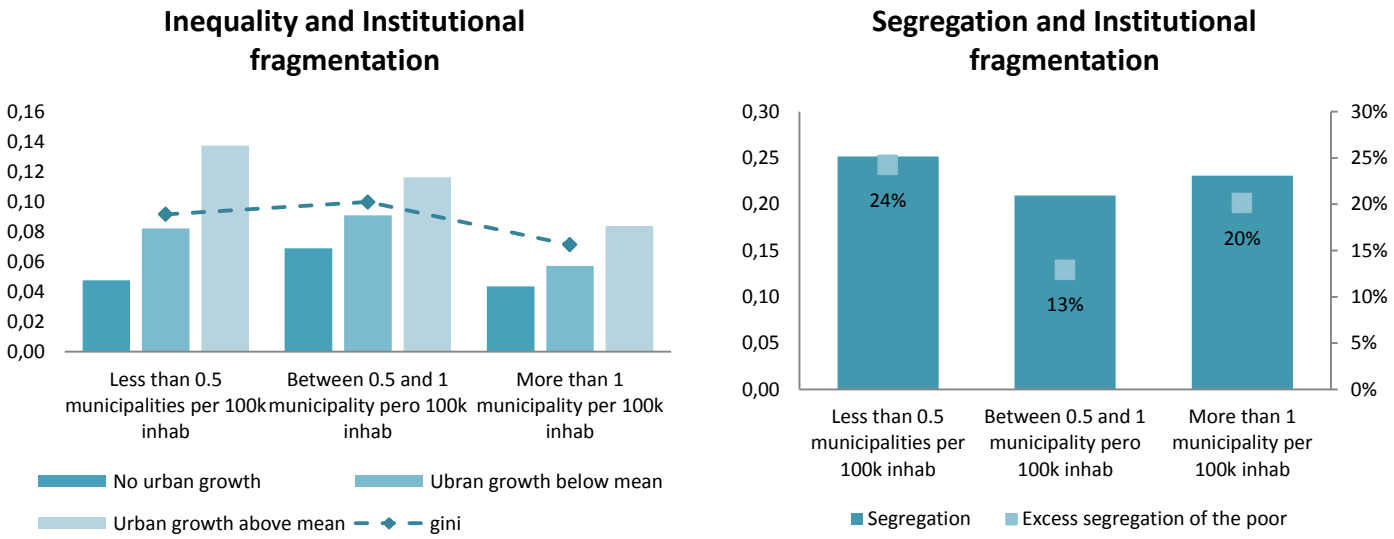
- Low fragmentation: below 0.5 municipalities per 100 thousand inhabitants
- Medium fragmentation: between 0.5 and 1 municipality per 100 thousand inhabitants
- High fragmentation: more than 1 municipality per 100 thousand inhabitants

We plot below our findings related to institutional fragmentation and both inequality and segregation. As with the size of the urban agglomerations, we find that inequality exhibits a recognizable patter but not segregation. In particular, there is evidence that the greater the institutional fragmentation, the lower the socioeconomic inequality. However, there is a marked difference between consolidated areas (with no urban expansion over the last decade)

and those that have grown more than average. While there is no relationship for the first group, for those areas that have experienced high urban growth, institutional fragmentations appears to be a facilitator of equality.

Our fragmentation indicator displays the number of local governments per 100,000 persons in a metropolitan area. The Argentina's urban system consisted of one or multiple incorporated municipalities in each metropolitan area, most of which have the power to regulate land use within their borders. When local governments have more direct power over urban policies, (i.e. land use decision-making processes and social housing location), taken together, it suggests those jurisdictions seem to be growing with less inequality. Given that many suburban jurisdictions are created to cater to households with similar tax and spending preferences (Oates, 1981; Tiebout, 1956), it follows that fragmentation would lead to relatively homogenous communities.

Figure 11. Inequality and Segregation and Institutional Fragmentation



Once again, we run sequential OLS models to test the statistical significance of these findings. We present the results of our robust estimations below.

Table 5. GINI and Institutional Fragmentation

GINI and INSTITUTIONAL FRAGMENTATION

	OVERALL GINI			GINI IN AREAS OF NO SPRAWL			GINI IN AREAS OF BELOW MEAN SPRWAL			GINI AREAS OF ABOVE MEAN SPRAWL		
	-0.007**	-0.002	-0.002	-0.004	-0.003	-0.001	-0.008**	-0.002	0.006	-0.012**	-0.004	0.001
	(0.003)	(0.003)	(0.006)	(0.004)	(0.006)	(0.006)	(0.003)	(0.003)	(0.004)	(0.005)	(0.005)	(0.009)
Observations	31	31	25	26	26	22	26	26	22	26	26	22
R-squared	0.132	0.529	0.703	0.032	0.367	0.723	0.173	0.662	0.846	0.173	0.423	0.622
Regions Fixed effects	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Socioeconomic controls	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 6. Segregation and Institutional Fragmentation

SEGREGATION and INSTITUTIONAL FRAGMENTATION

	OVERALL			SEGREGATION OF THE POOR			SEGREGATION OF THE RICH		
	-0.004	-0.008	-0.008	-0.006	-0.015	-0.01	-0.009	-0.012*	-0.013
	(0.009)	(0.006)	(0.014)	(0.01)	(0.009)	(0.013)	(0.009)	(0.006)	(0.014)
Observations	30	30	24	30	30	24	30	30	24
R-squared	0.01	0.591	0.735	0.013	0.51	0.721	0.034	0.502	0.756
Regions Fixed effects	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Socioeconomic controls	No	No	Yes	No	No	Yes	No	No	Yes

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

The regression analysis presents a mild case for the relationship between institutional fragmentation and inequality and segregation. Once regional controls are included, none of the relationships appears to be statistically significant. Therefore, we are unable to conclude that the observed relationship is a valid correlation or one that arises because of the cofounding relationship between areas in the country and both its institutional fragmentation and its level of inequality and segregation.

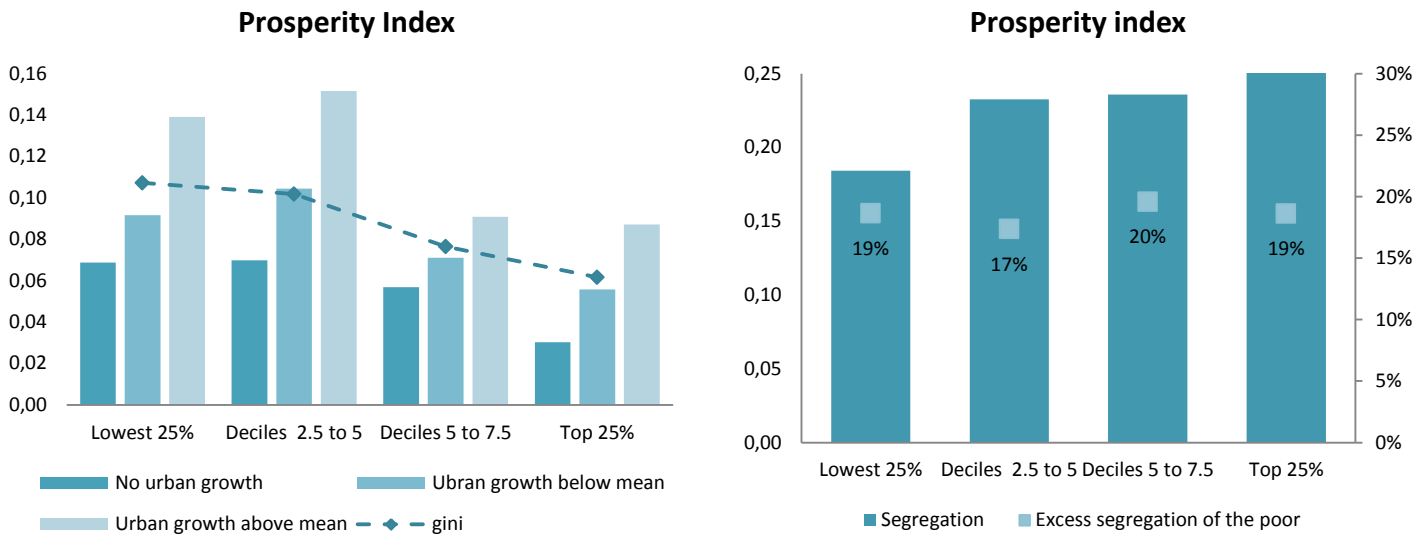
Prosperity and habitability indexes are further measures in which we can classify urban agglomerations in order to produce stylized facts. In this case we have grouped urban agglomerations depending on their ranking into quarters. We therefore have the lowest 25% scoring agglomerations, those that scored between the 2.5th and 5th decile, those that scored between the 5th and 7.5th decile, and the top 75% scoring ones (the name of the agglomerations that fall in these categories can be found in the appendix).

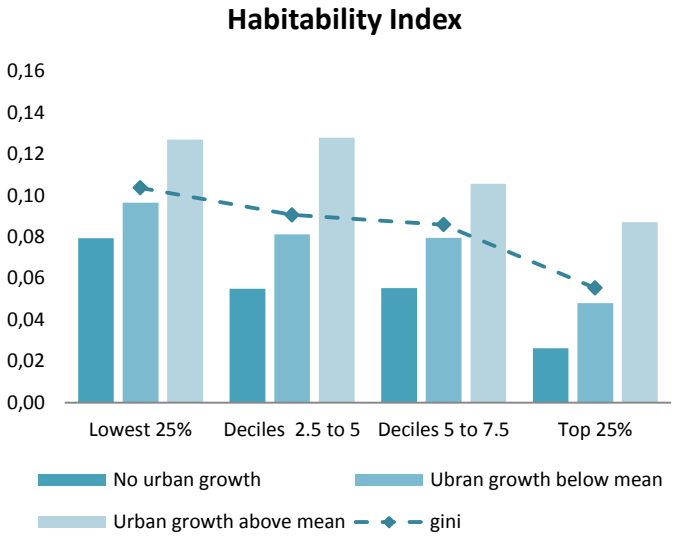
It becomes clear from the graphs below that the higher the scoring in both Prosperity and Livability, the lower the overall inequality. It is interesting to note that the highest scoring urban

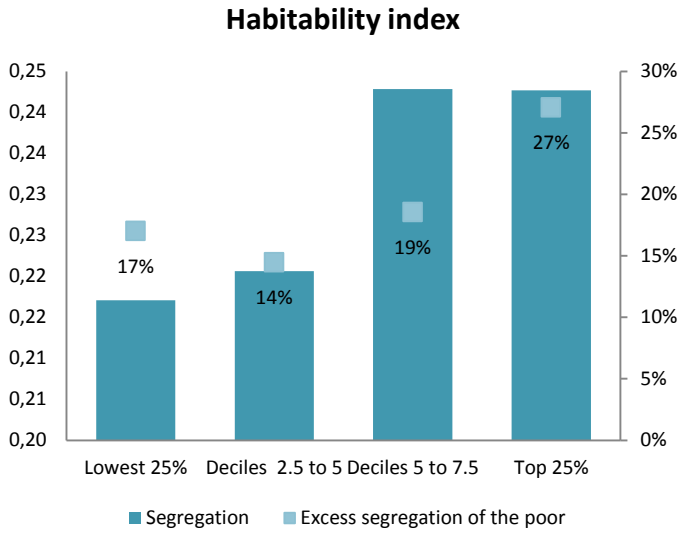
agglomerations are the ones for which the difference in inequality between the areas of no urban growth and the areas that have grown more than average is the greatest: in both cases inequality in high urban expansion areas is threefold that of no growth areas. If sustained in time, this trend might play a role in reducing inequality *between* urban agglomerations.

Regarding the segregation indexes, while there is no recognizable pattern when compared to the Prosperity index; there might be some association between better scoring Habitability indexes and higher levels of segregation, and particularly, of isolation of the poor and not of the rich. Households move into neighborhoods that offer them the best combination of housing and local amenities that they can afford (Oates, 1981; Tiebout, 1956) while policies and collective efforts may be excluding certain groups— i.e., low-income households, for example— from areas preferred by those with the power to do so. Although this structural source of racial segregation in wealthy communities is well documented (Massey & Denton, 1993; Pendall, 2000), there are few empirical studies on income segregation (Inhanfelt, 2004; Lens and Monkkonen, 2016)

Figure 12. Urban Growth, Segregation and Prosperity and Livability Indexes







Once we run OLS estimations to verify the statistical significance of these correlations we find that the only correlation robust to socioeconomic controls is that of Gini and the Prosperity Index. In this case, the relationship seems statistically strong enough to suggest that, once regions fixed effects and socioeconomic characteristics are taken into account, there is a positive association between better ranking agglomerations in terms of their prosperity indicators and more equally distributed populations. All other model specifications fail to show statistically significant associations. This might be due to either the small sample size we are working with or with the existence of socio-demographic cofounders that could be accounting for the observed correlation.

Table 7. GINI and Prosperity Index

GINI and the PROSPERITY INDEX

	OVERALL GINI			GINI IN AREAS OF NO SPRAWL			GINI IN AREAS OF BELOW MEAN SPRWAL			GINI AREAS OF ABOVE MEAN SPRAWL		
	-0.012***	-0.011***	-0.011**	-0.008	-0.004	0.019**	-0.010***	-0.009*	-0.007	-0.016**	-0.016*	-0.013
	(0.002)	(0.003)	(0.004)	(0.005)	(0.005)	(0.008)	(0.003)	(0.005)	(0.005)	(0.006)	(0.009)	(0.011)
Observations	31	31	24	26	26	21	26	26	21	26	26	21
R-squared	0.429	0.704	0.796	0.125	0.364	0.826	0.266	0.735	0.859	0.232	0.507	0.651
Regions Fixed effects	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Socioeconomic controls	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 8. Segregation and Prosperity Index

SEGREGATION and the PROSPERITY INDEX

	OVERALL			SEGREGATION OF THE POOR			SEGREGATION OF THE RICH		
	0.015**	-0.002	-0.023	0.017**	-0.001	-0.019	0.01	-0.006	-0.021
	(0.007)	(0.011)	(0.016)	(0.007)	(0.012)	(0.013)	(0.008)	(0.014)	(0.021)
Observations	30	30	23	30	30	23	30	30	23
R-squared	0.102	0.639	0.768	0.122	0.469	0.742	0.039	0.541	0.766
Regions Fixed effects	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Socioeconomic controls	No	No	Yes	No	No	Yes	No	No	Yes

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

The statistical results for the Habitability Index are similar to those found when analyzing the Prosperity indicator. The better agglomerations rank in their Habitability indicators the more equal they are. However, this relationship is not statistically significant once socioeconomic factors are accounted for. The relationship with segregation is thinner and only some of the models' specifications show mildly robust associations.

Table 9. GINI and Habitability Index

GINI and THE HABITABILITY INDEX

	OVERALL GINI			GINI IN AREAS OF NO SPRAWL			GINI IN AREAS OF BELOW			GINI AREAS OF ABOVE MEAN		
	-0.011***	-0.007*	-0.002	-0.010**	-0.012*	-0.009	-0.011***	-0.007*	-0.006	-0.010*	0.001	0.008
	-0.002	-0.003	-0.005	-0.005	-0.007	-0.005	-0.003	-0.004	-0.004	-0.005	-0.007	-0.011
Observations	33	33	25	28	28	22	28	28	22	28	28	22
R-squared	0.331	0.63	0.706	0.186	0.482	0.764	0.271	0.736	0.855	0.093	0.425	0.644
Regions Fixed effects	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Socioeconomic controls	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 10. Segregation and the Habitability Index

SEGREGATION and THE HABITABILITY INDEX

	OVERALL			SEGREGATION OF THE POOR			SEGREGATION OF THE RICH		
	0.004	-0.012*	-0.01	0.006	-0.013	-0.009	-0.002	-0.018**	-0.01
	-0.007	-0.007	-0.011	-0.008	-0.008	-0.012	-0.007	-0.009	-0.011
Observations	32	32	24	32	32	24	32	32	24
R-squared	0.009	0.675	0.744	0.015	0.519	0.722	0.001	0.613	0.751
Regions Fixed effects	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Socioeconomic controls	No	No	Yes	No	No	Yes	No	No	Yes

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

5. Can the pattern of urban sprawl explain inequality and segregation?

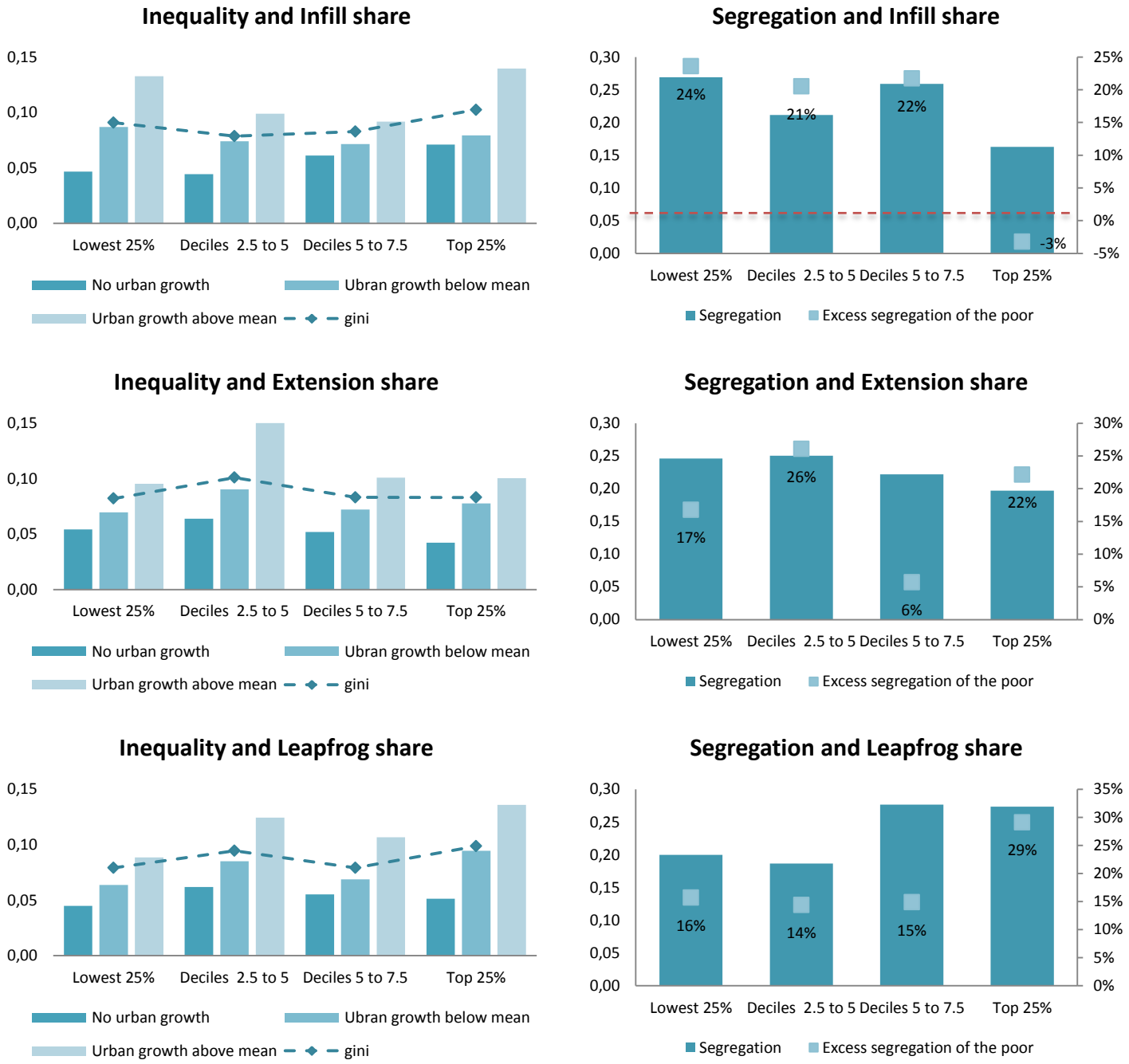
In this section we analyze the relationship between urban sprawl and our measures of inequality and segregation and intend to provide a causal interpretation to the observed relationships described below.

As has been described in the methodological section, we can classify urban expansion depending on the completion pattern the agglomeration has experienced. If new developments have occurred within the existing urban area, this expansion is considered as infill, if instead the growth has occurred by expansion of the urban footprint, then this is classified as continuous expansion, finally, if the urban growth has occurred disentangled from the preexisting urban area, then this discontinuous expansion is classified as leapfrog. Once these three categories of expansion are added up, one finds the total area of new developments occurring over the period under analysis, in this case 2001-2010.[6]

We have considered the share of each type of urban expansion over the total expansion experienced in the agglomeration and classified cities depending on their ranking on the share of each category. In this way we have four groups of agglomerations for each category of urban expansion. For instance, considering the share of infill over total urban expansion, we find Gran Rosario, Gran Santa Fe and Gran Cordoba among the 25% of cities that have had the lowest share of infill, while Formosa and Corrientes can be found in the group with the highest share of infill to total expansion.

[6] See Goytia and Pasquini (2013) for a complete explanation of this methodology for assessing urban extension patterns.

Figure 13. Inequality and patterns of urban growth (infill, extension and leapfrog)



There is no discernible pattern relating inequality and the different measures of urban sprawl. However, once we consider segregation, the data seems to show some interesting patterns. Agglomerations with higher shares of infill growth have the lowest segregation; and excess segregation of the poor is negative which means that the rich are more isolated that the poor.

Of all the correlation patterns analyzed so far in this report, this is the only instance in which excess segregation of the poor is negative. Besides, agglomerations with higher shares of leapfrog appear to be the most segregated and excess segregation of the poor is the highest.

In order to test the statistical significance and the causal relationship of these findings we estimate the following theoretical model:

$$I_j = \beta_0 + \beta_1 \text{Share of sprawl type} + \sum_h \beta_h \text{controls}_j^h + u_j$$

Where I stands for the following group of dependent variables in the urban agglomerate j:

- Inequality indicator (Gini)
- Segregation indicator
- Indicator of segregation of the poor
- Indicator of segregation of the rich

β coefficients will capture the causal relationship between our main explanatory variables and the dependent variables. These main explanatory variables are shares of each type of urban sprawl to total urban area expansion. As mentioned before the types of urban sprawl are classified into three categories: infill growth, extension growth and leapfrog. We are controlling for both socio-economic and regional variables (controls) that we add sequentially to the model. We include the following socioeconomic information:

- Average adult equivalent family income,
- average educational level of the head of household,
- share of informal head of household workers to total workforce,
- share of unemployed heads of household and share of immigrants in the urban agglomeration.

Finally, we assume that the model is subject to exogenous and random shocks captured by the disturbance term u_j.

In its simplest version this model could be estimated by OLS. We do this in the next sub-section in order to gain insights on the relationships that could be determining inequality and segregation. We call this our baseline empirical specification. However, we will be cautions when analyzing the results from this model specification since there are possible sources of reverse causation for our main explanatory variables. We will address this potential endogeneity of explanatory variables by implementing an IV approach. We follow Hilber and Robert-Nicoud (2009) and will instrument our main explanatory variables.

The argument considers that locations differ in exogenously given characteristics, like natural amenities and that these natural characteristics are relate to patterns of expansion but not directly linked to inequality or segregation. There they could act as instruments for the TSLS procedure.[7] Furthermore, past location decisions reflect desirable characteristics of a location that may change little over time: for this reason, we also use historical population density from 1893 as a first stage variable. We find that historical density is a reasonably good predictor of sprawl.

The variables used as sources of exogenous variability, our valid excluded instruments are: average maximum and minimum temperatures in the last decade, distance to the main costal area, and population density as of 1893. First, our identifying assumptions for the sprawl variables are:

1. That people, holding other things constant, will prefer mild climates to extreme ones and that climate is not directly related to the observed inequality and segregation of urban agglomerates.
2. That proximity to the main costal area can influence where people want to live therefore shaping the patterns of sprawl. Moreover, we assume that such distance is not directly related to the inequality or segregation of agglomerates, but only through its correlation with sprawl.
3. That population density in the far away past (we collected data published by INDEC for estimated agglomerates' population in the year 1893), is correlated with today's patterns and level of sprawl but cannot explain current inequality or segregation. Historical population density can be used as proxies of land characteristics that make areas more desirable to settlers before the urban complexities derived in patterns of inequality and segregation. The rationale for using the historical density from 1893 as an instrument is that it captures all the unobserved and time-invariant amenity and cost factors not already included in our set of amenity instruments that lead people to settle in a specific place. It also captures historic amenity and cost factors that were important a long time ago and which started a dynamic development process of cities. These factors may no longer be important nowadays, yet they remain relevant because of inertia, durable housing, or the generation of agglomeration forces (Hilber and Robert-Nicoud, 2009).

[7] The theoretical cross-sectional implication is that places endowed with desirable amenities will be more developed relative to others (ceteris paribus) (and nicer places are developed first)

Below we present the estimation results for the model that considers the Gini Index as the dependent variable. As was expected from the visual inspection of its correlation, there is no strong evidence in our data to support the relationship between different patterns of sprawl and inequality. Our results do not validate the association between overall sprawl and inequality in the urban agglomerates of Argentina. Once we consider the areas that have grown due to infill of leapfrog, none of the model specifications show statistically significant coefficients. And there is only mild evidence of a positive relationship between areas of greater growth due to extension and better ranking equality. However, these findings are not robust to the presence of socio-economic controls. This result might reflect the fact that one of the strongest determinants of inequality is the differences in skills of workers which can presumably be related to the socioeconomic variables included in the model. Once this is taken into account then there is few excess variability in the inequality level to be explained by other factors such as sprawl. This is particularly true in our case in which the small sample size we are dealing with might not have the statistical power to detect otherwise significant relationships.

Table 11. Regression results with Gini index

	INFILL						EXTENSION						LEAPFROG					
	Robust OLS			Instrumental variables approach			Robust OLS			Instrumental variables approach			Robust OLS			Instrumental variables approach		
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Urban area sprawl	**0.000**	**0.000**	**-0.002**	**0.002**	**-0.002**	**-0.003**	**-0.002**	**-0.007****	**-0.008**	**-0.006**	**-0.007****	**-0.007***	**0.002**	**0.004**	**0.005**	**0.004**	**0.002**	**0.004**
	(0.004)	**(0.004)**	**(0.006)**	**(0.005)**	**(0.004)**	**(0.004)**	**(0.003)**	**(0.003)**	**(0.006)**	**(0.006)**	**(0.004)**	**(0.004)**	**(0.003)**	**(0.003)**	**(0.005)**	**(0.005)**	**(0.003)**	**(0.003)**
Population in 2010		-0.000	-0.002		-0.001	-0.003		-0.002	-0.005		-0.005	-0.005		-0.001	-0.002		-0.001	-0.002
		(0.007)	(0.008)		(0.007)	(0.005)		(0.006)	(0.006)		(0.006)	(0.005)		(0.006)	(0.007)		(0.007)	(0.005)
Urban area 2010		0.007	0.004		0.006	0.002		0.005	0.005		0.006	0.004		0.005	0.002		0.005	0.001
		(0.005)	(0.006)		(0.005)	(0.004)		(0.005)	(0.005)		(0.005)	(0.004)		(0.005)	(0.006)		(0.005)	(0.004)
Adult equivalent average income			-0.019*			-0.022***			-0.014*			-0.016***			-0.019**			-0.021***
			(0.009)			(0.005)			(0.006)			(0.005)			(0.007)			(0.005)
Average education of the HH			-0.001			-0.002			-0.017			-0.015			-0.009			-0.008
			(0.025)			(0.016)			(0.034)			(0.018)			(0.030)			(0.017)
Share of informal HH workers			-0.209			-0.253***			-0.069			-0.122			-0.170			-0.223***
			(0.133)			(0.074)			(0.133)			(0.108)			(0.119)			(0.078)
Share of unemployed HH			0.829*			0.730**			0.462			0.468			0.726*			0.676**
			(0.407)			(0.326)			(0.363)			(0.371)			(0.334)			(0.328)
Share of inmigrant HH			0.067			-0.015			0.106			0.047			0.014			-0.051
			(0.173)			(0.100)			(0.156)			(0.106)			(0.171)			(0.104)
Constant	0.086***	0.050*	0.206	0.080***	0.066**	0.251***	0.094***	0.078***	0.217	0.101***	0.084***	0.234***	0.081***	0.049***	0.207	0.072***	0.054***	0.234***
	(0.011)	(0.024)	(0.137)	(0.017)	(0.030)	(0.081)	(0.009)	(0.017)	(0.121)	(0.016)	(0.019)	(0.073)	(0.012)	(0.014)	(0.122)	(0.015)	(0.014)	(0.072)
Observations	27	27	24	23	23	23	27	27	24	23	23	23	27	27	24	23	23	23
R-squared	0.000	0.651	0.786		0.683	0.848	0.015	0.740	0.820	0.030	0.754	0.844	0.011	0.674	0.801	0.049	0.701	0.852
Regions Fixed effects	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Share of infill sprawl is instrumented	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes

Instruments included: Share of developed land over total area, distance to main port, maximum and minimum average temperature, share of infill, extension and leapfrog sprawl btw 1990 and 2000, 1893 population densitiy
Notes:Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Once we consider overall segregation the regression approach and the IV specification seem to indicate a positive relationship between urban growth due to infill or extension and more homogeneity in terms of our Welfare Index, while leapfrog appears to explain greater segregation. As with inequality, once we include socioeconomic cofounders in the models, some of the statistically significant coefficients become non distinguishable from zero. It is

important to underscore that we are working with a small sample and, therefore, prone to high standard errors.

Table 12. Regression results with segregation

	INFILL						EXTENSION						LEAPFROG					
	Robust OLS			Instrumental variables approach			Robust OLS			Instrumental variables approach			Robust OLS			Instrumental variables approach		
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Urban area sprawl	**-0.022*** **	**-0.018** **	**-0.021**	**-0.038*** **	**-0.012**	**-0.007**	**-0.015** **	**-0.009**	**0.002**	**-0.031** **	**-0.030*** **	**-0.012**	**0.021*** **	**0.016***	**0.020***	**0.031** **	**0.019** **	**0.014**
	(0.006)	**(0.008)**	**(0.020)**	**(0.014)**	**(0.012)**	**(0.013)**	**(0.007)**	**(0.010)**	**(0.022)**	**(0.014)**	**(0.011)**	**(0.014)**	**(0.007)**	**(0.009)**	**(0.011)**	**(0.012)**	**(0.008)**	**(0.009)**
Population in 2010		-0.003	-0.009		-0.001	-0.006		-0.001	-0.004		-0.015	-0.008		-0.001	-0.006		-0.002	-0.005
		(0.014)	(0.019)		(0.017)	(0.016)		(0.015)	(0.022)		(0.020)	(0.018)		(0.015)	(0.021)		(0.016)	(0.015)
Urban area 2010		0.010	0.007		0.012	0.010		0.010	0.011		0.013	0.014		0.005	0.003		0.006	0.006
		(0.015)	(0.019)		(0.013)	(0.013)		(0.017)	(0.022)		(0.015)	(0.013)		(0.015)	(0.021)		(0.013)	(0.012)
Adult equivalent average income			-0.022			-0.013			-0.011			-0.001			-0.014			-0.011
			(0.025)			(0.018)			(0.025)			(0.018)			(0.024)			(0.015)
Average education of the HH			-0.004			0.007			0.019			-0.012			-0.028			-0.016
			(0.055)			(0.053)			(0.085)			(0.063)			(0.050)			(0.053)
Share of informal HH workers			-0.323			-0.358			-0.458			-0.146			-0.212			-0.236
			(0.420)			(0.241)			(0.481)			(0.375)			(0.417)			(0.246)
Share of unemployed HH			1.619			1.996*			2.299			1.587			1.493			1.711
			(1.564)			(1.139)			(2.091)			(1.359)			(1.301)			(1.082)
Share of inmigrant HH			-0.321			-0.363			-0.485			-0.256			-0.619			-0.506
			(0.556)			(0.366)			(0.568)			(0.416)			(0.622)			(0.353)
Constant	0.290***	0.259***	0.481	0.340***	0.220***	0.335	0.274***	0.198***	0.273	0.317***	0.277***	0.288	0.167***	0.154***	0.377	0.138***	0.147***	0.326
	(0.016)	(0.046)	(0.306)	(0.042)	(0.076)	(0.266)	(0.029)	(0.042)	(0.404)	(0.041)	(0.060)	(0.246)	(0.026)	(0.033)	(0.297)	(0.041)	(0.035)	(0.224)
Observations	26	26	23	22	22	22	26	26	23	22	22	22	26	26	23	22	22	22
R-squared	0.203	0.732	0.781	0.133	0.726	0.767	0.113	0.685	0.743	0.067	0.644	0.741	0.199	0.732	0.789	0.174	0.740	0.789
Regions Fixed effects	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Share of infill sprawl is instrumented	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes

Instruments included: Share of developed land over total area, distance to main port, maximum and minimum average temperature, share of infill, extension and leapfrog sprawl btw 1990 and 2000, 1893 population densitiy
Notes:Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

The strongest relationship is found once we consider segregation of the poor as our dependent variable. The data indicates a robust relationship between different forms of sprawl and segregation and, consistent with the preliminary results observed and the ones the regression analysis suggested for the overall segregation index, both infill and expansion are positively related to more homogeneous urban agglomerations while more leapfrog appears to explain greater heterogeneity. This means that the most disadvantaged are more evenly distributed in agglomerations that have not seen much of their sprawl due to discontinues expansions it borders. While recent urban expansion is a manifestation of growth, rising incomes and increased land and housing consumption, coupled with a general preference for suburban living of several groups, in the case of predominant leapfrog development, it may also be associated to segregation of the poor in the newly built urban peripheries of most cities.

Table 13. Regression results with segregation of the poor

	INFILL						EXTENSION						LEAPFROG					
	Robust OLS			Instrumental variables approach			Robust OLS			Instrumental variables approach			Robust OLS			Instrumental variables approach		
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Urban area sprawl	-0.027***	-0.027**	-0.034*	-0.046***	-0.034**	-0.028**	-0.021**	-0.022	-0.013	-0.035**	-0.040***	-0.030**	0.032***	0.036***	0.042***	0.041***	0.041***	0.039***
	(0.006)	(0.010)	(0.017)	(0.015)	(0.015)	(0.012)	(0.008)	(0.013)	(0.022)	(0.014)	(0.012)	(0.015)	(0.007)	(0.009)	(0.010)	(0.011)	(0.008)	(0.007)
Population in 2010		-0.001	-0.015		-0.001	-0.014		0.001	-0.014		-0.014	-0.019		0.001	-0.011		-0.001	-0.010
		(0.021)	(0.017)		(0.021)	(0.016)		(0.019)	(0.026)		(0.022)	(0.019)		(0.016)	(0.014)		(0.016)	(0.011)
Urban area 2010		0.007	0.001		0.003	0.002		0.004	0.009		0.008	0.014		-0.006	-0.010		-0.008	-0.007
		(0.021)	(0.017)		(0.016)	(0.012)		(0.021)	(0.025)		(0.016)	(0.014)		(0.018)	(0.016)		(0.013)	(0.009)
Adult equivalent average income			-0.047*			-0.044***			-0.022			-0.009			-0.037*			-0.035***
			(0.024)			(0.017)			(0.028)			(0.019)			(0.017)			(0.011)
Average education of the HH			0.067			0.072			0.066			0.029			0.008			0.015
			(0.068)			(0.051)			(0.098)			(0.066)			(0.040)			(0.039)
Share of informal HH workers			-0.486			-0.514**			-0.397			-0.001			-0.211			-0.211
			(0.372)			(0.234)			(0.585)			(0.394)			(0.294)			(0.180)
Share of unemployed HH			3.114			3.279***			3.292			2.474*			2.586**			2.725***
			(1.942)			(1.105)			(2.438)			(1.425)			(1.103)			(0.791)
Share of inmigrant HH			0.566			0.521			0.433			0.762*			0.017			0.113
			(0.441)			(0.355)			(0.610)			(0.436)			(0.453)			(0.258)
Constant	0.330***	0.316***	0.462	0.385***	0.357***	0.403	0.316***	0.258***	0.196	0.352***	0.328***	0.193	0.160***	0.151***	0.340	0.130***	0.147***	0.301*
	(0.022)	(0.064)	(0.327)	(0.044)	(0.095)	(0.258)	(0.031)	(0.063)	(0.434)	(0.042)	(0.067)	(0.258)	(0.024)	(0.036)	(0.197)	(0.038)	(0.034)	(0.164)
Observations	26	26	23	22	22	22	26	26	23	22	22	22	26	26	23	22	22	22
R-squared	0.27	0.63	0.74	0.179	0.628	0.738	0.181	0.612	0.725	0.182	0.616	0.729	0.389	0.785	0.848	0.394	0.788	0.857
Regions Fixed effects	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Share of infill sprawl is instrumented	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes

Instruments included: Share of developed land over total area, distance to main port, maximum and minimum average temperature, share of infill, extension and leapfrog sprawl btw 1990 and 2000, 1893 population densitiy
Notes:Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Finally, once we consider segregation of the rich as the variable to be explained, once again we find evidence that suggests that while infill and expansion favor homogeneity, leapfrog allows for greater segregation. In this case, as with the overall segregation indicator, models that account for socioeconomic cofounders are no longer statistically significant and therefore there are no robustness in these findings. Once again, this could be due to actual lack of a causal relationship between sprawl and segregation or insufficient statistical power due to small sample size.

Table 14. Regression results with segregation of the rich

	INFILL						EXTENSION						LEAPFROG					
	Robust OLS			Instrumental variables approach			Robust OLS			Instrumental variables approach			Robust OLS			Instrumental variables approach		
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Urban area sprawl	**-0.016***	**-0.006**	**-0.007**	**-0.044*****	**-0.001**	**0.012**	**-0.020****	**-0.012**	**0.008**	**-0.034****	**-0.026*****	**-0.009**	**0.018****	**0.006**	**0.002**	**0.034****	**0.007**	**-0.003**
	(0.008)	**(0.011)**	**(0.023)**	**(0.017)**	**(0.013)**	**(0.013)**	**(0.009)**	**(0.009)**	**(0.021)**	**(0.014)**	**(0.010)**	**(0.013)**	**(0.008)**	**(0.009)**	**(0.014)**	**(0.014)**	**(0.009)**	**(0.010)**
Population in 2010		0.000	0.010		0.016	0.016		-0.000	0.015		0.000	0.010		0.001	0.011		0.014	0.013
		(0.019)	(0.023)		(0.019)	(0.016)		(0.019)	(0.024)		(0.019)	(0.017)		(0.019)	(0.024)		(0.018)	(0.016)
Urban area 2010		0.020	0.006		0.014	0.013		0.016	0.006		0.013	0.012		0.018	0.006		0.011	0.011
		(0.021)	(0.018)		(0.014)	(0.013)		(0.019)	(0.017)		(0.014)	(0.012)		(0.021)	(0.020)		(0.014)	(0.013)
Adult equivalent average income			-0.023			-0.007			-0.023			-0.009			-0.020			-0.014
			(0.021)			(0.018)			(0.017)			(0.017)			(0.020)			(0.016)
Average education of the HH			-0.049			-0.034			-0.025			-0.063			-0.048			-0.037
			(0.082)			(0.053)			(0.110)			(0.059)			(0.087)			(0.055)
Share of informal HH workers			-0.776*			-0.754***			-0.949*			-0.545			-0.781*			-0.749***
			(0.417)			(0.244)			(0.442)			(0.352)			(0.389)			(0.254)
Share of unemployed HH			2.057			2.631**			2.661			1.845			2.155			2.405**
			(1.288)			(1.150)			(1.819)			(1.272)			(1.198)			(1.118)
Share of inmigrant HH			-0.430			-0.341			-0.537			-0.194			-0.496			-0.270
			(0.543)			(0.369)			(0.553)			(0.390)			(0.631)			(0.365)
Constant	0.260***	0.144**	0.621	0.339***	0.093	0.369	0.272***	0.157***	0.526	0.306***	0.192***	0.519**	0.164***	0.110***	0.568	0.109**	0.082**	0.481**
	(0.024)	(0.059)	(0.383)	(0.050)	(0.083)	(0.268)	(0.032)	(0.047)	(0.436)	(0.041)	(0.057)	(0.230)	(0.027)	(0.038)	(0.398)	(0.045)	(0.038)	(0.232)
Observations	26	26	23	22	22	22	26	26	23	22	22	22	26	26	23	22	22	22
R-squared	0.091	0.640	0.791		0.722	0.799	0.157	0.666	0.791	0.206	0.731	0.807	0.119	0.641	0.788	0.146	0.734	0.809
Regions Fixed effects	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Share of infill sprawl is instrumented	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes

Instruments included: Share of developed land over total area, distance to main port, maximum and minimum average temperature, share of infill, extension and leapfrog sprawl btw 1990 and 2000, 1893 population densitiy
Notes:Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

4. Extension: The Metropolitan Region of Buenos Aires, informal settlements and its correlation with inequality and segregation

The presence of informal settlements as well as its location within the urban area and its growth rates are important cofounders of inequality and segregation. In this extension we take a closer look at the Metropolitan Region of Buenos Aires in order to assess the relationship between the presence and growth of informal settlements and inequality and segregation. We do so by comparing, at the municipality level, a set of proxies for the intensity and relevance of informal settlements and inequality and segregations measures.

We work with satellite images to measure the increase of slums and informal settlements in the Metropolitan Region of Buenos Aires. After identifying over the latest available satellite image (circa 2010) the exact location of slums and measuring their built up area, we compare these same locations and their corresponding area on satellite images of 2001. The latest information on location of slums and informal settlements is provided by the NGO Un Techo Para Mi País for the year 2011. The NGO produced a comprehensive survey of characteristics and living conditions in the 633 identified slums and informal settlements in the Metropolitan Region of Buenos Aires and produced a map that locates them[8].

There are very dissimilar patterns of growth in the informal settlements of the municipalities that compose the metropolitan region of Buenos Aires: while the informal settlements in Moron have only expanded 4 % of their area between 2001 and 2010, those in Ezeiza have grown, on average, 46% over the same period. Differences in the kind of expansion that has guided their growth are also very dissimilar. Some have grown mainly because of infill while others have expanded their borders and grown capturing more land.

See below the table that shows, for each municipality in the metropolitan region of Buenos Aires the patterns of growth of their informal settlements

[8] Satellite images, though precise in distinguishing between built up from non-built up land, are unable to measure density or height of constructed areas therefore limiting the analysis of growth of slums which might grow following patterns of densification. This is particularly relevant for slums within the City of Buenos Aires where density rather than sprawl is the common way in which slums grow. In order to partially correct this, we will use Google Earth Imagery for selected slums and estimate growth by means of observation.

Table 15. Growth of informal settlements

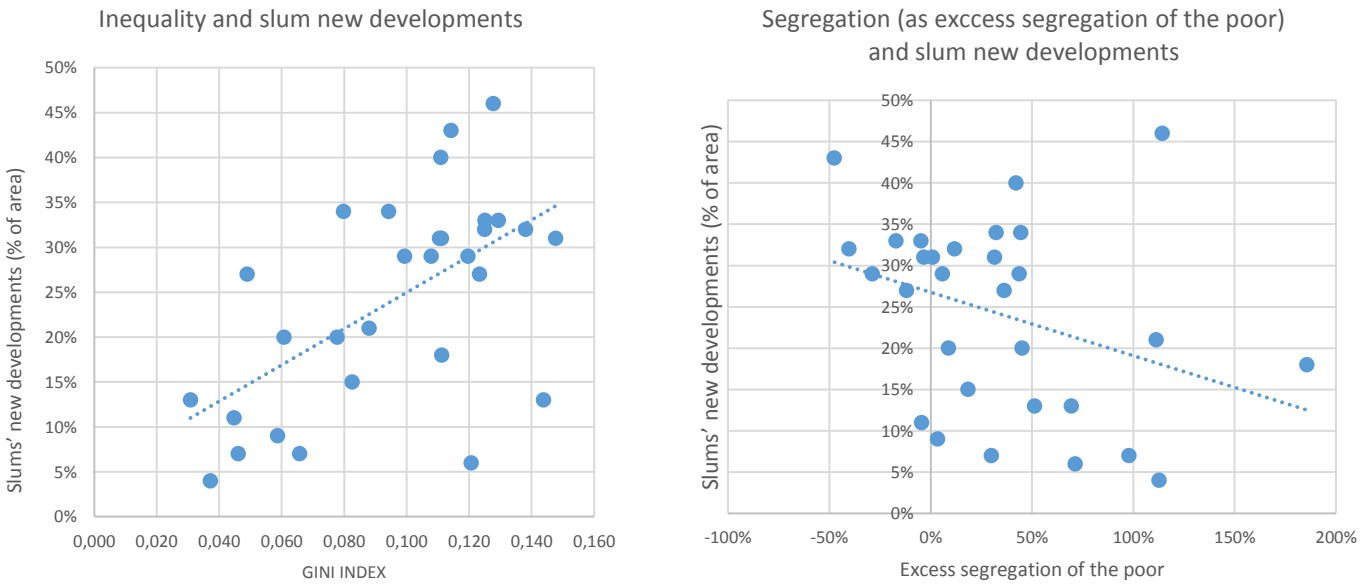
Municipality	% New developments	% extension	% leapfrog	% infill	Number of identified settlements (2011)
Moron	4%	0%	0%	4%	6
Marcos Paz	6%	0%	6%	0%	3
Tres de Febrero	7%	3%	0%	3%	12
Lanus	7%	0%	0%	7%	16
Hurlingham	9%	5%	0%	5%	14
San Isidro	11%	0%	0%	11%	9
General Rodriguez	13%	6%	6%	0%	16
Vicente Lopez	13%	13%	0%	0%	7
CABA	13%	2%	0%	11%	50
San Fernando	15%	8%	0%	6%	7
San Vicente	18%	13%	5%	0%	7
General San MartÝn	20%	4%	0%	16%	38
Avellaneda	20%	4%	0%	16%	26
Malvinas Argentinas	21%	6%	0%	14%	19
La Matanza 1	25%	15%	0%	9%	43
Ituzaingo	27%	21%	0%	5%	14
La Matanza	29%	25%	3%	1%	46
Quilmes	29%	7%	1%	21%	56
Jose C. Paz	29%	13%	2%	14%	24
San Miguel	29%	17%	0%	12%	14
Almirante Brown	31%	17%	1%	12%	18
Presidente Peron	31%	26%	1%	4%	10
Escobar	31%	20%	3%	8%	17
Florencio Varela	32%	20%	3%	8%	36
Pilar	32%	26%	3%	3%	28
Merlo	33%	19%	3%	10%	27
Moreno	33%	29%	3%	2%	42
Berazategui	34%	31%	3%	1%	3
Tigre	34%	22%	1%	11%	26
Lomas de Zamora	40%	10%	0%	29%	26
Esteban Echeverria	43%	24%	10%	9%	10
Ezeiza	46%	43%	0%	4%	8

Once we analyze the correlation between slum growth and inequality and segregation we find some interesting patterns. There is an observed positive relationship between more unequal municipalities and greater slum expansions. The causal mechanism tying this relationship is

unclear. It might be the case that more unequal municipalities allow for institutional environments in which slums can grow faster. Or it might well be in place the opposite mechanism, that places which have experienced more accelerated slum growth have become more unequal because of the arrival of new families that accentuates the Welfare index distribution lower tail.

In is also interesting to note that those municipalities that have experiences greater relative slum growth are also those where the segregation of the top deciles in the Welfare distribution was greater than that of the poor. The data seems to support the fact that the rich are the ones that tend to isolate themselves the most in areas of accelerated informal expansion. Once again the causality of this relationship is unclear and further analysis could be promising.

Figure 14. Inequality an Segregation and Slum Growth in Buenos Aires Metropolitan Region



The implications of this pattern of segregation should be studied. Other than the sorting literature that began with Tiebout (1956), the phenomenon of socioeconomic segregation has generally been approached with a concern for the concentration or marginalization of poverty (Massey and Kanaiaupuni, 1993; Jargowsky, 2002). The broader social impacts of isolation of high-income groups, on the other hand, have gotten less attention. Yet, the implications of the different segregation profiles found in GBA merit further attention.

6. Conclusions

Our results provide evidence that there is segregation of the poor and not of the rich in all urban agglomerates. This means that the most disadvantaged are more evenly distributed in agglomerations that have not seen much of their sprawl due to discontinue urban expansion of their borders.

Yet, we provide strong evidence that not all the patterns of urban development and built-up growth have the same effect. Leapfrog development appears to explain greater segregation - particularly of the poor- while both infill and extension are positively related to more homogeneous urban agglomerations. In most of the urban agglomerates, the segregation of the poor result is probably reflecting the fact that poor households live in areas where land is cheap and affordable –lacking public infrastructure services and with bad accessibility to major employment areas. Moreover, housing policies that locate large social housing projects in the urban periphery in order to save in land prices and build more units. Most of the recent policy advises concerned with social housing policies are now pointing out the risks of settling poor households into remote areas (Habitat-UN, 2016). Greater distance may reduce both the efficiency of the search for jobs and its intensity. Poor accessibility may also make workers less likely to accept job offers since the wage net of commuting costs is more likely to fall below some reservation level. Thus, these policies may house a lot of low income households but it may be reinforcing their economic condition helping to trap those families in the vicious cycle of poverty. In other words, it often creates neighborhoods besieged by crime and severely limits life chances in schooling, employment, health, intergenerational mobility, and other vital outcomes (Lens & Monkkonen, 2016).

Thus, the recent urban expansion may not simply be a manifestation of growth, rising incomes and increased land and housing consumption, coupled with a general preference for suburban living. In the case of leapfrog development, it is associated to income segregation of the poor, and this relation seems to be stronger for all urban metropolitan areas that are extending, except Greater Buenos Aires, which seems to display a particular trend.

In the metropolitan areas of Bs. As., a dual effect is noticed. In Buenos Aires City, the difference in our measure of welfare inequality is almost doubled between areas that have not grown in the last decade and those that have done so above average. In GBA, built up area growth and leapfrog development is associated to richer families locating in the outskirts and increases in segregation of the rich - rather than the poor. In this case, higher income households are located in remote areas as do want to be isolated in gated urbanizations, a significant trend that has characterize the last decades (Goytia and Lanfranchi, 2009). Consistently, we do find

that segregation of the affluent, not the poor, prevails in areas of accelerated informal urban expansion, measured by the extension of informal settlements.

We also find that there is a positive relationship between more unequal municipalities and greater slum expansions. The causal mechanism tying this relationship is unclear. It might be the case that places which have experienced more accelerated slum growth have become more unequal because of the arrival of new families that accentuates such disparities. Or it might well be in place the opposite mechanism: more unequal municipalities allow for institutional environments in which slums can grow faster. Further analysis could be promising to better understand this association. Additionally, the implications of this pattern of segregation should be studied. The implications of the different segregation profiles found in GBA merit further attention.

We find there is mild association between inequality and urban growth: areas that have experienced greater urban expansion are also more unequal, when considering our measure of inequality. However, models that account for socioeconomic cofounders are no longer statistically significant and therefore there is no robustness in these findings. Once again, this could be due to actual lack of a causal relationship between sprawl and inequality of insufficient statistical power due to small sample size.

Finally, we find that there is a positive association between better ranking agglomerations in terms of their prosperity indicators and more equally distributed welfare of their populations. Clearly, more targeted research on the role of inequality on prosperity is still needed.

To conclude, while in this paper we highlight key issues, proper integration of these features into a consistent theoretical framework can form the basis for subsequent empirical and policy making work.

References

- **Burchfield Marcy, Henry Overman, Diego Puga and Matthew Turner. 2006.** "Causes of sprawl: a portrait from space." The Quarterly Journal of Economics, May 2006
- **Galster, George, Royce Hanson, Michael R. Ratcliffe, Hal Wolman, Stephen Coleman, and Jason** Freihage. 2001. Wrestling sprawl to the ground: Defining and measuring an elusive concept. Housing Policy Debate 12(4): 681–717.
- **Gasparini Leonardo, Guillermo Cruces, Leopoldo Tornarolli and Daniel Mejía. 2011** "Recent Trends in Income Inequality in Latin America." Economía Vol. 11, No. 2, pp. 147-2011
- **Glaeser Edward and Matthew E. Kahn. 2004** "Growth and Urban Sprawl" in Vernon Henderson and Jacques-Francois Thisse, eds, Handbook of Regional and Urban Economics, Volume IV, Amsterdam. North-Holland, pp. 2481-2527.
- **Glaeser Edward, Matt Ressenger and Kristina Tobio. 2009** "Inequality in cities." Journal of regional science, VOL. 49, NO. 4, pp. 617–646.
- **Glaeser, E. L., Resseger, M. and Tobio, K. (2009),** INEQUALITY IN CITIES*. Journal of Regional Science, 49: 617–646. doi:10.1111/j.1467-9787.2009.00627
- **Goytia C. and Pasquni R. (2013)** Assessing Urban Land Use Regulation in Argentina:
- Literature Review and Research Strategy. Lincoln Institute of Land Policy Working Paper WP13CG2
- **Goytia C, Lanfranchi G (2009)** Informal neighborhoods in the Buenos Aires metropolitan region: understanding the effects of land regulation on the welfare of the poor. In: Lall SV et al. (ed) Urban Land Markets: improving land management for successful urbanization. Springer, New York, pp 163–190
- **Goytia C. and Pasquini R. (2012)** Zoning and Land Cover Metrics for Municipalities in Argentina (1990–2001) Lincoln Institute of Land Policy Working Paper WP13CG1
- **Hilber, Christian and Frédéric Robert-Nicoud**. 2013. On the origins of land use regulations: Theory and evidence from us metro areas. Journal of Urban Economics 75(1): 29–43.
- **Ihlanfeldt, K. R. (2004).** Exclusionary land use regulations within suburban communities: a review of the evidence and policy prescriptions. Urban Studies, 41(2), 261–283. doi:10.1080/00420980320016524 4
- **Kain, John F**. 1968. Housing segregation, negro employment, and metropolitan decentralization. The Quarterly Journal of Economics 82(2): 175–197.
- **Michael C. Lens & Paavo Monkkonen (2016)** Do Strict Land Use Regulations Make Metropolitan Areas More Segregated by Income? Journal of the American Planning Association, 82:1, 6-21, DOI: 10.1080/01944363.2015.1111163

- **Rearon Sean and Kendra Bischoff. 2011** "Income Inequality and Income Segregation." American Journal of Sociology, Vol 116, No.4, pp 1092-1153
- **Lee Barret, Sean F. Reardon, Glenn Firebaugh, Chad R. Farrell, Stephen A. Matthews and David O'Sullivan. 2008** "Beyond the census tract: patterns and determinants of racial segregation at multiple geographic scales." American Sociological Review, 73, pp 766-791
- **Oates, W. E. (1981).** On local fi nance and the Tiebout model. American Economic Review, 71(2), 93–98. Retrieved from https://www.aeaweb. org/aer/index.php
- **Pendall, R. (2000).** Local land use regulation and the chain of exclusion. Journal of the American Planning Association, 66(2), 125–142. doi:10.1080/01944360008976094
- **Rearon Sean, Glenn Firebaugh, David O'Sullivan and Stephen Mathews. 2006** "Measures of socioeconomic segregation." Paper presented at the 29th General Conference of the International Association for Research in Income and Wealth, Finland. Available at http://www.iariw.org/papers/2006/reardon.pdf
- **Reardon, S. F., & Bischoff, K. (2011).** Income inequality and income segregation. American Journal of Sociology, 116(4), 1092–1153. doi:10.1086/657114
- **Tiebout, C. M. (1956).** A pure theory of local expenditures. Journal of Political Economy, 64(5), 416–424. http://www.jstor.org/journal/jpoliecon

APPENDIX 1.

Table 16. Summary of indicators

Region		Prosperity indicator (0-100 scale)	Habitability indicator (0-100 scale)	Population 2010 (in thousand inhab)	Urban area 2010 (ha)	Annual population growth 2001-2010	Annual urban area growth 2001-2010	Per capita family income (EPH)	GINI	Segregation
Cuyo	Gran Mendoza	45	58	937	215	1.10%	3.27%	$ 1,254	0.06	0.19
	Gran San Juan	18	9	461	105	0.99%	2.93%	$ 1,094	0.1	0.28
	Gran San Luis	38	38	182	50	1.30%	3.10%	$ 1,259	0.07	0.18
GBA	Gran Buenos Aires	56	44	13588	2132	1.35%	3.69%	$ 1,810	0.11	0.43
NEA	Formosa	13	23	222	56	1.28%	3.25%	$ 1,002	0.13	0.13
	Gran Corrientes	6	0	346	61	0.98%	0.37%	$ 1,100	0.08	0.17
	Gran Posadas	4	7	319	79	1.46%	3.90%	$ 1,171	0.09	0.21
	Gran Resistencia	0	4	386	84	0.78%	2.38%	$ 948	0.11	0.15
NOA	Catamarca	30	13	198	33	1.58%	5.15%	$ 1,186	0.09	0.23
	Gran Salta	38	19	551	82	1.81%	4.33%	$ 1,174	0.14	0.31
	Gran San Salvador De Jujuy	25	48	310	42	1.22%	4.20%	$ 1,077	0.12	0.14
	Gran Tucuman - Tafi Viejo	29	45	794	221	0.82%	2.96%	$ 1,392	0.13	0.19
	La Rioja	45	10	179	70	2.45%	4.04%	$ 1,209	0.1	0.21
	Santiago Del Estero - La Banda	11	20	361	71	1.07%	3.10%	$ 913	0.12	0.19
Pampeana	Bahia Blanca - Cerri	68	71	291	92	0.63%	3.08%	$ 1,697	0.05	0.24
	Concordia	19	8	149	n.a.	0.86%	n.a.	$ 1,150	0.11	0.2
	Gran Cordoba	49	36	1455	272	0.69%	1.69%	$ 1,511	0.08	0.25
	Gran La Plata	57	57	787	202	1.41%	5.11%	$ 1,860	0.09	0.23
	Gran Parana	43	41	264	100	0.74%	4.73%	$ 1,407	0.08	0.25
	Gran Rio Cuarto	53	35	163	42	1.00%	4.61%	$ 1,832	0.06	0.14
	Gran Rosario	49	33	1236	321	0.70%	3.67%	$ 1,585	0.08	0.27
	Gran Santa Fe	28	28	490	126	0.85%	5.47%	$ 1,301	0.1	0.32
	Gran Santa Rosa	64	44	114	40	1.24%	3.25%	$ 1,982	0.04	0.2
	Mar Del Plata - Batan	n.a.	72	593	150	1.00%	4.49%	$ 1,678	0.06	0.25
	San Nicolas - Villa Constitucion	38	36	134	n.a.	0.69%	n.a.	$ 1,505	0.08	0.16
Patagonia	Cro. Rivadavia	68	61	175	33	2.84%	4.09%	$ 3,107	0.05	0.24
	Neuquen - Plottier - Cipolletti	51	28	341	111	1.78%	2.36%	$ 2,030	0.09	0.27
	Rawson - Trelew	55	51	98	32	1.20%	3.25%	$ 1,879	0.05	0.3
	Rio Gallegos	88	73	96	n.a.	2.19%	n.a.	$ 3,210	0.03	0.27
	Ushuaia - Rio Grande	n.a.	51	57	n.a.	2.66%	n.a.	$ 2,898	0.05	0.27
	Viedma - Carmen De Patagones	26	47	73	23	1.30%	1.60%	$ 1,627	0.07	n.a.

Table 17. Population and institutional fragmentation

REGION	Urban Agglomeration	Population 2010 (thousands of inhabitants)	Number of municipalities per 100 k inhab.
GBA	Buenos Aires	12047	0,3
	Catamarca	172	1,7
	Jujuy	278	1,1
NOA	Tucumán	738	0,9
	La Rioja	144	0,7
	Stgo. del Estero	328	0,6
	Salta	469	0,4
NEA	Resistencia	360	1,1
	Posadas	280	0,7
	Formosa	198	0,5
	Corrientes	317	0,3
Cuyo	San Juan	422	1,4
	San Luis	162	1,2
	Mendoza	849	0,7
Pampeana	Santa Rosa	102	2,0
	Paraná	247	1,6
	San Nicolás	126	1,6
	Rio Cuarto	149	1,3
	Santa Fe	454	1,1
	Rosario	1161	0,9
	Concordia	138	0,7
	La Plata	694	0,4
	Bahía Blanca	275	0,4
	Córdoba	1368	0,3
	Mar del Plata	542	0,2
Patagonia	Ushuaia	45	4,4
	Viedma	65	3,1
	Rawson	88	2,3
	Cdro. Rivadavia	136	1,5
	Río Gallegos	79	1,3
	Neuquén	291	0,7

Table 18. Prosperity and Habitability ranking

	Prosperity index	Habitability index
Lowest 25% scoring agglomerations	Concordia	Concordia
	Formosa	Gran Corrientes
	Gran Corrientes	Gran Posadas
	Gran Posadas	Gran Resistencia
	Gran Resistencia	Gran Salta
	Gran San Juan	Gran San F del V de Catamarca
	Gran San Salvador de Jujuy	Gran San Juan
	Stgo del Estero – La Banda	La Rioja
		Stgo del Estero – La Banda
Agglomerations scoring between the 2.5th and 5th percentile	Gran Salta	Formosa
	Gran San F del V de Catamarca	Gran Córdoba
	Gran San Luis	Gran Río Cuarto
	Gran Santa Fe	Gran Rosario
	Gran Tucumán – Tafí Viejo	Gran Santa Fe
	Rest of GBA	Neuquén – Plottier – Cipoletti
	San Nicolás – Villa Constitución	Rest of GBA
	Viedma – C. de Patagones	San Nicolás – Villa Constitución
Agglomerations scoring between the 5th and 7.5th percentile	Gran Córdoba	Gran Buenos Aires
	Gran Mendoza	Gran Paraná
	Gran Paraná	Gran San Luis
	Gran Río Cuarto	Gran San Salvador de Jujuy
	Gran Rosario	Gran Santa Rosa
	La Rioja	Gran Tucumán – Tafí Viejo
	Neuquén – Plottier – Cipoletti	Rawson - Trelew
	Rawson – Trelew	Viedma – C. de Patagones
Top 75% scoring agglomerations	Bahía Blanca – Cerri	Bahía Blanca – Cerri
	Cdro. Rivadavia – Rada Tilly	Cdro. Rivadavia – Rada Tilly
	CABA	CABA
	Gran Buenos Aires	Gran La Plata
	Gran La Plata	Gran Mendoza
	Gran Santa Rosa	Mar del Plata - Batán
	Río Gallegos	Río Gallegos
		Ushuaia – Río Grande

Table 19. New Developments: Infill, Extension and Leapfrog 2001-2010

REGIONS	Urban Agglomerate	New Developments (km2)	Infill (km2)	%	Extension (km2)	%	Leapfrog (km2)	%
Región Gran Buenos Aires	Buenos Aires	551,2	148	27	294	53	110	20
NOA	Tucumán	49,4	11	23	31	62	7	15
	Salta	25,2	4	16	14	54	8	30
	Stgo. del Estero	13,4	5	39	8	60	0	1
	Jujuy	12	4	31	8	65	0	4
	Catamarca	5,2	1	22	3	68	1	10
	La Rioja	18,6	4	23	13	68	2	9
NEA	Resistencia	13,3	5	34	8	57	1	9
	Corrientes	3,6	2	55	1	36	0	9
	Posadas	20,5	5	24	13	65	2	11
	Formosa	14	5	36	7	52	2	12
Cuyo	Mendoza	53,6	13	24	25	47	15	29
	San Juan	42,3	11	25	20	47	12	28
	San Luis	11,2	4	36	7	60	0	4
Pampeana	Córdoba	25,2	4	16	14	54	8	30
	Rosario	81,1	14	17	49	60	18	22
	La Plata	61,9	9	14	33	53	20	33
	Mar del Plata	49,2	9	19	28	57	12	24
	Santa Fe	44,6	4	9	21	46	20	45
	Bahía Blanca	22,5	6	28	14	64	2	8
	Paraná	30,7	3	10	12	37	16	52
	Rio Cuarto	12,4	3	26	8	67	1	7
	Concordia	n.a.	n.a.		n.a.		n.a.	
	San Nicolás	n.a.	n.a.		n.a.		n.a.	
	Santa Rosa	8,3	2	23	5	63	1	15
Patagonia	Neuquén	21,1	6	27	9	45	6	28
	Cdro. Rivadavia	10,1	2	22	5	50	3	29
	Rawson	7,7	2	31	5	62	1	7
	Río Gallegos	n.a.	n.a.		n.a.		n.a.	
	Viedma	3,2	1	37	2	58	0	5
	Ushuaia	n.a.	n.a.		n.a.		n.a.	

Table 20. Segregation of the poor and of the rich

Region	Urban Agglomerate	Segregation indicator	Segregation of the poor	Segregation of the rich
Cuyo	Gran Mendoza	0.19	0.22	0.17
	Gran San Juan	0.28	0.34	0.23
	Gran San Luis	0.18	0.16	0.18
GBA	Gran Buenos Aires	0.43	0.4	0.43
NEA	Formosa	0.13	0.21	0.11
	Gran Corrientes	0.17	0.17	0.18
	Gran Posadas	0.21	0.21	0.18
	Gran Resistencia	0.15	0.13	0.19
NOA	Gran Salta	0.31	0.41	0.24
	Catamarca	0.23	0.26	0.22
	Gran San Salvador De Jujuy	0.14	0.19	0.11
	Gran Tucuman - Tafi Viejo	0.19	0.19	0.17
	La Rioja	0.21	0.25	0.23
	Santiago Del Estero - La Banda	0.19	0.21	0.25
Pampeana	Bahia Blanca - Cerri	0.24	0.23	0.25
	Concordia	0.2	0.24	0.18
	Gran Cordoba	0.25	0.27	0.25
	Gran La Plata	0.23	0.31	0.17
	Gran Parana	0.25	0.29	0.22
	Gran Rio Cuarto	0.14	0.17	0.1
	Gran Rosario	0.27	0.25	0.29
	Gran Santa Fe	0.32	0.29	0.34
	Gran Santa Rosa	0.2	0.22	0.16
	Mar Del Plata - Batan	0.25	0.31	0.21
	San Nicolas - Villa Constitucion	0.16	0.2	0.14
Patagonia	Comodoro Rivadavia - Rada Tilly	0.24	0.3	0.24
	Neuquen - Plottier - Cipolletti	0.27	0.36	0.31
	Rawson - Trelew	0.3	0.29	0.2
	Rio Gallegos	0.27	0.29	0.22
	Ushuaia - Rio Grande	0.27	0.35	0.31

APPENDIX 2.

We run the same set of OLS and IV models presented in section 3 in which we study the relationship between sprawl and inequality and segregation but consider a different set of dependent variables. In the report we have shown results -both in terms of correlations and as part of theoretical models- in which segregation and inequality were calculated based on a Welfare Index that included family income together with other socioeconomic characteristics. In this appendix we have constructed our inequality and segregation indicators based solely on income and use these as our dependent variables.

Through the report we have chosen the Welfare Index as our main indicator instead of the income one since the former considers actual household data (once we take into account census data on socioeconomic characteristics other than income) while the latter is only an approximation of the income those households have. However, in this appendix we present results for income inequality and segregation in order to provide information that could be compared to other studies that deal with this subject. Our warning is that results should be considered cautiously since, as mentioned, income is only an approximation based on households' characteristics and not an actual figure provided by households surveys like the ones that other Latin American countries implement in their urban areas.

Table 21. Income inequality (Gini Index)

	INFILL						EXTENSION						LEAPFROG					
	Robust OLS			Instrumental variables approach			Robust OLS			Instrumental variables approach			Robust OLS			Instrumental variables approach		
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Urban area sprawl	**-0.003**	**-0.003**	**-0.001**	**0.001**	**0.015**	**0.016***	**-0.002**	**-0.002**	**0.012**	**-0.017**	**-0.007**	**0.009**	**0.002**	**-0.004**	**-0.009**	**0.008**	**-0.011**	**-0.017****
	(0.005)	**(0.007)**	**(0.014)**	**(0.010)**	**(0.010)**	(0.010)	**(0.007)**	**(0.006)**	**(0.010)**	**(0.011)**	**(0.009)**	**(0.010)**	**(0.005)**	**(0.005)**	**(0.013)**	**(0.009)**	**(0.007)**	(0.008)
Population in 2010		-0.005	-0.008		-0.000	-0.001		-0.004	-0.002		-0.012	-0.002		-0.003	-0.006		-0.003	-0.004
		(0.015)	(0.015)		(0.016)	(0.013)		(0.015)	(0.015)		(0.016)	(0.013)		(0.015)	(0.015)		(0.014)	(0.012)
Urban area 2010		0.016	0.017*		0.024**	0.023**		0.016	0.015*		0.022*	0.018*		0.018	0.020*		0.026**	0.026***
		(0.013)	(0.008)		(0.012)	(0.010)		(0.014)	(0.008)		(0.012)	(0.010)		(0.014)	(0.010)		(0.012)	(0.010)
Adult equivalent average income			0.003			0.018			-0.002			0.002			0.005			0.011
			(0.021)			(0.014)			(0.018)			(0.013)			(0.020)			(0.012)
Average education of the HH			0.015			0.027			0.040			0.035			0.033			0.050
			(0.058)			(0.042)			(0.060)			(0.045)			(0.069)			(0.043)
Share of informal HH workers			-0.059			-0.027			-0.269			-0.170			-0.150			-0.157
			(0.244)			(0.194)			(0.339)			(0.268)			(0.260)			(0.198)
Share of unemployed HH			0.172			0.585			0.739			0.730			0.432			0.805
			(1.218)			(0.860)			(1.169)			(0.922)			(1.085)			(0.832)
Share of inmigrant HH			-0.944***			-0.789***			-1.002***			-0.891***			-0.856**			-0.632**
			(0.251)			(0.265)			(0.259)			(0.264)			(0.307)			(0.264)
Constant	0.145***	0.127*	0.104	0.128***	0.017	-0.139	0.143***	0.121**	0.044	0.178***	0.133***	0.012	0.131***	0.115***	0.049	0.108***	0.108***	-0.048
	(0.021)	(0.061)	(0.350)	(0.032)	(0.069)	(0.215)	(0.022)	(0.043)	(0.289)	(0.032)	(0.048)	(0.181)	(0.018)	(0.031)	(0.337)	(0.030)	(0.031)	(0.182)
Observations	27	27	24	23	23	23	27	27	24	23	23	23	27	27	24	23	23	23
R-squared	0.007	0.516	0.733		0.550	0.711	0.004	0.515	0.749		0.579	0.737	0.002	0.520	0.746	0.012	0.613	0.740
Regions Fixed effects	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Share of infill sprawl is instrumented	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes

Instruments included: Share of developed land over total area, distance to main port, maximum and minimum average temperature, share of infill, extension and leapfrog sprawl btw 1990 and 2000, 1893 population densitiy
Notes:Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 22. Income segregation

	INFILL						EXTENSION						LEAPFROG					
	Robust OLS			Instrumental variables approach			Robust OLS			Instrumental variables approach			Robust OLS			Instrumental variables approach		
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Urban area sprawl	**-0.014****	**-0.012**	**-0.004**	**-0.019***	**-0.000**	**0.009**	**-0.012***	**-0.008**	**-0.001**	**-0.027*****	**-0.023****	**-0.010**	**0.016*****	**0.011**	**0.006**	**0.020****	**0.006**	**0.001**
	(0.005)	**(0.010)**	**(0.024)**	**(0.010)**	**(0.014)**	**(0.015)**	**(0.007)**	**(0.008)**	**(0.016)**	**(0.010)**	**(0.011)**	**(0.016)**	**(0.005)**	**(0.008)**	**(0.016)**	**(0.009)**	**(0.010)**	**(0.012)**
Population in 2010		0.013	0.015		0.025	0.018		0.014	0.015		0.011	0.012		0.014	0.015		0.023	0.015
		(0.015)	(0.023)		(0.020)	(0.020)		(0.016)	(0.023)		(0.021)	(0.020)		(0.016)	(0.022)		(0.019)	(0.019)
Urban area 2010		0.003	-0.000		0.000	0.002		0.003	0.001		-0.001	0.002		0.000	-0.002		-0.002	0.000
		(0.012)	(0.015)		(0.015)	(0.015)		(0.013)	(0.013)		(0.015)	(0.015)		(0.012)	(0.016)		(0.015)	(0.015)
Adult equivalent average income			-0.003			0.005			0.000			0.005			-0.002			-0.001
			(0.035)			(0.021)			(0.029)			(0.021)			(0.030)			(0.019)
Average education of the HH			0.033			0.044			0.034			0.015			0.024			0.035
			(0.069)			(0.063)			(0.090)			(0.071)			(0.083)			(0.066)
Share of informal HH workers			-0.231			-0.286			-0.232			-0.067			-0.188			-0.253
			(0.438)			(0.292)			(0.406)			(0.425)			(0.398)			(0.305)
Share of unemployed HH			1.989			2.338*			2.050			1.593			1.898			2.076
			(1.580)			(1.377)			(1.764)			(1.537)			(1.520)			(1.344)
Share of inmigrant HH			-0.181			-0.265			-0.204			-0.119			-0.258			-0.236
			(0.482)			(0.442)			(0.532)			(0.470)			(0.618)			(0.439)
Constant	0.240***	0.197**	0.113	0.256***	0.122	-0.014	0.236***	0.165***	0.076	0.275***	0.213***	0.104	0.152***	0.127**	0.101	0.139***	0.118***	0.081
	(0.017)	(0.072)	(0.482)	(0.030)	(0.089)	(0.321)	(0.023)	(0.053)	(0.445)	(0.030)	(0.063)	(0.278)	(0.017)	(0.047)	(0.426)	(0.029)	(0.041)	(0.278)
Observations	26	26	23	22	22	22	26	26	23	22	22	22	26	26	23	22	22	22
R-squared	0.166	0.328	0.412	0.179	0.305	0.375	0.135	0.307	0.409	0.074	0.281	0.389	0.210	0.324	0.417	0.227	0.335	0.402
Regions Fixed effects	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Share of infill sprawl is instrumented	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes

Instruments included: Share of developed land over total area, distance to main port, maximum and minimum average temperature, share of infill, extension and leapfrog sprawl btw 1990 and 2000, 1893 population densitiy
Notes:Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 23. Income segregation of the poor

	INFILL						EXTENSION						LEAPFROG					
	Robust OLS			Instrumental variables approach			Robust OLS			Instrumental variables approach			Robust OLS			Instrumental variables approach		
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Urban area sprawl	**-0.009**	**0.003**	**-0.001**	**-0.023***	**0.001**	**0.017**	**-0.016****	**-0.014**	**-0.030**	**-0.023***	**-0.018**	**-0.049*****	**0.019****	**0.015**	**0.026**	**0.020***	**0.011**	**0.019**
	(0.008)	**(0.015)**	**(0.029)**	**(0.013)**	**(0.018)**	**(0.019)**	**(0.008)**	**(0.012)**	**(0.017)**	**(0.013)**	**(0.014)**	**(0.018)**	**(0.007)**	**(0.014)**	**(0.022)**	**(0.011)**	**(0.013)**	**(0.014)**
Population in 2010		-0.007	-0.014		0.000	-0.010		-0.009	-0.026		-0.011	-0.032		-0.009	-0.015		-0.004	-0.015
		(0.024)	(0.031)		(0.026)	(0.025)		(0.020)	(0.030)		(0.025)	(0.023)		(0.021)	(0.027)		(0.024)	(0.022)
Urban area 2010		0.018	0.014		0.011	0.018		0.012	0.018		0.010	0.023		0.010	0.004		0.006	0.006
		(0.018)	(0.022)		(0.020)	(0.019)		(0.017)	(0.023)		(0.019)	(0.017)		(0.017)	(0.021)		(0.019)	(0.018)
Adult equivalent average income			-0.017			-0.006			-0.001			0.012			-0.021			-0.021
			(0.038)			(0.027)			(0.032)			(0.024)			(0.027)			(0.022)
Average education of the HH			0.071			0.086			0.006			-0.037			0.019			0.033
			(0.097)			(0.080)			(0.098)			(0.082)			(0.073)			(0.076)
Share of informal HH workers			-0.022			-0.100			0.517			0.931*			0.231			0.139
			(0.563)			(0.367)			(0.558)			(0.492)			(0.474)			(0.354)
Share of unemployed HH			2.326			2.810			0.743			-0.217			1.502			1.706
			(2.780)			(1.732)			(2.450)			(1.780)			(2.007)			(1.559)
Share of inmigrant HH			0.750			0.630			0.969			1.265**			0.547			0.545
			(0.667)			(0.556)			(0.754)			(0.545)			(0.859)			(0.509)
Constant	0.268***	0.217**	0.052	0.308***	0.223*	-0.124	0.288***	0.282***	0.158	0.305***	0.301***	0.182	0.185***	0.219***	0.158	0.182***	0.225***	0.144
	-0.026	(0.096)	(0.514)	(0.040)	(0.114)	(0.404)	(0.026)	(0.070)	(0.421)	(0.037)	(0.077)	(0.322)	(0.027)	(0.066)	(0.348)	(0.036)	(0.051)	(0.323)
Observations	26	26	23	22	22	22	26	26	23	22	22	22	26	26	23	22	22	22
R-squared	0.044	0.253	0.402	0.017	0.221	0.332	0.148	0.315	0.486	0.076	0.273	0.447	0.189	0.314	0.488	0.189	0.297	0.456
Regions Fixed effects	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Share of infill sprawl is instrumented	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes

Instruments included: Share of developed land over total area, distance to main port, maximum and minimum average temperature, share of infill, extension and leapfrog sprawl btw 1990 and 2000, 1893 population densitiy
Notes:Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 24. Income segregation of the rich

	INFILL						EXTENSION						LEAPFROG					
	Robust OLS			Instrumental variables approach			Robust OLS			Instrumental variables approach			Robust OLS			Instrumental variables approach		
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Urban area sprawl	**-0.008**	**-0.007**	**0.010**	**-0.013**	**0.021**	**0.025**	**-0.009**	**-0.001**	**0.028**	**-0.020**	**-0.011**	**0.024**	**0.007**	**-0.002**	**-0.023**	**0.013**	**-0.013**	**-0.027****
	(0.009)	**(0.011)**	**(0.029)**	**(0.013)**	**(0.017)**	**(0.018)**	**(0.008)**	**(0.011)**	**(0.019)**	**(0.012)**	**(0.014)**	**(0.018)**	**(0.007)**	**(0.011)**	**(0.018)**	**(0.012)**	**(0.012)**	**(0.013)**
Population in 2010		0.032*	0.037		0.045*	0.042*		0.033	0.046		0.030	0.045*		0.033*	0.036		0.041*	0.038*
		(0.017)	(0.034)		(0.025)	(0.023)		(0.019)	(0.031)		(0.025)	(0.023)		(0.019)	(0.031)		(0.023)	(0.022)
Urban area 2010		-0.010	-0.010		-0.005	-0.003		-0.009	-0.015		-0.009	-0.014		-0.008	-0.002		-0.003	0.002
		(0.014)	(0.021)		(0.019)	(0.018)		(0.014)	(0.017)		(0.019)	(0.017)		(0.014)	(0.019)		(0.019)	(0.018)
Adult equivalent average income			0.006			0.020			-0.013			-0.010			0.005			0.010
			(0.034)			(0.025)			(0.025)			(0.024)			(0.032)			(0.021)
Average education of the HH			-0.046			-0.035			0.006			-0.003			-0.007			0.000
			(0.088)			(0.075)			(0.112)			(0.082)			(0.102)			(0.075)
Share of informal HH workers			-0.550			-0.512			-1.000*			-0.907*			-0.738			-0.704**
			(0.599)			(0.343)			(0.469)			(0.489)			(0.508)			(0.348)
Share of unemployed HH			1.743			2.207			2.950			2.753			2.254			2.429
			(2.244)			(1.620)			(2.134)			(1.771)			(2.048)			(1.534)
Share of inmigrant HH			-0.642			-0.528			-0.781			-0.705			-0.401			-0.224
			(0.730)			(0.521)			(0.653)			(0.542)			(0.629)			(0.501)
Constant	0.224***	0.169**	0.358	0.241***	-0.005	0.145	0.226***	0.136*	0.344	0.259***	0.162**	0.344	0.179***	0.134**	0.344	0.163***	0.121**	0.278
	(0.025)	(0.075)	(0.542)	(0.038)	(0.111)	(0.378)	(0.025)	(0.073)	(0.492)	(0.036)	(0.076)	(0.321)	(0.026)	(0.057)	(0.542)	(0.038)	(0.050)	(0.318)
Observations	26	26	23	22	22	22	26	26	23	22	22	22	26	26	23	22	22	22
R-squared	0.039	0.237	0.336	0.026	0.189	0.357	0.047	0.224	0.404	0.019	0.212	0.397	0.032	0.225	0.404	0.009	0.265	0.420
Regions Fixed effects	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Share of infill sprawl is instrumented	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes

Instruments included: Share of developed land over total area, distance to main port, maximum and minimum average temperature, share of infill, extension and leapfrog sprawl btw 1990 and 2000, 1893 population densitiy
Notes:Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

We finally include two additional dependent variables, the prosperity and livability indexes. As mentioned in the report, these multi-dimensional indexes measure, respectively, the agglomerations' success in generating prosperity for its inhabitants (high productivity, strong dynamism and low level of poverty) and the cities' quality of life (access to public services, housing, transport, health, education, social inclusion and resilience).

Table 25. Prosperity indicator

	INFILL						EXTENSION						LEAPFROG					
	Robust OLS			Instrumental variables approach			Robust OLS			Instrumental variables approach			Robust OLS			Instrumental variables approach		
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Urban area sprawl	**-1.958**	**4.487**	**11.009*****	**-3.421**	**3.376**	**8.805*****	**0.114**	**2.994**	**-3.286**	**3.946**	**9.380****	**-1.282**	**1.591**	**-1.508**	**-3.784**	**-0.987**	**-3.156**	**-1.552**
	(2.457)	**(3.324)**	**(2.777)**	**(3.924)**	**(4.014)**	**(3.201)**	**(2.891)**	**(2.545)**	**(5.665)**	**(4.088)**	**(3.922)**	**(4.329)**	**(2.363)**	**(2.850)**	**(5.158)**	**(3.670)**	**(3.242)**	**(3.295)**
Population in 2010		3.578	3.029		-0.581	2.281		2.956	-1.845		3.823	-1.157		2.684	0.041		-0.957	-0.431
		(5.789)	(4.132)		(6.262)	(4.351)		(6.112)	(5.759)		(6.984)	(5.615)		(6.125)	(6.184)		(6.345)	(5.232)
Urban area 2010		-1.200	4.927*		0.539	4.320		-0.949	3.306		0.351	2.433		-1.310	4.414		1.281	2.841
		(6.090)	(2.495)		(4.781)	(3.402)		(5.840)	(4.150)		(5.176)	(4.229)		(6.228)	(4.347)		(5.099)	(4.313)
Adult equivalent average income			18.904***			17.272***			13.826*			11.937**			13.144*			11.605**
			(4.752)			(4.698)			(6.497)			(5.731)			(6.895)			(5.193)
Average education of the HH			2.035			0.528			-12.373			-8.177			2.136			-2.369
			(26.066)			(13.893)			(32.005)			(19.486)			(28.913)			(18.193)
Share of informal HH workers			139.048			141.482**			239.873			185.467			144.507			145.857*
			(87.432)			(63.847)			(146.491)			(115.494)			(142.683)			(84.524)
Share of unemployed HH			-588.391			-628.122**			-889.319			-827.382**			-629.708			-726.907**
			(384.531)			(282.442)			(558.583)			(397.997)			(472.533)			(355.356)
Share of inmigrant HH			182.629*			174.458**			210.354			167.990			233.354			174.897
			(86.771)			(86.913)			(148.929)			(113.815)			(148.751)			(112.952)
Constant	40.544***	10.026	-155.647	47.358***	22.974	-130.342*	34.636***	22.849	-38.007	26.586**	4.260	-32.434	30.307***	34.687**	-69.060	40.356***	43.479***	-43.723
	(7.407)	(22.529)	(101.675)	(12.157)	(26.970)	(70.432)	(8.966)	(17.805)	(133.611)	(11.923)	(21.476)	(78.122)	(8.211)	(13.150)	(121.471)	(11.781)	(13.547)	(77.768)
Observations	27	27	24	23	23	23	27	27	24	23	23	23	27	27	24	23	23	23
R-squared	0.019	0.528	0.810	0.021	0.541	0.794	0.000	0.506	0.683	0.041	0.454	0.677	0.013	0.487	0.692		0.503	0.686
Regions Fixed effects	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Share of infill sprawl is instrumented	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes

Instruments included: Share of developed land over total area, distance to main port, maximum and minimum average temperature, share of infill, extension and leapfrog sprawl btw 1990 and 2000, 1893 population densitiy
Notes:Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 26. Livability indicator

	INFILL						EXTENSION						LEAPFROG					
	Robust OLS			Instrumental variables approach			Robust OLS			Instrumental variables approach			Robust OLS			Instrumental variables approach		
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Urban area sprawl	**-6.033*** **	**-3.070**	**1.372**	**-7.682** **	**-3.689**	**1.488**	**0.310**	**1.912**	**-0.812**	**1.365**	**4.259**	**-1.787**	**3.011**	**2.002**	**-1.559**	**1.758**	**2.079**	**-1.224**
	(2.067)	**(3.376)**	**(3.878)**	**(3.739)**	**(3.014)**	**(2.457)**	**(2.624)**	**(2.002)**	**(4.744)**	**(4.269)**	**(2.941)**	**(2.816)**	**(2.161)**	**(2.524)**	**(3.286)**	**(3.766)**	**(2.310)**	**(2.248)**
Population in 2010		-0.560	-2.245		-2.994	-2.121		0.573	-3.022		1.451	-3.351		-0.040	-2.523		-2.047	-2.496
		(3.693)	(5.250)		(4.761)	(3.494)		(4.192)	(4.399)		(5.227)	(3.621)		(3.959)	(5.012)		(4.568)	(3.416)
Urban area 2010		-2.341	1.662		-1.007	1.929		-1.023	1.526		-0.304	1.931		-2.763	2.001		-1.266	2.035
		(2.789)	(3.661)		(3.635)	(2.738)		(3.462)	(3.437)		(3.868)	(2.754)		(3.411)	(3.929)		(3.670)	(2.814)
Adult equivalent average income			11.120**			11.521***			10.652**			11.454***			10.699*			10.827***
			(4.789)			(3.746)			(4.221)			(3.691)			(4.784)			(3.407)
Average education of the HH			14.783			14.676			11.901			9.434			17.458			16.541
			(12.098)			(11.412)			(18.877)			(13.181)			(13.566)			(12.499)
Share of informal HH workers			67.110			74.095			87.243			113.048			56.121			64.530
			(88.385)			(51.693)			(75.158)			(76.488)			(80.419)			(56.688)
Share of unemployed HH			-260.302			-244.092			-313.999			-341.482			-241.498			-239.602
			(347.094)			(229.028)			(394.536)			(255.077)			(321.066)			(232.197)
Share of inmigrant HH			178.843			191.026***			184.524			203.075***			195.846			200.573***
			(132.039)			(70.093)			(121.168)			(74.256)			(141.578)			(73.699)
Constant	54.626***	55.629**	-86.752	60.785***	61.930***	-92.328	36.338***	32.201***	-69.833	34.363***	22.434	-70.313	28.537***	38.009***	-82.486	32.894***	39.648***	-83.470
	(5.949)	(19.819)	(71.571)	(11.766)	(20.423)	(56.333)	(8.190)	(9.989)	(86.655)	(12.438)	(16.165)	(51.087)	(8.232)	(9.561)	(72.492)	(11.938)	(9.787)	(51.613)
Observations	26	26	23	22	22	22	26	26	23	22	22	22	26	26	23	22	22	22
R-squared	0.189	0.724	0.871	0.143	0.747	0.873	0.001	0.712	0.870	0.001	0.709	0.871	0.047	0.713	0.872	0.022	0.754	0.872
Regions Fixed effects	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Share of infill sprawl is instrumented	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes

Instruments included: Share of developed land over total area, distance to main port, maximum and minimum average temperature, share of infill, extension and leapfrog sprawl btw 1990 and 2000, 1893 population densitiy
Notes:Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Figure 15

Greater Buenos Aires Region-Welfare Index

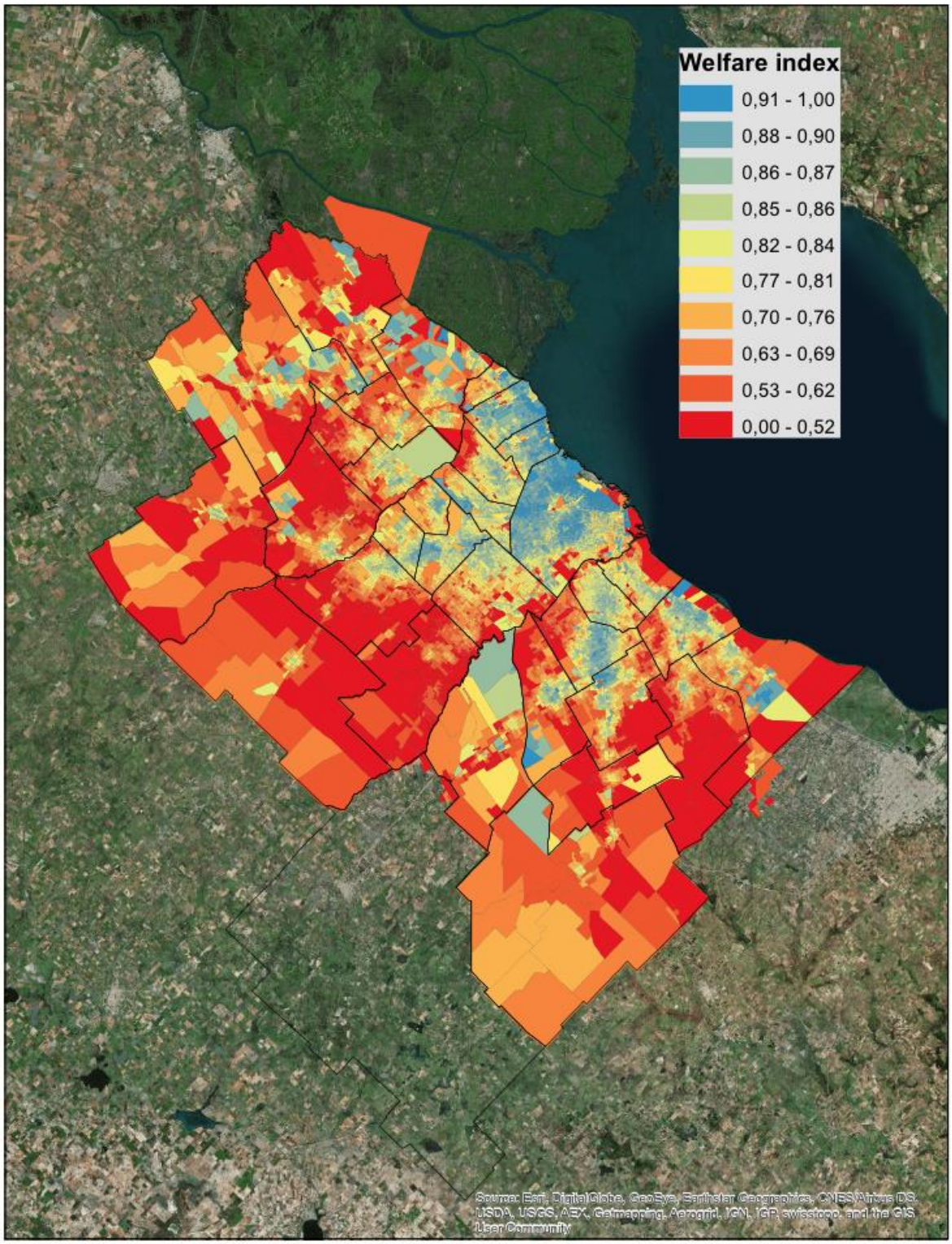
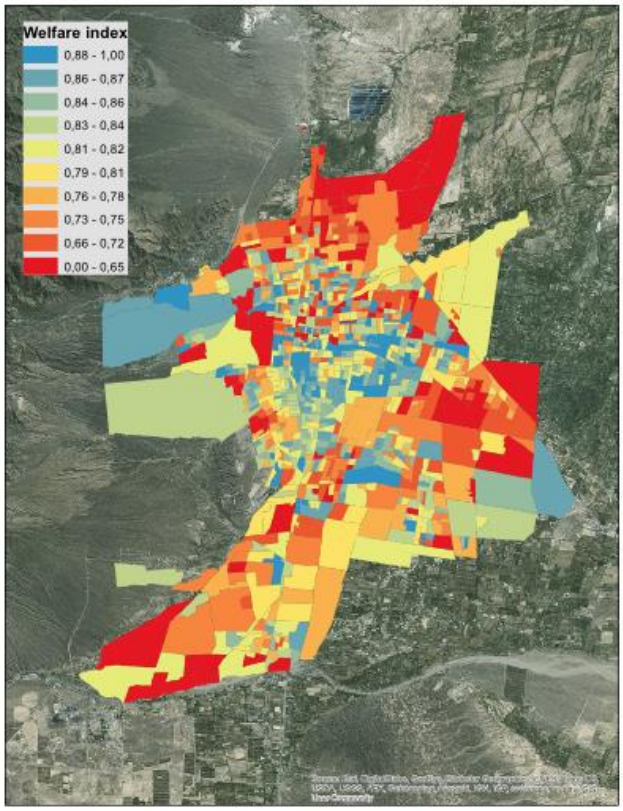


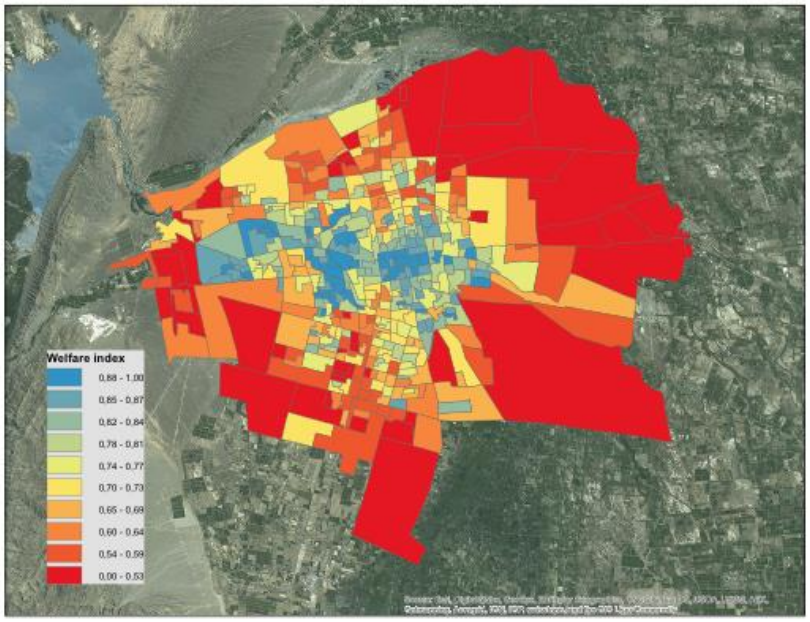
Figure 16

Cuyo Region –Welfare Index

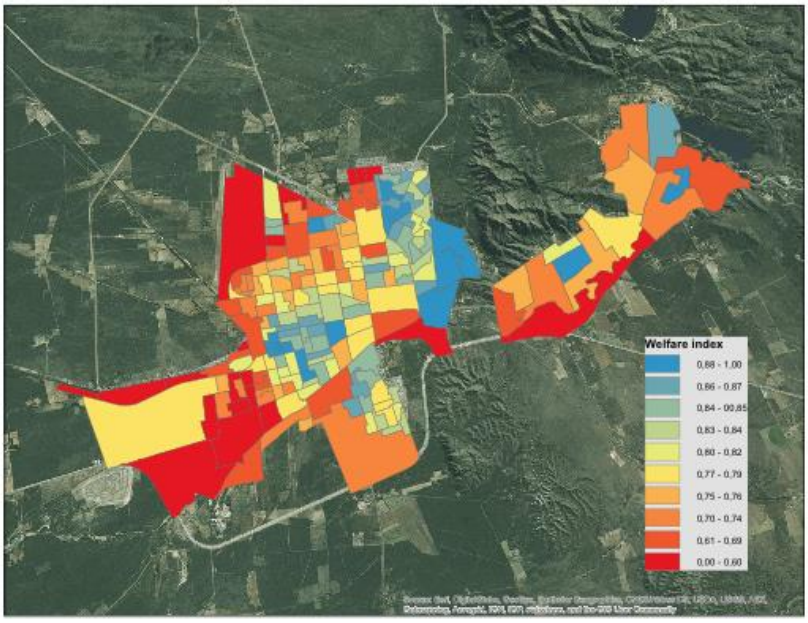
Gran Mendoza



Gran San Juan



Gran San Luis

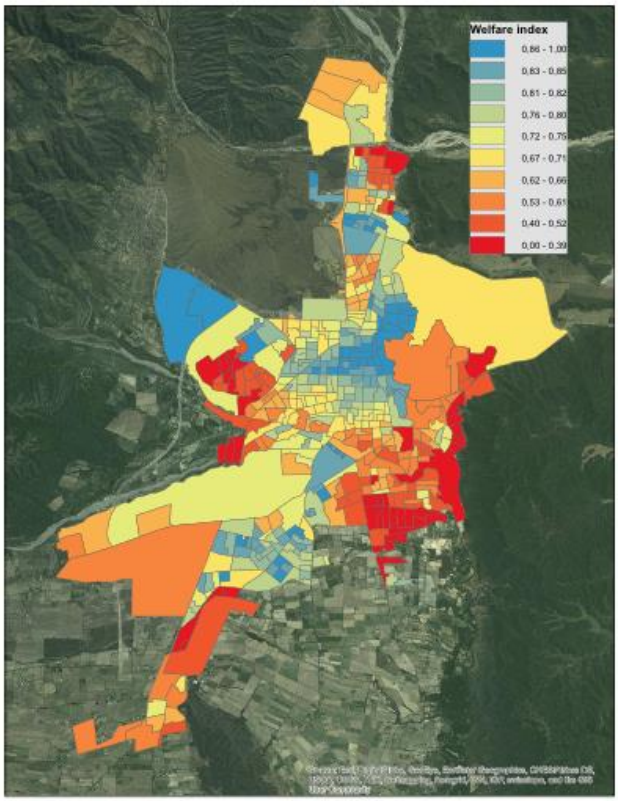


Source: CIPUV based on data from National Census (2010) and National Households Survey (INDEC)

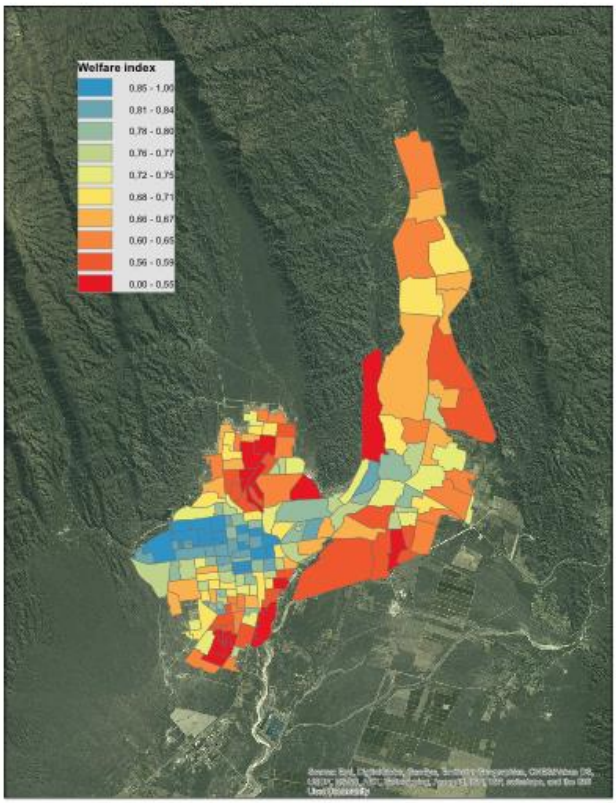
Figure 17

North Western Region (NOA) –Welfare Index

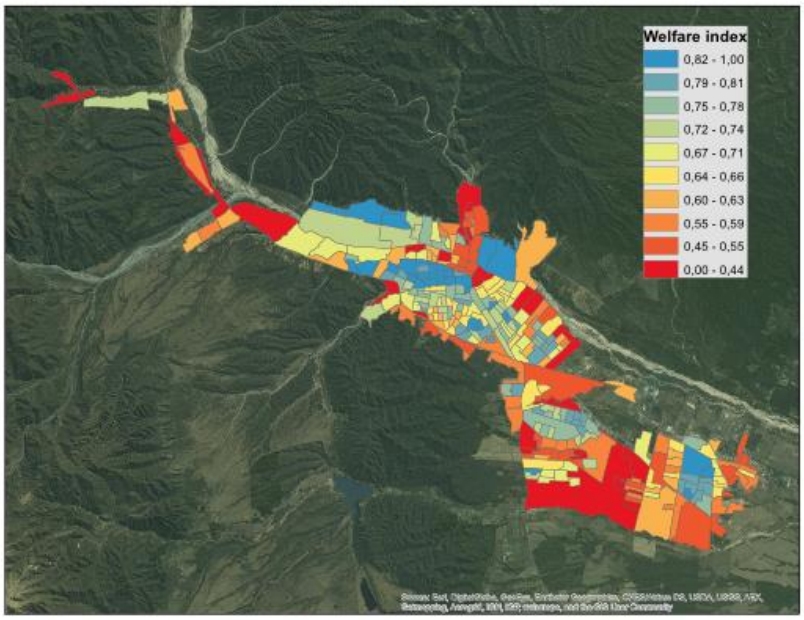
Gran Salta



Gran San Fernando del Valle de Catamarca



Gran San Salvador de Jujuy



La Rioja

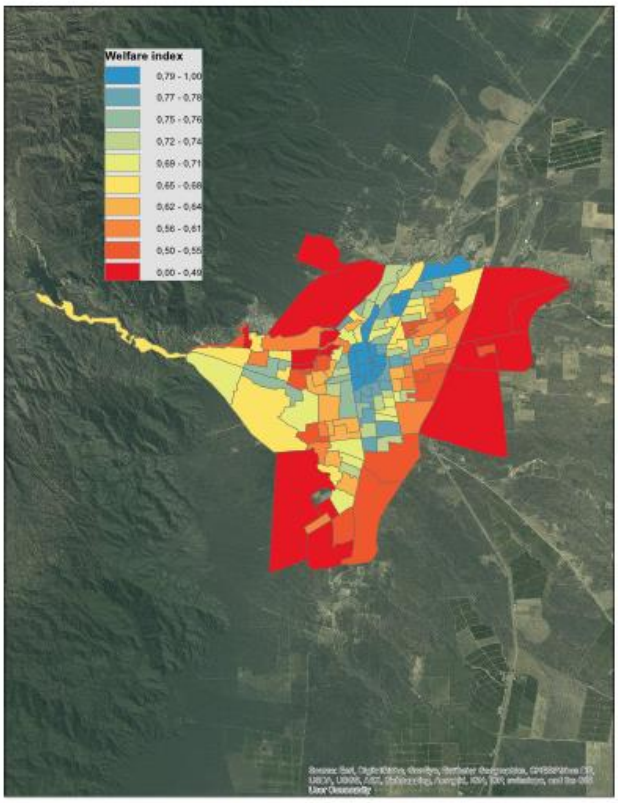
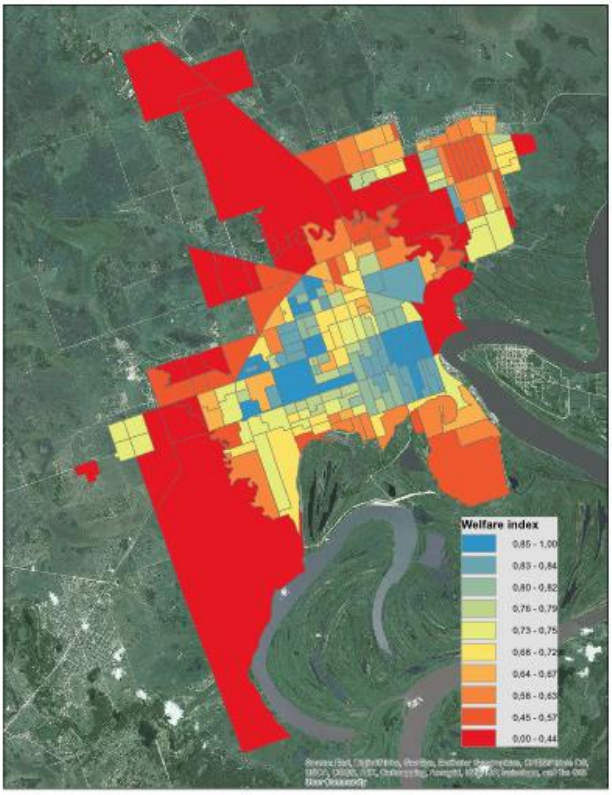


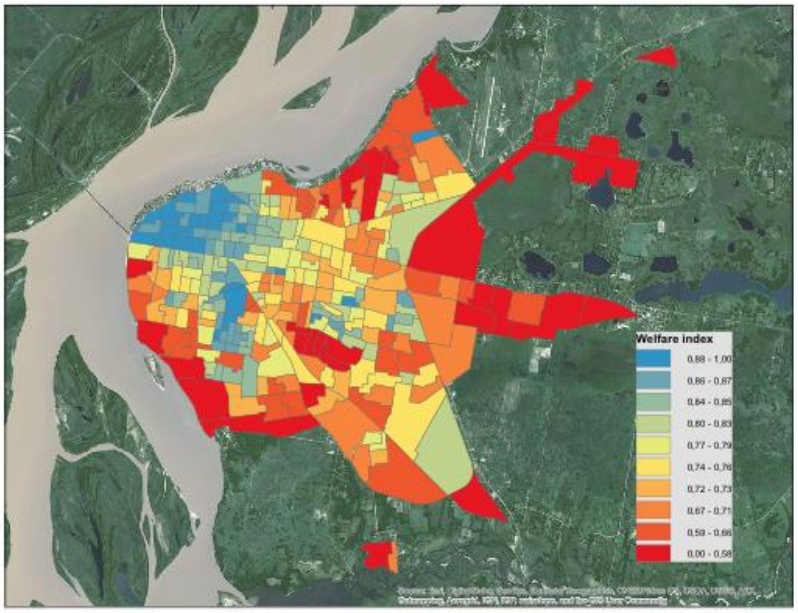
Figure 18

North Eastern Region (NEA) –Welfare Index

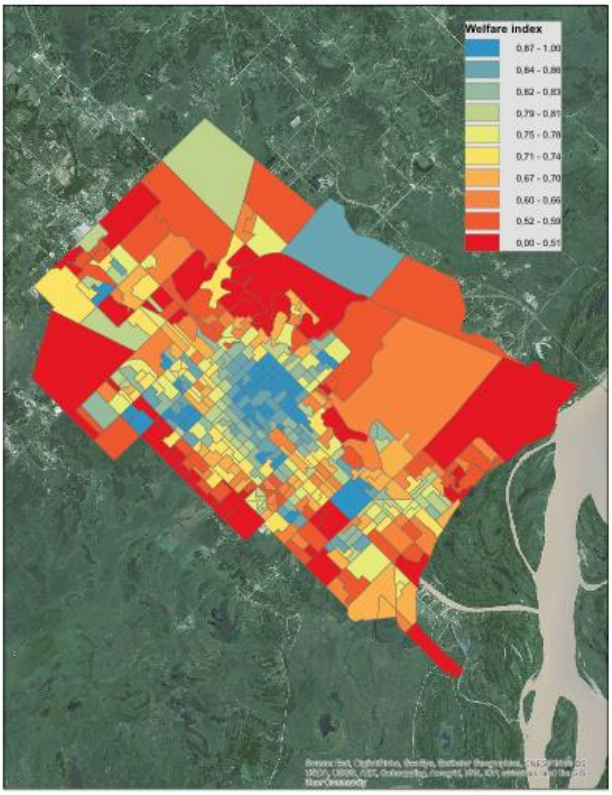
Formosa



Gran Corrientes



Gran Resistencia



Gran Posadas

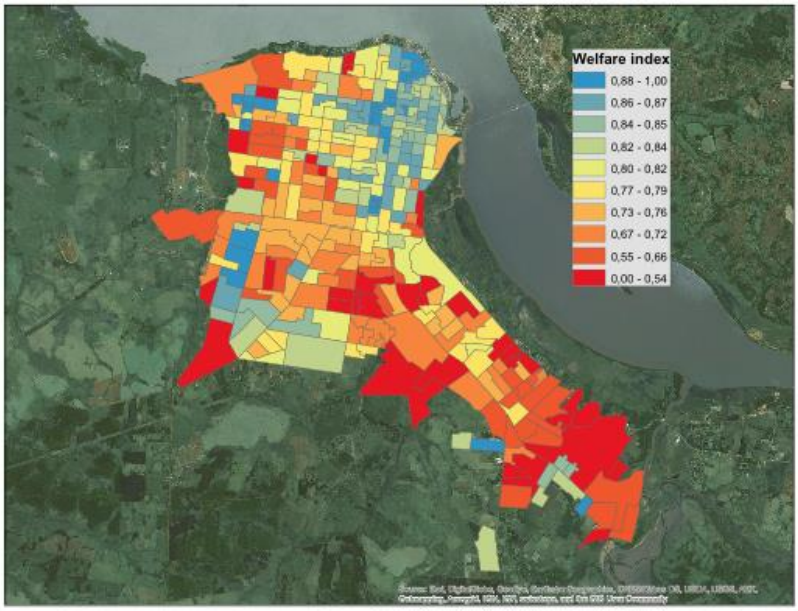
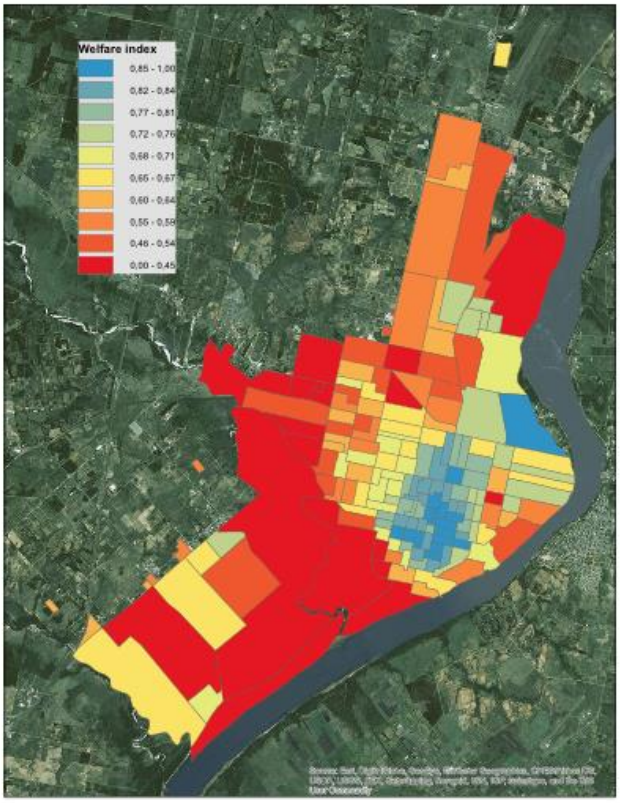


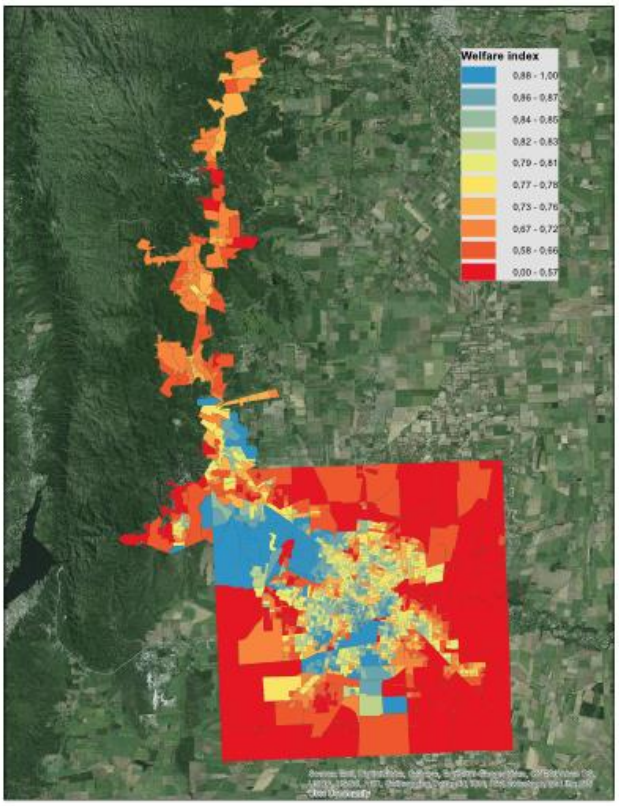
Figure 19

Pampeana Region –Welfare Index

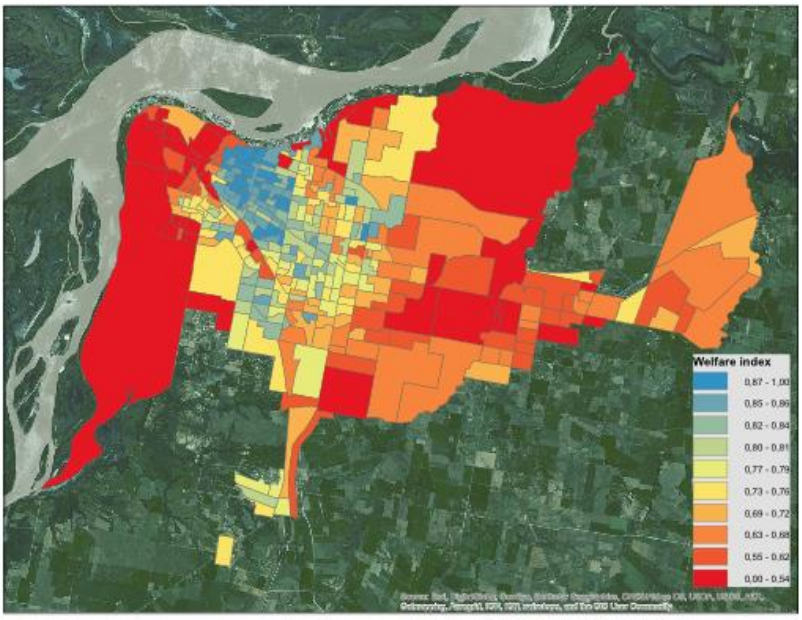
Concordia



Gran Córdoba



Gran Paraná



Gran Rosario

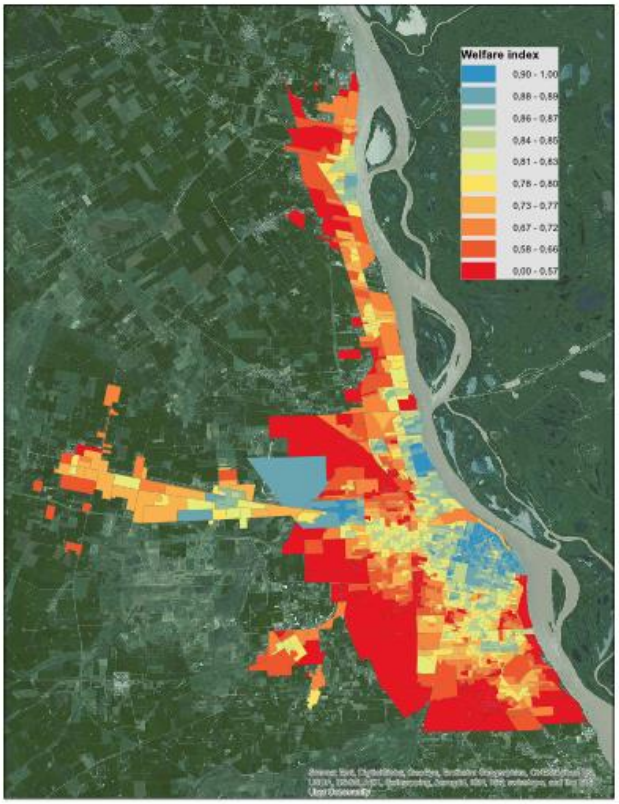
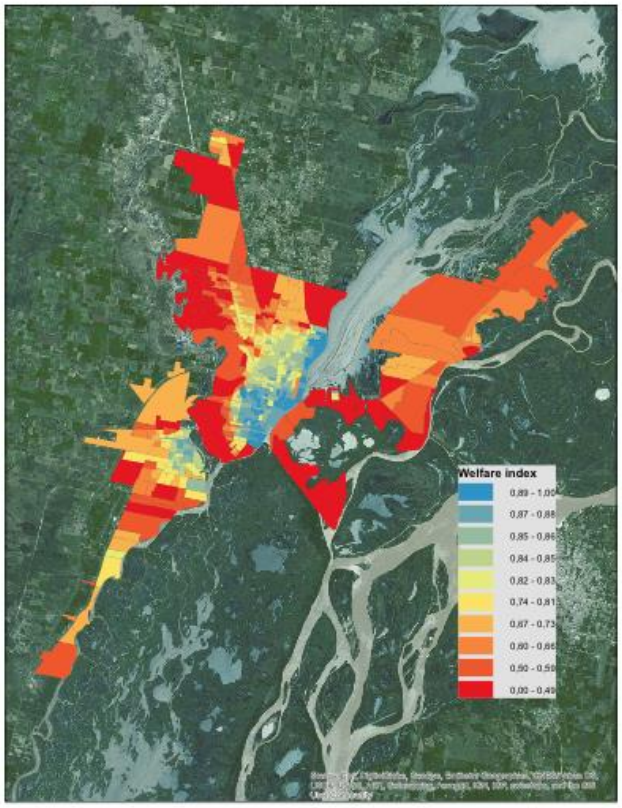


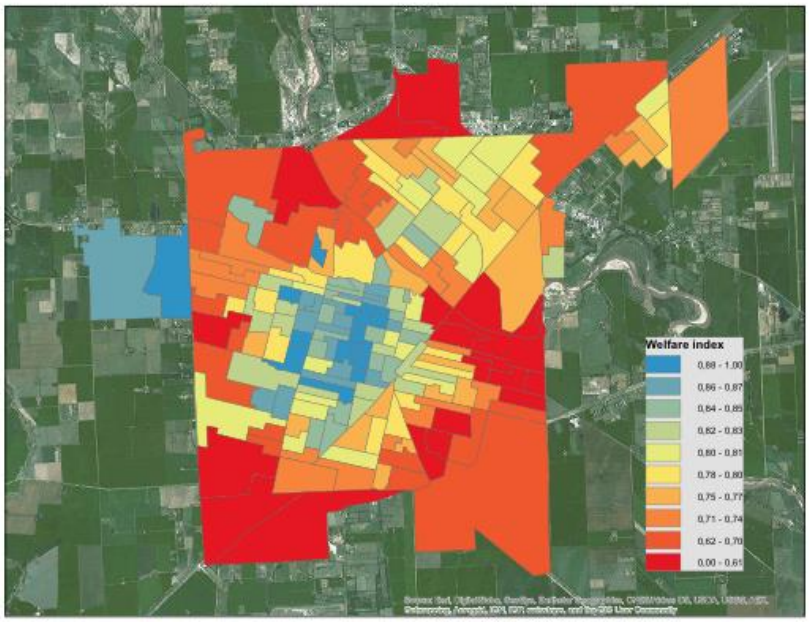
Figure 20

Pampeana Region – Welfare Index

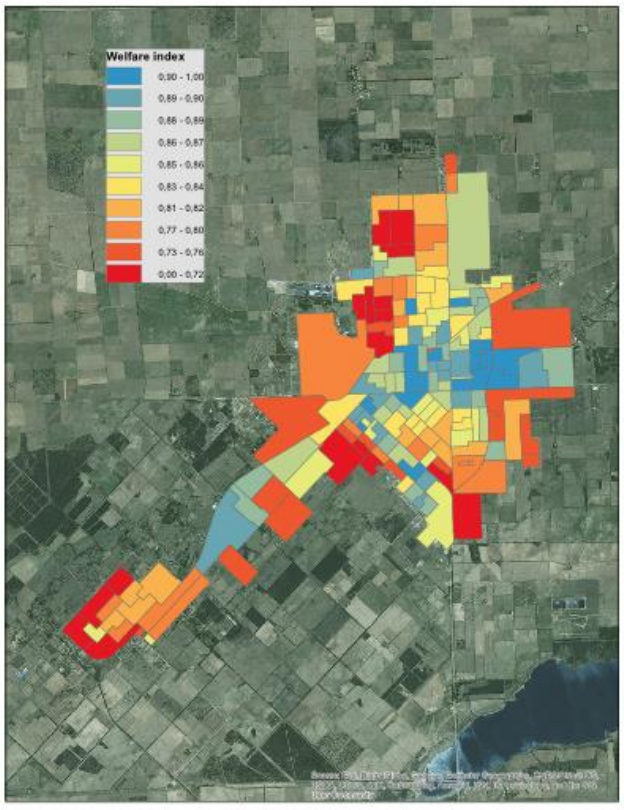
Gran Santa Fe



Gran Río Cuarto



Gran Santa Rosa



Mar del Plata - Batán

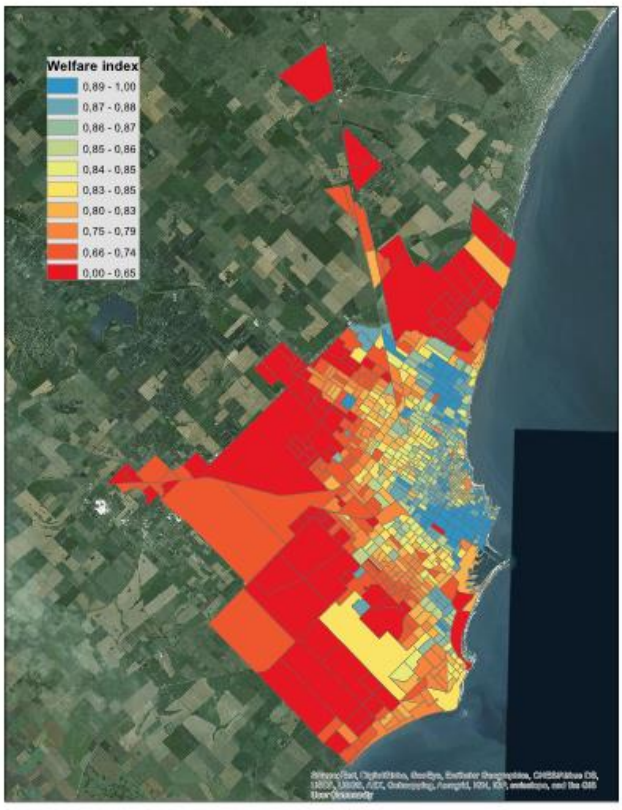
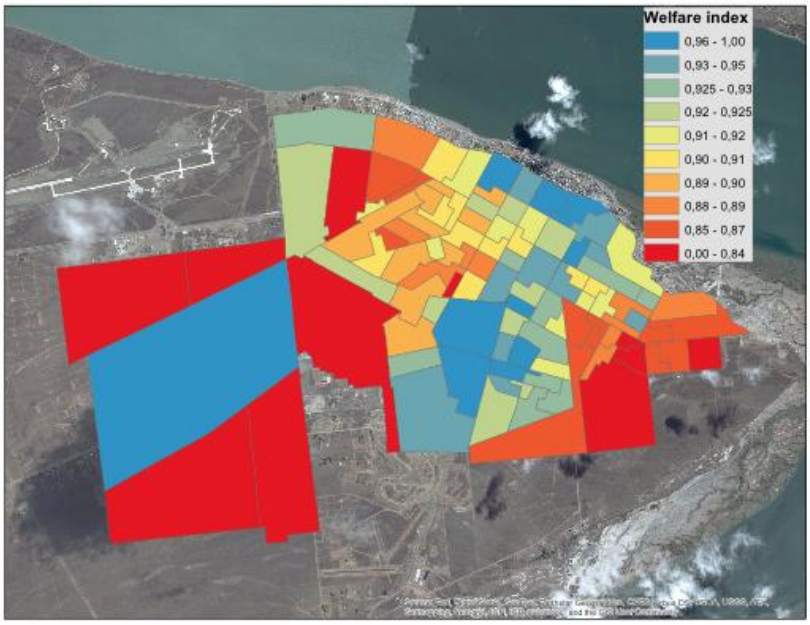


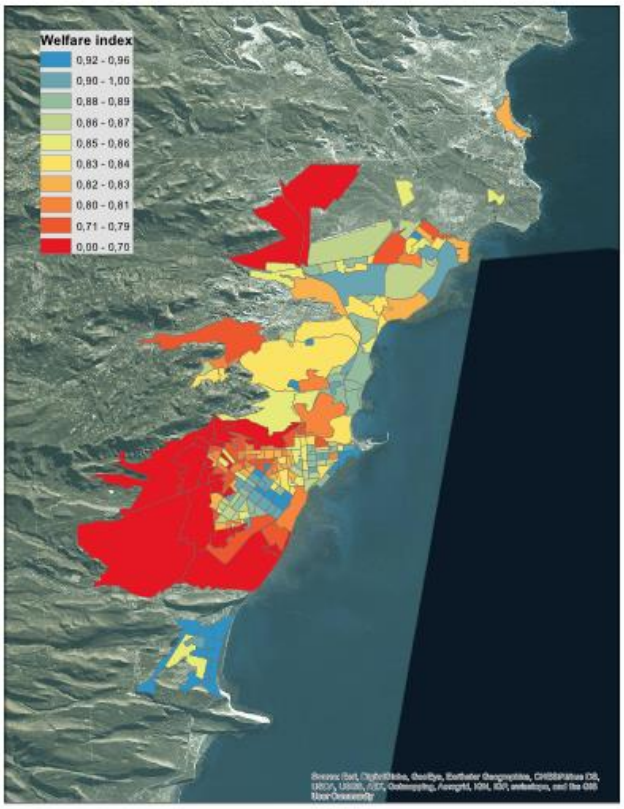
Figure 21

Patagonia Region –Welfare Index

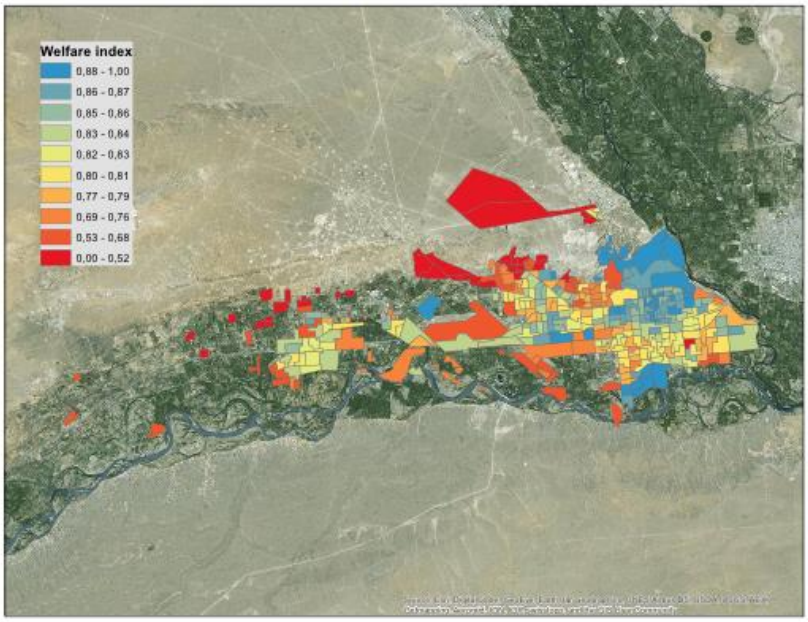
Río Gallegos



Comodoro Rivadavia-Rada Tilly



Neuquén-Plottier



Rawson-Trelew

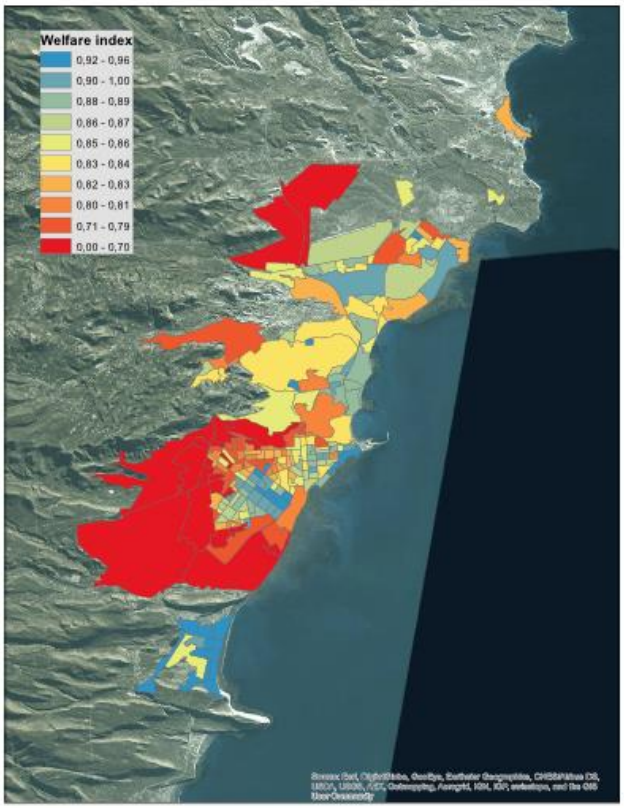
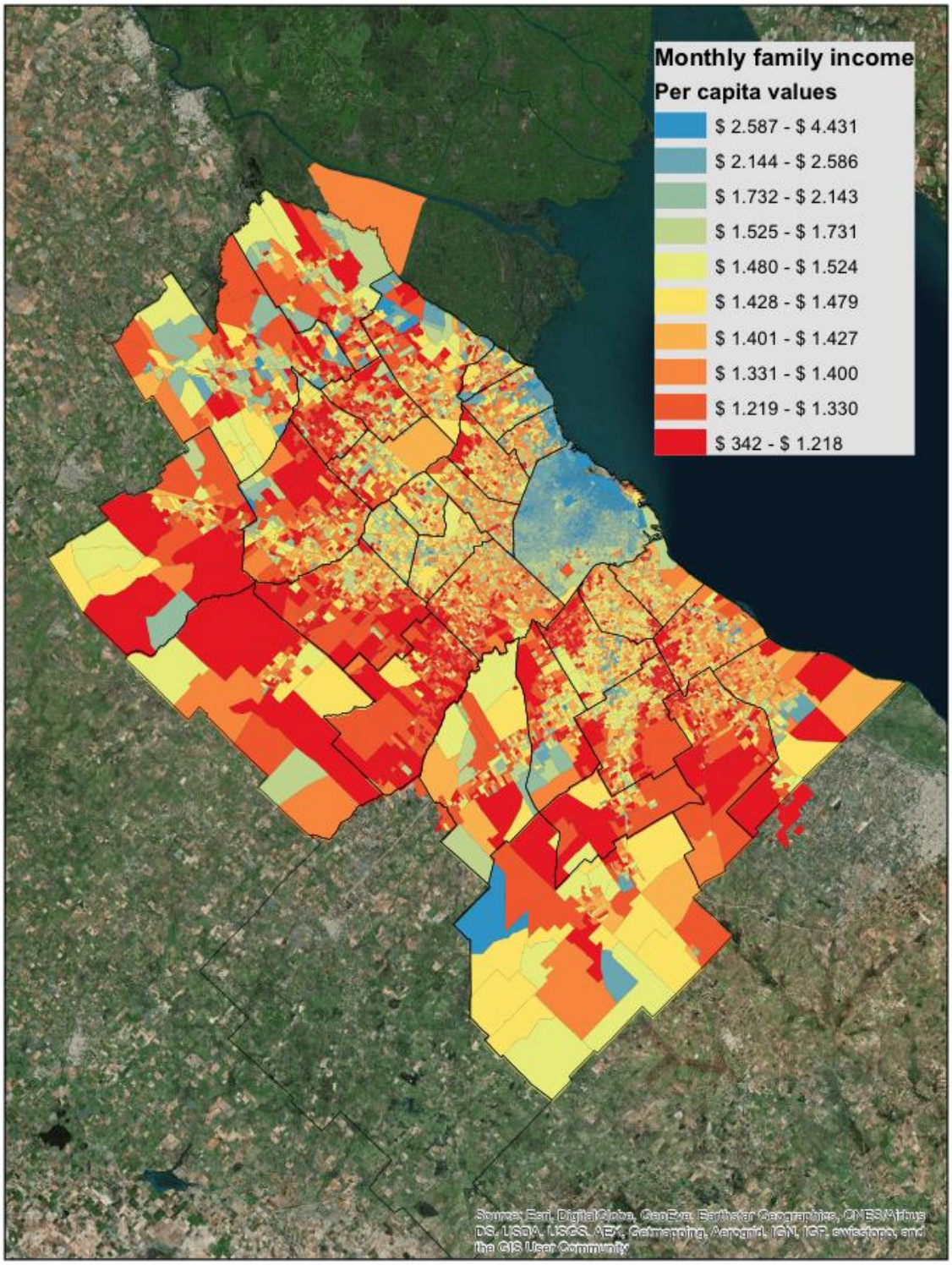


Figure 22

Greater Buenos Aires Region-Estimated income

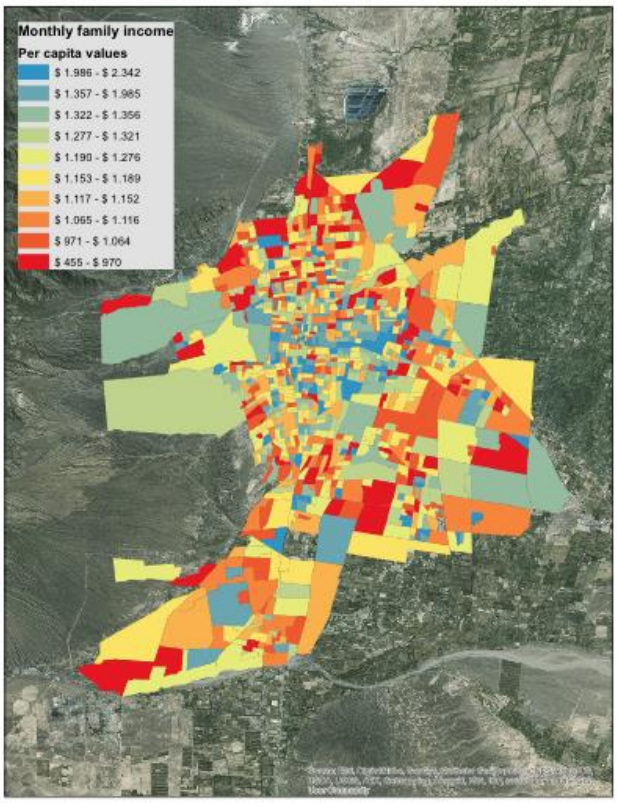


Source: CIPUV based on data from National Census (2010) and National Households Survey (INDEC)

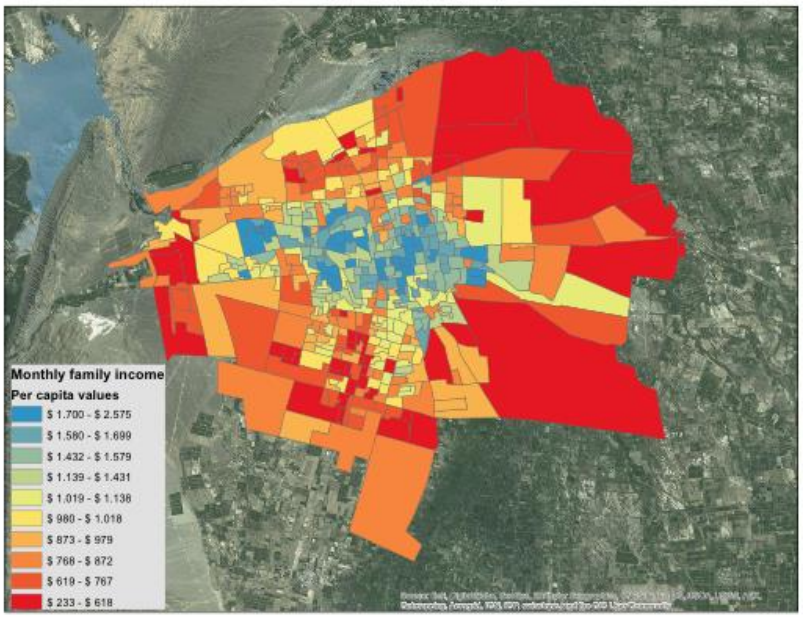
Figure 23

Cuyo Region –Estimated income

Gran Mendoza



Gran San Juan



Gran San Luis

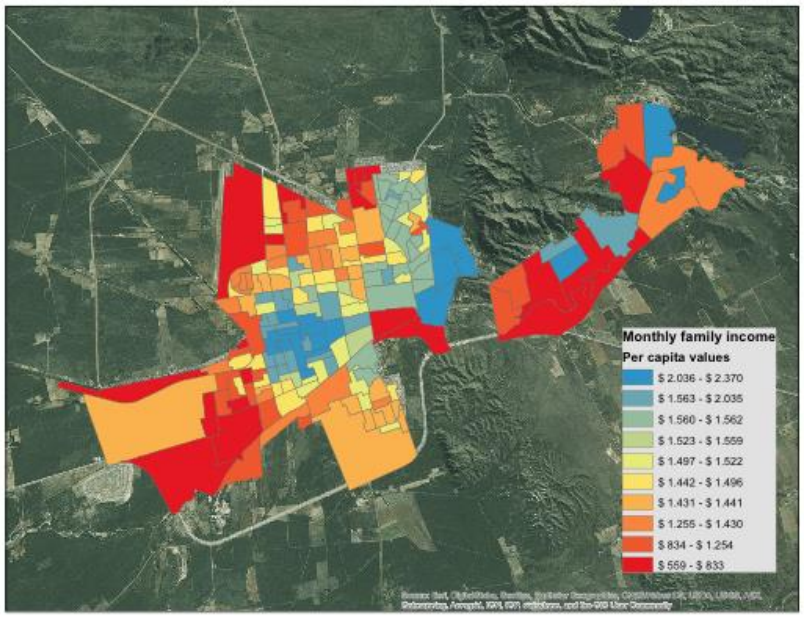
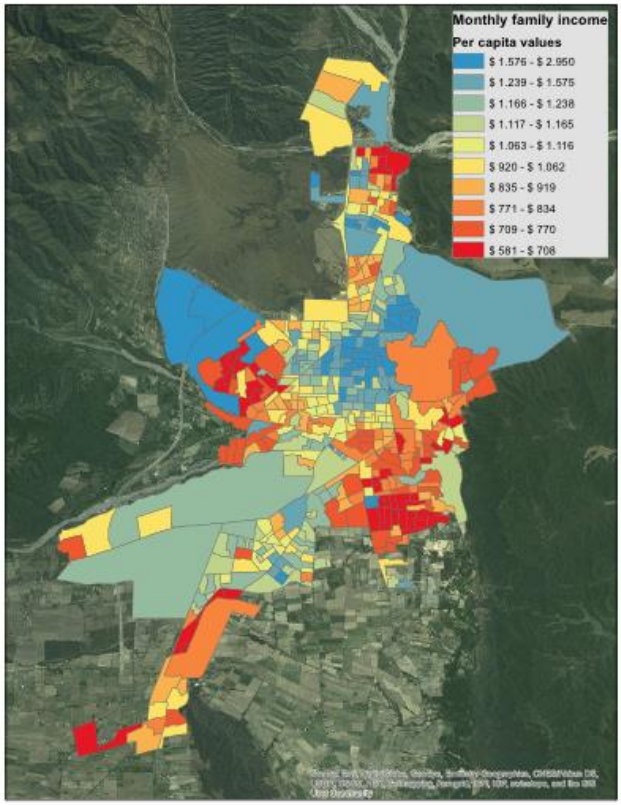


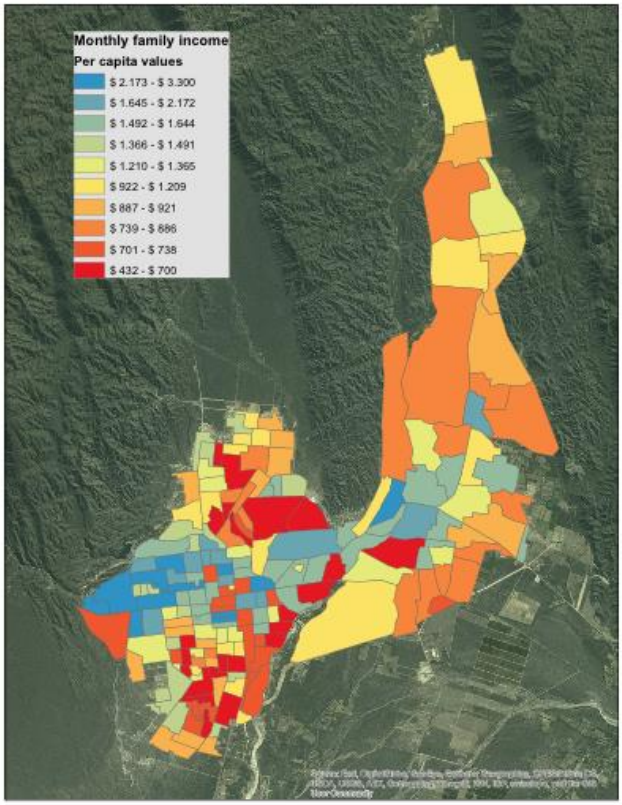
Figure 24

North Western Region (NOA) –Estimated income

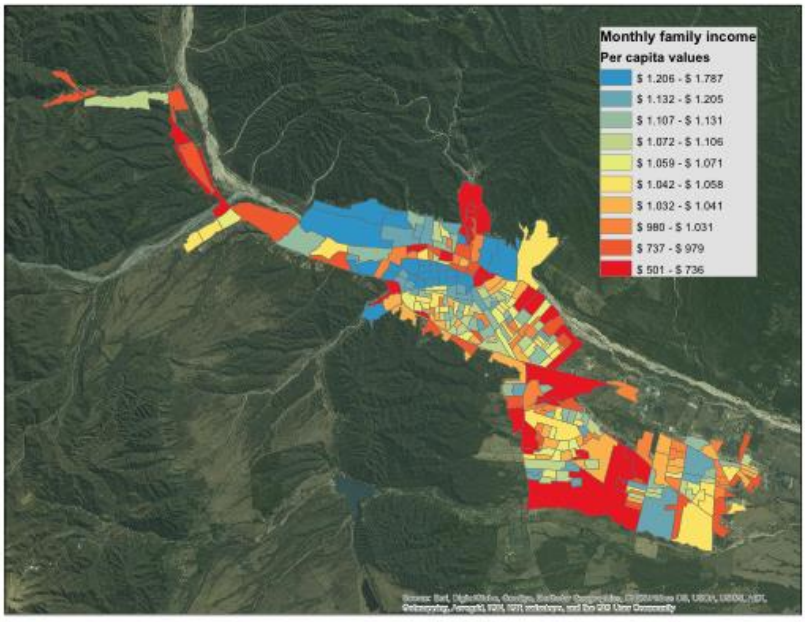
Gran Salta



Gran San Fernando del Valle de Catamarca



Gran San Salvador de Jujuy



La Rioja

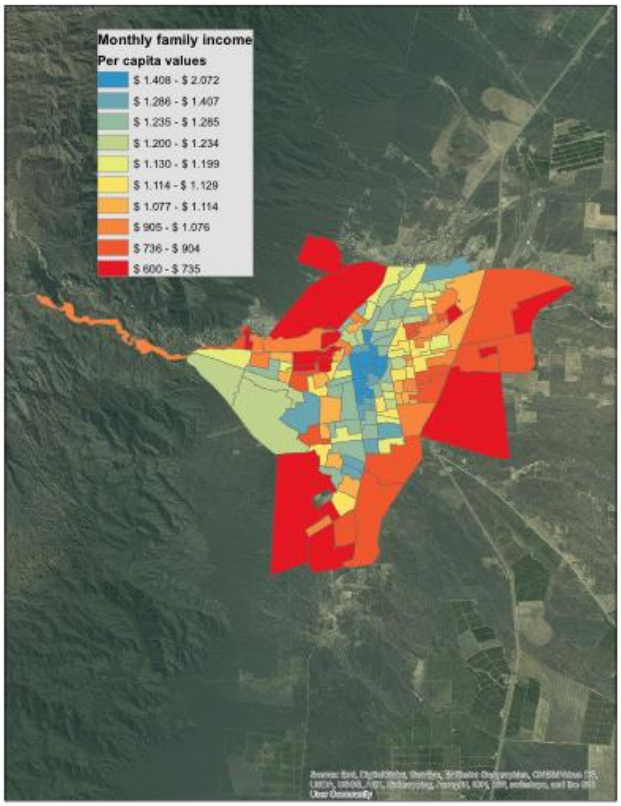
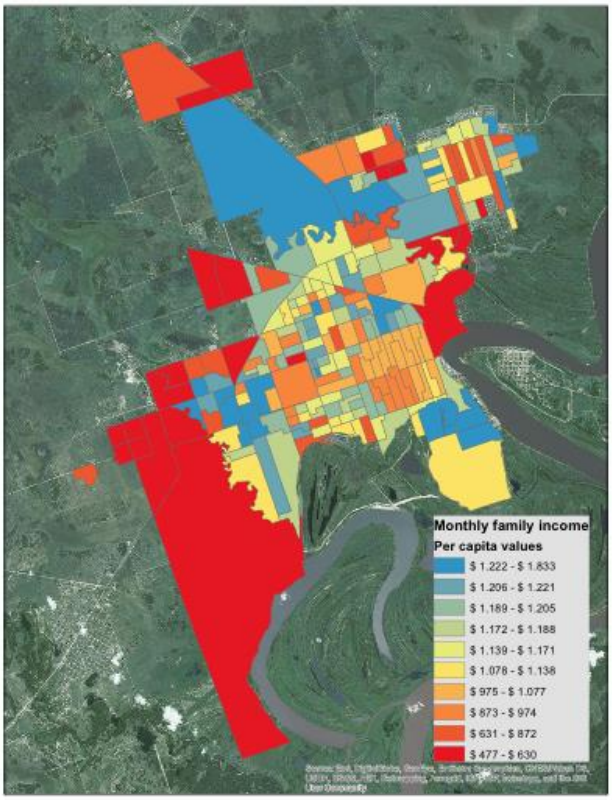


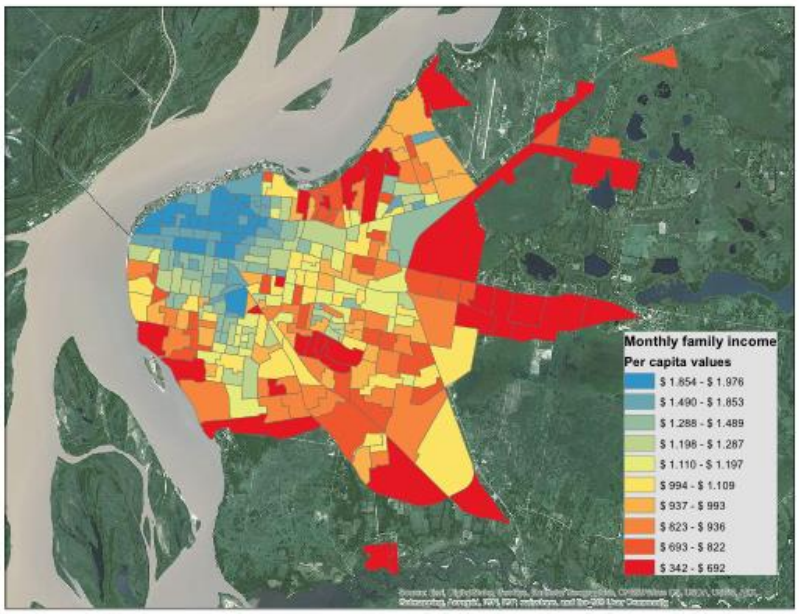
Figure 25

North Eastern Region (NEA) –Estimated Income

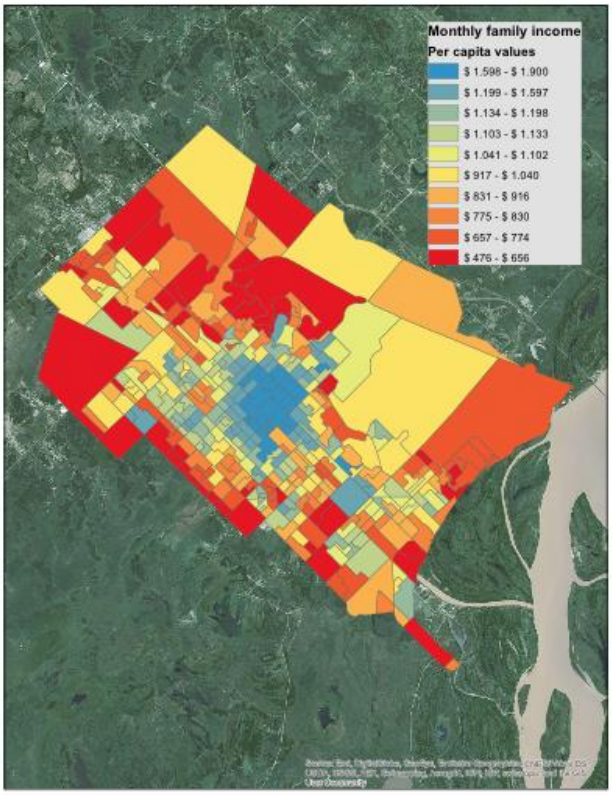
Formosa



Gran Corrientes



Gran Resistencia



Gran Posadas

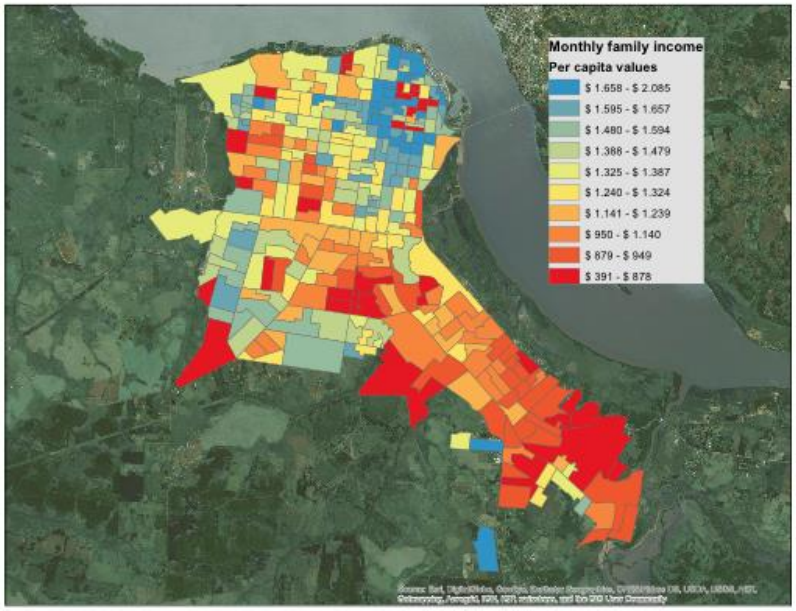
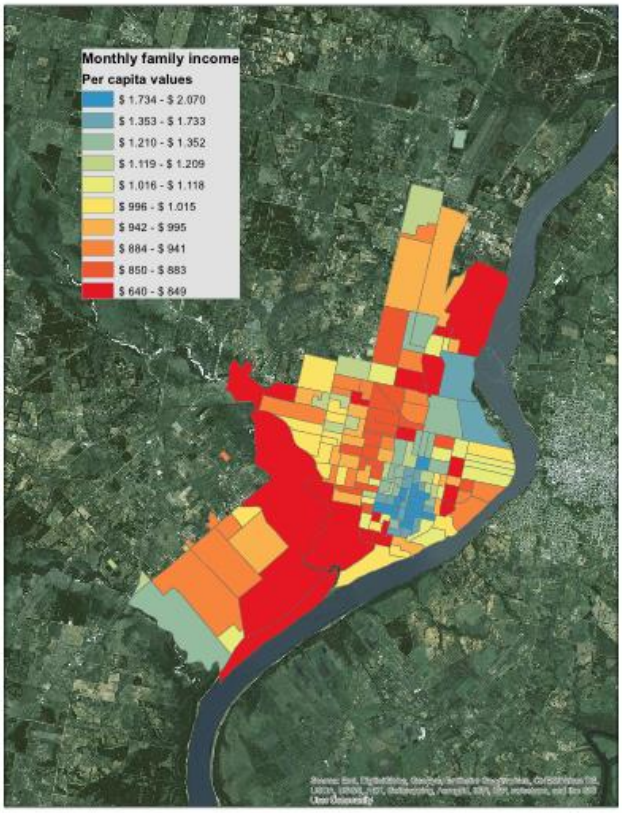


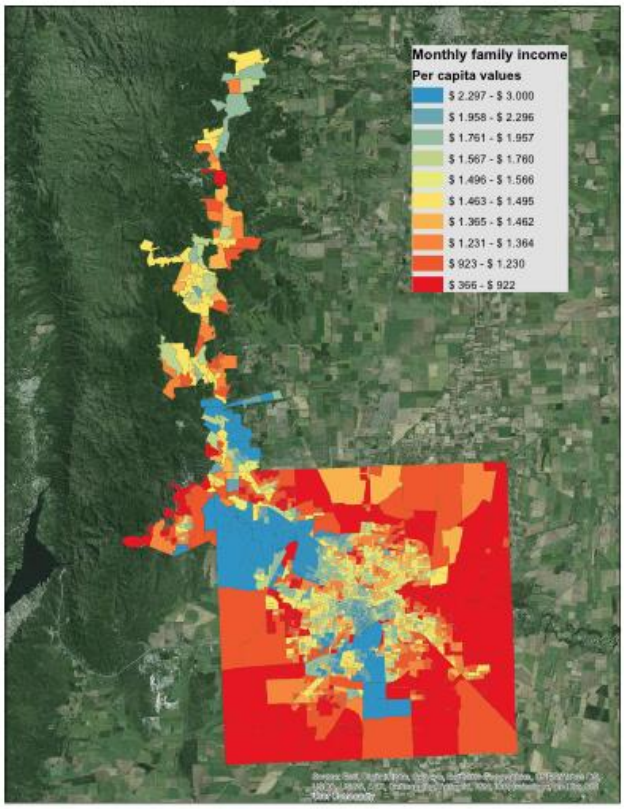
Figure 26

Pampeana Region –Estimated Income

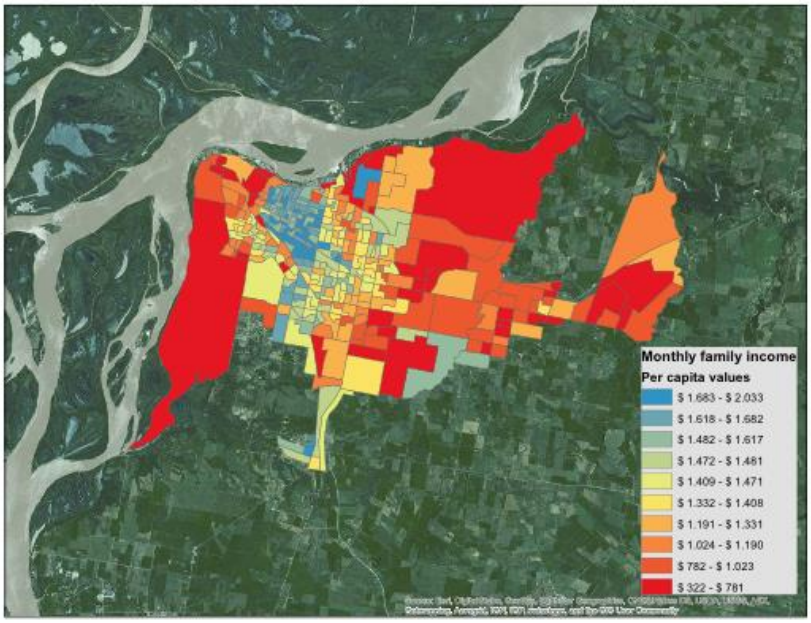
Concordia



Gran Córdoba



Gran Paraná



Gran Rosario

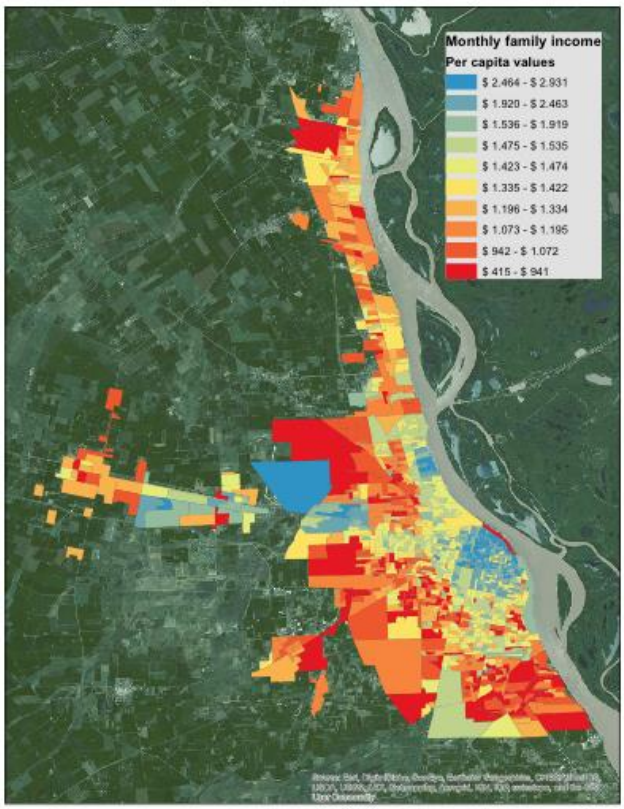
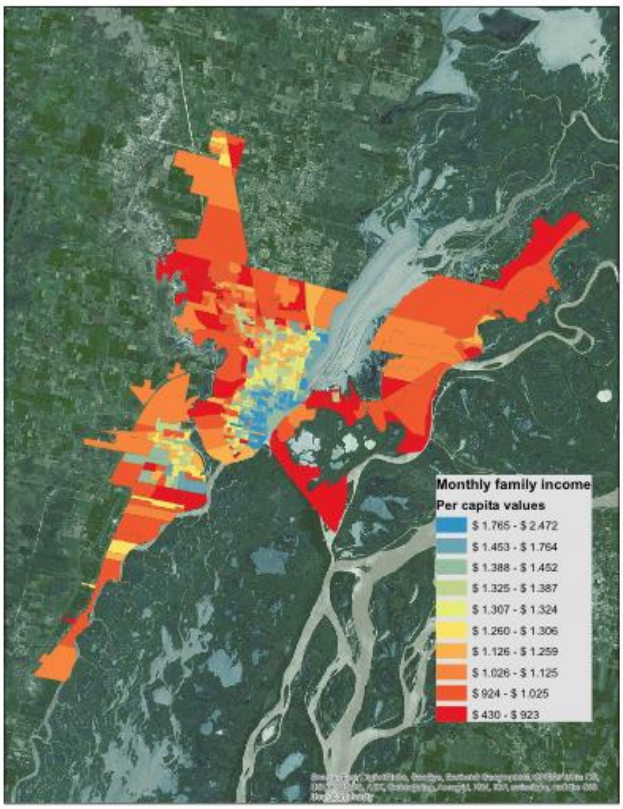


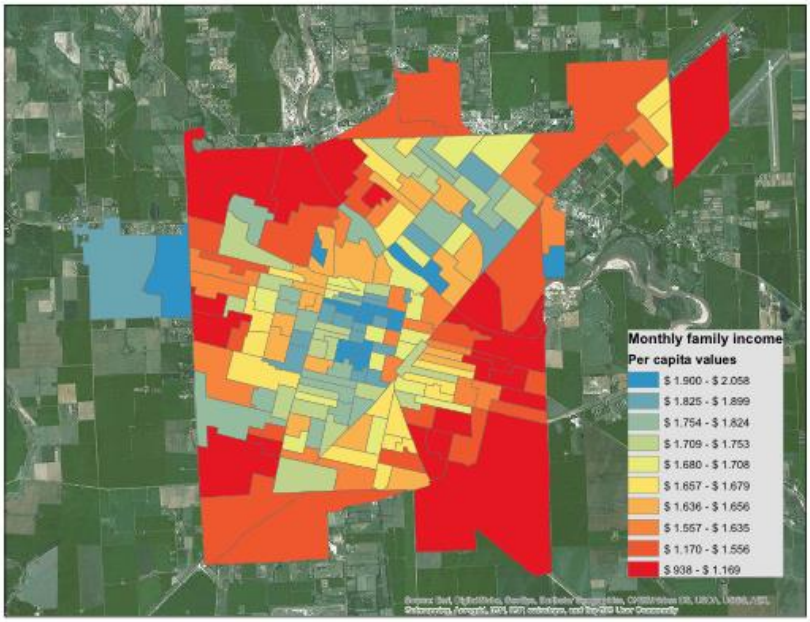
Figure 27

Pampeana Region – Estimated Income

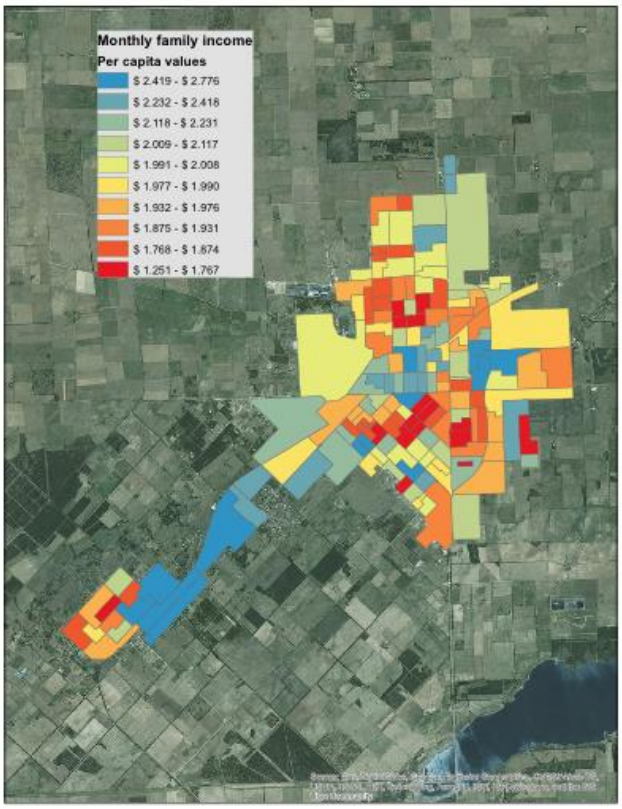
Gran Santa Fe



Gran Río Cuarto



Gran Santa Rosa



Gran La Plata

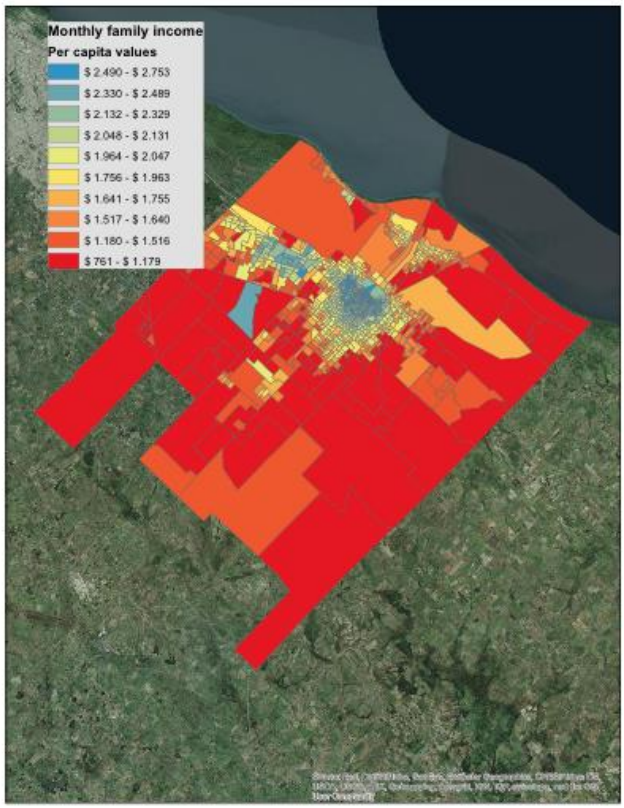
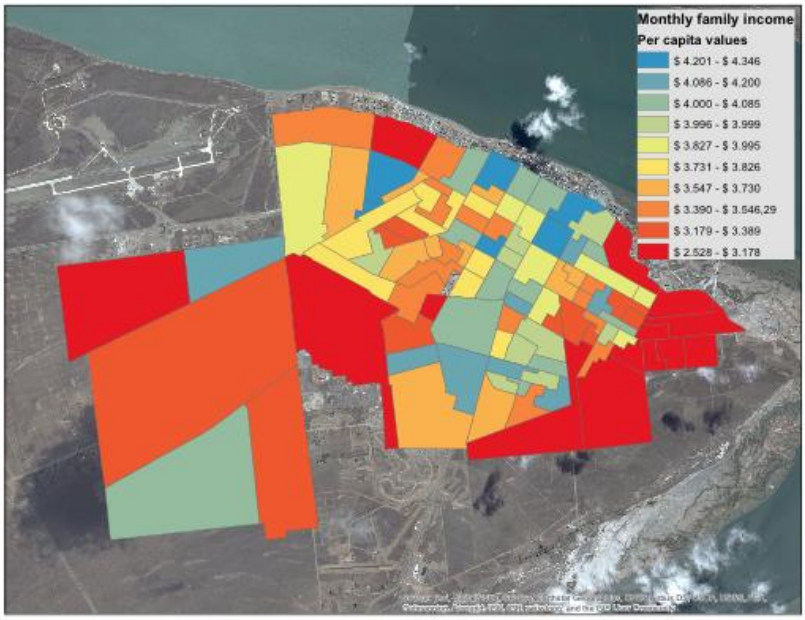


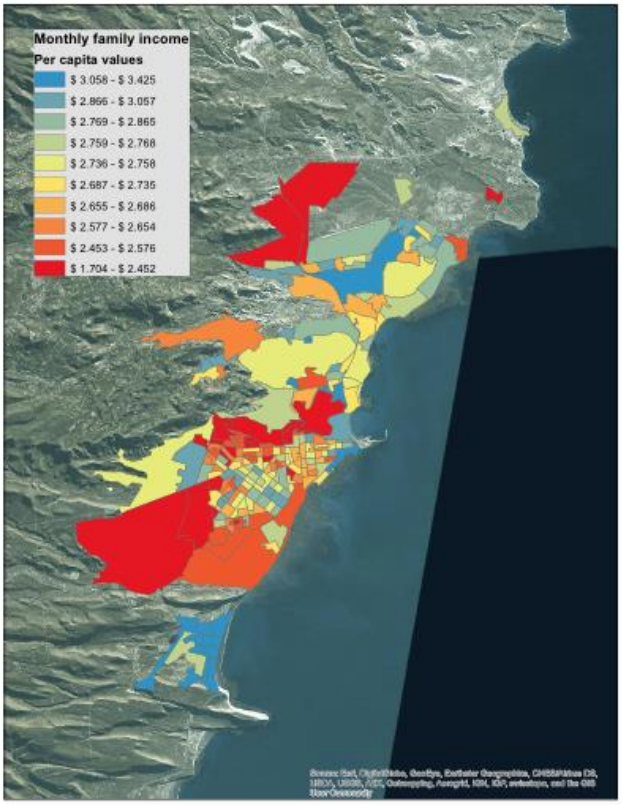
Figure 28

Patagonia Region –Estimated Income

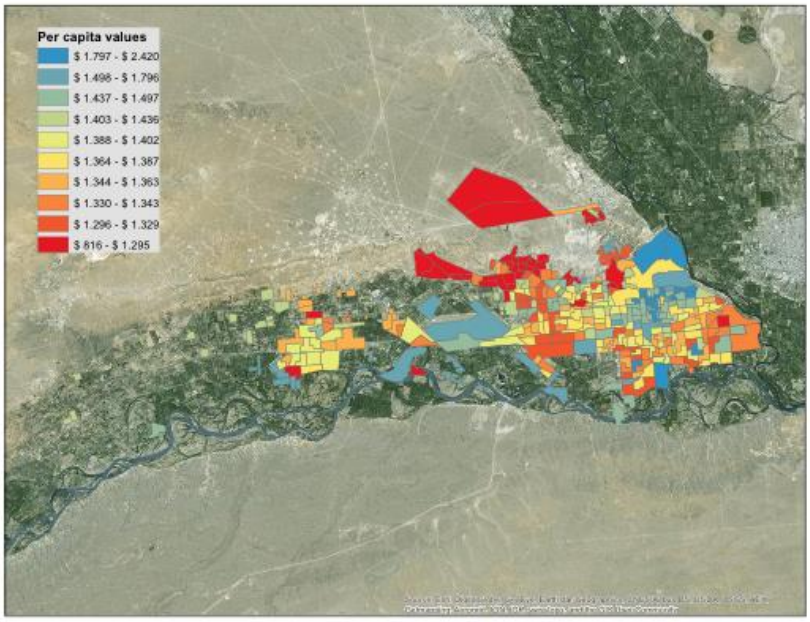
Río Gallegos



Comodoro Rivadavia-Rada Tilly



Neuquén-Plottier



Rawson-Trelew