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Spatial Inequalities in Latin America: mapping aggregate to micro-level disparities

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Spatial Inequalities in Latin America: mapping aggregate to micro-level disparities[1]

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1. Introduction

Inequality has a spatial dimension. Manifestations of inequality in the territory can encompass the imbalanced spatial distribution of population, goods, services, facilities, and activities. These imbalances are compounded by the uneven allocation of networks of critical infrastructure, i.e., transport, water and sanitation services, electricity, and other energy supplies. A frequent consequence of these imbalances is the (in)ability of diverse individuals and social groups to access essential opportunities for social and economic development such as employment, education, healthcare, social interactions, and key urban amenities. Spatial inequalities can also manifest in the concentration of social and environmental externalities. For instance, various studies have pointed at hotspots of crime, air pollution, and urban heat islands, among other externalities in specific parts of the territory, which in turn harm health, social cohesion, and the economy. In Latin America and the Caribbean (LAC), these unequal spatial distributions often tend to have a more marked negative effect on poorer households, who often live in rural areas or the periphery of large or small cities.

This paper examines spatial inequality in the region using a multiscale approach. We first describe the different scales at which spatial inequality may occur and introduce different dimensions of inequality in a spatial context. We then empirically assess the extent to which spatial inequality is different between developed and LAC countries. This analysis will help to focus on the most important issues that need to be addressed from a spatial dimension to reduce inequality in the region. Structural and macro level analyses are complemented by a case study assessment of examples of the consequences of spatial inequalities at the city scale across the region from previous research. The paper concludes with a summary

[1] Paper prepared for the Latin America and Caribbean Inequality Review, IADB. We thank comments and suggestions made to a preliminary draft to this work by Francisco Ferreira, Orazio Attanasio, Paolo Brunori and Diego Restuccia. Excellent research assistance from Nelson Castillo, Adolfo Ilufi, Sofia Montaner, Orlando Sabogal, Anastasia Trofimova and Alan Katzmann is gratefully acknowledged.

of the main findings and recommendations for policy and practice that have potential for the reduction of spatial inequalities.

2. Scales of analysis

Spatial inequality can refer to different things depending on the scale of the analysis. In this paper we address this issue by defining three distinct levels:

- *Rural/urban divide*: income inequality, access to services and infrastructure can differ between urban and rural areas. This is a topic where academic research has arguably been most active with respect to spatial inequality (Busso, Chauvin, and Herrera, 2021; Selod and Shilpi, 2021; Gollin, Kirchberger and Lagakos, 2017; Young, 2013; de Ferranti, Perry, Foster, Vand Lederman and Valdés, 2005). However, since urbanization in the region was close to 81 per cent in 2020 and is expected to reach 88 per cent by 2050[2], the urban/rural divide is possibly a declining influence in aggregate inequality in LAC countries.[3]

- *Capital/central regions versus other cities/regions*: a second level of analysis is between certain regions or cities versus laggard regions or smaller cities. Inequality at this level can be called "centralization" when there is one major city (e.g., the nation's capital), "metropolitan bias" in the words of Ferré, Ferreira and Lanjouw (2012) when there are several large metropolitan areas in each country or "primate cities", a concept often used in the urban studies literature as in Henderson (2002).

- *Within cities:* a third level of analysis is within cities. The focus here may be related to income disparity among households within cities or physical segregation that creates inequality of access to opportunities and public infrastructure. This is a crucial issue for the largest metropolitan areas of the region, where the poor tend to reside in the outskirts of the city where land is cheaper, leading to longer travel times to access labor and educational opportunities, health services, and amenities. The outskirts also generally suffer from an insufficient supply of infrastructure and public goods. Related to these issues is the geographic concentration of crime, pollution as well as other negative externalities in poorer areas, and the isolation of the rich in secluded and guarded neighborhoods.

[2] UN Department of Economic and Social Affairs, Population Dynamics, World Urbanization Prospects: The 2018 Revision. https://population.un.org/wup/Download/.

[3] This is not to say that rural poverty will not continue to be a central social concern. In addition, according to de Ferranti, et al. (2005), the rural sector is underestimated in the region and could be as high as twice the size estimated from official statistics.

3. Mapping structural inequalities in LAC: is the region more spatially unequal than other regions?

Several authors have examined some aspects of spatial inequality. Shorrocks and Wan (2005) present a review of the spatial decomposition of income or expenditure distributional measures for both developed and developing countries. However, only one LAC country is included in their review (Ecuador). Schwartzman (2017) presents an analysis of spatial inequality in the US. He finds that high-skilled workers tend to live in larger cities and earn higher wages, while low-skilled workers do not benefit from living in large cities. According to the author, income inequality between individuals residing in large and small cities has increased over time in the US.

Ferré et al. (2012) analyze poverty rates and access to infrastructure in eight developing countries, including Brazil and Mexico. They find that most poor individuals live in rural areas or smaller cities, and they also have less access to infrastructure. This has very important policy implications. They also decompose several inequality indices between slum and non-slum city dwellers, finding that the within group inequality is much more important than an income gap between these two groups on average.[4]

ECLAC (2016) is another contribution with a unique emphasis on Latin America. It analyses social inequality by comparing poverty rates, access to basic services, and education across regions in each country (first-level administrative territorial divisions). It also compares inequality between each country's capital and other urban and rural areas. In this sense, it adopts a similar territorial analysis as that proposed in this paper. The conclusions indicate that capital cities or regions, in general, have lower poverty levels than non-capital regions, except where industrial activities are concentrated outside the capital (northern Mexico, for example), tourism centers (as in Cuzco, Peru), or mining and other extractive industries. The territories with the highest levels of poverty are usually those with a high indigenous presence. Inequality indicators (Gini coefficient) follow an irregular pattern in the region, with some countries exhibiting lower inequality in capital regions, compared to other urban centers and rural areas, but the results are not general to all countries.

In the present paper, we address a slightly different question than Ferré et al. (2012) and ECLAC (2016). It is well known that LAC countries are significantly more unequal in terms of disposable income compared to developed countries. We would like to examine these differences in a spatial context. That is, is the difference between LAC and other countries due mainly to differences in one of the three spatial scales introduced above? Or is the difference observed in all spatial dimensions? Answering this question is essential to focus

[4] Agostini and Brown (2007) and Agostini, Brown and Góngora (2008) present an analysis of income distribution at the municipal level for Chile.

attention on the most important structural causes of the high-income inequality observed in LAC and to identify the most promising policy options to reduce spatial inequality in the region.

The closest to our aim is ECLAC (2010), where a comparison is presented between Latin American countries and OECD countries in terms of spatial concentration of economic activity and spatial inequality measured by the per capita GDP of the different regions. It finds that, unlike OECD countries, in Latin America, the concentration of economic activity rises in tandem with income inequality across regions. These regional disparities are starkly shown by the ratio of per capita GDP of the richest region to the poorest region reproduced in Table 1.

Table 1: GDP per capita of the richest region to the poorest region, selected countries

Latin America	**Year of data**	**Ratio**
Argentina	2005	8.09
Bolivia (Plurinational State of)	2006	3.55
Brazil	2006	9.22
Chile	2007	4.48
Colombia	2007	4.87
Mexico	2006	6.07
Peru	2007	7.57
OECD countries		
France	2005	1.95
Italy	2005	2.04
Japan	2005	1.57
Republic of Korea	2005	1.88
Netherlands	2005	1.31
Spain	2005	1.92
Sweden	2005	1.63

Source: ECLAC (2010)

In this paper, we use individual household survey data rather than regional GDP per capita to compare Latin America with OECD countries. In addition, we present a complete decomposition of inequality across several territorial dimensions.

3.1 Spatial decomposition

We undertake a spatial decomposition of income distribution using data from the Luxembourg Income Studies (LIS) database. The advantage of this data source is that

harmonized household-level data is available for 9 Latin American countries and 13 developed countries (see Appendix 1). The surveys years used for LAC countries are the following: Brazil (2016), Chile (2017), Colombia (2018), Guatemala (2014), Mexico (2018), Panama (2016), Paraguay (2018), Peru (2018), and Uruguay (2016). The corresponding information for developed countries is Austria (2018), Canada (2016), Czech Republic (2016), Denmark (2016), Finland (2016), France (2010), Germany (2018), Ireland (2017), Israel (2017), Italy (2016), Norway (2016), Slovakia (2018), United States (2018).

We decompose the Mean Log Deviation (MLD) measure of income inequality in each country. This indicator can be decomposed without generating a hard-to-interpret residual term as in the case of the Gini coefficient (Pyatt, 1976) and the weights of the between and within terms of the decomposition are independent (Shorrocks and Wan, 2005). In any case, all income distribution measures are highly correlated, so the choice of one measure may not be so critical.[5] As for the income variable, we use total disposable household income per capita for each observation in the surveys.

To analyze income distribution at the three spatial scales introduced above we decompose the total MLD between individuals living in rural areas and those living in urban areas. We calculate the within and between components of the income distribution for these two categories. Furthermore, to analyze the "centralization" or "metropolitan bias" scale of spatial inequality, we further decompose the within inequality level in a within and between term for urban households that live in a "large" city or region compared to urban households that live in a "small" city or region.

In Appendix 2 we derive said decomposition and arrive at the following result:

$$E_0(y) = W^{ub} + W^{us} + W^{r} + B^{ub/us} + B^{u/r} \qquad (1)$$

Where $E_0(y)$ is the total MLD, W^{ub} is a within component in big urban areas, W^{us} is the within component in small urban areas, W^{r} is the within component in rural areas, $B^{ub/us}$ measures the contribution to inequality from the mean difference between large and small urban areas, and $B^{u/r}$ is the mean difference between rural and urban areas.

These five components completely decompose the national inequality measure, and each of them can be compared between LAC countries and developed countries to examine whether there are discernible differences in spatial inequality between both groups.

[5] Preliminary estimations with the data do show a high correlation between the mean log deviation, Theil index and the Gini coefficient for the 22 countries of the dataset.

3.2 Empirical and conceptual issues

The LIS survey data includes four variables with a spatial component for each country. These are "Region", "Rural", "Size of the locality of residence", and "Type of area". The first variable indicates, for most countries, the first level administrative region of a household's residence. The second variable indicates whether an observation is a rural or urban household. The third variable is a further decomposition according to city size, while the last one is an additional definition of geographical categories that vary among countries. The categories for each of these four variables for the 22 countries in our dataset are presented in columns 2 to 5 of the table in Appendix 1. Not all surveys register each variable; moreover, there is heterogeneity as to the definition of "City size" and "Area" variables between countries.

This last point raises a first difficulty. How do we define "large" and "small" urban areas? This was done arbitrarily using a definition described in column 6 ("Alt 1") for large cities/areas for each country. For some countries, we also use a second definition to examine the robustness of results when there was no obvious definition of large urban or metropolitan areas. This second definition is described in column 7 ("Alt 2") of the table.

The advantage of using the variables defined in each survey is that the data is statistically representative for each category, so we should not be concerned about the statistical representation of the five components of the decomposition shown above. In addition, we avoid using small area poverty measure techniques that would require having census data for each country.

However, there are two drawbacks to our approach. First, administrative definitions of geographical areas may not correspond to economically relevant geographical boundaries. This issue is impossible to address in this study since it would have to be tackled on a country-by-country basis and would require a timely process of geographical definitions for each country. However, Ferré et al. (2012) find that their results for Brazil are robust to various urban area definitions. Therefore, as a first approximation, we use the administrative geographical areas defined in each survey.

The second drawback is that the decomposition is not invariant to the number of different units in each geographical category. The "between" component is sensitive to the number of units considered (Shorrocks and Wan, 2005), so the use of the different number of cities/areas for each country could distort the comparison across countries. However, in our application, this is not an issue since we only use a rural/urban and large/small urban area

as categories. Specifically, we do not define a sub-set of cities for the large and small urban definitions.[6]

Another issue is that our analysis implicitly assumes that prices are similar across different geographical areas (rural versus urban; large cities versus smaller cities). If the cost-of-living index differs among regions, then spatial income inequality measures - based on nominal income - could be distorted. Ferré et al. (2012) find that considering differences in the cost of living among different-sized urban areas in Brazil does result in a more equal income distribution. However, in this case, the effect is not enough to overturn their overall conclusion that poverty is relatively more concentrated in smaller urban areas.

In addition, there is also a compensating effect due to more amenities, variety, and quality of goods and services in larger urban areas. For the US, Diamond (2016) finds that inequality has increased more than nominal wages once amenities are considered. Handbury and Weinstein (2015) indicate that once quality and variety are controlled for, prices are lower in bigger cities.

Finally, if cost-of-living indices have a similar bias in developed and developing countries, then the comparison between those two groups might not be severely distorted.

3.3 Interpretation of the between components of the decomposition

Another vital empirical problem relates to the interpretation of the between component of the income distribution decomposition. Elbers, Lanjouw, Mistiaen, and Özler (2008) argue that comparing the between components across countries is problematic for two reasons.

First, between group inequality measures will depend on the number of groups and relative sizes among the population. Therefore, comparisons across countries will give a distorted view when the number of groups and their relative sizes differ. In the current application, the number of groups (rural/urban, urban large/urban small) is the same for each country, though their relative size in the population will differ.

Second, between group inequality usually represents a small fraction of overall inequality, which has led researchers to discount the policy relevance of average inequality across racial, geographic, gender, and other groups, and to focus more on within group inequality. But Elbers et al. (2008) note that this may be an unwarranted conclusion. The ratio of the between inequality term to total inequality will always be small since there is an upper limit to the between inequality term that will be much smaller than total inequality. The reason is that total inequality is the between group inequality when each household is considered

[6] That is, we do not calculate a between component within small or large urban areas. The heterogeneity of the geographical variables across the different country surveys precludes defining subgroups within the large and small urban area definitions in a comparable way.

as a separate group. This is compared to the inequality among a small set of groups which will obviously be much smaller.

To tackle both problems Elbers et al. (2008) suggest taking the ratio of the between inequality term to the maximum that this term could potentially reach in a given application. This maximum is the between inequality decomposition term when incomes are artificially assigned to each group in ascending order according to the relative average income of each group. For example, in our application, assume there are n_u urban households and n_r rural households, and that the average income is lower for rural households than urban households ($\mu_r < \mu_u$). The Elbers et al. (2008) approach would then assign the n_r households with the lowest income per capita to the rural group and the rest to the urban group, and then calculate the between term of the income distribution decomposition. The between group inequality measure will thus be maximum since there is no overlap in the income distribution between these two groups.

Since the Elbers et al. (2008) approach normalizes the between group component by the maximum obtainable in a given survey, it will be a suitable measure to compare across countries. Therefore, as an additional decomposition analysis, we apply this method to each country's income distribution decomposition to better gauge the relative importance of the between group inequality term and its policy implications.

3.4 Results

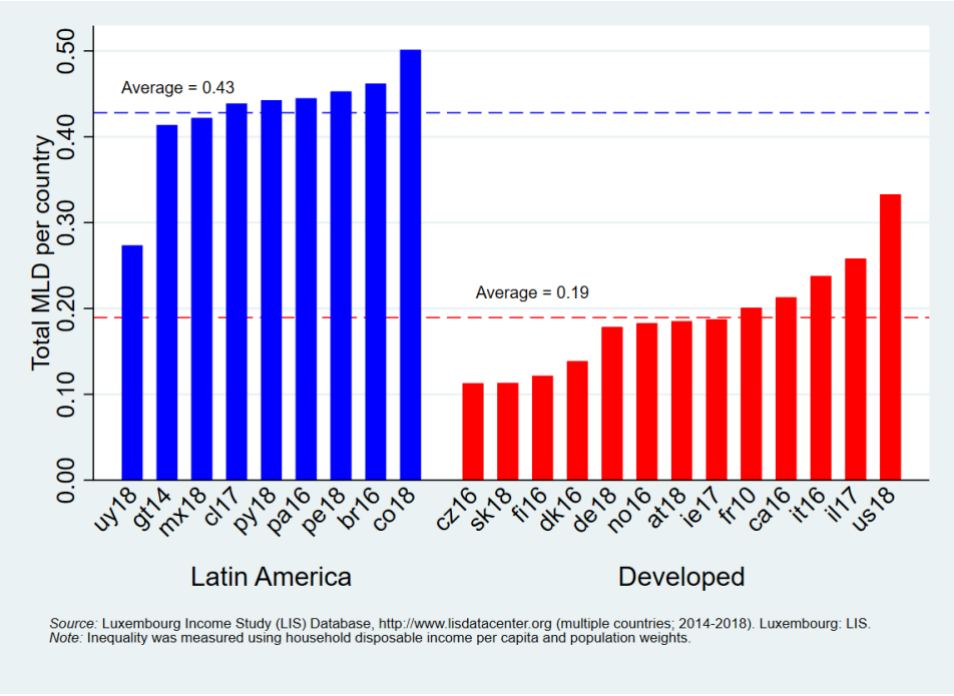
Figure 1 presents the results for the total Mean Log Deviation measure per country.[7] It can be seen that, as expected, Latin America is much more unequal compared to developed countries. The average MLD among the counties of the region is 0.43 compared to 0.19 for the latter. Except for Uruguay, all Latin American countries considered have a total inequality index above those of any of the developed countries.

Figure 2 presents the MLD within large urban areas (see Appendix 1 for the definition of large urban areas for each country).[8] Although, on average, Latin American countries exhibit higher inequality than developed countries (0.11 compared to 0.05), the results, in this case, are more diverse. Except for Chile, Brazil, and Colombia, many Latin American countries have inequality indices comparable to those of developed countries, particularly Mexico, Paraguay, and Panama.

[7] Income inequality was calculated using per capita household disposable incomes and survey population weights. Observations with zero or negative income were not used in the calculations.

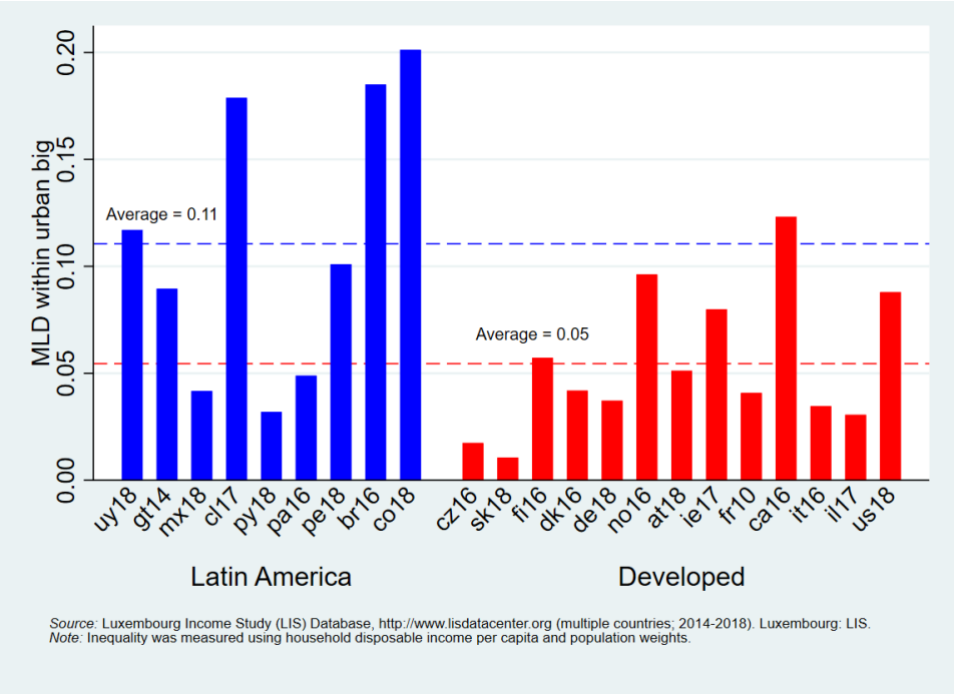
[8] We maintain the same ordering of countries as in Figure 1 so that countries to the left of each group have a lower total MLD index and countries to the right have a higher total MLD index.

Figure 1: Total MLD per country



Source: Luxembourg Income Study (LIS) Database, http://www.lisdatacenter.org (multiple countries; 2014-2018). Luxembourg: LIS.
Note: Inequality was measured using household disposable income per capita and population weights.

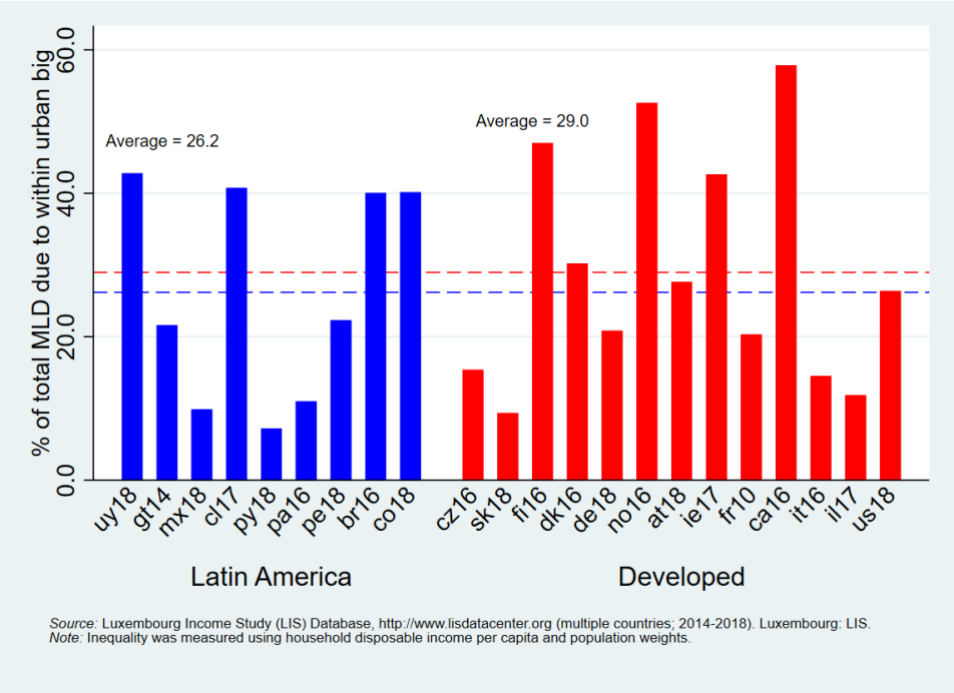
Figure 2: MLD within large urban areas



Source: Luxembourg Income Study (LIS) Database, http://www.lisdatacenter.org (multiple countries; 2014-2018). Luxembourg: LIS.
Note: Inequality was measured using household disposable income per capita and population weights.

Another interesting comparison is the percentage of overall inequality due to within large urban areas inequality. Figure 3 presents these results. In relative terms, the average contribution of within big urban areas inequality to total inequality is higher for developed countries compared to Latin America (29.0% to 26.2%). Therefore, the relative importance of within large urban areas inequality among both sets of countries is quite similar.

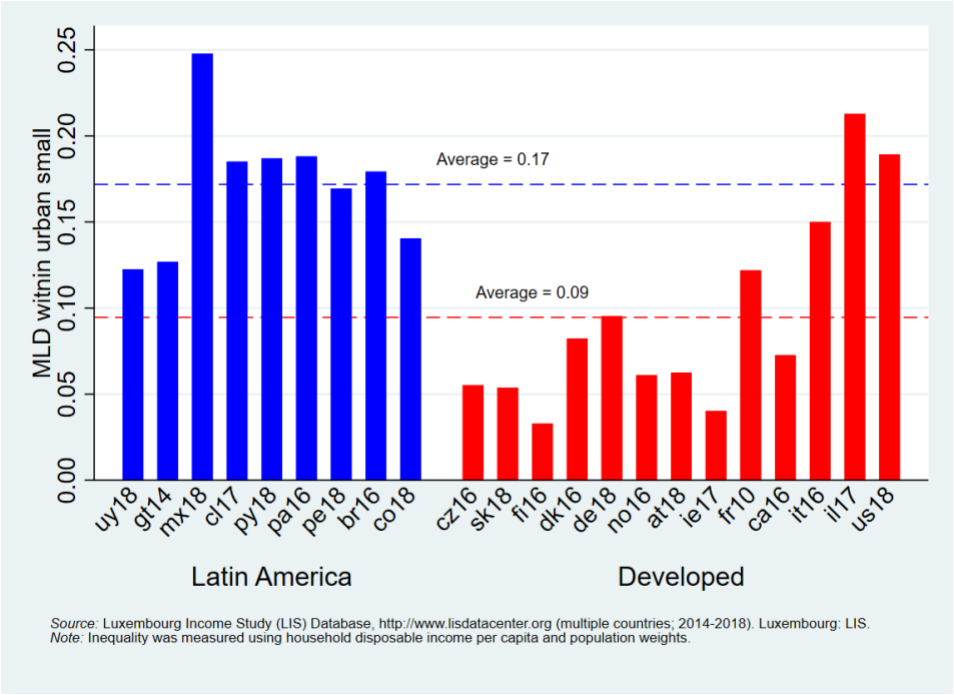
Figure 3: Proportion of total MLD due to within large urban areas inequality



Source: Luxembourg Income Study (LIS) Database, http://www.lisdatacenter.org (multiple countries; 2014-2018). Luxembourg: LIS.
Note: Inequality was measured using household disposable income per capita and population weights.

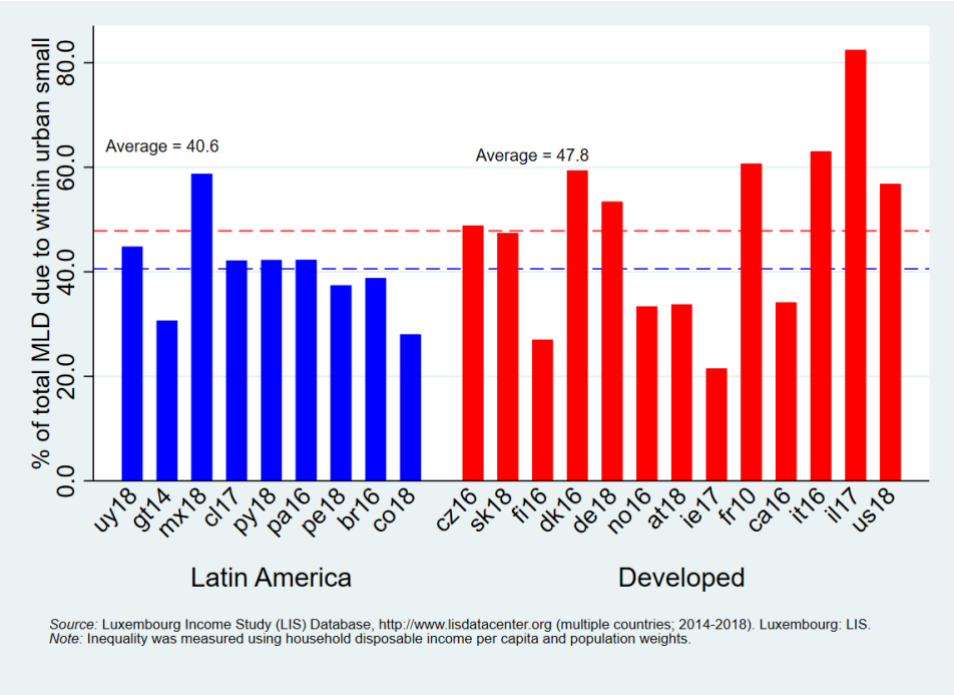
Figure 4 presents the within small urban areas inequality. In this case, Latin American countries exhibit higher inequality compared to most (but not all) developed countries. On average, the difference between both groups of countries is higher than in the case of within large urban areas. However, once again, if we look at the proportional contribution to overall inequality, we see that it is higher in developed countries, with 47.8%, compared to Latin America, with 40.6% (Figure 5). Within small urban area inequality is more important to overall inequality than the within large urban areas inequality.

Figure 4: MLD within small urban areas



Source: Luxembourg Income Study (LIS) Database, http://www.lisdatacenter.org (multiple countries; 2014-2018). Luxembourg: LIS.
Note: Inequality was measured using household disposable income per capita and population weights.

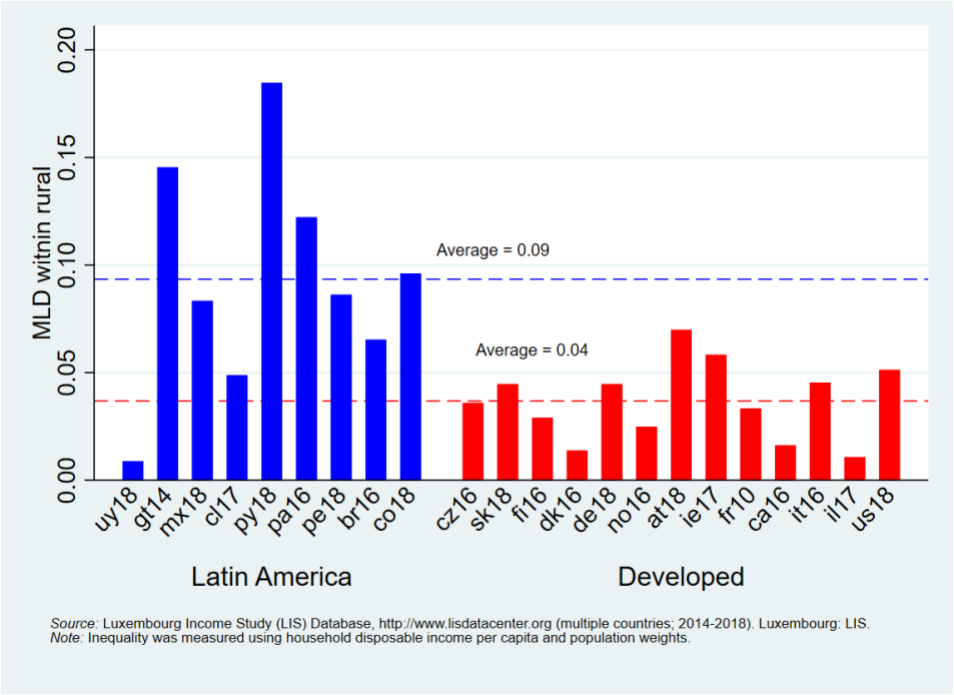
Figure 5: Proportion of total MLD due to within small urban areas inequality



Source: Luxembourg Income Study (LIS) Database, http://www.lisdatacenter.org (multiple countries; 2014-2018). Luxembourg: LIS.
Note: Inequality was measured using household disposable income per capita and population weights.

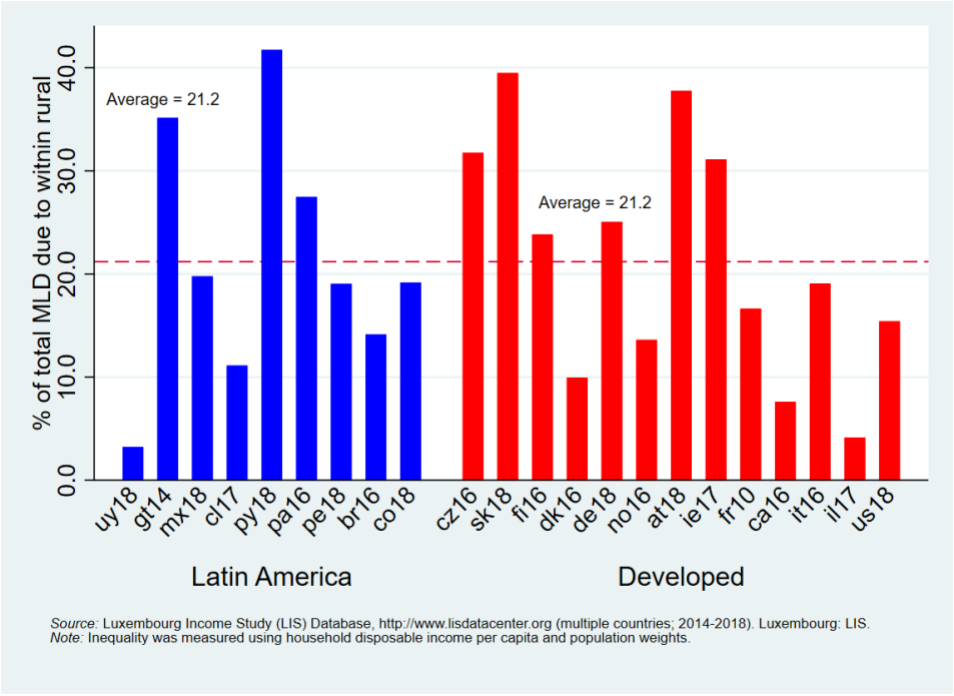
Figure 6 presents the within rural area inequality. Except for Uruguay and to a lesser extent Chile, inequality within rural areas is higher in Latin America than in the developed countries considered. More interesting, Figure 7 presents the contribution of rural area inequality to total inequality. There is no difference between both sets of countries with respect to this proportional metric.

Figure 6: MLD within rural areas



Source: Luxembourg Income Study (LIS) Database, http://www.lisdatacenter.org (multiple countries; 2014-2018). Luxembourg: LIS.
Note: Inequality was measured using household disposable income per capita and population weights.

Figure 7: Proportion of total MLD due to within rural areas inequality

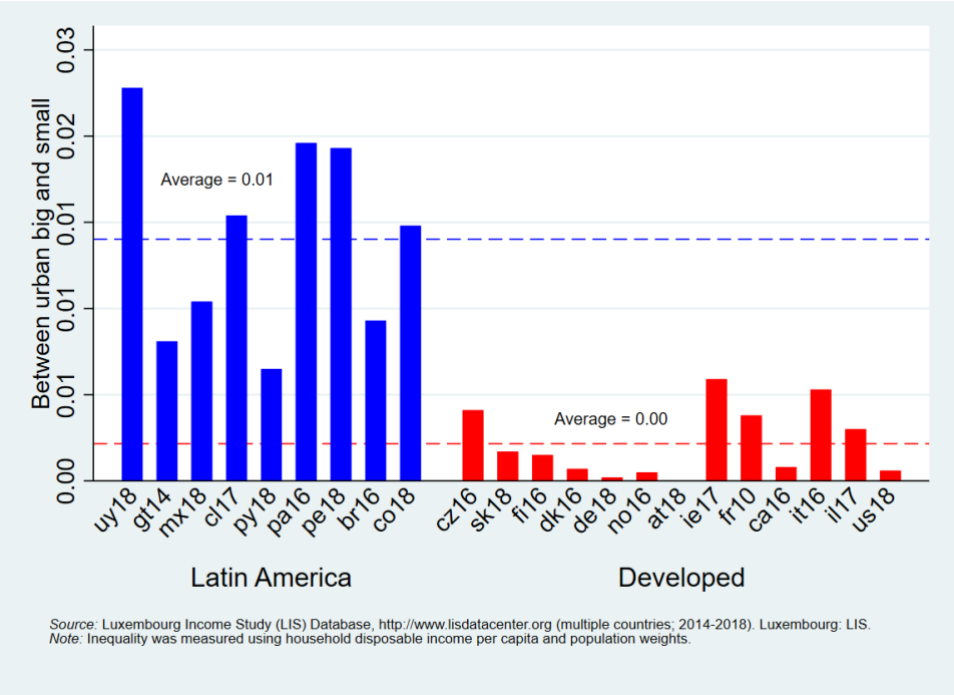


Source: Luxembourg Income Study (LIS) Database, http://www.lisdatacenter.org (multiple countries; 2014-2018). Luxembourg: LIS.
Note: Inequality was measured using household disposable income per capita and population weights.

With the caveats discussed above regarding the between components of the inequality decomposition, we next present these elements. Further below we present results applying the Elbers et al. (2008) procedure.

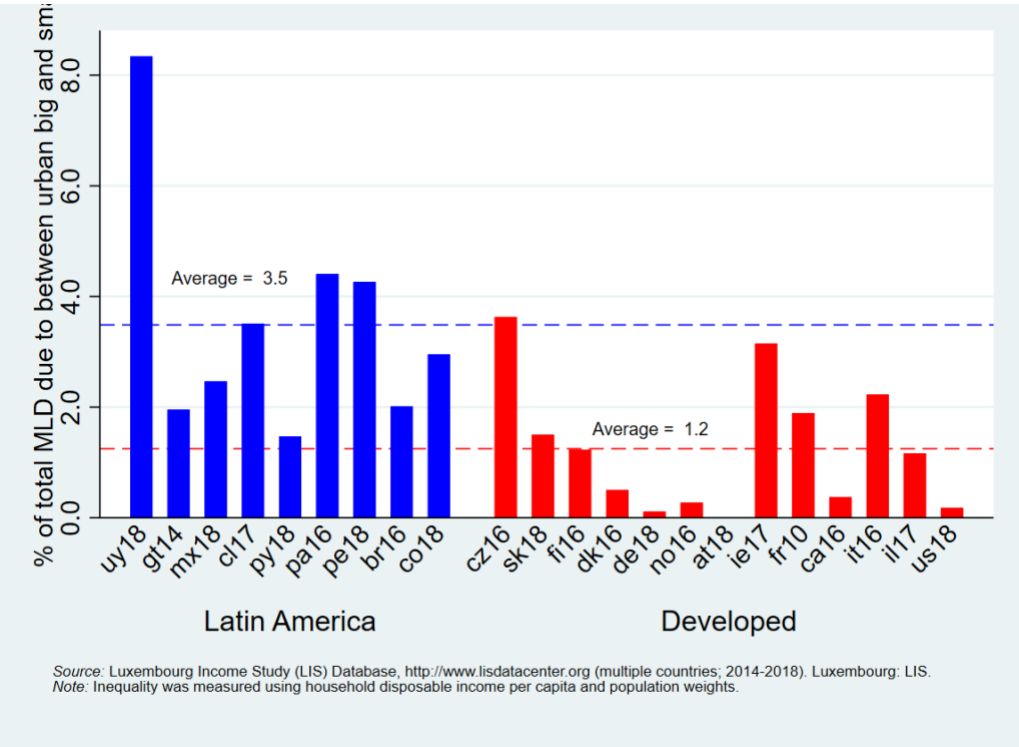
Figure 8 presents the between large and small urban area components. As expected, in absolute value this component is small. Despite this, we can see that there is a noticeable difference between Latin American countries and developed countries. In proportional terms this contrast is also present (Figure 9).

Figure 8: Inequality between large and small urban areas



Source: Luxembourg Income Study (LIS) Database, http://www.lisdatacenter.org (multiple countries; 2014-2018). Luxembourg: LIS.
Note: Inequality was measured using household disposable income per capita and population weights.

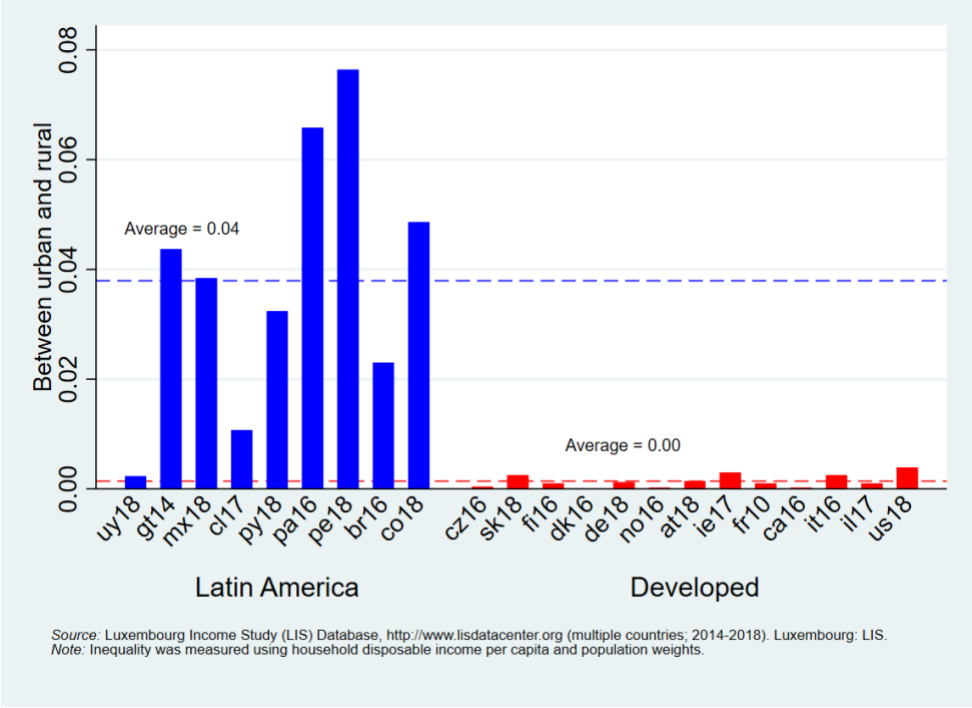
Figure 9: Proportion of total MLD due to inequality between large and small urban areas



Source: Luxembourg Income Study (LIS) Database, http://www.lisdatacenter.org (multiple countries; 2014-2018). Luxembourg: LIS.
Note: Inequality was measured using household disposable income per capita and population weights.

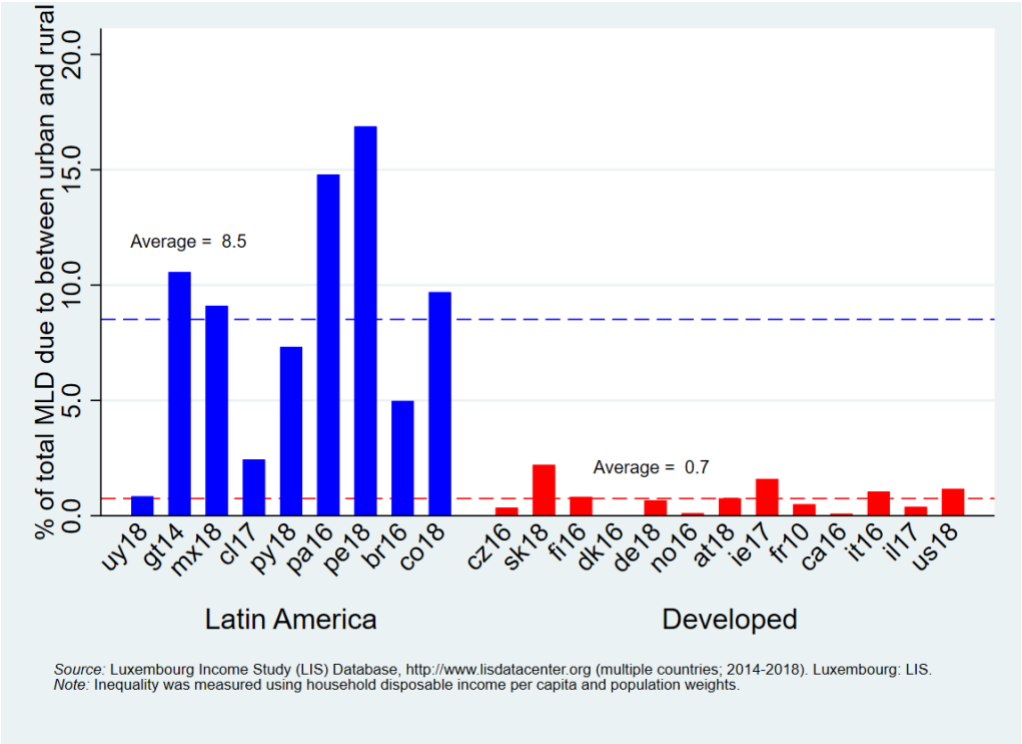
Figure 10 presents the inequality between urban and rural areas. Here we see a relevant difference between both groups of countries. While in developed countries the between urban and rural terms is very low, in Latin America it is much higher (except Uruguay and to some extent Chile). Figure 11 presents the proportion of total inequality represented by this between term, and it is striking that in Latin America this term alone can represent around 8% of total inequality. In some countries such as Panama and Peru, this term contributes 15% or more to total inequality.

Figure 10: Inequality between urban and rural areas



Source: Luxembourg Income Study (LIS) Database, http://www.lisdatacenter.org (multiple countries; 2014-2018). Luxembourg: LIS.
Note: Inequality was measured using household disposable income per capita and population weights.

Figure 11: Proportion of total MLD due to between urban and rural inequality

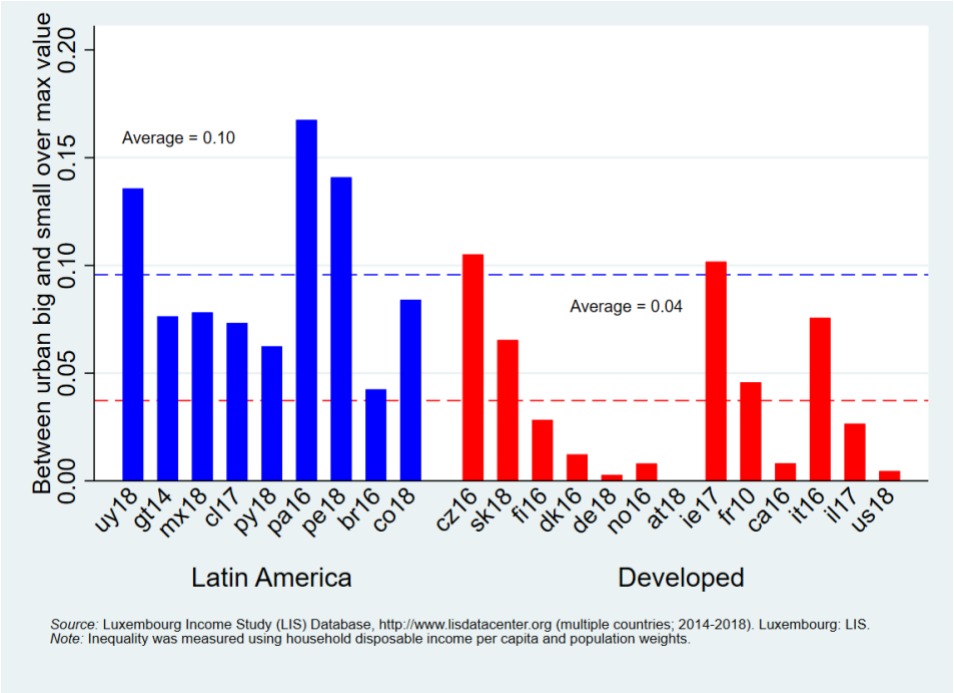


Source: Luxembourg Income Study (LIS) Database, http://www.lisdatacenter.org (multiple countries; 2014-2018). Luxembourg: LIS.
Note: Inequality was measured using household disposable income per capita and population weights.

Before we summarize our findings, it is important to analyze the results of applying the Elbers et al. (2008) approach to the between terms. As shown in Figures 8 and 10, the between terms are small in absolute value (although in the case of urban and rural areas, it is still significant for many Latin American countries). However, as discussed above, these terms will always be small. A complementary analysis is to compare the between measures to the maximum that these terms could reach given the number of groups and their relative sizes.

We simulated the maximum between terms as proposed by Elbers et al. (2008) and calculated for each country how close the actual between terms compare to these maximums. The results between urban big and small areas are presented in Figure 12. On average Latin American countries show a higher proportion of the between term to its maximum potential value (10%) compared to developed countries (4%). However, there are differences among countries. Uruguay, Peru, and Panama show a much higher inequality term while some developed countries, such as the Czech Republic, Ireland, and Italy, show a value higher than most Latin American countries.

Figure 12: Between urban big and small areas compared to its maximum potential value

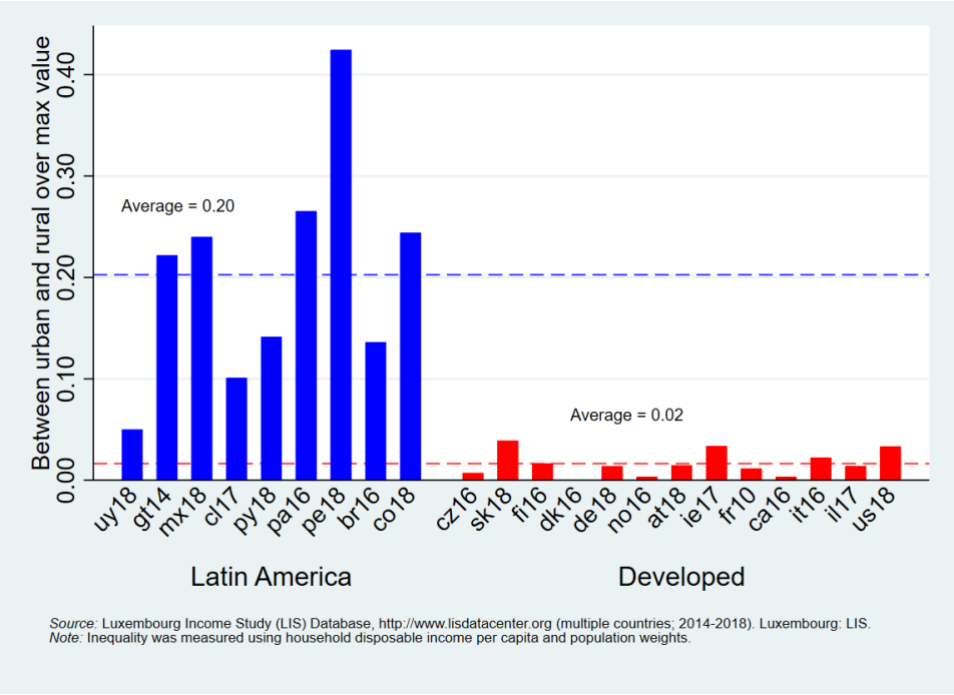


Source: Luxembourg Income Study (LIS) Database, http://www.lisdatacenter.org (multiple countries; 2014-2018). Luxembourg: LIS.
Note: Inequality was measured using household disposable income per capita and population weights.

A sharper difference is present with respect to the between rural and urban areas shown in Figure 13. In this case, except for Uruguay, Latin American countries exhibit an urban rural inequality term that is close to 20% of its maximum value but with many countries above this average. The case of Peru is particularly high, with a between term over 40% of its

maximum value. On average, the relative value for Latin America is ten times that for developed countries.

Figure 13: Between urban and rural areas compared to its maximum potential value



Source: Luxembourg Income Study (LIS) Database, http://www.lisdatacenter.org (multiple countries; 2014-2018). Luxembourg: LIS.
Note: Inequality was measured using household disposable income per capita and population weights.

Going back to our original question: what are the salient differences in spatial inequality between Latin America and developed countries? We can summarize the results as follows.

First, and perhaps unsurprisingly, Latin America is more unequal in all three spatial dimensions considered in this study. Table 2 presents the average values for the inequality decomposition and to what component we can attribute these differences.

Second, within small urban areas inequality is the most crucial decomposition term. This is consistent with the results of Ferré et al. (2012) and ECLAC (2010, 2016). It implies that more emphasis should be placed on poverty rates in smaller urban areas and not just large metropolitan areas. However, this is also the most important term for the case of developed countries, so it does not seem to be a characteristic unique to Latina America

Table 2: Spatial inequality decomposition, averages across country groups

	Latin America	Developed	Difference	% of total difference
Total MLD	0.43	0.19	0.24	
Within large urban areas	0.11	0.06	0.06	23.4%
Within small urban areas	0.17	0.10	0.08	32.2%
Within rural areas	0.09	0.04	0.06	23.4%
Between urban large and small	0.01	0.00	0.01	5.0%
Between urban and rural areas	0.04	0.00	0.04	15.5%

Source: Luxembourg Income Study (LIS) Database, http://www.lisdatacenter.org (multiple countries; 2014-2018). Luxembourg: LIS.

Third, there is a clear difference in inequality between rural and urban areas among both groups of countries. This is also present when we calculate the between terms using the approach suggested by Elbers et al. (2008). There is also a difference in the between term among large and small urban areas, particularly when using the Elbers et al. (2008) approach. However, in this last case, the results are less clear as there are important differences among countries within each group.

In what follows then the discussion will focus on the urban/rural divide and to a lesser extent on the centralization or urban primacy issue. We will not discuss the higher inequality in general in Latin America since this is a crosscutting theme not necessarily related to a spatial issue. However, we do emphasize that according to our results more emphasis should be placed on the inequality of households in smaller urban areas of the region, something already noted by Ferré et al. (2012). This does not mean that large urban areas do not matter. In fact, further below we will address the spatial segregation issue in large urban metropolises, which is a distinct topic in these areas.

3.5 *Robustness Checks*

We made several robustness checks on our results. First, we tested different definitions for large and small urban areas in some countries (see the table in Appendix 1). These results are summarized in Table 3 where it can be verified that they are very similar to those of Table 2.

Table 3: Spatial inequality decomposition, averages across country groups with alternative definition of large and small urban areas

	Latin America	Developed	Difference	% of total difference
Total MLD	0.43	0.19	0.24	
Within large urban areas	0.12	0.06	0.06	25.1%
Within small urban areas	0.17	0.09	0.08	31.4%
Within rural areas	0.09	0.04	0.06	23.4%
Between urban large and small	0.01	0.00	0.01	4.6%
Between urban and rural areas	0.04	0.00	0.04	15.5%

Source: Luxembourg Income Study (LIS) Database, http://www.lisdatacenter.org (multiple countries; 2014-2018). Luxembourg: LIS.

Second, we also eliminated the richest 1% and the poorest 1% of households for each country (according to the distribution of per capita disposable income and population weights). Naturally, this reduces all the inequality measures. However, the same patterns and qualitative conclusions from the main results are found using these restricted samples, as shown in Table 4.

Table 4: Spatial inequality decomposition eliminating the richest and poorest 1% in each country, averages across country groups

	Latin America	Developed	Difference	% of total difference
Total MLD	0.32	0.13	0.19	
Within large urban areas	0.07	0.03	0.04	20.2%
Within small urban areas	0.13	0.07	0.06	34.0%
Within rural areas	0.07	0.03	0.05	25.0%
Between urban large and small	0.01	0.00	0.01	3.2%
Between urban and rural areas	0.03	0.00	0.03	17.6%

Source: Luxembourg Income Study (LIS) Database, http://www.lisdatacenter.org (multiple countries; 2014-2018). Luxembourg: LIS.

4. Urban structures and spatial inequalities: are LAC cities different from other regions?

One aspect that is not addressed by the income distribution decomposition analysis shown above is the issue of geographical segregation within urban areas. City dwellers may live more or less segregated for a given income distribution.

Comparative studies of urban segregation are scarce. Tammaru et al. (2015) perform a comparison across and through time of urban segregation in 13 European capital cities. Some studies have compared segregation between US and European cities (Musterd, 2005; Van Kempen and Murie, 2009). However, as far as we know, there are no studies comparing urban segregation among Latin American cities or between these cities and those of other regions of the world. This is an area that deserves further research.

Despite the lack of comparable data on urban segregation at the regional level, we can approach this issue through two complementary approaches. First, we present a comparative analysis of indicators of urban growth and urban characteristics using data from the Atlas of Urban Expansion (AUE), which collects and analyzes information on the quantity and quality of urban expansion in a stratified global sample of 200 cities and metropolitan areas of more than 100,000 inhabitants (Blei and Angel, 2021). Although not directly related to urban segregation, this comparison may provide an interesting contrast between cities in Latin America and other regions of the world. Second, we complement this last approach using case studies of cities. We are unable to contrast this information with comparable case studies in other parts of the world. What we lose in comparability we gain in a more detailed understanding of the urban structures of some cities in Latin America.

4.1 Comparison using the Atlas of Urban Expansion

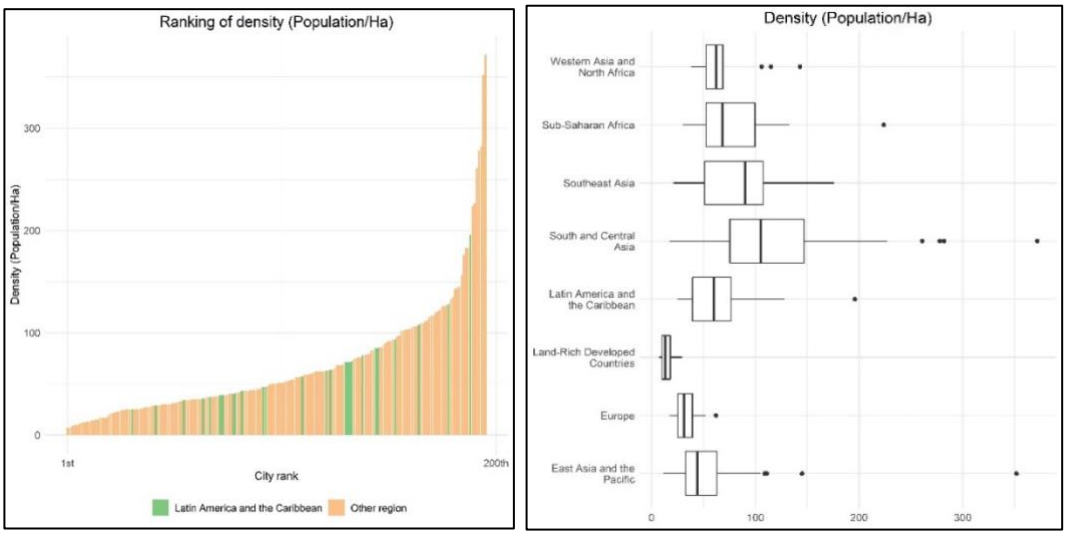
Using indicators from the AUE, we compare cities in LAC in two categories: small cities (between 100,000 and 999,999 inhabitants), and big cities (above 1,000,000 inhabitants). This categorization differs from the one used in the previous section to account for the distribution of cities in the AUE. Furthermore, we adopt a more disaggregated categorization of global regions, accounting not only for industrialized countries and developing countries but also recognizing that some developed countries have very land-rich territories, which invariably will influence their urban development trajectories. 26 cities from 12 countries in Latin America and the Caribbean are included in the sample[9], with Brazil and Mexico being over-represented with eight and five cities, respectively.

As shown in Figure 14 (left), LAC cities in the AUE sample are well distributed across the spectrum of urban density measured as Population/Ha. However, when aggregating cities by region, it becomes clear that, on average, cities in LAC are denser than wealthier regions such as Europe and countries such as the United States, Canada, New Zealand, and Australia, which belong to the category of *Land-rich Developed Countries.* By contrast, cities

[9] List of LAC cities: Buenos Aires, Cordoba, Cochabamba, Belo Horizonte, Curitiba, Florianopolis, Ilheus, Jequie, Palmas, Ribeirao Preto, Sao Paulo, Santiago, Bogota, Valledupar, Holguin, Quito, San Salvador, Guatemala City, Culiacan, Guadalajara, Mexico City, Reynosa, Tijuana, Leon, Cabimas, Caracas.

in other regions in the global south such as Southern Asia and Africa have higher population densities.

Figure 14: LAC cities in the ranking of cities in the AUE (Left) and Boxplot of urban density by region (Right)



Source: Own elaboration based on data from the *Atlas of Urban Expansion (AUE) (Blei and Angel, 2021[10]) .*

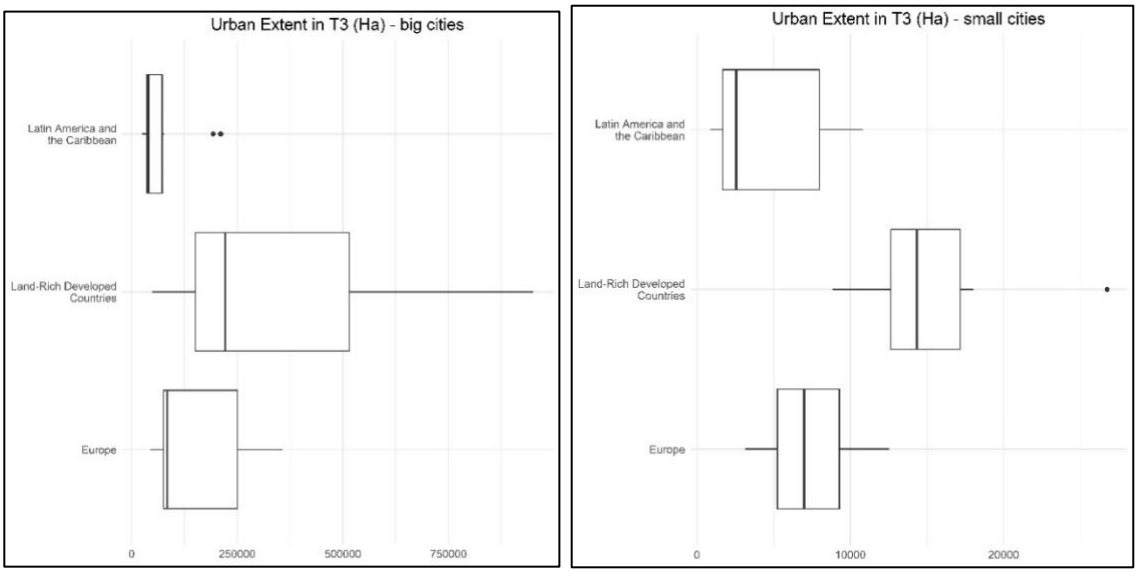
Higher densities, such as those shown in Figure 14, suggest that cities in LAC are less dispersed than those in wealthier regions, which may decrease spatial inequalities through shorter distances to access opportunities and social interactions. The AUE provides further evidence on urban forms across global regions by measuring Urban Extent, understood as the surface area of cities and metropolitan areas belonging to a single functional area. When comparing the Urban Extent of cities in LAC with those in more developed regions for the most recent period where data is available in the AUE[11] (see Figure 15), it becomes clear that both big and small cities in LAC occupy less land than cities in industrialized contexts. Smaller surface areas indicate that, overall, the extension of cities in LAC tends to be smaller than those in industrialized contexts.

Figure 16 enables further comparison between urban extent and density in LAC by presenting a ranking of cities according to these two indicators. Among the larger cities, Bogota and Caracas lead in terms of density, while Valledupar, Holguin, and Leon are those higher in the density ranking of small cities. By contrast, cities such as Sao Paulo, Mexico

[10] Database, http://atlasofurbanexpansion.org/ (multiple countries; 2014-2018). New York University (NYU).
[11] T3 = Circa 2014, depending on the city.

City, and Buenos Aires - three of the largest cities in the region in terms of population - also have the highest surface area in the region.

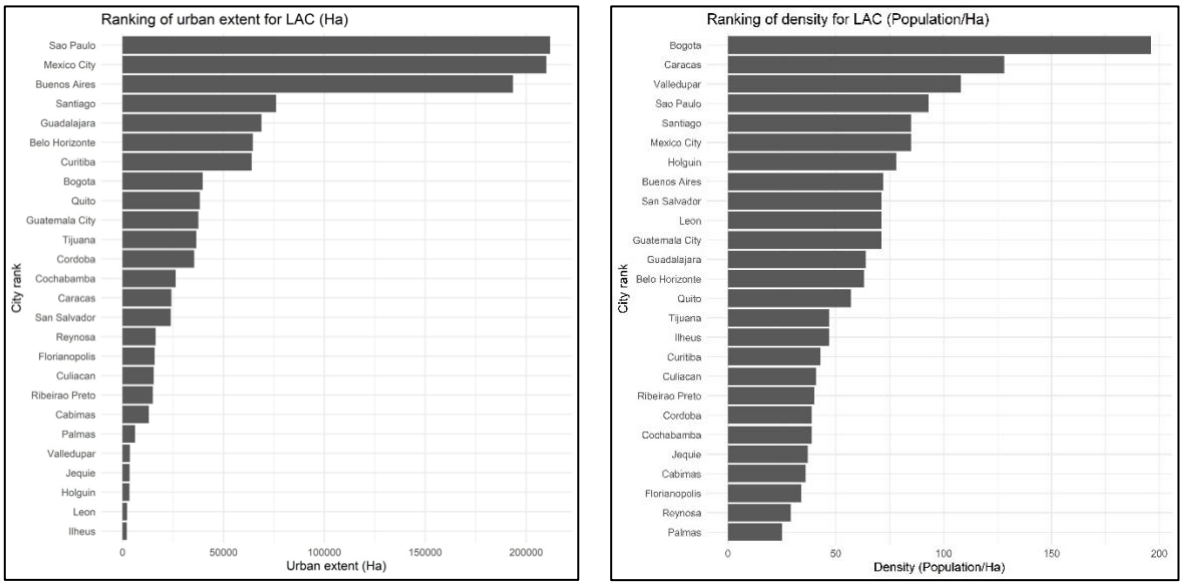
Figure 15: Urban Extent comparison between LAC cities and wealthier global regions by type: big cities (left) and small cities (right)



Source: Own elaboration based on data from the *Atlas of Urban Expansion (AUE) (Blei and Angel, 2021).*

The spatial concentration of population (density) and surface area (urban extent) are relevant indicators of potential spatial inequalities among residents of LAC cities. However, rapid urbanization and expansion of the urban area can play a significant role in consolidating spatial inequalities associated with lack of access to basic infrastructure, the concentration of lower-income population in the peripheries, and informal urban development, among others. Using data from the AUE, we compared urban expansion rates, understood as the ratio between the total added area between two periods and the urban extent in the baseline period, for different global regions and within LAC. Figure 17 shows the comparative distributions of urban expansion rates for the periods between T1 (~1990), T2 (~2000), and T3 (~2014).

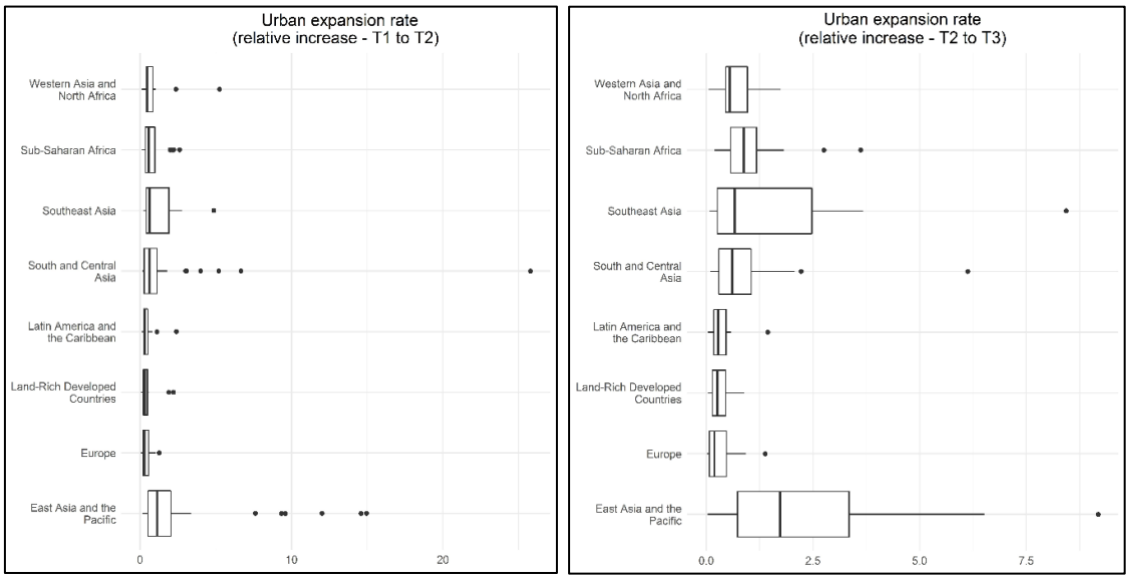
Figure 16: Ranking of LAC cities by urban extent (left) and density (right)



Source: Own elaboration based on data from the *Atlas of Urban Expansion (AUE) (Blei and Angel, 2021).*

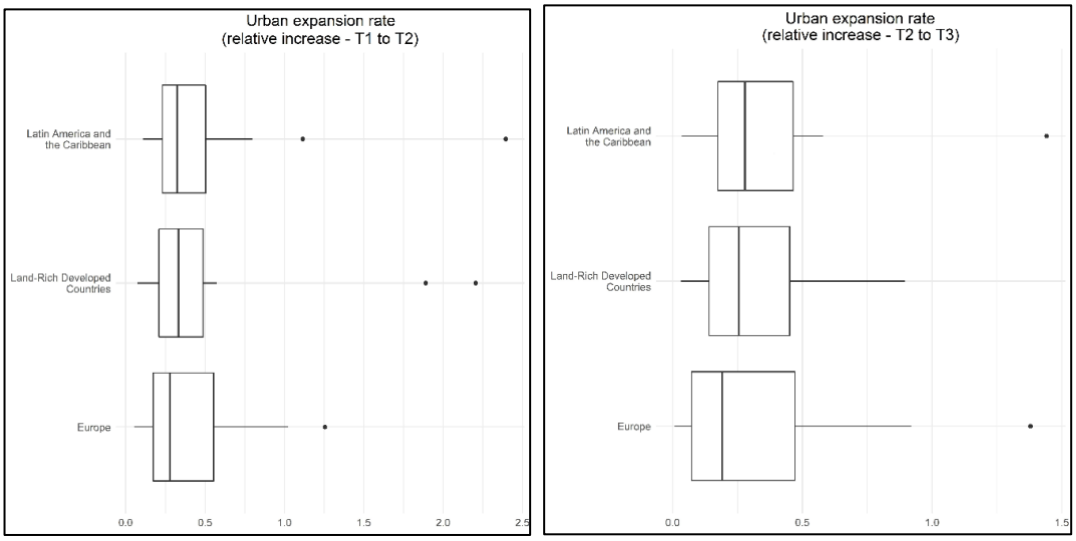
Figure 17 shows that although average urban expansion rates in the 90s did not differ much across regions, LAC cities added area to their urban extent in similar proportion to industrialized country cities. Differences in urban expansion rates are markedly larger in the second period of analysis, with African and Asian cities growing at a higher rate than cities in LAC. Figure 18 expands on the comparison between LAC and cities in wealthier regions, showing a marginally higher average urban expansion rate for cities in the region above cities in Europe and Land Rich Developed Countries.

Figure 17: Boxplot of urban expansion rate for all global regions T1-T2 (Left) and T2-T3 (Right)



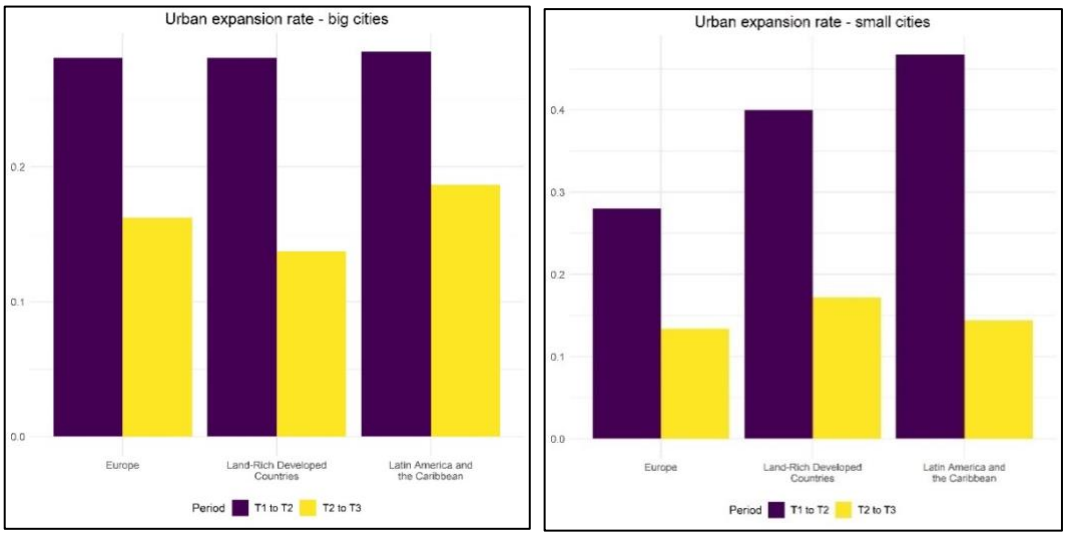
Source: Own elaboration based on data from the Atlas of Urban Expansion (AUE) (Blei and Angel, 2021).

Figure 18: Boxplot of urban expansion rate for LAC and wealthier global regions T1-T2 (Left) and T2-T3 (Right)



Source: Own elaboration based on data from the Atlas of Urban Expansion (AUE) (Blei and Angel, 2021).

Figure 19: Urban Expansion Rate for LAC and wealthier global regions by type of city: big cities (left) and small cities (right)



Source: Own elaboration based on data from the Atlas of Urban Expansion (AUE) (Blei and Angel, 2021).

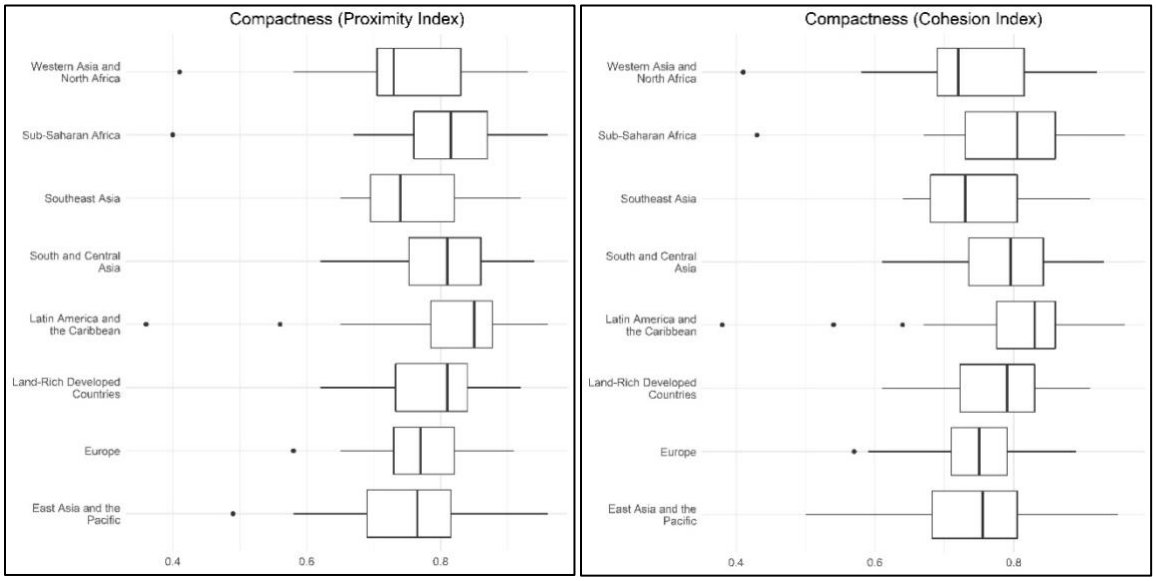
Cities in LAC have grown slower in the second period of analysis, following a similar trend in wealthier global regions. However, the average urban expansion rate for big cities in the region is larger than those in wealthier regions. The opposite is true for small cities (Figure 19).

The patterns of urban expansion have implications for the ability of different social groups to access opportunities and they precondition patterns of spatial concentration of activities and infrastructure, land prices, and availability and access to open public spaces. These consequences can be foreshadowed by features of the urban environment such as fragmentation and compactness. In the AUE, compactness measures "the extent to which the overall geographic shape of urban extent approximates a circle, the shape that minimizes the average distance from any point within it to its center or, alternatively, the shape that minimizes the average distance between all points within it" (Angel et al., 2016, p23). Compactness is measured using two indices, the proximity index, and the cohesion index. The first is "the ratio of the average beeline distance of all points in the equal area circle to city hall and the average beeline distance of all points in the urban extent to city hall." The second is "the ratio of the average beeline distance of all points to all other points in the equal area circle and the average beeline distance of all points to all other points in the urban extent" (Angel et al., 2016, p23). Both indices vary between 0 and 1, with higher values corresponding to urban extents that are closer in shape to the circle.

In turn, “fragmentation measures the degree to which the built-up area saturates the city’s urban extent or, conversely, the extent to which the built-up area within it is fragmented by urbanized open space” (Angel et al., 2016, p22).

Using these two types of indicators, we examine how cities in LAC fare in comparison with other regions.

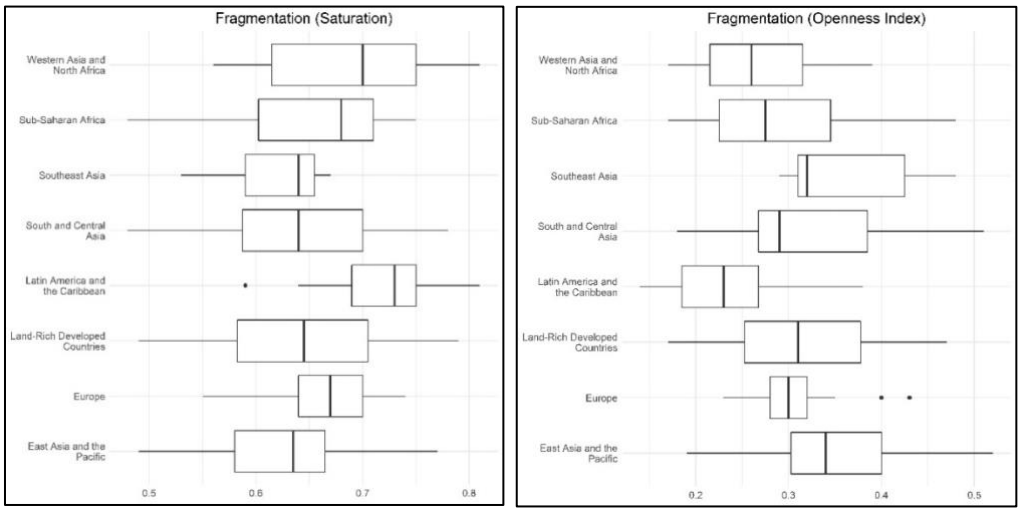
Figure 20: Compactness indices for LAC and other global regions: Proximity index (left) and Cohesion index (right)



Source: Own elaboration based on data from the Atlas of Urban Expansion (AUE) (Blei and Angel, 2021).

As shown in Figure 20, LAC cities are, on average, the most compact compared with other urban areas in the AUE sample. Both compactness indicators of Figure 20 show that LAC urban forms are closest to a circle of comparable areas, contributing to reducing urban distances. Therefore, this is a positive feature for reducing urban inequalities. Nonetheless, it must be considered jointly with the degree of urban expansion as those in peripheral settlements remain at a disadvantage, albeit comparable across peripheries in the same city.

Figure 21: Fragmentation indices for LAC and other global regions: Saturation index (left) and Openness index (right)

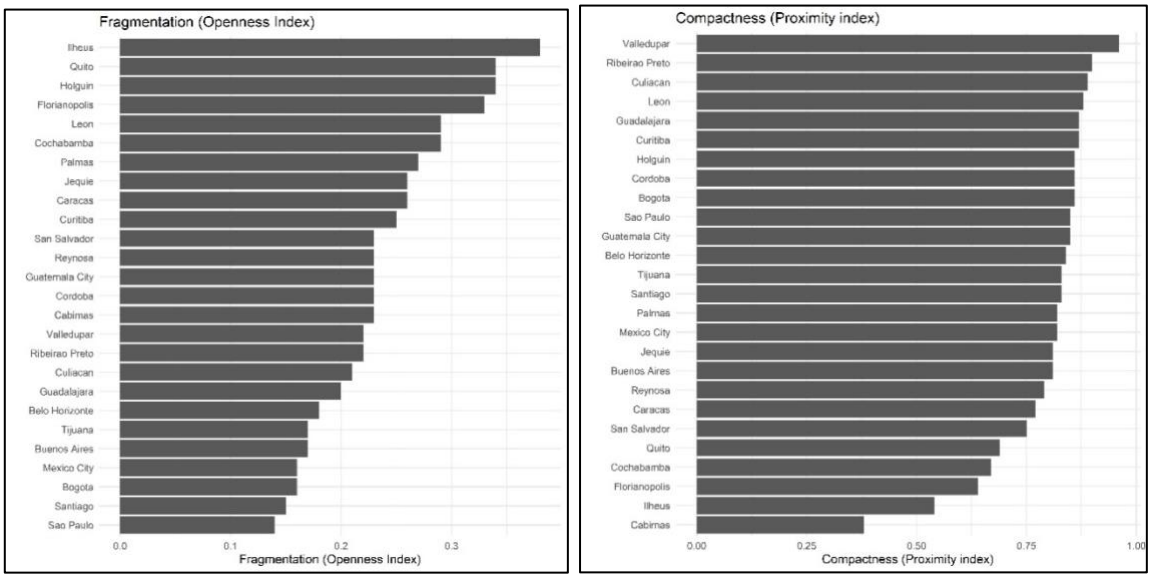


Source: Own elaboration based on data from the Atlas of Urban Expansion (AUE) (Blei and Angel, 2021).

Figure 21 shows indices of fragmentation for LAC compared with other global regions. In this context, LAC cities' average scores and distribution suggest these cities are less fragmented than those in other regions. Land in LAC is more saturated with development than cities in industrialized societies and even those in other parts of the global south. Furthermore, the openness index suggests cities in LAC also lack open spaces, which are not only indicative of a high speed of urbanizing land but also a potential lack of green and open public spaces that are relevant for well-being. Less availability of open spaces is likely to generate inequalities in access for those further away from available land. Data confirms earlier findings from Inostroza et al (2013) for a sample of 10 cities over a period of 20 years.

Figure 22 shows the ranking of the above metrics for LAC cities in the AUE sample. Larger and denser cities tend to have fewer open spaces, as reflected in their low openness index. In contrast, most cities in the sample have a similar index of compactness, suggesting uniformly expanding urban extents across the region.

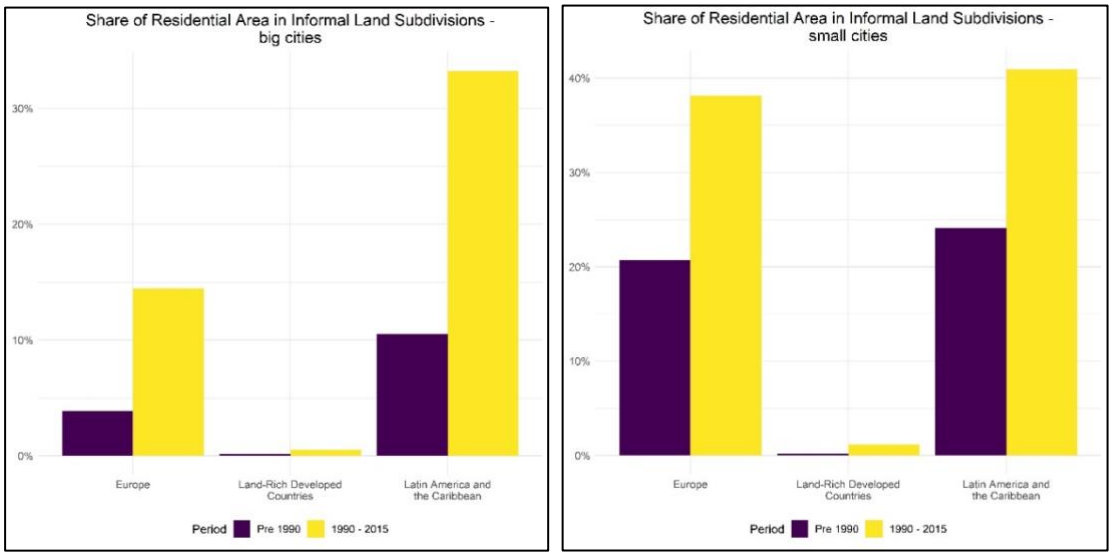
Figure 22: Fragmentation and Compactness indices for cities in LAC and other global regions: Openness index (left) and Proximity index (right)



Source: Own elaboration based on data from the Atlas of Urban Expansion (AUE) (Blei and Angel, 2021).

Insights about urban form presented in this section can relate to informal land occupation and residential development indicators. According to data from the AUE, this indicator has increased globally in the second analysis period, even in industrialized contexts (Figure 23). However, cities in LAC show a much higher proportion of informal residential land. Furthermore, this indicator is larger in small cities, suggesting a stronger tendency of informal occupation in growing cities with less than 1 million inhabitants. Informal land is likely located in the expansion areas, which in compact and less fragmented cities contributes to saturation, population density, and segregation of the peripheries. This confirms results obtained by regional research on four cities that suggest that social inequality is tightly related to segregation, imposing disproportionate barriers for daily mobility of residents of segregated areas (Vignoli, 2008).

Figure 23: Share of residential land in informal land subdivisions for cities in LAC and wealthier global regions: Big cites (left) and small cities (right)

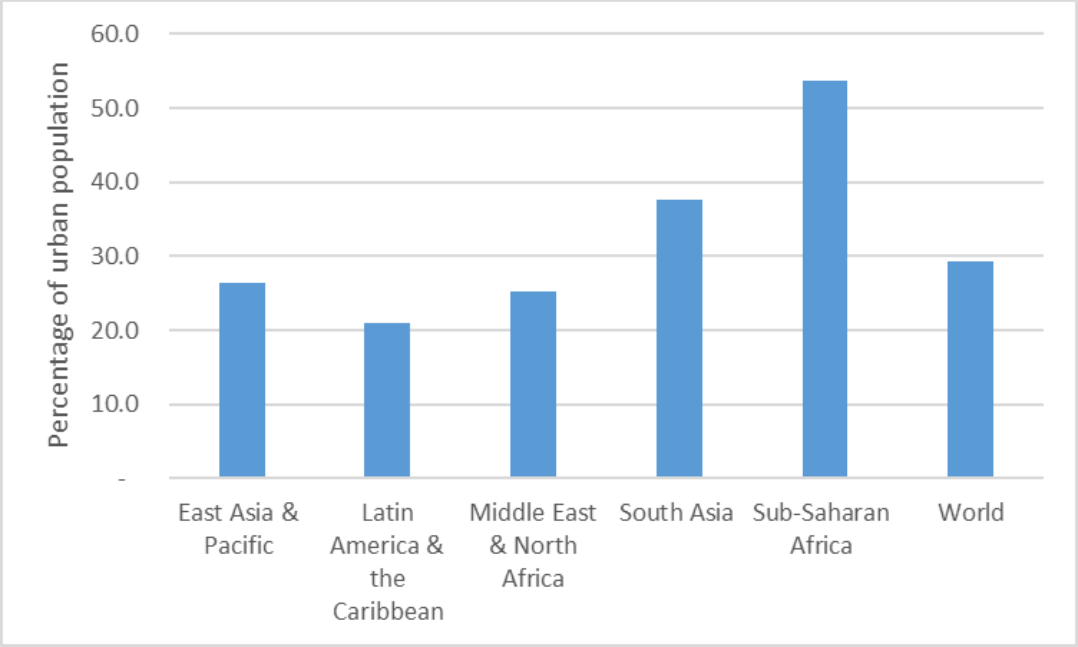


Source: Own elaboration based on data from the Atlas of Urban Expansion (AUE) (Blei and Angel, 2021).

Related to these last findings, there is comparable data on the share of the urban population that lives in slums.[12] On average, Latin America and the Caribbean exhibit a lower share compared to other developing regions (Figures 24). However, it is still high in many LAC countries (Figure 25) and certainly higher than in developed countries, where this share is either zero or very low.

[12] A slum household is defined as a group of individuals living under the same roof lacking one or more of the following conditions: access to improved water, access to improved sanitation, sufficient living area, housing durability, and security of tenure, as adopted in the Millennium Development Goal Target 7.D.

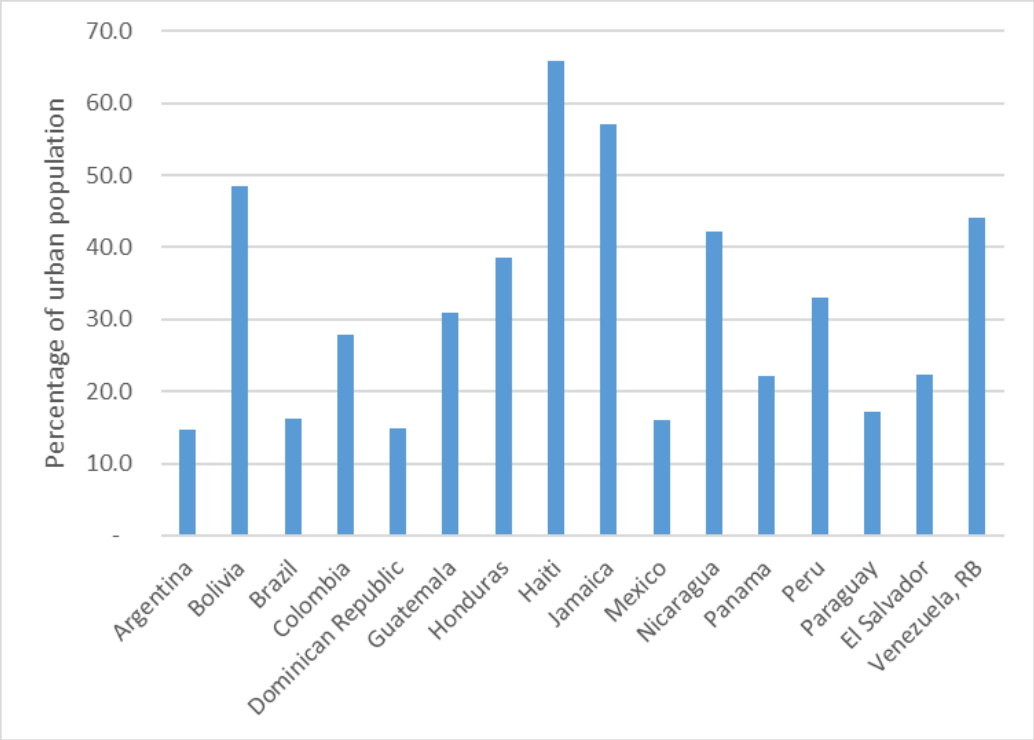
Figure 24: Share of the urban population living in slums[13], average by region, 2018



Source: United Nations Human Settlements Programme (UN-HABITAT, 2013).

[13] Population living in slums is the proportion of the urban population living in slum households. A slum household is defined as a group of individuals living under the same roof lacking one or more of the following conditions: access to improved water, access to improved sanitation, sufficient living area, housing durability, and security of tenure, as adopted in the Millennium Development Goal Target 7.D. The successor, the Sustainable Development Goal 11.1.1, considers inadequate housing (housing affordability) to complement the above definition of slums/informal settlements.

Figure 25: Share of the urban population living in slums, LAC countries, 2018



Source: United Nations Human Settlements Programme (UN-HABITAT, 2013).

What can we conclude from the data shown in this subsection? First, Latin American cities are denser, more compact, and more saturated (less open space) than developed country cities. Furthermore, a large fraction of urban inhabitants lives in slums and informal land settlements. Although with the available data we cannot judge the urban segregation in LAC cities, previous research suggests that many of the poorest inhabitants in slums live in the periphery of cities, without public services and long commutes to access health, educational, and labor opportunities.

4.2 Case studies

To delve deeper into the characteristics of urban development in LAC we present more detailed information of several cities in case studies that illustrate some of the broader drivers of spatial inequality at the city level. This section is organized by topic and does not aim to compare LAC cities to other regions of the world. However, it provides local nuances on some of the region's most significant consequences of inequality.

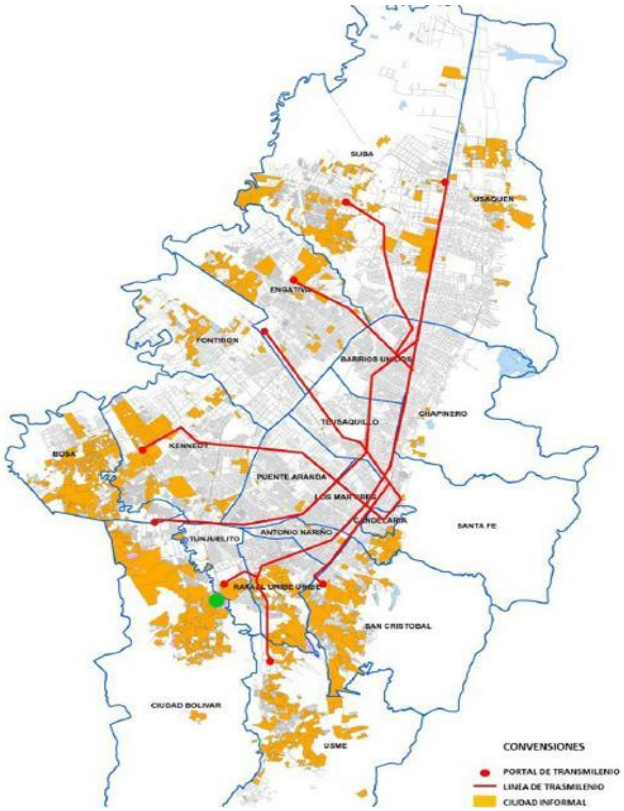
Informal occupation of land

The region's demand for formal affordable housing has primarily surpassed supply, leaving room for informal developments that have stepped in to fill the gap. Individual plots of land are sold in areas where building is restricted or forbidden and has little or no suitable infrastructure for transport and utilities. As part of the process of informal occupation, families build their homes through self-help housing, creating unauthorized connections to nearby electric and water lines, if available. This, considering that mainstream town planning does not recognize informal settlements in the provision of public utilities and infrastructure networks unless they have attained 'critical mass' that enables them to exert enough political pressure to have their neighborhood 'legalized'.

The increase in size and political significance of segregated nodes influences local authorities to provide connections to utilities and build other infrastructure like sewerage, pavements, roads, and street lighting. Additionally, research has shown that the lack of access to formal housing options and the high cost of formal housing is a major driver of informal housing development (Gilbert, 2005).

These informal settlements often locate on the outskirts of already established cities, sometimes in neighboring municipalities, leading to the emergence of conurbation and urban expansion processes. The combined effect of market forces and localization of poverty in LAC cities has been well documented in earlier literature (Kellett and Gilbert, 2006; Abramo, 2012; Andreano et al., 2020). This is exemplified in Figure 26, which shows that most informally developed neighborhoods in the city of Bogotá have been located on the peripheries since the 1950s. Figure 27, which illustrates the population and informal development explosion between 1993 and 2007 in the peripheral settlement of Altos de Cazucá in Socha (in the periphery of Bogotá), Colombia, provides a clear picture of the typical speed of expansion of informal settlements in large Latin American cities.

Figure 26: Location of neighborhoods of informal origin in the periphery of Bogotá (Colombia) 1950-2000



Source: (Dávila et al., 2006).

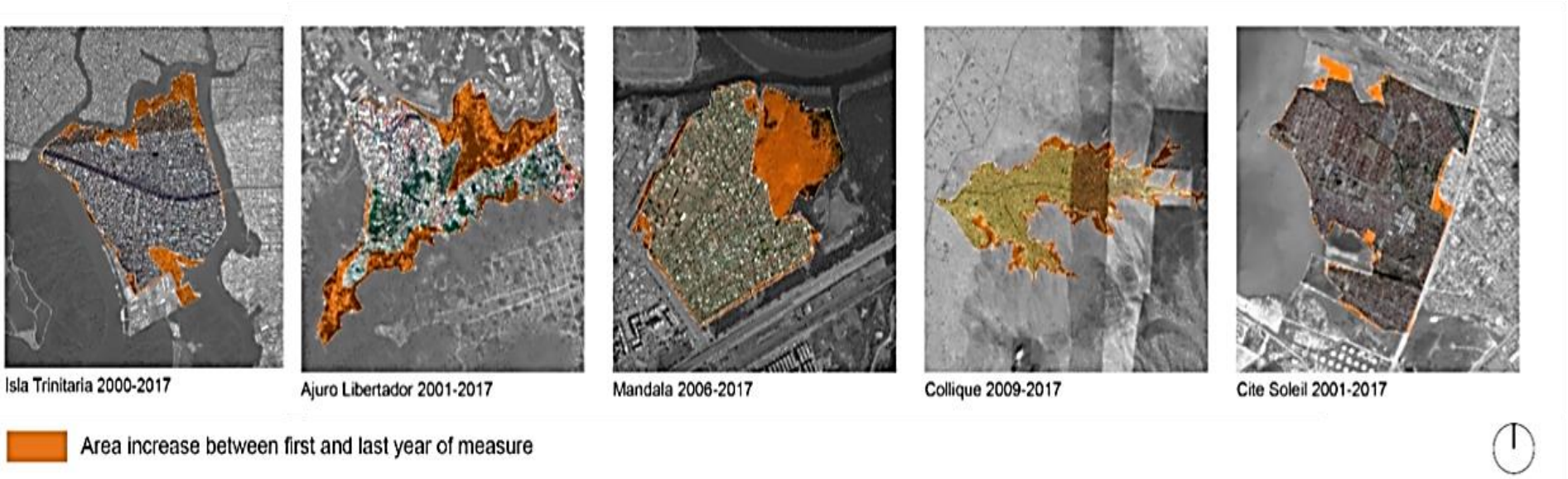
Figure 27: Location of neighborhoods of informal origin in the periphery of Bogotá (Colombia) 1950-2000

Source: (Oviedo Hernandez, 2017).

Figure 28 builds on data from the Atlas of Informality at the University of Colorado[14] for five informal settlements in the cities of Guayaquil, Caracas, Callao, and Port Au prince. The evidence shows similar trends to the observed urban expansion behavior observed for Altos de Cazucá in Soacha, for settlements in Callao and Caracas.

[14] The atlas is an initiative to compile historical urban expansion data on informal settlements across the global south. More information is available at: https://www.atlasofinformality.com.

Figure28: Urban expansion over time in selected settlements in Latin American cities: Isla Trinitaria (Guayaquil, Ecuador), Ajuro Libertador (Caracas, Venezuela), Mandala and Collique (Callao, Peru), Cite Soleil (Port au Prince, Haiti)



Source: Samper et al. (2020).

Gated communities and urban spatial segregation

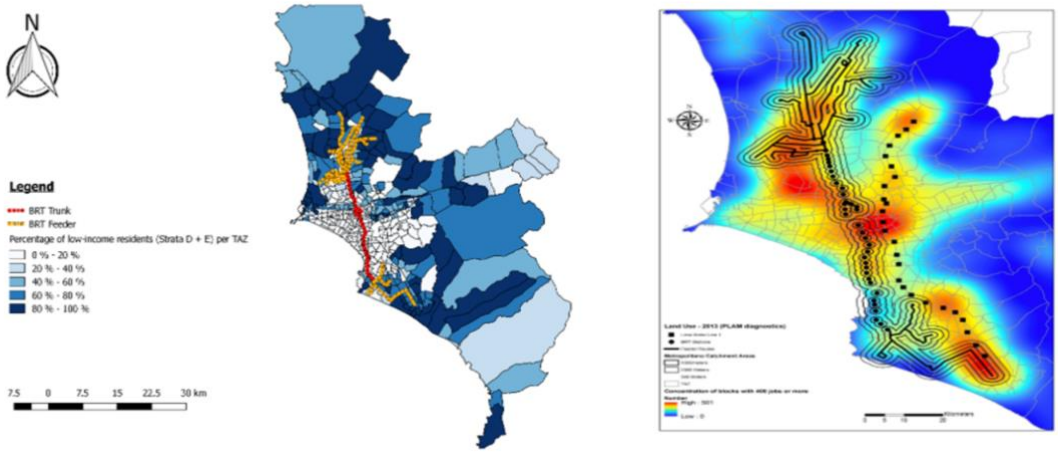
According to Thibert and Osorio (2014), there is a prevalent tendency towards spatial segregation in most cities within the region. This concept of segregation refers to the concentration of certain social groups, as determined by factors such as income, ethnicity, and status, in specific areas within a city or metropolitan region. In the context of Latin America, this phenomenon is further exacerbated by the proliferation of gated communities and suburban settlements that are primarily inhabited by the elite, who typically seek larger living spaces, enhanced security, and a reduced sense of "social burden" by residing in areas that are farther from the city center.

Research on gated communities in Latin America has consistently demonstrated that these developments serve to reinforce patterns of spatial segregation and social exclusion. Evidence from studies of gated communities in Mexico City and Buenos Aires suggest they reflect a form of exclusionary urbanism, where residents can purchase not only physical security, but also social and symbolic boundaries (Riaño, 2006; Lees, 2000). Caldeira (2000) argues that gated communities in Brazil reflect the growing class stratification within urban areas, as well as the increasing sense of insecurity felt by the middle and upper classes. In his study of gated communities in Buenos Aires, Lees (2000) highlights how these developments represent a form of "privatized urbanism", while Beauregard (2007) in his examination of gated communities in Santiago, Chile, contends that these developments reflect the growing sense of social and political fragmentation within urban areas. In Barra de Tijuca in metropolitan Rio de Janeiro and Great Buenos Aires suburban *condominios* such as those in the Brazilian case can be either dense, giving priority to high-rise buildings of well-equipped apartments and common facilities, or occupy large areas of land to maximize housing units size and available green spaces and other facilities. In both cases, however, they contribute to the proliferation of inner-city enclaves or suburban developments in what some authors refer to as *fortified privilege* (Borsdorf et al., 2016).

Socio-spatial segregation and concentration of employment

Low-income dwellers, forced to move to the outskirts of the city, are left behind in terms of infrastructure and employment and must undergo limitations in terms of their ability to fulfil several social, political, and economic needs. Figure 29 illustrates the segregation of low-income residents (Left) and the concentration of jobs (Right) in Lima (Peru), favoring high-income households (Oviedo et al., 2019). Like many larger cities in the global south, Latin American megacities are generally characterized by a concentration of business and economic activities in central business districts (CBD). Such is the case in Buenos Aires Rio de Janeiro, and Santiago de Chile, where its CBD is informally dubbed as *Sanhattan*.

Figure 29: Density of low-income households and jobs in Lima, Peru

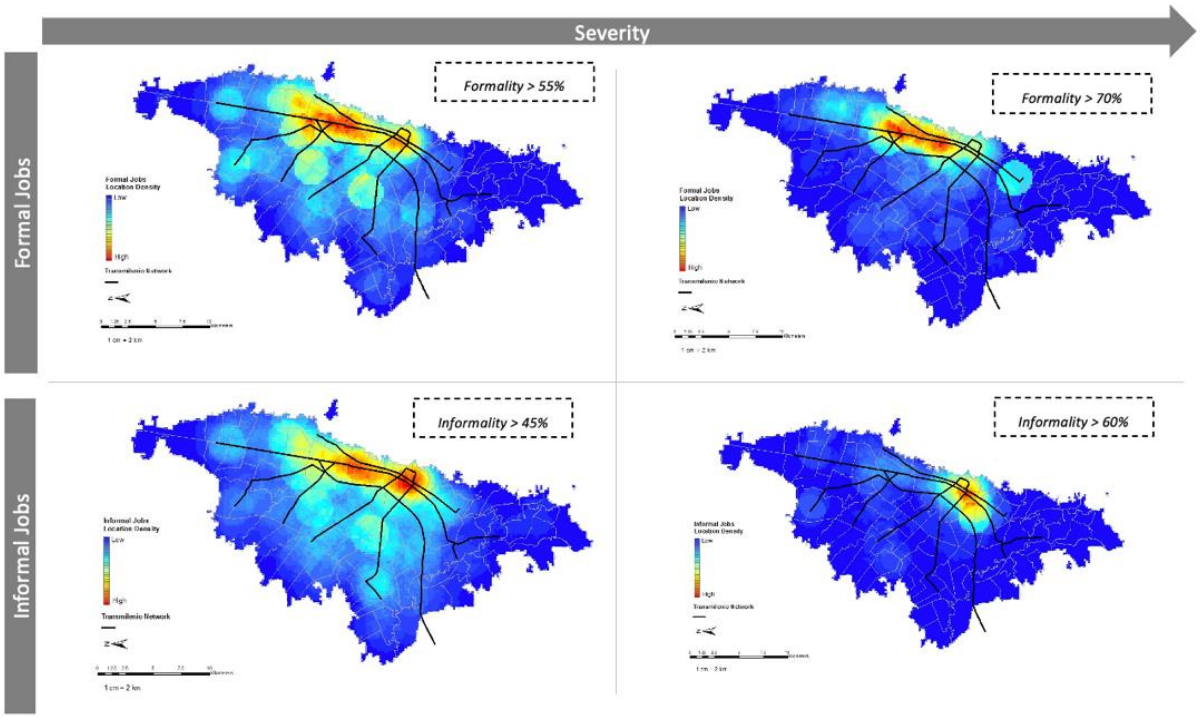


Source: Oviedo et al. (2019).

Bogotá fits the trend of urban segregation and concentration of employment. Evidence presented by Guzman et al. (2018) shows the concentration of jobs and study activities in one city area, which is later explored in the context of formal and informal employment by Oviedo et al.(2019) (see Figure 30). Atuesta et al. (2018) further analyzed the link between employment and housing, stating that in the case of Mexico City, moving only 1 percent closer to the workplace, generally increased housing price by 3 percent. As argued by Oviedo (2021), this cycle of social and spatial segregation has knock-on effects not only on accessibility of different populations to diverse opportunities but influences the attractiveness of certain areas from a perspective of infrastructure investment, creating a self-reinforcing process of hyperconnectivity and attractiveness in the same areas of the city.

Concentration of employment and spatial segregation map are not the exclusive remit of the formal economy. As shown in Figure 30, in Bogotá, informal work is concentrated in the same area of the city as formal jobs, where coverage of the mass public transport system, Transmilenio, is better.

Figure 30 Formal and informal jobs in Bogotá, Colombia



Source: Oviedo et al. (2019).

The case of Bogotá adds depth to the hypothesis of social segregation, which can lead to social exclusion. Such a hypothesis fits with long-established analysis of the urban dynamics of cities in the region (Sabatini, 2006). The concentration of social and economic opportunities around business districts and agglomerations with high connectivity leads to patterns of unidirectional travel from areas with high populations, including low-income neighbourhoods, to the central business districts. The maps below show such a pattern in relation to both formal and informal employment, with the spatial hotspot of socially excluded populations as a backdrop.

Socially excluded populations tend to coincide with informal settlements. Scholl et al. (2022) report that residents in these neighborhoods tend to experience even more severe mobility exclusion in Latin America, including not only economic activities (between 6 -Bogota- and 38 km -Buenos Aires- in average distance), but inaccessible subway stations (31 km average distance in Buenos Aires and 9.7 in Mexico City), health facilities (4.8 km in Lima and 5.16 in Bogota), and bus transit stations (11.1 km in Mexico City and 8.1 km in Lima), with the worst indicators in Buenos Aires. The cycle of segregation and concentration of opportunities feeds into a process of selective inclusion and segregation of specific social groups, marked by economic, social and spatial disadvantages (Smets and Salman, 2016).

Transport costs and accessibility

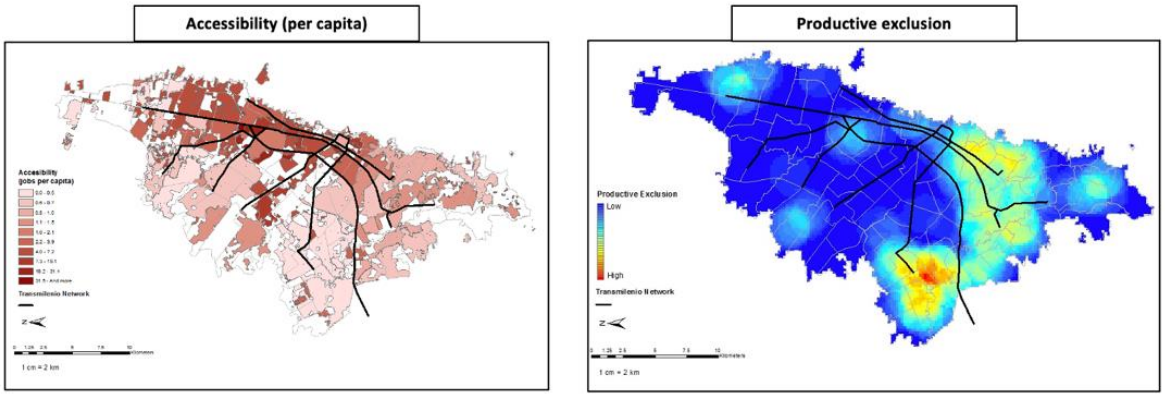
A study of household transport expenditure across 12 countries in Latin America and the Caribbean revealed that private transport accounts for 76 percent of expenditure, while public transport accounts for the remaining 24 percent (Gandelman, Serebrisky, and Suárez-Alemán 2019). This study also found that public transport is often a necessary good for the region's low- and middle-income households. At the same time, higher-income citizens tend to view it as an inferior good (Gandelman et al., 2019). The study also found that transport expenditure as a percentage of income in Latin America and the Caribbean (17 percent) was among the highest compared to other world regions in 2010, with 9 percent in sub-Saharan Africa, 11 percent in Eastern Europe, and Central Asia, and 5 percent in South Asia. This suggests that urban mobility in Latin America and the Caribbean is on average more expensive, and those with lower incomes tend to bear the highest economic burdens of accessibility. For example, in Port-Au-Prince, Haiti, domestic workers earning the minimum wage can spend between 10 and 24 percent of their income (depending on the number of transfers required) using the semi-formal public transport service known as tap-taps. Hence, transport is an important dimension in urban space that determines employment opportunities and spatial inequality, with some areas left aloof from urban transport system.

The trade-offs between transport affordability, decisions to forgo trips, and the use of informal or non-motorized transport alternatives, on the one hand, and the sacrifice of other essential goods and services (Gomide, Leite, and Rebelo, 2006), on the other, occur at different scales and in the short, medium, and long terms, with some trade-offs being conscious decisions and others unintended. In the long term, higher degrees of housing affordability are traded off with the day-to-day costs of transportation and potentially the immobility of some household members, particularly in low-income families.

Individuals living in informal housing make the most substantial trade-offs with transport affordability, given the limited access to infrastructure and public transport services that most informal communities face in the long term. Affordability constraints are exacerbated by the lack of transportation options in high- and low-accessibility low-income areas. Despite these challenges, the ability to own a home in the long-term is often traded off with location and its associated transport costs (Rojas, De Muelder, and Shannon, 2015). The negative loop of opportunity concentration in the affluent and financial sectors of the city puts a burden on the accessibility and affordability of low-income groups, who are likely to become captive walkers or public transport users with an inadequate level of service (Tiznado-Aitken et al., 2020).

Figure 310 shows the highest level of accessibility in Bogotá (Colombia) coinciding with the lowest levels of exclusion, while people experiencing exclusion do not have a decent access to public transport and subsequent opportunities.

Figure 31: Accessibility compared to excluded areas in Bogota, Colombia



Source: Oviedo et al. (2019)

Unequal accessibility refers not only to an ability to reach opportunities but is also analyzed through the perspective of unequal travel time (Vecchio et al., 2020). Poorer households tend to have less accessibility and transport options that make their journey longer, reducing accessibility, particularly by public transport, which makes it essential to develop infrastructure targeted to the poor and excluded.

In response to the above dynamics, several infrastructural projects across Latin America have improved the accessibility of socially excluded groups. For instance, an assessment of TranBrasil BRT in Rio de Janeiro shows its potential to improve job accessibility by around 10 percent while benefiting the urban population by approximately 60 percent, benefitting mostly low-income groups more dependent on transit transportation (Pereira, 2019). Something similar has been documented in Mexico City as Metro investments have lower labour market informality of poor residents living on the city's outskirts (Zárate, 2019).

5. Ways forward: policy and practice

The spatial inequality described so far may have many and varied causes. There are issues related to structural transformations in development (Rodrik, 2016; Huneeus and Rogerson, 2023; Eckert, Juneau and Peters, 2023), land rights (Besley, 1995; De Janvry, et al., 2015), trade liberalization (Lattes, 1995; Henderson, 2002; Gasparini, Gutierrez, and Porto, 2004; de Ferranti et al., 2005; Villarreal and Hamilton, 2012; Zhang and Wan, 2017; Arends-Kuenning et al., 2019) and other agricultural productivity issues that may influence on within rural inequality as well as the rural/urban income gap. Internal migration will also influence patterns of urbanization, centralization and spatial inequality within cities (Lucas, 1997; ECLAC, 2007 and 2009; Cohen, 2006; Gilbert, 2005; Habitat, 2012).

It would be a lengthy endeavour to summarize the complete development, agricultural, demographic and trade literature as it relates directly or indirectly to spatial inequality in general and to Latin America in particular. In addition, most of these topics are well treated elsewhere. Rather, in what follows, we discuss two policy areas that have been less extensively studied in relation to spatial inequality issues and that could have a first-order effect on reducing inequality at the three scales addressed in this study. First, we discuss the issue of infrastructure investments from a territorial or spatial viewpoint. Second, we discuss the possible role of transport pricing and subsidies in ameliorating spatial inequality.

Our focus on the above two issues does not mean ignoring other relevant policy dimensions in Latin America. Enhanced agricultural productivity, structural transformation and other development policies, better education, health care and social policies targeted to poorer households in rural, smaller cities and the periphery of larger urban areas will likely reduce spatial inequality. But to keep the discussion manageable, we will concentrate on infrastructure and transport issues where we believe we can make the most relevant contribution.

5.1 Infrastructure Investments

Public infrastructure investment is a key issue related to the spatial disparities observed in Latin America, between rural areas and urban areas, between small and large urban areas, and within large metropolitan areas.

Henderson (2002) argues that there is an inverted U shape in the relation between urban concentration and development. Initially, resources are scarce, and it makes economic sense to concentrate infrastructure investments in one or two major cities. As development progresses, a country will have more resources to invest in the hinterland regions. However, he also notes that the de-concentration tendency (with a turning point around a GDP per capita of $5,300) has been extremely modest in developing countries compared to the historical trend in developed countries. He attributes this to three main causes: government structures and institutions, trade openness, and the concentration of infrastructure investments.

Government structure and institutions may be an important cause of high urban primacy in developing countries. Henderson's (2002) empirical results indicate that when the primal city is also the country's capital city, its size is 25% greater than when it is not the capital city. In addition, the higher central government expenditure is to overall government consumption, the higher is primal concentration. Both results would suggest that political concentration may be an important determinant of urban primacy, although Henderson (1999) finds only a modest effect of decentralized government structures on urban concentration.

Infrastructure investments also play an essential role. Henderson (2002) finds that navigable waterways, roads, and telephone density are negatively related to urban concentration. De Ferranti et al. (2005) also argue that existing evidence indicates that in developing countries, higher rural infrastructure investments increase agricultural productivity. Bird (2019) notes that the rural poverty trap is related to geographical isolation and partial integration into fragmented markets. She proposes infrastructure investments (electricity coverage and roads) in rural areas as one of the policy recommendations (in addition to promoting agriculture and human capital formation).

What has been discussed so far also applies to within-city inequality or segregation. Principles of economic rationality underpinning transport and infrastructure provision lead to precarious coverage of roads, utilities, and essential social services in 'less-profitable' areas of the city (Samuels, 2001). These conditions feed upon a continuous cycle of spatial segregation and poverty that reshapes city boundaries through informal settlements in the peripheries (Thibert & Osorio, 2014). Consequently, the mobility of peripheral populations differs significantly from those living in more attractive and better-served areas of the city due to imposed connectivity gaps (Oviedo & Dávila, 2016).

The increase in private vehicle ownership, associated with rising incomes in the region, further compounds the challenges of providing sufficient quality and coverage of public transit across the urban population. Both car and motorcycle ownership are expected to continue increasing in the region, with an average annual growth rate of car ownership of around 5.53 percent until 2030 (including Argentina, Mexico, Brazil Chile, Dominican Republic, and Ecuador) (Roque and Masoumi, 2016), as well as increasing motorcycle ownership in leading cities (Roque and Masoumi, 2016; Hagen, Pardo, and Valente, 2016). The growth of motorcycle ownership has surpassed that of cars in many cities, accounting for 10 to 49 percent of the vehicle fleet in several cities. Given current income and economic growth trends, motorization rates are expected to more than double by 2030 (relative to 2002) (Yañez-Pagans et al., 2019).

Rapid motorization rates exert significant pressure on infrastructure provision. As a result, major transport networks frequently serve higher-density central areas where the time savings of interventions are more noticeable in the short term. For example, transit line densities 2014 in Bogota and Buenos Aires show higher concentrations of public transit lines in the urban core, exhibiting high-density variations between the city center and its periphery (in meters of bus lines per square meter). In the case of Bogota, this density drops from an average of 0.071 to 0.047 m/m2, and in the case of Buenos Aires, the average density drops from 0.079 to 0.019 m/m2 (Blei and Angel, 2021).

The call for more infrastructure investment in rural areas, or smaller cities and poor peripheral urban areas, will collide with limited public funds that are often geared to funding projects in the larger cities, strategic investments such as trunk highways or ports, or relatively more affluent areas of metropolitan cities where citizens have higher political

clout. Therefore, it's not enough to recommend more emphasis on these investments without discussing how in practice such a policy can overcome the budgetary restrictions that burden public investments in infrastructure.

One possible solution is the use of Public-Private Partnerships (PPP) to fund infrastructure investments where tolls make these projects privately profitable (usually in the bigger metropolitan areas, richer urban areas, and main highways connecting the main cities of a country) and thus freeing up public resources to invest in the less privately profitable projects in rural areas, smaller urban areas, or the periphery of large cities.[15]

Although data are hard to come by, it is interesting to note that the Infrastructure Committee of the Ministry of Public Works (MOP) in Chile, a country that has developed a large PPP infrastructure program in the last 30 years, noted that in the early 90s, most of the infrastructure investment budget of MOP was destined to the maintenance and rehabilitation of the Panamerican highway (Ruta 5). This main trunk highway has since been concessioned to private operators in almost all of its length, allowing MOP to invest in rural roads, rural water provision, and non-trunk roads.[16] As another example, the same Committee indicates that under public management, even with tolls that accrued to the public sector, it took over 40 years to complete the expansion of the Panamerican highway between Santiago and Talca (nearly 250 kilometres). In less than 20 years this highway was expanded to high standards between Puerto Montt and La Serena (1,500 kilometres) under PPPs.

Telecoms coverage is another infrastructure that can help to reduce spatial inequality between rural and urban areas. Increasingly, internet access can shorten geographical distances, allowing individuals and households in remote areas to access public services, educational opportunities, health services, and productivity-enhancing information (e.g. price information for crops in different markets) without having to travel physically. According to Ziegler et al. (2020), 71% of the urban population in Latin America had significant internet connectivity while only 36.8% of the rural population had significant access, a coverage gap of more than 34 percentage points. It also notes that while most countries have Universal Access Funds to promote digital inclusion, they have a series of

[15] As Engel, Galetovic and Fischer (2013; 2021) have convincingly argued, PPPs do not in general free public resources since projects could have been developed without PPPs using government debt with revenues from tolls accruing to the public sector. However, as an empirical matter, no Latin American country has developed a large-scale infrastructure program funded with tolls for the public sector. Thus, if we assume that PPPs allow for tolls to be implemented which cannot be introduced under public management, then PPPs will effectively free fiscal resources to use in other non-PPP projects.

[16] *Acta Ordinaria Sesión Ordinaria de febrero de 2022*, *Consejo de Concesiones*, *MOP, Santiago*. https://concesiones.mop.gob.cl/Consejo_Concesiones/Documents/2022/Febrero/Acta_Ordinaria_2022_Febrero_20220224.pdf. The Infrastructure Committee (Consejo de Concesiones) is an independent 5-member panel created by the Infrastructure Concession Law (Decreto 900, 1996) as a consultation body to the Minister of Public Works in matters related to infrastructure and PPPs.

limitations that must be overcome to bridge the connectivity gap between rural and urban areas.

In some countries (e.g. Chile) spectrum is assigned to telecom companies using a beauty contest instead of a monetary payment. As part of these auctions, coverage requirements in rural areas are included as part of the spectrum licenses. For example, in the auction of the 700 Mghz spectrum, companies had to install mobile telephone antennas with mobile internet capabilities in over 1,200 rural or isolated areas. This has expanded coverage in rural areas that perhaps would not have been possible with a highest bidder monetary auction, as used in Brazil or Peru, since resources accruing to the treasury from the winning bids are seldom recycled to the telecoms sector by the financial authorities of these countries.

Besides increasing connectivity from the supply side, more can be done to push digital inclusion from the demand side. Ziegler et al. (2020) note that only 7% of government paperwork can be completed online in Latin America. Increasing this figure as well as other programs to increase online access to services (in health and education, for example) can greatly enhance the digital accessibility of rural households instead of physical connectivity.

As for urban infrastructure investments, in a recent publication of the Inter-American Development Bank examining the multiple contributions of transport to inclusive development in LAC, Scholl et al. (2022) report that the region has seen significant investments in public transit infrastructure in recent years, often accompanied by institutional and regulatory reforms. Figures from 2016 from ECLAC, estimated total investment of US$124 billion for urban mobility projects between 2016 and 2022, with a particular focus on large-scale infrastructure projects.

Among the most popular alternatives for public transport infrastructure investments adopted in the region in recent years are Bus Rapid Transit (BRT) systems. After positive experiences with such systems in cities across Colombia, Brazil, and Ecuador in the early 2000s, a significant number of local and regional governments in the region, as well as a number of international development agencies, have invested in the implementation of BRTs in several cities of LAC.[17] In the period between 2010 and 2020, 799.5 km of BRT infrastructure was built (BRT+ Centre of Excellence & EMBARQ, 2021), at an average cost of US$11,504,575 per km representing an overall investment of approximately US$9.2 billion[18] (in 2013 U.S. dollars). Additionally, 113.1 km of urban aerial cable cars were constructed in countries such as Bolivia, Colombia, Venezuela, Ecuador, the Dominican Republic, Brazil, and Mexico, totaling an estimated US$2.02 billion in investments (in 2020 U.S. dollars).

[17] Not all BRT experiences have been successful, however. See Gómez-Lobo (2020) for an evaluation of the experience in intermediate cities of Colombia.
[18] In 2013 US Dollars.

Furthermore, 39 active public transport infrastructure projects worth US$5.26 billion are expected to be undertaken in the region between 2019 and 2025 (Hannon et al. 2020). Of these, some of the more expensive, and potentially transformative from a perspective of spatial inequalities, are urban railway projects (i.e., light rails and metros), with over 308.2 km of new metro systems or extensions built between 2010 and 2020, under a conservative estimate of US$150 million per km (Priemus, Flyvbjerg, and van Wee 2008), representing a total investment of US$46.2 billion across the region. Additionally, an estimated US$50 billion in investments in metro and light rail systems will be made in the region between 2019 and 2025 (Hannon et al. 2020).

Increasing research indicates that transport infrastructure investments are important to reduce segregation and inequality within large metropolitan areas. Tsivanidis (2019) evaluates the Transmilenio bus rapid transport reform in Bogota, Colombia, which enhanced the capital's GDP growth (2 to 12 per cent) in the period from 2000 to 2016 and accounted for approximately 30 per cent of the population growth. That model has brought a new perspective on urban models and the effect of infrastructure on agents whose economic activities are located remotely, linking the saved time and its welfare gain. Even though Transmilenio was greatly criticized for the absence of appropriate zoning strategy and coherent land policies, the author states that well-targeted schemes, adjusted to migration patterns from the rest of the country, can further enhance welfare gains (ibid).

In turn, Zárate (2021) finds that a new Metro line in Mexico City allowed individuals living in low-income neighborhoods in the periphery access to better-paying formal jobs in the central of the city. In the paper, the author emphasizes the link between high fare costs and formal employment and concludes that approximately seven per cent of informality can be eliminated in the areas of ongoing infrastructure (in that case subway stations), which can lead to up to 25 per cent in the welfare gains (ibid).

Therefore, to reduce rural-urban, small urban to large-urban or within city income disparities, infrastructure investments must consider territorial equity considerations. These criteria may counter traditional cost-benefit analysis of these projects that will tend to bias investments to denser and richer parts of the country or city. A balance must then be achieved between economic resource allocation efficiency considerations and territorial equity considerations in the appraisal of infrastructure investments. One such approach has been the exemption of rural road investments in Chile from the cost-benefit rate of return analysis that, otherwise, all investments projects must meet to be eligible for publicly funding.

5.2 Transport affordability and mobility

Building roads and other transport infrastructure may be insufficient if affordable transport services are unavailable to poorer rural households. Therefore, some assistance or subsidy

may be necessary to provide transport services. The same can be said regarding internet connectivity, especially fixed broadband connections.

There is an interesting example of a systematic transport subsidy program implemented for rural and isolated areas in Chile. The National Public Transport Law approved in 2009 to fund the financial deficit of the Santiago transit reform of 2007 (called Transantiago) created a matching fund to subsidize transit in the cities and areas outside the capital. Among other programs, these funds have been used to introduce and subsidize transport services for rural and isolated areas. These include bus, boat, ferry, and airplane services.

There are two features of the policy that are worth mentioning. First, a formal methodology has been developed to measure the degree of isolation of different areas: where transport services are inexistent or are very expensive.[19] This methodology determines whether a given zone warrants a transport subsidy to improve connectivity to regional or provincial capitals. Second, contracts are competitively tendered to the bidder that offers the lowest subsidy to undertake the service (routes and frequencies are established in the contract).

Table 5 presents information on the subsidized services for rural and isolated areas, the number of potential beneficiaries, the expenditure in 2021, and the budgeted expenditure for 2022. There are two broad programs, subsidized public transit (buses, airplanes, boats, and ferries) for rural and isolated areas and a special program for rural children to attend school with free transport.[20] There are 1,186 services in the first program benefiting over 900 thousand individuals and with an annual expenditure of 68 million dollars in 2021. The second program funds 796 school transport services for children that live in rural or isolated areas. It benefits close to 60 thousand children with an annual expenditure of close to 25 million dollars.

[19] This methodology is formalized in Resolución Exenta 1975/2011, of July 4, 2011.
[20] All subsidized transit services also offer free or discounted student fares.

Table 5: Subsidy programs for rural and isolated zones, Chile

Program		
Connectivity for rural and isolated zones	Number of services	1,186
	Number of beneficiaries	916,600
	Expenditure 2021 (US$ millions)	68.3
	Budget 2022 (US$ millions)	75.2
Free school transport (rural)	Number of services	796
	Number of beneficiaries	59,428
	Expenditure 2021 (US$ millions)	25.1
	Budget 2022 (US$ millions)	38.7

Source: https://dtpr.gob.cl/infosubsidios.

Rural school transport subsidies have also been implemented in Brazil, México, and Colombia.[21] Other LAC countries also have rural transport subsidies but, as far as we are aware, no systematic evaluation of these policies has been undertaken.

On the other hand, research has been undertaken on the social benefits of urban transit subsidies. However, most of these studies have focused on the allocative efficiency of transit fares rather than their distributional impacts. Results seem to suggest that transit subsidies are economically efficient.[22] In addition, given the evidence presented above that transit is a necessity or an inferior good in Latin America (Gandelman, et al. 2019), subsidizing public transport has the additional benefit of being progressive. The mobility benefits that these subsidies provide may be a useful way for poorer individuals to overcome the economic and social barriers of living on the periphery of cities. However, often these subsidies only benefit formal transit services while many poorer households only have access to informal non-subsidized transport (Serebrisky, et al, 2009). Demand-side means tested subsidies may be a more promising policy option to target benefits to the

[21] See Clio Dinámica Consulting (2016) for a summary of these and other experiences and also for an evaluation of the Chilean free school transport subsidy.

[22] See the review provided in Gómez-Lobo and Serebrisky (2023) and a recent study in Asunción, Paraguay, by Rizzi, Cherubini and Koffmann (2023).

truly needy. There are some examples in Latin America, the most successful being the means tested subsidy implemented in Bogotá (Gómez-Lobo, Sánchez and González, 2022).

6. Conclusion

This paper comprehensively examined the various scales at which spatial inequalities manifest in the LAC region. Using information from the Luxembourg Income Study (LIS) database we were able to decompose and compare inequality between LAC countries and high-income countries in a within large urban areas, smaller urban areas and rural areas component and a between component for these three groups. The analysis reveals, perhaps unsurprisingly, that Latin America is more unequal in all of these spatial dimensions. However, it also revealed that in LAC, within small urban areas inequality is the most important term. This is consistent with the results of Ferré, et al. (2012) and ECLAC (2010, 2016). It implies that more emphasis should be placed on poverty rates in smaller urban areas and not just large metropolitan areas. Also, a prominent feature of LAC inequality compared to developed countries is the wide gap between average per capita incomes in rural areas compared to urban areas and, to a lesser extent, between small and large urban areas.

At the city scale, complementary data suggests that the poor in urban areas in LAC countries tend to occupy peripheral neighbourhoods. The availability of land in the peripheries of many cities of large and middle size in the region and the lack of regulation for urbanization have facilitated the informal development of housing in the urban hinterlands of Latin American cities. Rapid population growth driving urban expansion can be attributed to both natural population growth, in-migration from other parts of the country, and in-migration from people in the cities themselves seeking affordable housing while still maintaining access to the main opportunities urban agglomerations provide. Many lower-income in-migrants are drawn to the less connected peripheries, in part due to the actions of illegal land developers. These dynamics often present themselves in contexts where local governments lack the capacity to regulate informal land occupation and development, and where regulatory restrictions limit the influence of other authorities on informal urbanization processes.

What can be done to reduce spatial inequality in LAC? There is no single policy that will reduce inequality in each of the spatial dimensions analysed in this paper. However, those that encourage agricultural productivity growth will probable reduce the urban-rural inequality as rising productivity would increase average earnings for rural inhabitants. Trade liberalisation in countries with a comparative advantage in agricultural goods or natural resources would most probably also reduce this gap. In addition, when export activities concentrate in small or middle-sized cities, then trade liberalization would also promote more internal migration to these urban areas, possibly increasing inequality within these

cities but reducing the income gap with larger urban areas. Also, barriers that limit the efficient allocation of resources, particularly labour, across space will also affect the urban-rural divide. Eliminating these barriers, through land ownership certificates not linked to land use, for example, would also increase agricultural productivity and reduce the rural-urban income gap.

Infrastructure investments will play a prominent role in reducing spatial inequality at three scales analysed. Traditional transport planning, which includes road infrastructure investments, has had a positive impact on accessibility and travel conditions for many urban and rural residents in LAC. Infrastructure investments are identified as a potentially powerful mechanism for closing the gaps between wealthier and poorer households. Increased government focus for these investments to redress spatial inequalities in the region should be promoted. This includes rural and secondary roads integrating rural areas and smaller cities to dynamic economic sectors or larger metropolitan areas.

Transport infrastructure investments at the urban should also be designed to improve the mobility needs of poorer households living in the periphery of cities. This highlights the need for a more inclusive approach to transport and infrastructure, as well as land-use planning that considers the needs and perspectives of those who are economically and socially disadvantaged. An examination of the fragmentation of connectivity networks in areas that have been bypassed within the social structures of many cities in the region suggests that such broken connectivity leads to higher travel expenditure and highly constrained accessibility, potentially exacerbating social exclusion.

In Latin America, where governments have only recently begun to shift towards sustainable transport policies that benefit the poor as a state policy, innovative travel methods and alternative uses of existing options may have the potential to strengthen current understandings of the challenges involved in reducing transport-related exclusion. These range from large-scale infrastructure projects such as Metro investments or bus rapid transit systems to targeted interventions in deprived areas such as aerial cable cars.

Transport is central to poverty alleviation, but poverty also constrains access to transport in terms of affordability and attractiveness for public investment in infrastructure and services. It is vital to revise conventional cost-benefit criteria that drive the spatial distribution of public investment and infrastructure provision, which often results in projects in wealthier and more central areas being more attractive from an economic perspective. This is partly due to the omission of wider economic benefits of connectivity to poorer or more distant areas. In Latin America, where labour market informality is high, investments that help poorer individuals in the periphery access formal job opportunities may have additional benefits to those conventionally measured (Zárate, 2021; Tsivanidis, 2019).

Fiscal constraints will limit the level of public expenditure that can be allocated to infrastructure investments. Using tolls to recoup privately profitable investments in denser o richer parts of a country or city, either through PPPs or publicly managed projects, could contribute to free-up resources for socially profitable (but privately unprofitable) infrastructure projects in rural or non-central areas of a country.

The lack of adequate connectivity also imposes high financial burdens on poor households, particularly in areas without integrated transport systems, but these can be addressed through targeted subsidies and financial alleviations of the cost of access, both in rural as well as urban areas. There are some interesting experiences in this regard in the region, with target transit subsidies in Bogota and formal rural transport connectivity and subsidies in Chile being prime examples. The dissemination of these experiences may help to design better policy interventions in other LAC countries.

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Appendix 1: LIS Database and variables used in the income inequality decomposition

	Spatial variables included in each survey				Definition of large city/area used	
Country	**Region**	**Rural**	**Size of locality of residence**	**Type of area**	Alt 1	Alt 2
Austria 2018	[11] Burgenland [12] Niederösterreich [13] Wien [21] Kärnten [22] Steiermark [31] Oberösterreich [32] Salzburg [33] Tirol [34] Vorarlberg	[0] not rural area [1] rural area	[1] less than 10.000 [2] between 10.000 - 100.000 [3] more than 100.000 [4] Wien	[1] cities (densely populated area) [2] towns and suburbs (intermediate density area) [3] rural areas (thinly populated areas)	[4] Wien (Viena) of *Size of locality of residence* variable	---

Brazil 2016	[11] Rondônia [12] Acre [13] Amazonas [14] Roraima [15] Pará [16] Amapá [17] Tocantins [21] Maranhão [22] Piauí [23] Ceará [24] Rio Grande do Norte [25] Paraíba [26] Pernambuco [27] Alagoas [28] Sergipe [29] Bahia [31] Minas Gerais [32] Espírito Santo [33] Rio de Janeiro [35] São Paulo [41] Paraná [42] Santa Catarina [43] Rio Grande do Sul [50] Mato Grosso do Sul [51] Mato Grosso [52] Goiás [53] Distrito Federal	[0] not rural area [1] rural area	---	[1] municipality capital of a federal un [2] rest of metropolitan area (Região Me [3] rest of the Integrated Development R [4] rest of federal unit (UF), excluding	[1] and [2] of *Type of area* variable	---

Canada 2016	[10] Newfoundland and Labrador [11] Prince Edward Island [12] Nova Scotia [13] New Brunswick [24] Quebec [35] Ontario [46] Manitoba [47] Saskatchewan [48] Alberta [59] British Columbia	[0] not rural area [1] rural area	[1] rural area outside CMAs or CAs [2] CA, population under 30,000 [3] rural area or CA, population under 3 [4] CA, population 30,000 to 99,999 [5] rural area or CA, population under 1 [6] CA, population under 100,000 [7] CMA, population 100,000 to 499,000 [8] CA, pop. 30,000 to 99,999 or CMA, po [9] CMA, population 500,000 and over	---	[9] CMA, Pop 500k or more of *Size of locality of residence* variable	---

Chile 2017	[1] Tarapaca [2] Antofagasta [3] Atacama [4] Coquimbo [5] Valparaiso [6] Libertador Bernardo O Higgins [7] Maule [8] Bio Bio [9] La Araucania [10] Los Lagos [11] Aysen [12] Magallanes y La Antartica Chilena [13] Region Metropolitana Santiago [14] Los Rios [15] Arica y Parinacota [16] Ñuble	[0] not rural area [1] rural area	---	[1] urban [2] rural	[13] Region Metropolitana de Santiago of *Region* variable	---

Colombia 2018	[108] Atlantic region, Atlántico [113] Atlantic region, Bolívar [120] Atlantic region, Cesar [123] Atlantic region, Córdoba [144] Atlantic region, La Guajira [147] Atlantic region, Magdalena [170] Atlantic region, Sucre [215] Oriental region, Boyacá [225] Oriental region, Cundinamarca [250] Oriental region, Meta [254] Oriental region, Norte de Santande [268] Oriental region, Santander [305] Central region, Antioquia [317] Central region, Caldas [318] Central region, Caquetá [341] Central region, Huila [363] Central region, Quindio [366] Central region, Risaralda [373] Central region, Tolima [419] Pacific region, Cauca [427] Pacific region, Chocó [452] Pacific region, Nariño [476] Pacific region, Valle del Cauca [511] Bogotá, Distrito Capital	[0] not rural area [1] rural area	---	[1] city or metropolitan area [2] other urban area [3] rural area	[1] city or metropolitan area of *Type of area* variable	---

Czech Republic 2016	[11] Praha [21] Stredocesky [31] Jihocesky [32] Plzensky [41] Karlovarsky [42] Ustecky [51] Liberecky [52] Kralovehradecky [53] Pardubicky [61] Vysocina [62] Jihomoravsky [71] Olomoucky [72] Zlinsky [81] Moravskoslezsky	[0] not rural area [1] rural area	[1] less than 200 inhabitants [2] 200 - 499 inhabitants [3] 500 - 999 inhabitants [4] 1000 - 1999 inhabitants [5] 2000 - 4999 inhabitants [6] 5000 - 9999 inhabitants [7] 10000 - 49999 inhabitants [8] 50000 - 99999 inhabitants [9] 100000 and over inhabitants	[1] cities (densely populated area) [2] towns and suburbs (intermediate dens [3] rural areas (thinly populated areas)	[11] Praha of *Region* variable	[1] cities (densely populates area) of *Type of area variable* and [9] 100000 and over inhabitants of *Size of locality of residence* variable
Denmark 2016	[1] Kobenhavn og Frederiksberg Kommun [2] Kobenhavns amt [3] Nordsjaelland [4] Bornholms amt [5] Ostsjaelland [6] Vestsjaellands amt + Storstroms amt [7] Fyns amt [8] Sydjyllands amt [9] Ostmidjyllands amt [10] Vestmidjyllands amt [11] Nordjyllands amt	[0] not rural area [1] rural area	[1] Capital area [2] Town >100,000 [3] Town 50,000-100,000 [4] Town 40,000-50,000 [5] Town 30,000-40,000 [6] Town 20,000-30,000 [7] Town 10,000-20,000 [8] Town 5,000-10,000 [9] Town 2,000-5,000 [10] Town 1,000-2,000	[1] capital/ metropolitan area [2] town/ urban area [3] rural district	[1] capital/metropolitan area of *Type of area* variable	---

			[11] Town 500-999 [12] Town 200-499 [13] Rural			

Finland 2016	[1] Uusimaa [2] Varsinais-Suomi [4] Satakunta [5] Kanta-Häme [6] Pirkanmaa [7] Päijät-Häme [8] Kymenlaakso [9] Etelä-Karjala [10] Etelä-Savo [11] Pohjois-Savo [12] Pohjois-Karjala [13] Keski-Suomi [14] Etelä-Pohjanmaa [15] Pohjanmaa [16] Keski-Pohjanmaa [17] Pohjois-Pohjanmaa [18] Kainuu [19] Lappi [21] Ahvenanmaa	[0] not rural area [1] rural area	[1] <5.000 inhabitants [2] 5.000 - <50.000 inhabitants [3] 50.000 inhabitants or more	[1] cities (densely populated area) [2] towns and suburbs (intermediate dens [3] rural areas (thinly populated areas)	[1] cities (densely populated area) of *Type of area* variable with [3] more than 50.000 inhabitants of *Size of locality of residence* variable	---

France 2010	[1] Parisandsuburbs (ÎledeFrance) [2] Parisbasin (BassinParisien) [3] Northregion (Nord) [4] Eastregion (Est) [5] Westregion (Ouest) [6] South-Westregion (Sud-ouest) [7] Centre-Eastregion (Centre-est) [8] Mediterraneanregion (Méditerranée) [9] Guadeloupe [10] Martinique [11] French Guiana (Guyane) [12] Réunion [13] Mayotte	[0] not rural area [1] rural area	[1] rural area [2] 2,000 to 4,999 inhabitants [3] 5,000 to 9,999 inhabitants [4] 10,000 to 19,999 inhabitants [5] 20,000 to 49,999 inhabitants [6] 50,000 to 99,999 inhabitants [7] 100,000 to 199,999 inhabitants [8] 200,000 to 1,999,999 inhabitants [9] Paris agglomeration	[2] municipality belonging to urban area [3] municipality belonging to urban area [4] municipality belonging to urban area [5] municipality belonging to urban area [6] municipality belonging to urban area [7] municipality belonging to urban area [8] municipality belonging to urban area [9] municipality belonging to urban area [10] municipality belonging to urban are [11] municipality belonging to Paris urb	[9] Paris agglomeration of *Size of locality of residence* variable	---

Germany 2018	[1] DE1-Baden-Wuerttemberg [2] DE2-Bavaria [3] DE3-Berlin [4] DE4-Brandenburg [5] DE5-Bremen [6] DE6-Hamburg [7] DE7-Hesse [8] DE8-Mecklenburg-Western Pomerania [9] DE9-Lower Saxony [10] DEA-NorthRhine-Westphalia [11] DEB-Rhineland-Palatinate [12] DEC-Saarland [13] DED-Saxony [14] DEE-Saxony-Anhalt [15] DEF-Schleswig-Holstein [16] DEG-Thuringia	[0] not rural area [1] rural area	[1] less than 2.000 inhabitants [2] 2.000-5.000 inhabitants [3] 5.000-20.000 inhabitants [4] 20.000-50.000 inhabitants [5] 50.000-100.000 inhabitants [6] 100.000-500.000 inhabitants [7] 500.000 or more inhabitants	[1] large density region, very high dens [2] large density region, very high dens [3] large density region, high density c [4] large density region, high density c [5] large density region, medium density [6] large density region, medium density [7] large density region, low density (r [8] large density region, low density (r [9] medium density region, very high den [10] medium density region, medium densi [11] medium density region, medium densi [12] medium density region, low density [13] medium density region, low density [14] low density (rural) region, medium [15] low density (rural) region, medium [16] low density (rural) region, low den [17] low density (rural) region, low den	[7] 500.000 or more inhabitants of *Size of locality of residence* variable and [1] large density region of *Type of area* variable	---

Guatemala 2014	[1]Guatemala [2]El Progreso [3]Sacatepéquez [4]Chimaltenango [5]Escuintla [6]Santa Rosa [7]Sololá [8]Totonicapán [9]Quetzaltenango [10]Suchitepéquez [11]Retalhuleu [12]San Marcos [13]Huehuetenango [14]Quiché [15]Baja Verapaz [16]Alta Verapaz [17]Petén [18]Izabal [19]Zacapa [20]Chiquimula [21]Jalapa [22]Jutiapa	[0]not rural area [1]rural area	---	[1]I: Metropolitan [2]II: North [3]III: Northeast [4]IV: Southeast [5]V: Central [6]VI: Southwest [7]VII: Northwest [8]VIII: Petén	[1] Metropolitan of *Area* variable	---
Ireland 2017	[4] IE04: Northern & Western [5] IE05: Southern [6] IE06: Eastern & Midland	[0] not rural area [1] rural area	---	[1] cities (densely populated area) [2] towns and suburbs (intermediate dens [3] rural areas (thinly populated areas)	[1] cities (densely populated area) of *Type of area* variable	---

Israel 2017	[11] Jerusalem [21] North: Zefat [22] North: Kinneret [23] North: Yizrael-Afula [24] North: Acre [25] North: Yizrael-Nazareth [29] North: Golan [31] Haifa: Haifa [32] Haifa: Hadera [41] Center: Sharon [42] Center: Petah-Tikva [43] Center: Ramla [44] Center: Rehovot [51] Tel Aviv: Tel Aviv [52] Tel Aviv: Ramat Gan [53] TelA viv: Holon [61] South: Ashkelon [62] South:Be'er Sheva [70] Yehuda and Shomron	[0] not rural area [1] rural area	[1] Jerusalem [2] Tel Aviv [3] Haifa [4] Rishon L-Zion [5] Ashdod [6] Petah Tikva [7] Netanya [8] Be'er Sheva [9] 100000-200000 residents [10] 50000-100000 residents [11] 20000-50000 residents [12] 10000-20000 residents [13] 2000-10000 residents [14] Urban non-Jewish localities [15] Rural localities	[1] very peripherial [2] peripherial [3] medium peripherial [4] central [5] very central	[1] Jerusalem of *Size of locality of residence* variable	[1] Jerusalem and [2] Tel Aviv of *Size of locality of residence* variable

Italy 2016	[1] ITC1-Piemonte [2] ITC2-Valled'Aosta [3] ITC4-Lombardia [4] ITH1andITH2-Trentino [5] ITH3-Veneto [6] ITH4-Friuli [7] ITC3-Liguria [8] ITH5-Emilia Romagna [9] ITI1-Toscana [10] ITI2-Umbria [11] ITI3-Marche [12] ITI4-Lazio [13] ITF1-Abruzzo [14] ITF2-Molise [15] ITF3-Campania [16] ITF4-Puglia [17] ITF5-Basilicata [18] ITF6-Calabria [19] ITG1-Sicilia [20] ITG2-Sardegna	[0] not rural area [1] rural area	[1] 0-5.000 inhabitants [2] 5.000-20.000 inhabitants [3] 20.000-40.000 inhabitants [4] 40.000-50.000 inhabitants [5] 50.000-200.000 inhabitants [6] 200.000-500.000 inhabitants [7] more than 500.000 inhabitants	---	[7] more than 500k inhabitants in *Size of locality of residence* variable	---

Mexico 2018	[1] Aguascalientes [2] Baja California [3] Baja California Sur [4] Campeche [5] Coahuila de Zaragoza [6] Colima [7] Chiapas [8] Chihuahua [9] Ciudad de México [10] Durango [11] Guanajuato [12] Guerrero [13] Hidalgo [14] Jalisco [15] México [16] Michoacán de Ocampo [17] Morelos [18] Nayarit [19] Nuevo León [20] Oaxaca [21] Puebla [22] Querétaro [23] Quintana Roo [24] San Luis Potosí [25] Sinaloa [26] Sonora [27] Tabasco [28] Tamaulipas [29] Tlaxcala [30] Veracruz de Ignacio de la Llave [31] Yucatán [32] Zacatecas	[0] not rural area [1] rural area	[1] less than 2.500 inhabitants [2] between 2.500 and 14.999 inhabitants [3] between 15.000 and 99.999 inhabitant [4] 100.000 and more inhabitants	---	[9] Ciudad de México of *Region* variable	---

Norway 2016	---	[0] not rural area [1] rural area	[1] less than 5000 inhabitants [2] 5000 - 9999 inhabitants [3] 10000 - 19999 inhabitants [4] 20000 - 49999 inhabitants [5] 50000 inhabitants or more	[1] urban [2] rural	[5] 50k inhabitants or more of *Size of locality of residence* variable	---
Panama 2016	[1] Bocas del Toro province [2] Coclén province [3] Colón province [4] Chiriquí province [5] Darién province [6] Herrera province [7] Los Santos province [8] Panamá province [9] Veraguas province [10] Comarca Kuna Yala [11] Comarca Emberá [12] Comarca Ngäbe Buglé [13] West Panamá province	[0] not rural area [1] rural area	---	[0] other province [1] Panamá city [2] the rest of Panamá district [3] San Miguelito [4] Arraiján district [5] La Chorrera district [6] the rest of West Panamá province [7] the rest of Panamá province	[1] Panama City of *Type of area* variable	[1] Panama City and [2] the rest of Panamá district of *Type of area* variable
Paraguay 2018	[0] Asunción [2] San Pedro [5] Caaguazú [6] Caazapá [7] Itapúa [10] Alto Paraná [11] Central [20] other	[0] not rural area [1] rural area	---	---	[0] Asuncion of *Region* variable	---

Peru 2018	[1]costa norte [2]costa centro [3]costa sur [4]sierra norte [5]sierra centro [6]sierra sur [7]selva [8]lima metropolitana	[0]not rural area [1]rural area	[1]more than 500,000 dwellings [2]from 100,000 to 499,999 dwellings [3]from 50,000 to 99,999 dwellings [4]from 20,000 to 49,999 dwellings [5]from 2,000 to 19,999 dwellings [6]from 500 to 1,999 dwellings [7]rural area	---	[8] Lima Metropolitana of *Region* variable	[1] More than 500.000 dwellings of *Size of locality of residence* variable
Slovakia 2018	[10] Bratislavský kraj (Bratislava) [21] Trnavskýn kraj (part of Western Slovakia) [22] Tren?iansky kraj (part of Western Slovakia) [23] Nitriansky kraj (part of Western Slovakia) [31] Žilinský kraj (part of Central Slovakia) [32] Banskobystrický kraj (part of Central Slovakia) [41] Prešovský kraj (part of Eastern Slovakia) [42] Košický kraj (part of Eastern Slovakia)	[0] not rural area [1] rural area	---	[1] cities (densely populated area) [2] towns and suburbs (intermediate density area) [3] rural areas (thinly populated areas)	[10] Bratislava of *Region* variable	[1] cities (densely populated area) of *Type of area* variable

United States 2018	[11] Maine [12] NewHampshire [13] Vermont [14] Massachusetts [15] RhodeIsland [16] Connecticut [21] NewYork [22] NewJersey [23] Pennsylvania [31] Ohio [32] Indiana [33] Illinois [34] Michigan [35] Wisconsin [41] Minnesota [42] Iowa [43] Missouri [44] NorthDakota [45] SouthDakota [46] Nebraska [47] Kansas [51] Delaware [52] Maryland [53] DistrictofColumbia [54] Virginia [55] WestVirginia [56] NorthCarolina [57] SouthCarolina [58] Georgia [59] Florida [61] Kentucky [62] Tennessee [63] Alabama [64] Mississippi [71] Arkansas [72] Louisiana	[0] not rural area [1] rural area	[0] non-metropolitan/not identified [2] 100,000 -< 250,000 inhabitants [3] 250,000 -< 500,000 inhabitants [4] 500,000 -< 1,000,000 inhabitants [5] 1,000,000 -< 2,500,000 inhabitants [6] 2,500,000 -< 5,000,000 inhabitants [7] 5,000,000 inhabitants or more	[1] central city [2] balance of MSA [3] non MSA	[7] More than 5M, inhabitants of *Size of locality of residence* variable, with [1] central city and [2] balance of rest of MSA with *Type of area* variable	---

	[73] Oklahoma [74] Texas [81] Montana [82] Idaho [83] Wyoming [84] Colorado [85] NewMexico [86] Arizona [87] Utah [88] Nevada [91] Washington [92] Oregon [93] California [94] Alaska [95] Hawaii					

Uruguay 2016	[1] Montevideo [2] Artigas [3] Canelones [4] Cerro Largo [5] Colonia [6] Durazno [7] Flores [8] Florida [9] Lavalleja [10] Maldonado [11] Paysandú [12] RíoNegro [13] Rivera [14] Rocha [15] Salto [16] SanJosé [17] Soriano [18] Tacuarembó [19] Treinta y Tres	[0] not rural area [1] rural area	[1] over 1 million inhabitants (Montevideo) [2] 5,000 to 1 million inhabitants [3] less than 5,000 inhabitants	[1] Montevideo [2] town of 5,000 inhabitants or more [3] town of less than 5,000 inhabitants [4] rural area	[1] Montevideo of *Type of Area* variable	---

Appendix 2: Decomposition of spatial inequality

The Mean Log Deviation income distribution measure for a given country is defined as:

$$E_0(y) = \frac{1}{n} \cdot \sum_{i=1}^{n} ln \frac{\mu}{\mu_i}$$

where *n* is the total number of observations in the survey (expanded by sample weights) and μ is the sample average of the income variable (using sample weights).

Assume first we divide the sample into urban and rural households, then we can undertake the following decomposition:

$$E_0(y) = \left(\frac{n_u}{n} \cdot \frac{1}{n_u} \cdot \sum_{i \in N_u} ln \frac{\mu_u}{\mu_i} + \frac{n_r}{n} \cdot \frac{1}{n_r} \cdot \sum_{i \in N_r} ln \frac{\mu_r}{\mu_i} \right) + \left(\frac{n_u}{n} \cdot ln \frac{\mu}{\mu_u} + \frac{n_r}{n} \cdot ln \frac{\mu}{\mu_r} \right)$$

where n_u is the total number of individuals who reside in urban areas, μ_u is the average income among urban individuals, and N_u is the set of individuals in urban areas. The variables with an *r* subscript are analogous to those for urban individuals but defined for rural observations.

The first parenthesis represents the Within component of the decomposition and the second the Between component. This equation can be expressed as:

$$E_0(y) = \left(\frac{n_u}{n} \cdot E_0^u(y) + \frac{n_r}{n} \cdot E_0^r(y) \right) + B^{u/r} = \frac{n_u}{n} \cdot E_0^u(y) + \frac{n_r}{n} \cdot E_0^r(y) + B^{u/r} \qquad \text{(A1)}$$

Now we further decompose the within urban component into large and small cities (or regions, depending on the country). Let's say there are n_{ub} households in the big cities and n_{us} households in the small cities, with $n_u = n_{ub} + n_{us}$. Then,

$$E_0^u(y) = \left(\frac{n_{ub}}{n_u} \cdot \frac{1}{n_{ub}} \cdot \sum_{i \in N_{ub}} ln \frac{\mu_{ub}}{\mu_i} + \frac{n_{us}}{n_u} \cdot \frac{1}{n_{us}} \cdot \sum_{i \in N_{us}} ln \frac{\mu_{us}}{\mu_i} \right) + \left(\frac{n_{ub}}{n_u} \cdot ln \frac{\mu}{\mu_{ub}} + \frac{n_{us}}{n_u} \cdot ln \frac{\mu}{\mu_{us}} \right) \qquad \text{(A2)}$$

Substituting equation (A2) into equation (A1) yields:

$$E_0(y) = \frac{n_{ub}}{n} \cdot E_0^{ub}(y) + \frac{n_{us}}{n} \cdot E_0^{us}(y) + \frac{n_r}{n} \cdot E_0^{r}(y) + B^{ub/us} + B^{u/r}$$

where,

$$B^{ub/us} = \frac{n_{ub}}{n} \cdot ln \frac{\mu}{\mu_{ub}} + \frac{n_{us}}{n} \cdot ln \frac{\mu}{\mu_{us}} \qquad \text{(A3)}$$

Notice that in this last expression, the denominator of the weights is *n*, not n_u.

Therefore, the decomposition will have five terms:

$$E_0(y) = W^{ub} + W^{us} + W^{r} + B^{ub/us} + B^{u/r} \qquad \text{(A4)}$$

Where the first three terms are the within components for large cities, small cities, and rural areas, respectively. Each of these components is the Entropy 0 measures for the respective group of households multiplied by a weighing factor.