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Urban primacy and slum prevalence in Latin American and Caribbean countries in the 1990-2020 period

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Abstract:

Slums are a global concern due to their impact on urban health and urban planning. Although Latin America and the Caribbean is one of the most urbanized developing regions, slums are still a significant concern. However, most studies have concentrated on a single city, using a sample of Latin American and Caribbean (LAC) countries or treating the region as one unit to analyze income inequality and urban primacy. Here, we present an analysis of the relationship between slums and urban primacy for LAC countries for the 1990–2020 period, controlling for GDP per capita and public spending on housing. In addition, we model the relationship between slums and demographic variables such as the fertility rate, migration rate, and urbanization. The analysis is based on panel data from the World Bank and The Economic Commission for Latin America and the Caribbean (ECLAC). During the period of study, a clear positive relationship is evident between urban primacy in the largest city and the slum rate in each LAC country. However, a high level of heterogeneity is observed in this relationship and our model explains the variation in the slum rate within countries better than the variation between countries.

Keywords: Slums; panel data; Latin America; urban primacy; urbanization.
JEL Classification: R0; R12.

Primacía urbana y prevalencia de barrios marginales en los países de América Latina y el Caribe en el período 1990-2020

Resumen:

Los barrios marginales son una preocupación mundial por su impacto en la salud y la planificación urbana. Aunque América Latina y el Caribe (ALC) es una de las regiones en desarrollo más urbanizadas, los barrios marginales siguen siendo una preocupación importante. La mayoría de los estudios se han concentrado en una sola ciudad, a nivel mundial utilizando una muestra de países de ALC o tratando la región como una unidad. Aquí presentamos un análisis de la relación entre los barrios marginales y la primacía urbana en los países de ALC para el período 1990-2020, controlando el PIB per cápita y el gasto público en vivienda. Nos preguntamos sobre la relación entre los barrios marginales y la primacía urbana, después de controlar la heterogeneidad no observada de los países de ALC. Además, modelamos la relación entre los barrios marginales y variables demográficas como la tasa de fertilidad, la tasa de migración y la urbanización. El análisis se basa en datos de panel del Banco Mundial y la Comisión Económica para América Latina y el Caribe (CEPAL). Durante el período de estudio, es evidente una relación clara entre la primacía urbana en la ciudad más grande y la tasa de barrios marginales en cada país de ALC. Sin embargo, se observa un

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alto nivel de heterogeneidad en esta relación y nuestro modelo explica mejor la variación en la tasa de barrios marginales dentro de los países que la variación entre países.

Palabras clave: Tugurios; Datos de Panel; Latinoamérica; concentración urbana; urbanización.
Clasificación JEL: R0; R12.

1. Introduction

The world is currently more urban than rural, with around 56% of people living in urban areas in 2023 (Moreno-Monroy et al., 2021). However, the annual growth rate of the global urban population has been decreasing in recent decades. From an average of 3% in 1960, it dropped to 1.5% in 2020. The main driver of urban growth is currently the developing economies, where urbanization is still taking place (Glaeser and Henderson, 2017). These countries grow at an annual average rate of 4%. In contrast, developed economies experience a much lower growth rate of approximately 0.5% (World Bank, 2023).

Despite of a high level of urbanization in Latin American and Caribbean (LAC) countries, which is generally associated with development, improved amenities, and higher living standards, the reality is that urbanization in LAC countries is facing challenges in terms of economic growth, productivity, and industrialization (Castell-Quintana, 2017). Indeed, we observe the phenomena of "urbanization without growth" and "poor country urbanization" highlighted by Fay and Opal (2000) and Glaeser (2013).

Slums have become a prominent feature of urbanization in developing economies, often dominating the landscapes of cities. The definition of a slum refers to illegal, poorly constructed settlements without services (Milbert, 2006). Despite a decrease in the slum rate of around 14 percentage points over the last decade in LAC countries, it is still an significant human settlements and urban issues. Recognizing the significance of this issue, the Sustainable Development Goals (SDGs) call upon governments to improve the living conditions of slumdwellers, as these conditions have remarkable implications for economic growth (UN, 2015). [1] As a result, achieving sustainable urbanization has become a primary and urgent challenge for developing countries, where millions of people lack adequate access to essential services such as electricity, clean water, and sanitation (Castell-Quintana, 2017; Henderson, 2010).

The main contribution of this paper is a panel data analysis examining the relationship between slums in LAC countries and various demographic and socioeconomic determinants such as urbanization, the fertility rate, income, education, poverty, urban primacy, and the net migration rate. We investigate the relationship between slums and urban primacy during the 1990–2020 period, controlling for the unobserved heterogeneity of LAC countries. We go in depth into the trends for several LAC countries and offer a comparative perspective across the region. The data comes from The Economic Commission for Latin America and the Caribbean (ECLAC) and the World Bank, for the period of 1990 to 2020.

Importantly, we focus on the relationship between urban primacy and slums in LAC countries, whereas most previous work has focused on slums globally, analyzing certain LAC countries only or treating the region as one unit. In addition, most research has focused on urban primacy and poverty (monetary measures) or quality of life. Findings show that inequality increases with higher urban primacy levels, and a negative relationship has been found between urban concentration and quality of life, as well as a positive relationship between urbanization (density) and quality of life (Henderson, 2002; Henderson and Turner, 2020).

Closer to our study, Woo and Jun (2020) focus on urbanization, globalization, and slums, but they use a pooled model and cross-sectional data instead of a panel and the results are mixed as urbanization is found to be either positively or negatively related to urbanization.

The remainder of the paper is structured as follows. In the next section, we introduce the relevant literature. Subsequently, we outline the data sources employed, followed by a section dedicated to the methodology used. We then present the results of our analysis. In the subsequent section, we offer some

[1] See https://unstats.un.org/sdgs/report/2023/Goal-11/

concluding remarks. Finally, we present policy recommendations based on our findings and discuss potential avenues for future research.

2. Literature

Historically, urban areas have been closely linked to economic development, industrialization, and physical infrastructure (Henderson, 2002). In addition, densely populated areas are known to be more productive (Glaeser and Henderson, 2017). The micro foundations of agglomeration economies show how urban areas offer increasing returns to scale, enabling firms to benefit from better job matching, learning, and the sharing of infrastructure (Duranton and Puga, 2004). A substantial body of literature has explored the advantages of agglomeration (Combes et al., 2008; Matano et al., 2020).

Developing regions exhibit problems of congestion and urbanization without growth (Castell-Quintana and Wenban-Smith, 2020; Gollin et al., 2013). Despite their relative poverty, it has been observed that cities in the developing world exhibit relatively high productivity levels and often provide access to essential services such as safe water, improved sanitation, schooling, and inoculations (Henderson and Turner, 2020). However, Puga (1998), Glaeser and Henderson (2017) highlight the distinct patterns of urbanization between developed and developing economies, with slum formation often accompanying the rapid urbanization characteristic of developing countries.

The concept of slums is closely related to urban poverty and informal housing. Slums are characterized by illegal land occupation, substandard and non-durable housing materials, a lack of public services, and overcrowding (UN-Habitat, 2003; Woo and Jun, 2020). Authors such as Sheuya (2008), Gilbert (2007), and Davis (2006) analyze the multidimensional concept of slums and its implications. Methodologies to identify slums often rely on censuses, surveys, and satellite imagery data. Some authors have gone beyond the dichotomous specification of a slum household, elaborating a scale called the slum severity index (Obaco et al. 2022; Patel et al., 2014). Mulbert (2006) presents a discussion of historical perspectives of slum identification. He highlights that the current definition refers to criteria that are very broad, and spatial and neighborhood characteristics are absent.

Bolay (2006) asserts that the existence of slums worldwide is indicative of the crucial role that slums play in contemporary urbanization. There are too few decent houses available to accommodate the increased urban population; thus, poor people scramble to find lower-cost housing units and, as a consequence, slums develop. At the same time, slums have typically been described as a 'scandal' and are considered 'shameful' and 'unhealthy', not only for inhabitants but also for the rest of the city and the country (Milbert, 2006). In spite of significant international funding, public policies that have been implemented in slum areas have not achieved the expected success. Thus, slums are often considered to be a permanent rather than a transitional phenomenon in less developed regions (Alves, 2021).

Jedwab et al. (2017) note that there is limited research on slums as a cost of agglomeration in developing countries. Brueckner and Lall (2015) present theoretical models of urban costs of living and the economics of squatting, while Brueckner (2013) explores the characteristics of households residing in slum dwellings in Indonesia, finding that these households tend to have lower levels of education and larger family sizes. Similarly, Friesen et al. (2018) find that slums are of a similar size across major cities in the developing regions of Asia, Latin America, and Africa.

According to Fox (2014), the emergence of slums can be attributed to three types of factors: demographic, economic, and institutional. In terms of demographic factors, urbanization is primarily driven by rural-urban migration and natural population growth (Castell-Quintana and Wenban-Smith, 2020). Historically, migration waves from rural to urban areas have been identified as significant drivers of urbanization (Jedwab and Vollrath, 2015). Currently, we can observe that rural–urban migration is a characteristic more associated to Africa and Asia, while urban–urban migration is more important in Latin America. In addition, Jedwab et al. (2017) also suggest that higher fertility rates in developing regions contribute to rapid urbanization, which is also associated with higher slum rates in urban areas compared to rural areas.

In terms of economic factors, urban poverty is emphasized as a primary cause for the existence of slums (Ravallion et all., 2007). For example, 36 per cent of urban households in developing countries have an income below the poverty line (Milbert, 2006). The inability to escape from slums due to the lack of housing improvement over time is also discussed in the literature. More specifically, slums can act as poverty traps, making them a permanent rather than transitional phenomenon (Marx et al., 2013). Two separate dimensions of slums can be distinguished: Their inhabitants mostly live on a very low income, and the space itself has a highly varied status, commercial value and environmental characteristics.

Institutional factors primarily stem from weak institutions, often rooted in the country's historical context. Even during periods of economic growth, slums continue to develop in spite of international and national projects designed to halt their spread. Institutional factors are highly relevant in influencing the development and the conditions of slums (Paniagua, 2022). In their inability to deal with many urban problems, local and national authorities let slums develop as a form of "low-cost" urbanization. Although centralization is not conducive to reducing income inequality and providing better urban infrastructure, for municipal governments slums are not a priority; priorities are defined by voters and interest groups (Mulbert, 2006).

We can also consider urban primacy as a determining factor (Henderson, 2002). The largest metropolitan area concentrates most of the slum dwellings, but this trend seems to change (World Bank, 2009), and a strand of the literature has focused on the potential drawbacks of excessive urban primacy. From a practical standpoint, when the social marginal costs outweigh the social marginal benefits, this implies that these cities tend to be oversized. Over-concentration can lead to a reduction in the benefits of agglomeration, resulting in congestion, impeding national economic growth, and increasing slums and inequality (Castells-Quintana, 2016; Castells-Quintana et al., 2020; Henderson, 2002).

Frick and Rodríguez-Pose (2017, 2018) analyzed urban primacy and economic growth by assessing congestion levels using a panel dataset of developing countries. They found that the impact of urban primacy on economic growth varies depending on the country's income level. They observed a positive effect of urban primacy on economic growth in high-income countries but no significant effect in developing countries. This suggests a non-linear relationship between urban primacy and economic growth.

Henderson and Turner (2020) analyzed urbanization in the developing world using satellite imagery and living condition surveys, and their findings suggest a decline in services to high-density slums at very high levels of urban primacy. Additionally, studies by Obaco et al. (2021) and Mitra and Nagar (2018) reveal evidence of congestion in larger cities in developing economies. Indeed, the relationship between urban primacy and economic growth is not uniform and can exhibit non-linear patterns.

Similarly, Sekkat (2016) investigates the impact of urban primacy on poverty in developing countries using panel data and concludes that deconcentrating urbanisation away from cities with populations larger than 5 million does not have a significant impact on poverty. Another study by Castell-Quintana (2016), also employing panel data, demonstrates how the effects of urban primacy on economic growth can vary depending on the quality of the urban environment, and particularly urban infrastructure, in Sub-Saharan Africa. Thus, while urbanization on its own does not cause development, sustained economic development is unlikely to occur without urbanization (Henderson, 2010).

3. Latin American and Caribbean (LAC) countries

Like many other developing regions of the world, LAC countries are experiencing urban sprawl and/or uncontrolled growth. On average, in 2020 the urbanization rate in LAC countries was around 81% (World Bank, 2023). Currently, rural-urban migration refers mostly to Africa and Asia South, while urban-urban migration is more important in Latin America as the continent is more urbanized and the flow across cities is more significant. Practically, medium-sized cities are becoming more relevant (IDB, 2015).

Despite significant economic growth in the past two decades, inequality remains high in the region (Aroca and Atienza, 2016; UNDP, 2021). Poverty and inequality have led to 44% of the population of Latin America living in favelas, slums, informal settlements, and poor neighborhoods where they are

deprived of adequate housing conditions and the supply of basic services (Magalhães et al., 2016). Currently, the implications for the poor living in the slums of Latin America's large cities, where narco-trafficking is now pervasive, are particularly dismal (Fay, 2005).

Most studies have concentrated on a single city or country, using a sample of LAC countries or treating the region as one unit (Woo and Jun, 2020). In the Appendix, see Table A1, we present a table summarizing the relevant analyses of LAC countries that consider urbanization and slums as well as sociodemographic factors. Most works that have focused on urban primacy or urban concentration consider poverty (monetary measures) or quality of life (including particular features of slums according to the UN-Nation definition). Inequality increases with higher urban-primacy levels, but a negative relationship has been found between urban concentration and quality of life, and a positive relationship between urbanization (density) and quality of life (Henderson, 2002; Henderson and Turner, 2020).[2]

The most similar evidence to our study is found in Woo and Jun (2020), where the authors analyze urbanization, globalization, and slums. They find that political and social globalization indeed reduces urban slum populations and that economic globalization exerts a negative effect on slums in developing countries. But they do not use a panel in their analysis, and the results are mixed as urbanization is found to be positively related to urbanization using cross-sectional data but is not significant in certain periods.

As for specific country-level analyses, Obaco et al. (2020) focus on the deprivation level in Ecuadorian provinces, while Obaco et al. (2022) examine the spatial distribution of the multidimensional poverty index (MPI) in Uruguay and Ecuador. They find that Ecuador has made improvements in reducing spatial disparities, whereas Uruguay has experienced minimal change. However, despite the improvements in Ecuador, Uruguay nevertheless maintains a higher standard of living. Celhay and Undurraga (2022) study the specific case of Santiago, Chile, and find that slumdwellers are significantly more likely to prioritize location over housing quality than people in subsidized housing.

Bosso et al. (2021) explore rural-urban migration in Brazil, linking it to poverty, informality, and poor housing. Furthermore, Cavalvanti et al. (2018) show that urban poverty, inequality, and rural-urban migration explain much of the variation in slum growth in Brazil from 1980 to 2000. Ex-ante evaluation of the impacts of policy interventions shows that removing barriers to formalization has a strong impact on slum reduction. Cavalcanti et al. (2019) mention that urban poverty, rural-urban migration and land use regulations explains much of the variation in slum growth in Brazil between 1980 – 2000. Similarly, Alves (2021) studies Brazil at the city level, revealing that economic growth in cities causes slum growth because it attracts a larger number of low-income households.

4. The Data

We build panel data for the period from 1990 to 2020, with a time interval of approximately 4 or 5 years. The data are gathered from:

I. World Bank data, accessible at https://data.worldbank.org/indicator

II. ECLAC (Economic Commission for Latin America and the Caribbean) data accessible at https://statistics.cepal.org/portal/cepalstat/dashboard.html?lang=es

We define our depending and independent variables of interest as the following:

a) Slums, as defined by UN-Habitat (2002), are housing units with at least one of the following characteristics: inadequate access to safe water; inadequate access to sanitation and other infrastructure; poor structural quality of housing; overcrowding; and insecure residential status. Consequently, this is a dichotomous classification where a household is or is not a slum.

[2] His quality-of-life variable is constructed based on health quality (child mortality rate for children under 5 years old), schooling quality (children per classroom in primary school), and neighborhood quality of life (percentage of households with access to potable water within 200m and percentage of households with regular waste collection).

b) Urban primacy can be defined in different ways; here, we use the proportion of urban population living in the largest city with respect to the total urban population.

We use data from the following countries: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, Honduras, Haiti, Mexico, Nicaragua, Panama, Peru, Paraguay, El Salvador, Trinidad and Tobago, and Venezuela.[3]

5. The Methodology

In base of that, we propose a panel data analysis of LAC countries using three main specifications. Using panel data allows for better control of the unobserved heterogeneity in Latin American and Caribbean (LAC) countries. First, we test for the benefits of urbanization in the region and the relationship between spending on human capital and slums using Equation (1):

$$Slum_{it} = \tau_i + \theta_1 Urban_{it} + \theta_2 Educ_{it} + \epsilon_{it} \quad (1)$$

where $Slum_{it}$ is the slum rate of country *i* at time *t*. $Urban_{it}$ is the urbanization rate, and $Educ_{it}$ is public spending on education as a percentage of GDP. τ_i are country fixed effects, θ_i is the parameter to be estimated, and ϵ_{it} is the error term.

Equation (2) explores the effect of the fertility rate and net migration rate on the slum rate of country *i*.

$$Slum_{it} = \gamma_i + \delta_1 Fert_{it} + \delta_2 NetMig_{it} + \varepsilon_{it} \quad (2)$$

where $Slum_{it}$ is the proportion of slum households in country *i* at year *t*. $Fert_{it}$ is the fertility rate of the country, and *NetMig* is the net migration rate. γ_i are country fixed effects, and δ_i is the parameter to be estimated. ε_{it} is the error term.

Equation (3) explores our main research question, which is to study the relationship between urban primacy and the slum rate, controlling for income and public spending on housing and the heterogeneity present in LAC countries.

$$Slum_{it} = \alpha_i + \beta_1 Prim_{\text{it}} + \beta_2 \log\left(GDP_{per_{it}}\right) + \beta_4 PG_{it} + u_{it} \quad (3)$$

where $Slum_{it}$ is the proportion of slum households in country *i* at year *t*. α_i are fixed effects, and $GDP_{per_{it}}$ is the representation of the income level of the country in per capita terms, as a proxy for economic development in log form. PG_{it} is the proportion of public spending on housing by the central government. β_i is the parameter to be associated with each variable of interest. u_{it} is the error term.

In addition, we use the Housman test to select between fixed effects (FE) and random effects (RE). FE are preferred in the main specification presented above (see Tables A4-A6 in the Appendix). To address endogeneity concerns, instrumental variable (IV) estimation is employed. In this case, variables are lagged by twenty periods (Frick and Rodríguez-Pose, 2018; Quintana, 2016).

6. Results

Table 1 summarizes the main trends regarding slums in Latin America and the Caribbean during the period from 2000 to 2020[4] and provides an overview of key indicators related to slum conditions as defined by UN-Habitat (2003). Tenancy, which refers to the percentage of people who own their dwellings, decreased in Latin American and Caribbean (LAC) countries during the period analyzed. The overcrowding rate in urban areas has increased, reaching a peak of around 35% in 2005. This indicates

[3] Uruguay does not publish information on slums.
[4] CEPALStat (ECLAC) indicators available for 2000-2020 only.

that cities in LAC countries are facing challenges in terms of accommodating their growing populations. The percentage of the population with access to safe water remained relatively stable throughout the period of analysis, but there was a significant increase in the coverage of sewage systems, which nearly doubled during the period of 2000 to 2020. The slum rate, which represents the proportion of the urban population living in slums, decreased over the period. This suggests some improvement in the living conditions of the population.

Table 1.
Slum trends in Latin America in percentages

		2000	2005	2010	2015	2020
Tenancy rate	National	74.8	73.8	72.0	71.7	67.8
	Urban	73.6	72.1	70.2	69.9	65.1
	Rural	79.3	80.0	78.9	79.2	77.5
Overcrowding rate	National	31.0	38.1	34.7	31.1	36.8
	Urban	26.3	34.7	31.5	28.3	33.6
	Rural	48.7	50.3	46.9	42.4	47.6
Access to safe water rate	National	72.0	73.0	75.0	75.0	75.0
	Urban	82.0	82.0	83.0	82.0	81.0
	Rural	41.0	43.0	45.0	49.0	53.0
Access to sewage rate	National	15.0	18.0	23.0	28.0	34.0
	Urban	19.00	23.00	27.00	33.00	40.00
Slum rate		**31.86**	**28.15**	**21.78**	**18.35**	**17.70**

Source: Authors' own elaboration of CEPALStat and World Bank data.

In Table 2, we present some descriptive statistics for the variables used in our analysis of LAC countries. Trinidad and Tobago and Haiti have the highest slum rate, whereas Argentina, Chile, and Costa Rica have the lowest. The highest levels of urban primacy are found in Panama, Paraguay, and Trinidad and Tobago. The lowest levels are seen in Brazil and Venezuela. We observe a complex heterogeneity in the LAC region. The correlation matrix among variables is presented in Table A2 in the Appendix.

Table 2.
Descriptive statistics of variables (NxT=106)

Variable	Description	Source	Mean	Std. Dev.	Min.	Max.
$Slum_{rate}$	Proportion of the urban population living in slums (in %)	World Bank	32.73	21.11	3.9	93.4
$Prim_{it}$	Population in the largest city (% of urban population)	World Bank	34.31	15.65	11.01	76.78
GDP_{per}	GDP per capita, PPP (current international $)	World Bank	10,740	7,011	1,942	31,780
$Urban_{rate}$	Proportion of urban population (in %)	World Bank	69.29	13.88	28.51	91.88
$Educ$	Public spending on education (in % of GDP)	ECLAC	4.46	1.64	1.03	8.9

TABLE 2. CONT.
Descriptive statistics of variables (NxT=106)

Variable	Description	Source	Mean	Std. Dev.	Min.	Max.
PG	Public spending on housing and community services (in % of GDP)	ECLAC	0.57	0.63	0.15	2.48
$Fert_{rate}$	Number of children per woman	ECLAC	2.49	0.82	1.07	5.48
$NetMig_{rate}$	Ratio (rate per 1,000 inhabitants) between the net annual migratory balance, corresponding to a determined period, and the average population in the same period	ECLAC	-1.54	6.15	-44.49	23.88

Source: Authors' own elaboration of CEPALStat and World Bank data.

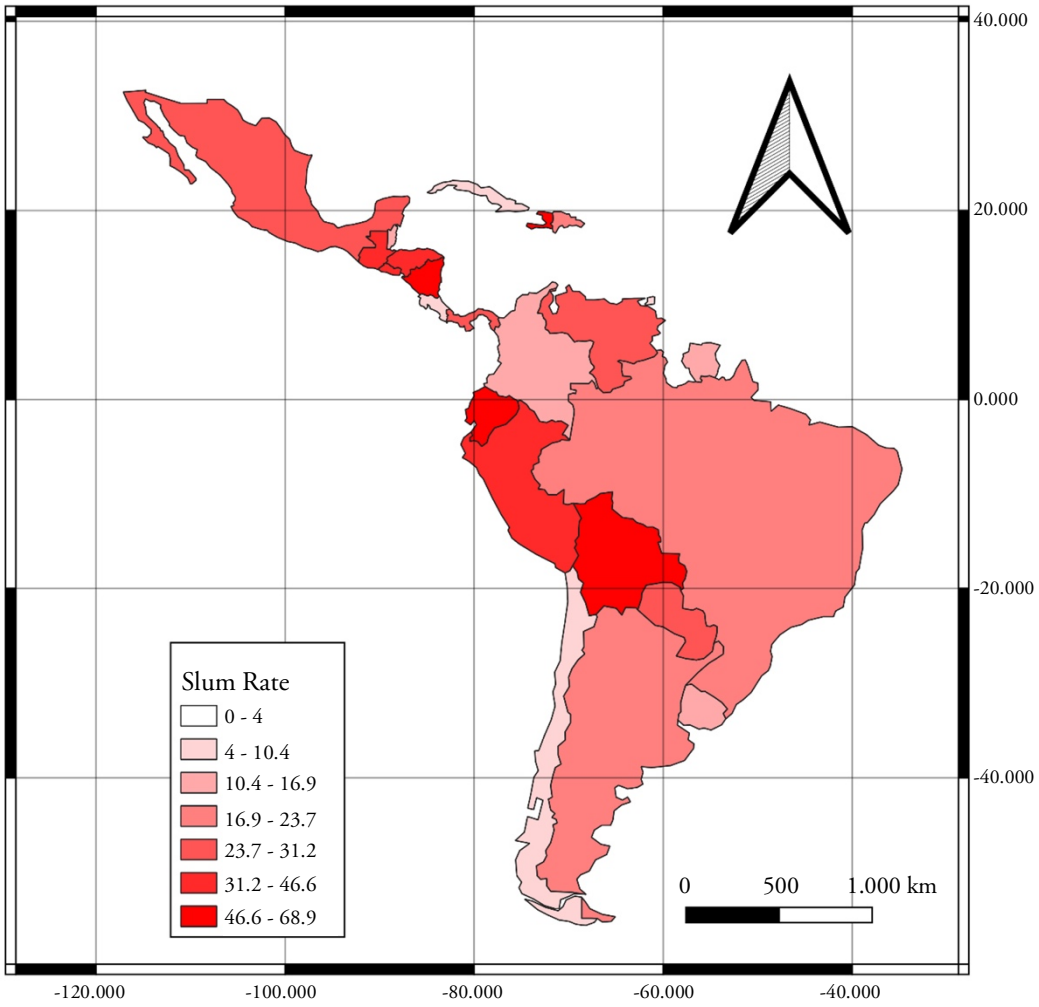
The selection of variables is based on the literature on factors that help explain the formation of slums in developing countries, such as the cost of infrastructure, human capital formation, fertility rates of poor households and urban primacy.[5] We control for net migration rates to take into account whether countries have a positive or negative balance of people. Urban poverty can be addressed by real incomes and income inequality (Cavalvanti et al., 2018). We use income variables such as GDP per capita in PPP and public spending on education to address human capital, as well as public spending on social housing programs as a percentage of GDP. Figure 1 shows the average slum rate during the period of analysis.

Table 3 shows the results obtained from Equation (1) and Equation (2). In column (1), the dependent variable is the slum rate against the urban population rate, while column (2) reports the results of the regression of slum rate against public spending on education. Column (3) shows the results of the regression of slum rate against both variables. Column (4) and column (5) consider the slum rate against the fertility rate and the net migration rate of the country, respectively.

The slum rate is negatively related to urbanization and public spending on education in LAC countries. The fertility rate is positively associated with the slum rate, in line with the hypothesis of Jedwab et al. (2017) and others, and the correlation is relatively strong when controlling for the net migration rate of LAC countries. The net migration rate is negative, implying that a negative balance of migration in LAC countries is associated with a decrease in the slum rate.

[5] Slum dwellings are associated with having more children in the household. In addition, a high fertility rate is associated with slum areas, rather than rural areas (Brueckne, 2013; Frink et al., 2014; Gupta et al., 2005; Mulbert, 2006). Moreover, since the 1980s market-led housing policies have been strongly favored in the LAC region as part of liberal reforms that governments have enacted to increase economic growth and public housing (Magalhães et al., 2016).

FIGURE 1.
Average slum rate in LAC (1990-2020)



Source: Authors' own elaboration of World Bank data.

TABLE 3.
Results of estimating equation (1) and equation (2)

Dependent variable: slum rate

	(1)	(2)	(3)	(4)	(5)
Variables	**FE-Eq(1)**	**FE-Eq(1)**	**FE-Eq(1)**	**FE-Eq(2)**	**FE-Eq(2)**
Urban	-1.037***		-0.470*		
	(0.147)		(0.250)		
Educ		-2.983***	-1.752*		
		(0.809)	(1.027)		
Fert				12.50***	12.19***
				(1.115)	(1.110)
NetMig					-0.225*
					(0.118)

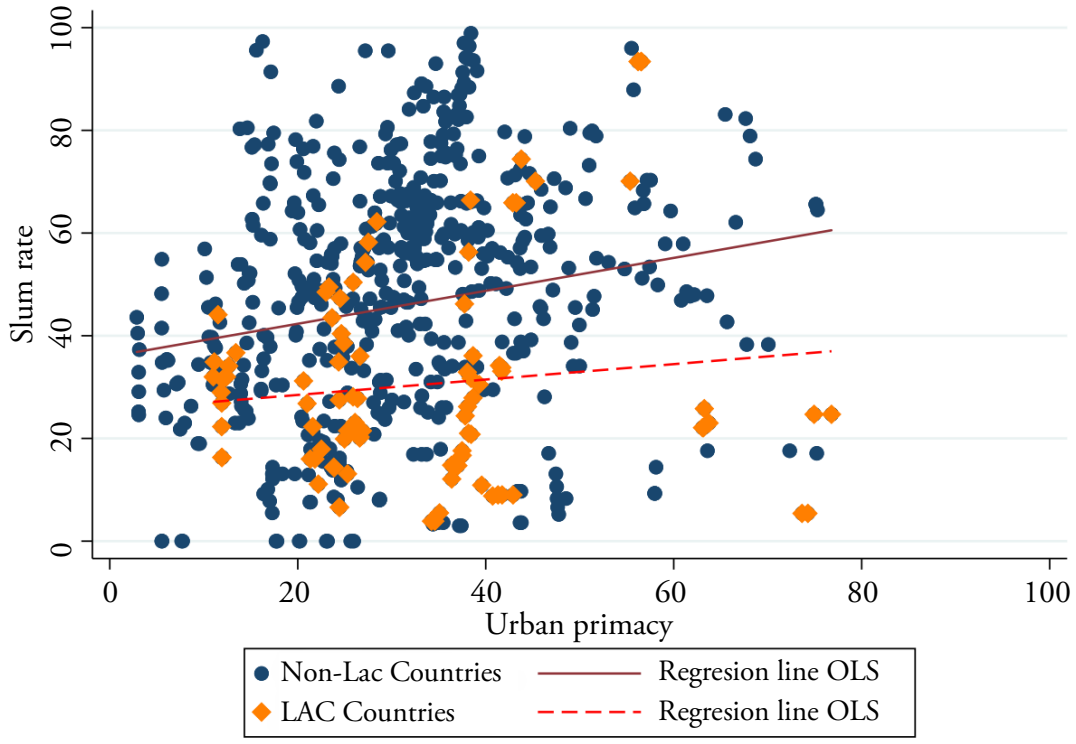
TABLE 3. CONT.
Results of estimating equation (1) and equation (2)
Dependent variable: slum rate

	(1)	(2)	(3)	(4)	(5)
Variables	**FE-Eq(1)**	**FE-Eq(1)**	**FE-Eq(1)**	**FE-Eq(2)**	**FE-Eq(2)**
Constant	104.1***	39.46***	68.35***	0.0942	0.514
	(10.29)	(3.630)	(15.79)	(2.876)	(2.841)
Observations	106	73	73	106	106
R^2 (Overall)	0.379	0.026	0.209	0.722	0.737
R^2 (Within)	0.367	0.201	0.251	0.593	0.610
R^2 (Between)	0.265	0.041	0.209	0.821	0.737
N. of countries	19	18	18	19	19

Note: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. The reduced number of observations is due to some countries not providing information on the *Educ.* variable for certain years.
Source: Authors' own elaboration.

Figure 2 illustrates the relationship between the slum rate and urban primacy in the LAC countries for the 1990-2020 period, using data obtained from the World Bank database. The graph highlights the heterogeneity among LAC countries and indicates a positive slope in relation to urban primacy.

FIGURE 2.
Slum rate and urban primacy in developing countries:
1990-2020, with a timespan of 5 years



Source: Authors' own elaboration of World Bank and ELAC data.

Table 4 shows the main results of the analysis obtained from estimating Equation (3) for LAC countries. Column (1) considers urban primacy, and column (2) considers urban primacy and income as explanatory variables. Column (3) refers to urban primacy and public spending in housing as explanatory variables, and column (4) to urban primacy and human capital investment. Finally, column (5) considers the same variables as column (2) but using IV (instrumental variable) estimates instead of OLS (ordinary least squares). The instrument is significant in the first step, and the weak identification leads to a rejection of the null hypothesis.

Table 4.
Results of estimating Equation (3)

Dependent variable: slum rate

	(1)	(2)	(3)	(4)	(5)
Variables	**FE**	**FE**	**FE**	**FE**	**FE-IV**
Prim	1.527***	1.055***	2.313***	1.069*	2.097***
	(0.328)	(0.267)	(0.546)	(0.586)	(0.568)
Log(GDP)		-12.62***			-10.97***
		(1.737)			(2.019)
PG			-3.916*		
			(1.992)		
Educ				-2.442***	
				(0.846)	
Constant	-20.47*	109.9***	-46.03**	1.600	110.6***
	(11.24)	(20.03)	(17.96)	(21.04)	(20.01)
Observations	106	106	84	73	106
R^2 (Overall)	0.002	0.216	0.048	0.009	0.213
R^2 (Within)	0.201	0.507	0.295	0.248	0.419
R^2 (Between)	0.007	0.076	0.029	0.039	0.046
Number of id	19	19	18	18	19
Under-identification test (P-value)					0.000
Weak identification test (F-test)					29.010

Note: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. The under-identification test p-value indicates that the first step is significant; therefore, the instrument is valid. The weak identification F-statistic is higher than 16.38, indicating that the instruments are not weak. An overidentification test is not included because the equation is exactly identified. The reduced number of observations is due to some countries not providing information on the *Educ*. variable in certain years. Table A3 in the Appendix shows that there is no problem of multicollinearity in the specification, based on VIF values.
Source: Authors' own elaboration.

Our proxy for urban primacy is significant and positive, implying that a higher urban concentration in the largest city is associated with a higher slum rate in LAC countries during the period of analysis. This relationship is still significant—although the magnitude of the effect is reduced—after controlling for our proxy for income. Using an IV approach, the estimated parameter for urban primacy is higher and significant in this estimation. We also observe that income is relevant, in addition to public investment in both housing and human capital. This points to the relevance of government as an institution that can effectively reduce the slum rate in LAC countries.

The R^2 values show that the models explain the variation within countries rather than the variation between countries, with up to 50% of the within-country variation being explained and only 8% of the between-country variation. This demonstrates the high level of heterogeneity among LAC countries, which is more difficult to explain. Finally, fixed effects from Equation (2) and Equation (3) are shown in the Appendix (See Figures A1 and A2). Darker green and larger circles represent greater urban primacy, while red shades represent the level of fixed effects of slums, which is high for all countries. There is so much more to be explained regarding the slum rate associated with each country and there are still differences to exploit.

7. Conclusions and policy implications

In this paper, we have investigated the association between the urban slum rate and urban primacy in LAC countries. Urban primacy is measured as the share of the urban population in the largest city with respect to the total urban population in each LAC country. We used panel data analysis to assess these relationships and control for heterogeneity between LAC countries for the 1990–2020 period. The data comes from ECLAC and World Bank databases. We also investigate the role of other demographic variables such as the fertility rate, urban population, and net migration rate. In addition, we control for variables associated with government spending on education and housing and community services, as well as GDP per capita as a proxy for income level.

In general terms, LAC countries follow the main trends of developing regions in terms of the slum rate. However, we observe that slum rate variation within countries is better explained than that between countries. This is notable, as it reveals high heterogeneity in the LAC region. Our findings are important because few works have focused on LAC countries to explore slum rates and urban primacy. Most works have used monetary measures of poverty and quality of life indicators and explore their relationship with the slum rate.

In more detail, we observe that the slum rate is positively related to the fertility rate. More populated areas must have more females and are associated with a higher slum rate (Jedwab et a., 2017). Instead, the slum rate is negatively related to the net migration rate of LAC countries. Urbanization and urban poverty could be important determinants of slums (Obaco et al., 2022). Urbanization is a driver of economic growth and better housing standards. The negative correlation between the slum rate and the net migration rate indicates that the negative balance of migration in LAC countries is associated with a higher slum rate.

Urban primacy shows a significant and positive relationship with the slum rate after controlling for development through proxies such as government spending on human capital and housing, and GDP per capita. This is validated with a robustness test using IV and additional controls. In addition, we show the relevant role of government in reducing slums in LAC countries during the period of analysis.

Our results based on panel data help to clarify patterns of urban primacy and the slum rate in LAC countries and indicate a negative relationship between urbanization and the slum rate, in contrast to the results of Woo and Jun (2020) where a positive relationship was found using a pooled model and cross-sectional data from a large sample of developing countries. We observe similar findings when we use poverty and urban concentration, but the analysis would not be considered the same.

With regard to policy implications, our country-level analysis presents a deeper view of trends within countries and we can conclude that urban primacy in the largest cities in LAC countries was positively related to the slum rate during the period of analysis. This implies that a reduction in urban primacy in the largest city would promote investment in and migration to medium-sized and small cities. Urbanization in LAC countries increases with the economy and improvements in housing, but having one oversized city might not be good for development. In Latin America and the Caribbean, there are several countries with only one particularly large urban city, including Colombia, Chile, Mexico, Peru, and the Caribbean island nations. Our results also point to the importance of institutions and policies in reducing slums. With higher inequality following the COVID-19 pandemic, LAC countries might experience an increase in the slum rate in the coming years. This paper provides data that can be used as a basis for comparison.

Future research will determine whether the patterns found in our results are maintained in the coming decades. However, for a deeper understanding of the relationship between urban primacy and slums, microdata and city/country-level analyses are needed in light of the high level of heterogeneity that characterizes LAC countries.

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Annex

Table A1.
Review of literature on slums and urbanization for LAC countries only

Author(s)	Country/area	Variables/proxies for slums/deprivation	Explicative variable	Dependent Variable	Period	LAC countries in the sample
Alves (2021)	Brazil/Cities	At least one of the following: security of tenure, structural quality and durability of dwelling, safe water, sanitation facilities, and sufficient living area	Economic growth	**Slums**	1991–2010	Brazil
Castell-Quintana (2017)	World/Countries	Gini	City size	Income	1950–2015	Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, Guatemala, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Puerto Rico, Uruguay, Venezuela
Cavalcanti et al. (2018)	Brazil/Sao Paulo	Group of at least 50 housing units, illegally occupied and disordered urbanized pattern and/or lack of basic services such as sewage or electricity	Urban poverty, migration and land-use regulations	**Slums**	1980–2000	Brazil

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TABLE A1. CONT.
Review of literature on slums and urbanization for LAC countries only

Author(s)	Country/area	Variables/proxies for slums/deprivation	Explicative variable	Dependent Variable	Period	LAC countries in the sample
Celhay and Undurraga (2022)	Chile/Capital	Poor neighborhoods fulfilling one of the two following criteria: i) at least 50% of the residents are illegal occupants; ii) at least 50% of the residents lack access to at least one of these basic services: electricity, drinkable water, improved sanitation.	**Slums**	Inner city, non-poverty, labor force participation	1960–2008	Chile
Christiaensen and Todo (2014)	World/Countries	Monetary measure	Urbanization	Poverty headcount ratio	1980–2004	Bolivia, Brazil, Chile, Colombia, Ecuador, Costa Rica, El Salvador, Panama, Paraguay, Peru, Venezuela
Frick and Rodríguez-Pose (2018)	World/Countries	HHI (Herfindahl e Hirschmanconcentration index)	Urban concentration	GDP per capita	1985–2010	Argentina, Bolivia, Brazil, Chile, Colombia, Dominican Republic, Ecuador, Honduras, Mexico, Panama, Paraguay, Peru, Uruguay
Henderson (2002)	World/Metro areas	Health and schooling: child mortality rate for children under 5 years old and children per classroom in primary school. Housing: percentage of households with access to potable water (within 200 m) and percentage of households with regular waste collection.	Urban primacy	Urban quality of life	1996	Bolivia, Brazil, Cuba, Ecuador, Peru

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TABLE A1. CONT.
Review of literature on slums and urbanization for LAC countries only

Author(s)	Country/area	Variables/proxies for slums/deprivation	Explicative variable	Dependent Variable	Period	LAC countries in the sample
Henderson and Turner (2020)	World regions	Electricity, safe drinking water, improved sanitation and educational attainment	Density	Quality of life	2010–2016	Colombia 2010, Dominican Republic 2013, Guatemala 2014-15,
Jedwab et al. (2017)	World/Countries	UN-Habitat classification for slums	Internal migration, urban fertility rate, **slum**	Urban population	1960–2010	Colombia, Ecuador, Guatermala, Mexico, Peru.
Marx et al. (2013)	Countries	UN-Habitat classification for slums	Urban growth	**Slums**	1990–2007	Mexico, Brazil
Obaco et al. (2021)	Ecuador/Provinces	Electricity, safe drinking water, improved sanitation, overcrowding and housing assets	Urban population	Deprivation	2010–2017	Ecuador
Ooi and Phua (2007)	World/Continents	UN-Habitat classification for slums	Urbanization	**Slums**		Asia, Eastern Asia, South-Central Asia, South-East Asia, West Asia, global total
Ravallion et al. (2007)	World/Continents	Monetary measure	Urban growth	Poor and headcount index	1993–2002	East Asia and Pacific, China, Eastern Europe and Central Asia, Latin America and the Caribbean, Middle East and North America, South Asia, India, Sub-Saharan Africa
Sekkat, K. (2016)	World/Countries	Monetary measure	Urban concentration	Poverty headcount ratio	1980–2010	Bolivia, Brazil, Colombia, Costa Rica, Dominican Rep., Ecuador, El Salvador, Guatemala, Honduras, Nicaragua

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TABLE A1. CONT.
Review of literature on slums and urbanization for LAC countries only

Author(s)	Country/area	Variables/proxies for slums/deprivation	Explicative variable	Dependent Variable	Period	LAC countries in the sample
Woo and Jun (2020)	World/Countries	UN-Habitat classification for slums	Globalization index, urban population and urban growth	**Slums**	1995, 2005, 2014	Dominican Republic, Mexico, Guatemala, Honduras, El Salvador, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Ecuador, Peru, Brazil, Bolivia, Paraguay, Chile, Argentina.

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TABLE A2.
Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Slum	1.000						
(2) Prim	0.056	1.000					
(3) PG	-0.021	0.339	1.000				
(4) Educ	-0.092	-0.267	-0.224	1.000			
(5) Urban	-0.516	-0.439	-0.285	0.045	1.000		
(6) Fertility	0.730	-0.010	-0.015	-0.181	-0.432	1.000	
(7) NetMig	-0.267	0.213	0.071	0.200	0.074	-0.188	1.000

TABLE A3.
Variance inflation factor

	VIF	1/VIF
Primacy	1.4	.714
Log(GDPper)	1.344	.744
PG	1.148	.871
Mean VIF	1.297	.

TABLE A4.
Hausman (1978) specification test for Equation (1)

	Coef.
Chi-square test value	16.687
P-value	0.0001

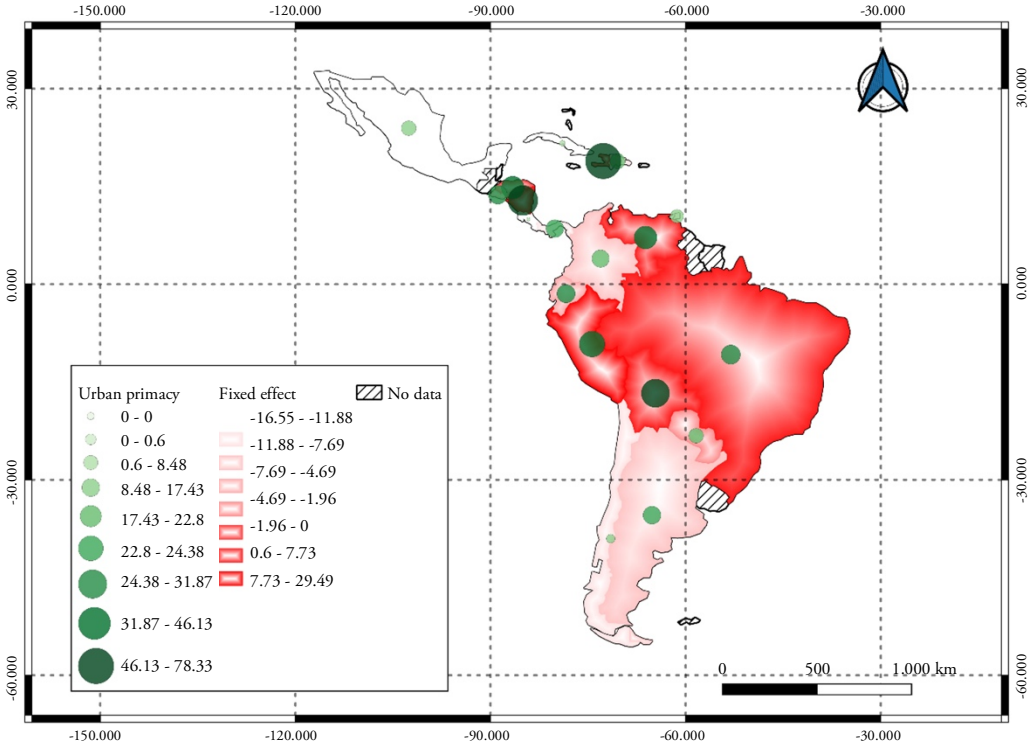
TABLE A5.
Hausman (1978) specification test for Equation (2)

	Coef.
Chi-square test value	16.14
P-value	0.0001

TABLE A6.
Hausman (1978) specification test for Equation (3)

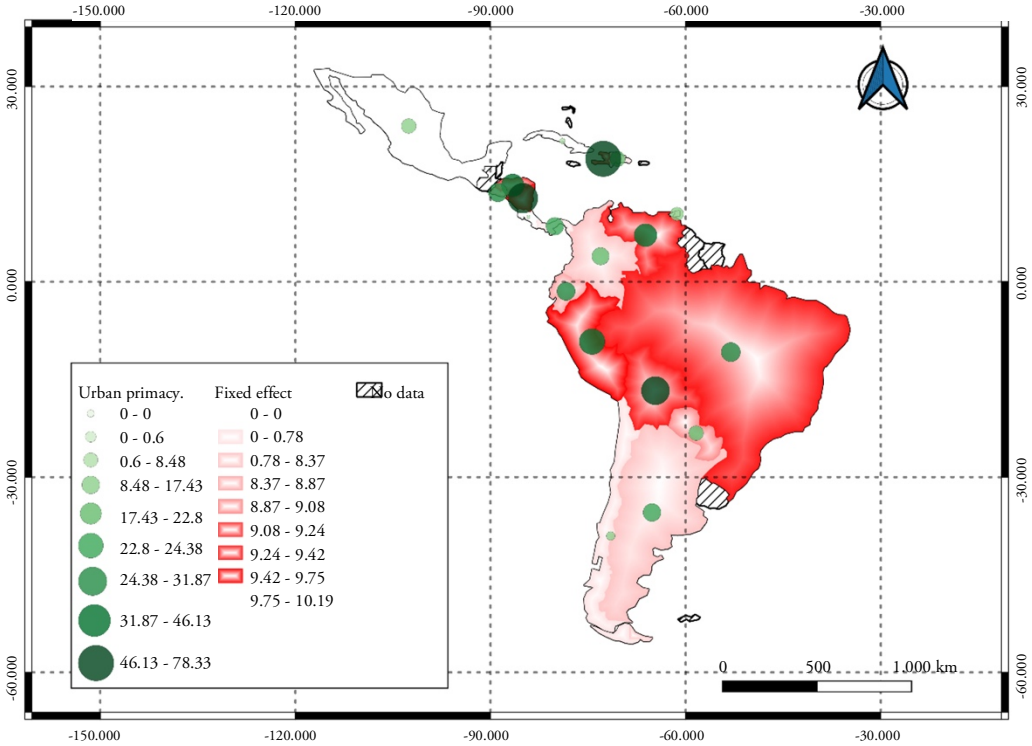
	Coef.
Chi-square test value	16.69
P-value	0.0002

FIGURE A1.
Fixed effects estimated from Equation (2), and urban concentration



Source: Authors' own elaboration of CEPALStat and World Bank data.

FIGURE A2.
Fixed effects estimated from Equation (3), and urban concentration



Source: Authors' own elaboration of CEPALStat and World Bank data.