Investigación

Levels of Urban Primacy in the Urban System of the Administrative and Planning Region of the Coffee Region*

[English Version]

Niveles de primacía urbana en el sistema urbano de la Región Administrativa y de Planificación del Eje Cafetero

Níveis de primazia urbana no sistema urbano da Região Administrativa e de Planejamento do Eje Cafetero

Received 05 May 2022. Accepted 19 July 2022

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› *How to quote:*
Gaviria, M. A, Galvis, D.M & Aristizábal, A.F. (2023). Levels of Urban Primacy in the Urban System of the Administrative and Planning Region of the Coffee Region. *Ánfora*, *30*(55), 176-200. https://doi.org/10.30854/anf.v30.n55.2023.946
Universidad Autónoma de Manizales. L-ISSN 0121-6538. E-ISSN 2248-6941.

* Article derived from the "RAP Eje Cafetero, territorialidad y sistema de ciudades" research project, financed by the Universidad Católica de Pereira and registered in the Research and Innovation Department with code CI-020-04. Declaration of interests: The authors declare that there is no conflict of interest. Data availability: All relevant data can be found in the paper.

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Abstract

Objective: The article explores the existing scenarios and premium dynamics in the Coffee Axis Administrative and Planning Region (RAP EC) and its departmental entities. **Methodology:** For this purpose, researchers started from the range-size principle and distanced themselves from approaches that associated urban primacy with dysfunctionality in the spatial system under analysis, conceiving it as a particular aspect of urban concentration characteristic of capitalist development. The municipality was adopted as the spatial unit of analysis, and the population variable recorded by DANE in the 1985, 1993, 2005, and 2018 censuses was taken as input. **Results:** Indicators of inequality in the spatial distribution of this population were estimated, and indicators of urban primacy and chronological intensity in the evolution of this primacy condition were calculated. The information obtained in this way served to demonstrate the presence of primacy conditions at the departmental level, but the absence of such circumstances at the regional level. **Conclusions:** These results allowed concluding that there is a polycentric organization of the system of cities in the RAP EC, which constitutes a development asset favoring territorial cohesion in the region. This organization is based on the articulation of the departmental capitals.

Keywords: urban concentration; urban hierarchy; urban dynamics; city system; primacy.

Resumen

Objetivo: en el artículo se exploran los escenarios y la dinámica primacial existentes en la Región Administrativa y de Planificación del Eje Cafetero (RAP EC) y sus entidades departamentales. **Metodología:** para ese propósito se parte del principio rango–tamaño y se toma distancia de los planteamientos que asocian la primacía urbana con una disfuncionalidad en el sistema espacial en análisis, al concebirla como un aspecto particular de la concentración urbana característica del desarrollo capitalista. Se adopta como unidad espacial de análisis el municipio, y se toma como insumo la variable de población registrada por el DANE en los censos de 1985, 1993, 2005 y 2018. **Resultados:** se estiman indicadores de desigualdad en la distribución espacial de esa población, y se calculan indicadores de primacía urbana y de intensidad cronológica en la evolución de esa condición primacial. La información así obtenida sirvió para evidenciar la presencia de condiciones primaciales a nivel de departamentos, pero inexistencia de tales circunstancias en la escala regional. **Conclusiones:** estos resultados permiten concluir sobre la presencia de una organización policéntrica del sistema de ciudades de la RAP EC, que con fundamento en la articulación de las capitales de departamento se constituye en un activo de desarrollo que favorece la cohesión territorial en la región.

Palabras clave: concentración urbana; jerarquía urbana; dinámica urbana; sistema de ciudades; primacía.

Resumo

Objetivo: O artigo explora os cenários existentes e a dinâmica primacial na Região Administrativa e de Planejamento do Eixo Cafeeiro (RAP EC) e suas entidades departamentais. **Metodologia:** Para este fim, partimos do princípio do tamanho de faixa e nos distanciamos das abordagens que associam a primazia urbana à disfuncionalidade no sistema espacial em análise, concebendo-a como um aspecto particular da concentração urbana característica do desenvolvimento capitalista. O município é adotado como a unidade espacial de análise, e a variável populacional registrada pela DANE nos censos de 1985, 1993, 2005 e 2018 é utilizada como input. **Resultados:** São estimados indicadores de desigualdade na distribuição espacial desta população, e são calculados indicadores de primazia urbana e de intensidade cronológica na evolução desta condição de primazia. As informações assim obtidas serviram para demonstrar a presença de condições de primazia a nível departamental, mas a ausência de tais circunstâncias a nível regional. **Conclusões:** Estes resultados nos permitem concluir sobre a presença de uma organização policêntrica do sistema de cidades no RAP CE, que, com base na articulação das capitais departamentais, constitui um ativo de desenvolvimento que favorece a coesão territorial na região.

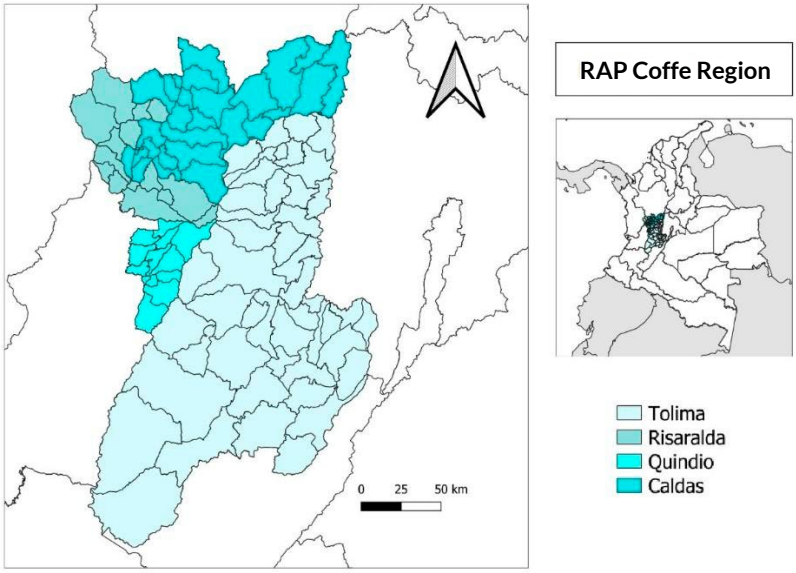
Palavras-chave: concentração urbana; hierarquia urbana; dinâmica urbana; sistema de cidades; primazia.

Introduction

In the study and understanding of urban dynamics, the socio-spatial condition of urban primacy has been of priority interest. In the interpretation of these results, some approaches observe it as a manifestation of dysfunctionality in the conformation of a system of cities. Others consider it a particular expression of the process of urban concentration characteristic of capitalist development.

In addition to the interest in studying this urban phenomenon at the regional level, there is a need to advance the identification and understanding of the various elements that influence the territorial planning of the Coffee Region Administrative and Planning Region (RAP EC). The Coffee Axis is a territorial association that integrates the Colombian departments of Caldas, Risaralda, Quindío, and Tolima, along with their 100 municipalities (Figure 1). Among its defining elements are the spatial distribution of the population and the phenomena of urban concentration.

Figure 1. Administrative and Planning Region of the Coffee-growing Axis (RAP EC).



Aligned with academic and regional development management concerns, this document presents the results of a study on the conditions and primary dynamics present in the RAP EC. The theoretical approach of this work is based

on the rank-size principle, which defines the population of a city (or municipality) according to the position it occupies, based on population size, in the group of cities within the region under study.

Urban primacy is understood as a specific structure of a city system in which the largest city has a significantly higher population than the other cities, indicating an excessive weight in the system's configuration and functioning. In addition to other approaches, Cuervo's proposal (2004) is accepted, interpreting urban primacy as contradicting the so-called "Zipf's Law" and as a specific aspect of urban concentration. In this way, it distances itself from approaches that associate it with dysfunctionality in the urban system under analysis.

The methodological design utilized the rank-size principle to estimate indicators of inequality in the spatial distribution of the population. This exercise was complemented by calculating conventional indicators of urban primacy, as well as an indicator of chronological intensity to analyze the evolution of these primacy conditions. Estimates and calculations of indicators were made at the departmental and regional levels.

In addition to this introduction, the structure of the document includes four other sections containing a review of the theoretical and study background. This section discusses the approach of urban primacy as dysfunctionality and also includes a review of some previous national and international works. Likewise, the document provides a description of the methodological aspects that guided the proposed analysis and the presentation of the results. It highlights that, unlike what was observed at the departmental scale, at the level of the RAP EC, the evidence obtained allows ruling out the presence of primacy conditions. Instead, a polycentric configuration is evident in its system of cities. Finally, the conclusions section proposes this polycentric condition as a development asset that favors territorial cohesion in the region.

Theoretical and Study Backgrounds

The concept of "urban primacy" emerged as counter-evidence to the consideration that the "desirable" behavior of an urban network requires that the size of cities behave as an arithmetic function of their rank, which is known in different fields as Zipf's Law. Given this normative condition, primacy has traditionally been interpreted as a symptom of dysfunctionality or disintegration of the urban network. However, this interpretation neglects the fact that this law corresponds more to a particular version of the rank-size principle, as proposed by Cuervo (2004).

The rank-size principle was initially proposed by Auerbach in 1913 (as cited in Cuervo, 2004). It explains the population *Pi* of city *i* as a function of its rank *ri*, defined in decreasing order of size within the national or regional set of cities (equation 1).

$$(1) \quad P_i = \frac{K}{r_i^q}$$

The parameter *q* is close to one (1) in absolute value, and *K* corresponds to the size of the largest city; since *P1 = K/1*.

G.K. Zipf (as cited in Pumain and Saint-Julien, 2014) popularized a particular version of the rank-size principle, known as Zipf's Law, based on his studies on city size distributions and observed regularities. In this case, he considered the value of parameter *q* equal to one (1), so that the relationship contained in equation 1 describes the population size of the cities as an inverse proportion of their rank: the second city has half the population of the first, the third one third, the fourth one fourth, and so on successively. This relationship in Zipf's approach assumed a normative character, as an expression of the degree of unity and integration of the respective urban system (Cuervo, 2004).

Urban primacy constitutes the main counter evidence to Zipf's Law. In the first place, because it constitutes a phenomenon in which the relationships between the first city of a country (region) and its urban network are characterized by an excessive weight in the way the latter is configured and functions. Secondly, the presence of primacy conditions in a system of cities is not necessarily indicative of dysfunctionality, as noted by Cuervo (2004).

Referring to urban primacy as an expression of abnormality in the configuration of a system of cities in Latin America, Manuel Castells (1973) introduced the term "macrocephaly" in urban research as part of his theory of dependent urbanization. This expression originates from medicine and refers to a pathological state that requires treatment. In Castells' approach, it is used to describe the existence of major cities or urban centers that are disproportionately larger than the rest of the cities in the system that support them.

In Castells' approach, urban macrocephaly is an expression of a structural dysfunction characteristic of Latin American urban systems. It corresponds to a social pathology that is considered peculiar to the Latin American case, and the possibility that it constitutes a generic disease of capitalist urbanization is ruled out. Therefore, speaking of urban macrocephaly implies, according to the theory of dependent urbanization, recognizing a particular "structural malformation" of the Latin American case.

However, the process of urban concentration, as a phenomenon associated with the primacy condition of a city, is inherent to industrial capitalist development (Singer, 1979). In reference to this, Neil Smith (2020) warns that uneven development and territorial inequality are phenomena closely linked to the capitalist system: "Uneven development is the concrete manifestation of the production of space in capitalism" (p. 129). In correspondence with the above, it cannot be affirmed that primacy as urban macrocephaly is a peculiar aspect of the Latin American urbanization process. In a historical-comparative analysis, Cuervo (2004) evidences the presence of these conditions in Western and Eastern European countries during the 19th and 20th centuries. Likewise, Pumain and Saint-Julien (2014) highlight the existence of this urban condition in all the countries of the world, although to a greater degree in developing countries. For this reason, they consider it a rule rather than an anomaly in the configuration of urban systems.

Similarly, it is not clear to argue that urban macrocephaly corresponds to a structural "dysfunctionality," in the sense that it generates obstacles to the process of capitalist accumulation; on the contrary, the urban concentration that accompanies it, can generate advantages of agglomeration due to economies of urbanization. With this, exchange, correspondence and learning are facilitated (Fujita et al., 2000; Duranton & Puga, 2003).

In relation to the above, in the 2009 world development report, prepared by the International Bank for Reconstruction and Development (World Bank, 2009), it is argued that one of the transformations that has favored the good performance of economies, is the greater density of cities. In this way, proximity produces immense benefits and eases access to the world of agglomeration economies, and warns that the development of the territories will continue to be unbalanced, although it can and should be inclusive: "Growing cities, the mobile population and dynamic trade have been the catalysts of progress in the developed world for the past two centuries. Now these forces are driving the most dynamic parts of the developing world" (p. 13).

In Colombia, the mission of experts for the strengthening of the system of cities, created by the National Planning Department (DNP, 2014), bases its analysis on a conceptual framework focused on the urbanization and agglomeration phenomenon. From this, it is highlighted that cities have acquired and will continue to occupy a leading role as "engines of development" due to their ability to achieve better use of economies of scale. This favors an increase in integral development and the reduction of poverty in the country. Correspondingly, it formulates six strategic lines aimed at promoting from the nation the economic, social, and territorial development of cities as a system.

Therefore, like *Zipf's Law*, there is no normative basis to consider the presence of urban primacy as an expression of some abnormality. Consequently, in Cuervo's line (2004), this urban phenomenon is not assumed as dysfunctionality or abnormality, but is seen as a particular and specific dimension of a more general and comprehensive process: that of urban concentration. This orientation, it is intended to demonstrate that the relationships between the first cities of the RAP EC and the rest of the municipal entities are characterized by an excessive weight, in the way in which the urban system that they integrate works and is configured.

Among the factors associated with the condition of urban primacy, Cuervo (2004) argues that its historical trajectory has been related to socioeconomic transformations and industrialization phases, highlighting a certain inertia in the process that reduces the possibility of abrupt changes as a result of these transformations. Alternatively, the fundamental determinants of the synchronous function of urban primacy are related to the size of the country (region), the degree of territorial integration, the maturity of the urbanization process, and the urban network structure.

A larger area tends to reduce the degree of primacy, since it is more demanding for the larger city to impose a certain monopoly or hegemony of an economic, political, or social nature. Greater integration of the national (regional) space contributes to expanding the radius of influence of the primary city, thus expanding its possibilities of becoming a hegemonic city. In relation to the above, the disintegration of spaces may be associated with geographical accidents that isolate regions, with ethnic, socioeconomic, cultural, religious or linguistic differences. In turn, this may be the manifestation of a weak state intervention capacity at the regional level (Cuervo, 2004).

The urban phenomenon of primacy is the subject of research in different fields and scales. Some recent studies at the Latin American level are those of Parnreiter (2005), Antillón (2013), Navarrete (2017), and Gómez (2020). Parnreiter (2005) sets out to study the repercussions of globalization on urban development in Latin America in a comparative exercise for Mexico and Chile, and considers the development of urban primacy as one of the aspects to be analyzed. He observed a reduction in the demographic primacy of Mexico City, driven by integration into the North American economic zone, while in Santiago de Chile the growth of the advanced services sector was decisive for the conservation of its primary condition.

In a historical analysis, Antillón (2013) reviewed the evolution of urban primacy in Nicaragua between 1870 and 1950 —a period in which the city of Managua consolidated itself as the primary city of its urban system— in a process linked to the transition of the Nicaraguan economy from commercial capitalism, oriented to the export of raw materials and agricultural products, to

an incipient industrial capitalism. In his statements, the author highlighted "the importance of considering primacy, not only in demographic terms, but also in political, administrative and infrastructure terms" (p. 27), phenomena that were widely related.

With a different approach, Gómez (2020) explored the relationship between public spending, subnational taxation and reduction of urban primacy. For the analysis, he used a sample of 38 countries (16 from Latin America and 22 from other regions around the world), considering primacy as the dependent variable, and spending and the decentralized public finances as the independent variables. In this way, he was able to show an inverse relationship that suggests that more efficient decentralized public spending contributes to the reduction of urban primacy.

Another variant in the analysis is the one proposed in the works of Navarrete (2017) and Schweitzer (2020). The first conducts a study with a historical-chronological approach in which the impact that was and still is generated by the conflicts for urban primacy in Honduras is explored. The second identifies the roots of urban concentration, primacy, and macrocephaly in Argentina, relating these processes to the development models that the country went through to advance in proposals for territorial reorganization.

In the Colombian case, recent works include those by Montoya (2013), Gallego and Suárez (2017) and Rubiano and Eligio (2019). Montoya (2013) argues that with the momentum of globalization, at the national level, centripetal forces tend to prevail over centrifugal ones. This makes evident the transformation of the urban model, in force until the eighties of the 20th century, toward an urban network with a central axis in Bogotá, which gradually strengthens its position as a primary city at the national level. It also warns that urban systems, such as the Coffee Axis, have lost their relevance in the national context.

Gallego and Suárez (2017) suggest that the current characterization of Colombia's urban concentration process is one of "First nature" configuration, in which Bogotá established itself as the country's most important economic hub as a result of initial relief conditions, state intervention, and an economic transformation process focused on industrialization. The authors advise that "for the Colombian case, the primary process of urbanization led to an enlargement of regional disparities, limiting as a result the country's economic development" (p. 56).

Finally, in a comparative study, Rubiano and Eligio (2019) discuss the revision of the population, economic, and state-level fundamentals in the Administrative and Special Central Planning Region (RAP Central) and the Administrative and Pacific Planning Region (RAP Pacific), from which they identify the presence of what they refer to as "urban macrocephalites" produced by Bogota and Cali.

According to their interpretation, this is an inappropriate configuration that leads to asymmetries with the cities over which they have immediate influence. As a result, it is necessary to put into practice a model that deconcentrates and takes note of this phenomenon.

Pioneering studies include those by Goueset (1998) and Cuervo (2004). The first provides evidence that shows that in Colombia, the first take off in the area around Bogota began in the 1950s. Goueset advises that the two periods of greatest intensity for the primary concentration of the country's capital took place between 1964 and 1973 and 1985 and 1990. This allows saying that this is a relatively recent socio-political development in the country, unlike its counterparts in Latin America, where this process has roots that go back to the early 20th century or even earlier.

Cuervo's (2004) is a substantial theoretical and methodological foundation for many earlier works; in it, the historical and spatial factors that determine urban primacy are discussed for 19 countries, including Colombia, three from western Europe, three from eastern Europe, seven from central America, and six from southern America. It is important to note that, in contrast to other continents, Latin America does not exhibit the same degree of industrial decline and urbanization as other continents. Colombia, however, exhibits a direct correlation between economic growth and urbanization, with levels and intensities that are lower than those of other countries in the region but higher than those of European countries.

Methodology

In RAP EC, which is made up of four departments, the following municipal conditions and dynamics are studied: A group of 100 territorial city entities, including Caldas, Quindío, Risaralda, and Tolima. The analysis' spatial unit is the municipality, and the observational variable is the population as recorded in the National Statistical Office's 1985, 1993, 2005, and 2018 censuses (DANE).

Beginning with the range-size principle, and using a univariate lineal regression exercise, the parameter q is estimated. It is a measure of the size disparity between cities based on their populations, with the more pronounced disparity being greater than its absolute value. Due to this, equation 1 is linearized by applying natural logarithms to both sides of the equation, resulting in equation 2[1].

1 According to Pumain and Saint-Julien (2014), this estimate attempts to adjust the observed distribution of the population to a statistical distribution model before establishing a dependency relationship between the population and the range of the cities, which is inappropriate given that, in the construction of the initial

$$(2) \quad LnP_i = A - qLnr_i$$

An absolute value of q that is different from one (1) is evidence against the Zipf Law, so a value above the unit is a first sign of the presence of fundamental conditions in the studied city system. To determine this final point, the regional and departmental population indices for the two (S2), four (S4), and one (S11) cities are calculated.

$$S2 = \frac{P1}{P2}$$

$$S4 = \frac{P1}{P2 + P3 + P4}$$

$$S11 = \frac{2P1}{P2 + P3 + \cdots \ldots P11}$$

The populations of the cities in ranges 1, 2, 3, 4, ..., and 11 are represented by P1, P2, P3, P4, ..., and P11, respectively.

Analyzing the results of these calculations, it is taken into consideration that the distribution of the population and the size of the cities are in accordance with the so-called Zipf Law when *S2=2*, *S4=1*, *and S11=1*. *When S2>2 (S22)*, *S4>1 (S41)*, and *S11>1 (S11<1)* occur, the urban system exhibits a tendency toward concentration (dispersion), meaning that there are larger (small) cities than those that adhere to the rule of range-size. In this sense, fundamental conditions in the city system can be seen (Zhuoyong, 2008).

Finally, the Coefficient of Chronological Intensity (CIC), proposed by Cuervo (2004) and calculated using the index of the four cities, is used to estimate the Chronological intensity in the evolution of those initial conditions:

$$CIC = \frac{S4_i - S4_j}{i - j}$$

With $S4_i$ y $S4_j$ the primacy index for the four cities for years i and j, with i marking the conclusion of a period of urban primacy evolution and j marking the year that the period's evolution first began.

equation, the range is determined from the population.

Primacy Conditions in the RAP EC

According to data from the 2018 DANE national census of population and housing, there are 3,811,747 people living in the RAP EC, with about 75% of them living in the city and the remaining 25% living in urban centers and rural areas This geographical area contains 7.9% of the country's population, with Tolima having the most residents there (34.9%), followed by Caldas, Risaralda, and Quindío (departmental entities accounting for 26.2%, 24.7%, and 14.2% of the population, respectively) (Table 1).

Table 1. RAP EC. Population by departments.

	1985		1993		2005		2018		Municipios
	Total	%	Total	%	Total	%	Total	%	
Caldas	960.260	29.3	993.536	28.5	996.434	27.0	998.255	26.2	27
Risaralda	681.414	20.8	775.112	22.2	877.974	23.8	943.401	24.7	14
Quindío	450.100	13.7	477.438	13.7	511.181	13.9	539.904	14.2	12
Tolima	1.186.822	36.2	1.244.218	35.6	1.304.216	35.3	1.330.187	34.9	47
RAP	3.278.596	100	3.490.304	100	3.689.805	100	3.811.747	100	100

Source: calculations based on DANE census data.

The municipalities' largest cities are their respective departments' capitals: The four municipalities where 45.3% of the RAP EC's population is concentrated are Ibagué (529,635 residents), Pereira (467,269 residents), Manizales (434,403 residents), and Armenia (295,208 residents). Another town that stands out for its population is Dosquebradas, which has 217,178 residents. The remaining towns all have populations under 100,000, with eight of them having more than 50,000 residents, ten having between 30,000 and 50,000, and 77 having fewer than 30,000.

Recent data show that between 2005 and 2018, the region's population grew by 0.25 percent annually on average, significantly less than the 0.9% national average. Tolima and Caldas, the two departments with the highest population in the RAP, registered a lower population dynamic throughout the analysis period, and they reached annual growth rates of 0.15% and 0.01%, respectively, in the most recent intercensal period. These numbers were lower than those of Quindío (0.42%) and Risaralda (0.55%). This resulted in their sustained loss of participation in the region's overall population.

The municipalities of Villamaria and Riosucio in Caldas are the ones that exhibit the most dynamic growth on a local level, with intercensal population growth rates ranging between 1% and 1.55%. The first is adjacent to Manizales city and both of these municipalities have significant commercial activity. Dosquebradas, a Risaraldense municipality adds significant industrial activity to the commercial development, and the other is Pueblo Rico. The final two, Melgar (Tolima) and Salento (Quindío), have distinctive tourist attractions that define their dynamics.

Table 2 shows the results of the estimation of the parameter q for departments and RAP EC are recorded, in all cases the estimated coefficient is statistically different from zero. Its absolute value is greater for the departments of Quindío and Risaralda. This denotes greater inequality in the population size of its municipalities. According to the national census in 1993, Caldas, Tolima, and the RAP EC there was an absolute value of q lower than the unit; that evidenced a more balanced distribution of the population between its territorial entities, but, after the census, only the department of Tolima retained that condition.

The position of Risaralda and Quindío has to do with the size and degree of integration of their territory. The reduced size of Quindío and the fact that both departments have a strong connection between their municipalities and the capital cities and urban area favored the economic, political, and social hegemony of Pereira and Armenia. Another reason is that in these departments, the capital is imposed as the only regional center of provision of services and attractions, and the corresponding subcenters are located in the municipalities of Dosquebradas and Calarcá. Manizales, as the capital city of Caldas, shares the condition of regional center with La Dorada, a municipality in the Northeast of the department, and two of its subcenters, Riosucio and Supía, they are equally distanced north of the departmental entity (Gaviria & Aristizábal, 2020).

In the case of Tolima, its large size and limited territorial integration of its capital Ibagué join to explain its condition of department with a greater and persistent population dispersion. This is shown by the low degree of labor disruption of the population of the neighboring municipalities, it led it to be classified by the Mission for the strengthening of the City System as an only cluster city (DNP, 2014).

Table 2. RAP EC. Coefficient of size inequality of cities.

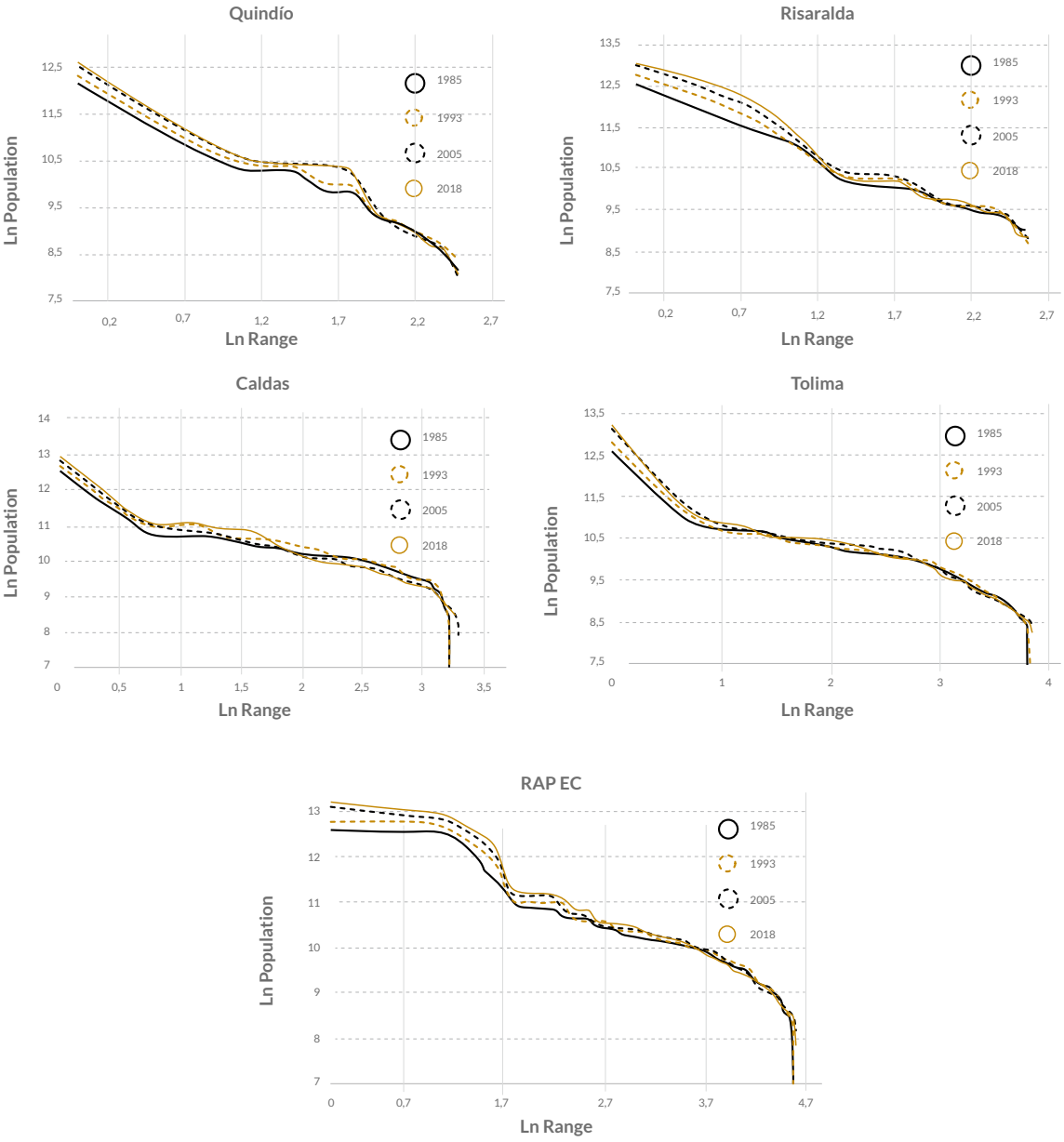
	Quindío				Risaralda			
	1985	**1993**	**2005**	**2018**	**1985**	**1993**	**2005**	**2018**
q	-1.466	-1.489	-1.489	-1.646	-1.299	-1.402	-1.507	-1.538
R^2	0.974	0.974	0.974	0.921	0.980	0.969	0.972	0.931
Std error	0.081	0.077	0.077	0.152	0.054	0.073	0.074	0.121
Prob	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Caldas				**Tolima**			
	1985	**1993**	**2005**	**2018**	**1985**	**1993**	**2005**	**2018**
q	-0.910	-0.982	-1.044	-1.114	-0.853	-0.891	-0.898	-0.909
R2	0.868	0.889	0.858	0.856	0.912	0.895	0.816	0.801
Std error	0.074	0.073	0.085	0.091	0.040	0.046	0.064	0.068
Prob	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

RAP EC				
	1985	**1993**	**2005**	**2018**
q	-0.918	-0.972	-1.049	-1.091
R^2	0.931	0.932	0.952	0.956
Std error	0.026	0.027	0.024	0.024
Prob	0.000	0.000	0.000	0.000

Source: Calculations based on DANE census data.

A common fact among the four departments and the RAP EC is the growing trend that shows the parameter *q* in its absolute value; it is reflected in the upward behavior of the curve slope that relates the natural logarithm of the range and the size of the municipalities (Figure 2). At the regional level, both behaviors show an increase in inequality in population distribution between their municipalities. It suggests an advance in population concentration processes that may be configuring or deepening primacy conditions on departmental and/or regional scales.

Figure 2. RAP EC, Range relationship – size, departments and region.



Source: Calculations based on DANE census data.

To review the presence of primacy conditions in the EC RAP, departments and dynamics of evolution, the primacy indices S2, S4, S11 and the Chronological Intensity Coefficient (CIC) recorded in Table 3 and Figure 3 were calculated. On the departmental scale, although with significant differences in their degrees, the four entities that are part of the planning region show primacy conditions of their capital due to $S2>2$, $S4>1$ and $S11>1$ values.

The lowest primacy condition is observed in Risaralda and it has decreased in the last intercensal periods. This is largely explained by the population expansion of the municipality of Dosquebradas, connected to the capital city Pereira, it has the largest recent annual intercensal growth of 1.23% in the department; it is higher by 0.53 percentage points to its capital. This department entity registered its largest primacy dynamic between 1993 and 2000 due to the migration to the capital and its urban area driven by the crisis of the coffee sector. Thus, while *S2* decreased, *S4* and *S11* indicators showed higher increase.

Contrary to what Cuervo (2004) stated on fundamental determinants of synchronous function of urban primacy, Tolima and Caldas showed the highest degree of primacy. In both cases, the extension and minor territorial integration suggest a limit to the preponderance of their capitals in the way the city systems that comprise them are configured and functioned. However, in the observed situation, the fact that the peripheral municipalities of these departmental entities have been high expellers of population for violence and agricultural crisis weighs more (Dulcey, 2009). It allowed a population growth of the capitals quite higher than the departmental average.

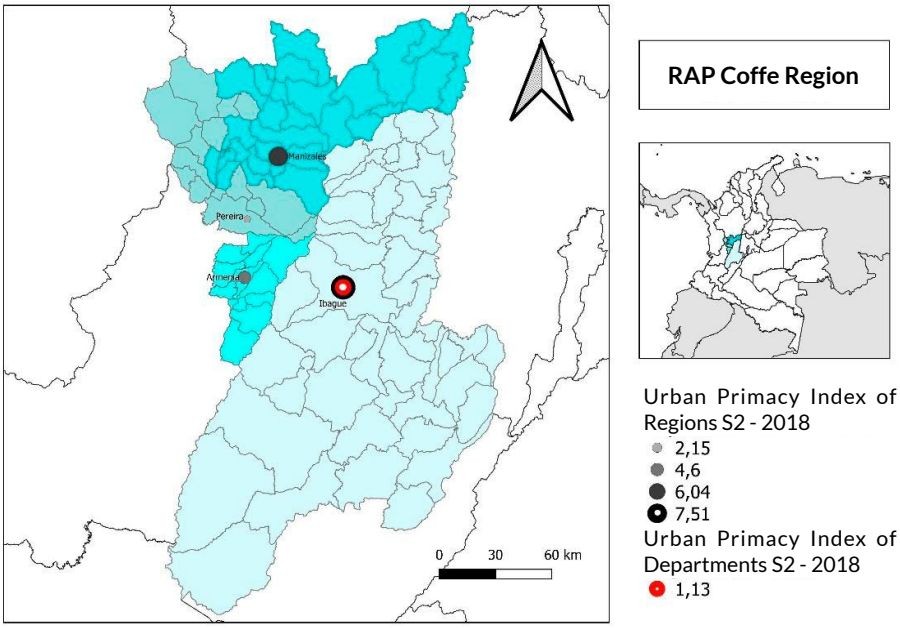
In Caldas, although its primacy condition showed a reduction in 1985 and 1993, the coffee crisis of the end of the last century accelerated this relative depopulation of peripheral municipalities and a greater concentration in the capital. It stopped the population dispersion process and promoted the intense resumption of primacy dynamics in the department at the regional level only surpassed by Tolima.

Table 3. RAP EC: Indicators of Urban Primacy.

Entity	Indicator	1985	1993	2005	2018
Quindío	S2	3.57	3.78	3.81	4.06
	S4	1.68	1.81	1.90	2.06
	S11	1.99	2.15	2.24	2.44
	CIC	0.016	0.008	0.012	
Risaralda	S2	2.84	2.54	2.47	2.15
	S4	1.52	1.53	1.57	1.45
	S11	1.86	1.95	2.11	2.08
	CIC	0.0014	0.0031	-0.0095	
Caldas	S2	5.52	5.13	5.23	6.04
	S4	2.13	1.95	2.21	2.31
	S11	1.76	1.67	2.09	2.24
	CIC	-0.023	0.022	0.008	
Tolima	S2	5.35	5.72	6.57	7.51
	S4	2.08	2.53	3.04	3.34
	S11	1.73	2.11	2.61	2.75
	CIC	0.056	0.043	0.023	
RAP EC	S2	1.02	1.03	1.16	1.13
	S4	0.39	0.40	0.46	0.44
	S11	0.51	0.52	0.61	0.58
	CIC	0.002	0.005	-0.002	

Source: Calculations based on DANE census data.

Figure 3. RAP EC, S2 Urban Primacy Index, 2018.



Source: Calculations based on DANE census data.

To an average degree, Quindío presents a primacy condition with sustained growth, although with a chronological intensity lower than Caldas and Tolima; it is coherent with its smaller geographical extension and greater integration of its territory. As in the previous cases, this rise of urban primacy was widely linked to migration that favored the population concentration in the capital and was driven by the coffee crisis of the late 20th century.

On the regional scale, according to values of the indicators S2<2, S4<1 and S11<1 observed for the RAP EC, no primacy conditions are revealed in the bigger city, Ibagué. By the influence of the presence and size of the capitals Pereira, Manizales, Armenia, and the municipality of Dosquebradas in which each of them houses more than 200,000 inhabitants. The largest dynamics of primacy rise lived between 1993 and 2005 that was influenced by migratory process toward the main urban centers, and this was motivated by the sudden fall of grain prices and the resulting crisis in the coffee activity when Ibagué was a clear recipient of population influxes. (Dulcey, 2009). However, the trend was slowed down in the last intercensal period; it helped to stabilize the levels of dispersion in the spatial distribution of RAP population.

Contrary to the reported in RAP EC, researches for other regions of the country such as the Central and the Pacific RAP, that covers a similar period (Rubiano & Eligio, 2019), show the existence of broad primacy conditions in these territories. In Central RAP whose main city is Bogotá, the S2 indicator reached levels with values between 13 and 15.03; while S4 and S11 values that fluctuated between 5.28 and 7.88. S2 values in the Pacific RAP, whose main city is Cali, ranged from 6.27 to 6.79; S4 values ranged from 2.38 to 2.62; while S11 values ranged from 2.33 to 2.53. In addition to the extensive primacy conditions, the urban system has a population concentration in the main city.

As previously discussed, there is no reason to assign a normative content to this spatial fact and qualify its presence as a dysfunctionality or abnormality in the urban system under consideration given the current state of knowledge on urban primacy. According to Cuervo's (2004) reflection, primacy is assumed to be a specific manifestation of a larger and more general process: urban concentration.

From this perspective, an examination of the phenomenon in the EC RAP revealed a distinct trend toward urban concentration in the capital cities of each of its constituent departments. In the case of Risaralda and its connected areas, there is a concentration of population and economic activity in which the capital cities gain weight in both configuration and functionality of the city system to which they belong. At the regional scale, centrifugal forces continue to supersede centripetal forces, leading to the configuration of an urban network comprising four dominant cities. Furthermore, the spatial distribution of the population within the region exhibits a significant degree of dispersion. The state of dispersion is influenced by the presence of functional centers (La Dorada) and subregional (Riosucio and Supía) of regional organization; and of tourist attraction nodes (Melgar) located in peripheral areas relative to the respective departmental capitals of Caldas and Tolima.

Therefore, the EC RAP shows a "polycentric" arrangement[2] in its urban network wherein the cities of Ibagué, Pereira, Manizales, and Armenia are the primary centers that foster and integrate the system, with the capacity to take turns in leading this endeavor. This condition can undoubtedly serve as a strength and a developmental asset, given that progress is achieved in the integration of these capital cities. In general terms, it is widely accepted that a regional structure comprising different interrelated centers is not only inherently more democratic, but also potentially better equipped to advance its developmental process. Because this structure allows for a conscious and active participation in its processes. (Maturana & Vial, 2011). Due to the same cause, the European

2 The term 'quadricephaly' has been replaced with a more appropriate term for the current situation, because the focus in this study is on an abnormality in the arrangement of cities within the RAP EC system.

Union has incorporated polycentrism into its territorial strategy for mitigating the consequences of an inequitable development, and promoting territorial cohesion.

In relation to the latter, the *Territorial Agenda of the European Union 2020* "promotes polycentric and balanced territorial development" as a first priority, because "it is a key instrument for territorial development and cohesion." It warns that when the most developed cities collaborate as parts of a polycentric system, they add value and act as centers that contribute to the regional development (European Union, 2011, p. 8).

Conclusions

The estimated indicator of inequality in city size allowed the RAP EC to be characterized as a region with a relatively dispersed population among the municipal entities that comprise it, and with special influence of this arrangement of departments of Caldas and Tolima. However, the last two intercensal periods showed that the process was reversed, changing the population distribution conditions among its municipalities. This fact suggests the presence of population concentration processes and the possibility of primacy conditions.

The evidence collected through traditional indicators of urban primacy indicates that, despite the observed decline in population dispersion, there is no presence of primacy conditions on a regional scale in its largest city: Ibagué. On the contrary, the EC RAP city system has a polycentric organization in which the four departmental capitals stand out: Ibagué, Pereira, Manizales, and Armenia all have functional characteristics that allow them to exercise regional development leadership.

This polycentric condition is a strength and a developmental asset for the administrative and planning region, because, based on the structures of the centers, urban nuclei with varying degrees of spatial interaction are favored. This is evident in various aspects, such as population mobility, the flow of information, and the exchange of goods and services, which collectively establish an interdependent regional system that relies on the interconnection of different centers. Currently, the latter is reinforced by various factors including the presence of transportation infrastructure, specifically the Coffee Highway and Bogotá-Buenaventura trunk road; the alignment of environmental goals in the vicinity of the Nevados National Natural Park; and the robust historical and cultural connections.

This interconnection mentioned here plays a significant role in the organization of the RAP EC's city system which facilitates agglomeration advantages for the smaller municipalities, thereby moving toward a more equitable and territorial cohesive development. The RAP EC is characterized by a significant number of small municipalities with 77% of them having fewer than 30,000 inhabitants. As a result, these municipalities are exempt from the issues associated with population concentration, such as pollution, road congestion, urban deterioration, and social exclusion. However, this situation also creates a spatial separation between these municipalities and the benefits of agglomeration economies for productive investment. How can these entities avail themselves of the agglomeration advantages enjoyed by their capital cities? The solution is to encourage collaboration, interaction and interconnectivity between these municipalities and their major cities.

The Regional Administrative Program for Economic Cooperation (RAP EC) must prioritize the development of interconnectivity among its territorial entities leading to the consolidation of a polycentric network in order that these small municipalities benefit from the productivity increase of economic concentration. In accordance with the provisions of the Law on Regions —specifically Law 1962 of 2019— which establishes the functions of the Administrative and Planning regions to promote the creation and strengthening of city networks as drivers of regional development (Art. 4). This highlights the importance of promoting relationships amongst territorial entities, grounded in both physical and digital connectivity. Additionally, establishing a regional university system geared toward the creation of a research and innovation network, as well as the consolidation of business alliances, among other considerations.

The "Technical Support Document" was presented to the Territorial Planning Commission of the Senate of the Republic of Colombia to establish the RAP EC. It outlined seven strategic planning and management axes. The "Regional Strategic Plan" for RAP EC, 2021 identified three regional facts based on these axes, namely equity, knowledge economy, and sustainable territory. As part of the regional fact of the knowledge economy, one of the objectives is the development of a modern and competitive digital and intermodal infrastructure that strengthens the region's connectivity with the rest of the country and the world. The consolidation of an intermodal system is also being planned to improve the region's connectivity with the main consumption centers of the country and its seaports, thereby positioning itself as the central node through which 70% of the country's cargo passes. However, these proposals primarily emphasize interregional linkages, while relegating the intraregional articulation to a secondary position despite the latter favoring territorial cohesion and equitable development within the region.

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