



## RESUMEN AMPLIADO

**Título:** City size and Slums: Evidence from Ecuador

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This paper analyzes the relationship between urban growth and quality of life. We use Ecuador as case of study and slums as indicator of the minimum of quality of life offers by the cities. We pay more attention to the case of Guayaquil as the larger cities in the developing world suffers from higher rates of slums. We use eight variables to define our slum measure, and evaluate the period 1990, 2001, and 2010. We find that more than half of the households in cities of Ecuador has at least one slum characteristics. However, the global tendency is that larger cities offer lower slum level. To address the slum level, we build a slum index which weight were measured by two options; adding dummies and Principal Components Analysis. To summarize, Guayaquil shows a pattern in which new areas are based on slum characteristics. Following the ideas of slum creation we focus on two explanations, a rapid urbanization and an incapacity to reduce inequality generating urban poverty. Both explanations are associated to the slum creations in Ecuador and in Guayaquil.

**Keywords:** Slums; FUAs; Quality of life; developing countries; Ecuador.

**JEL classification:** R10, R11, R1



## City size and Slums: Evidence from Ecuador

As we have seen in the previous chapter, cities are centers of production, enjoying a list of advantages derived from the three main sources of agglomeration: learning, sharing and matching. The demand for density comes then from workers and firms. On the contrary, costs of cities are usually seen from the consumption side: workers face higher rents in large cities, they commute longer, suffer higher crime rates and pollution. As Glaeser et al. (2001) stressed, cities are good for production and bad for consumption.

Nevertheless, such view is far from reality. As cities get bigger they might play a superior function in the territorial system (the neoclassical supply-oriented dynamic approach, Camagni et al., 1989, Royuela and Suriñach, 2005) and can enjoy a large variety of consumer goods and personal services or better and superior public services, such as Universities or large and good hospitals. These can be linked to the concept of sharing. Glaeser et al. (2001) also list as a consumption advantage of cities the way they allow for facilitating enjoyable social contact

. Agglomeration Quality of life (QoL) and urbanization is a transcendental topic for developing economies because one can think that cities usually offer better QoL, but it seems not to be the case in cities of the developing world. The urbanization in the developing world is characterized by extreme poverty and bad quality of their institutions (Glaeser and Henderson, 2017). As fact, two-thirds of the global population live in developing regions and around 30% of this urban population in the developing world are living in slums (UN-Habitat (2015). This fact directly affects to the standard of living in cities due to the lack of planning and management of the urban areas, and of course, the coverage of basic infrastructure offered by the cities.

In this case, we address the consideration of slums in cities of the developing world. Slums are generally defined as informal settlements (UN-Habitat, 2003). Indeed, slums are the parts of the cities usually located at the borders of the cities, characterized by housing that are built by non-durable materials with lack of basic needs and generally overcrowded.

Glaeser (2011) suggests that slums bring opportunities to poor and non-educated workers to benefit from agglomeration effects, because larger cities present higher wages and better and larger amenities. Thus, they can improve their QoL over the time. In fact, United Nations (2015) mentions some specific cases of slums where the people have improved their initial living conditions over time, but there is also evidence of the other way around. Marx et al. (2013)



show that people born in slums live most of their life in slums, or if they moved they do to a different slum, thus hardly improving their QoL.

On the other hand, the lack of access to basic needs might pick down the agglomeration effects (Castell-Quintana, 2016). He shows that there is not only needed urbanization to benefit from the agglomeration, but the basic infrastructure is also very relevant. The urban growth seems not strongly correlated with development and economic growth in the developing world (Chen et al., 2014; Castell-Quintana, 2016). The World Bank (2011) also considers the importance of the covering of the basic infrastructure for the good work of cities. Combes and Gobillon (2015) suggest that the topic of welfare analysis across areas has been less studied in the literature of agglomeration effects. It is important to know if the benefits of agglomeration expressed in higher wages for workers are being translated into a better welfare for both skilled and unskilled workers.

This paper focuses on the slums characteristics of the households in cities of the developing world. We use Ecuador as the case of study. We present an analysis where we compare a slum index across cities to provide evidence that after controlling for the household's individual characteristics, cities in the developing world tend to offer better physical QoL to their inhabitants. We also analyze this relationship where the two largest cities are excluded from the sample. Results suggest a negative relationship between cities size and slum characteristics. In addition, we do not find evidence of congestion related to a higher level of slum characteristics in the two largest cities. All our results are robust to IV strategy.

This paper is structured as the following. First, the section 4.2 shows the related literature on the topic of slums and city size. Then, the section 4.3 introduces the case of study. Next, the methodology to identify the relationship is introduced in section 4.4. Finally, the conclusions of the analysis are presented in section 4.5.

## **1.1 Related literature**

The concept of QoL is not an easy concept, because it can be analyzed from different points of view. From the social science point of view, it can be considered as the combination of the two main components, the physical and psychological elements (Liu, 1978; Royuela et al., 2003). Physical components of QoL are related to cover the basic needs that can be considered as standard in a society such as access to safety and drinkable water, electricity and sewage system. The physiological elements are more related to the happiness, opportunities, satisfaction as a human being.



QoL concept is also related to the idea of well-being and deprivation. Well-being can be considered as a broader idea of QoL, but as we show above, it can be a fuzzy concept with the QoL as well-being can be also understood as a multidimensional concept with not a single scalar measure such as multidisciplinary indices of poverty, life satisfaction and human development (Athanasoglou, 2015; Decancq and Lugo, 2013; OECD, 2013). Dasgupta and Weale (1992) mention the basic constituents of well-being such as health, welfare, freedom of choice, among others. But they also consider there are determinants of well-being such as availability of food, clothing, and access to basic services.<sup>1</sup>

Deprivation instead focuses more on the bad aspect of the society as the lack of basic needs for a group of the society that are standard for the rest of the society (Durán and Condorí, 2017; Cabrera-Barona et al., 2016; Havard et al., 2008; Narayan, 2000). Deprivation are generally studied under two main aspects: material deprivation and social deprivation. Material deprivation considers the lack of basic needs as electricity, public water, decent housing among others, while social deprivation considers the social-economic contrast in that society such as black people, young/orderly or specific weak social groups (Durán and Condorí, 2017; Cabrera-Barona et al., 2016; Havard et al., 2008). An important characteristic of material quality of life, when you consider access to basic services, is that all residents should entitle to use the services, wherever they are located. Royuela et al., (2003) consider that the opportunities for a group are at least as important as the opportunities enjoyed by the individual.

Similarly, the OECD (2013) applies in its framework's the consideration of the division of QoL in two main components. The first one is the quality of life composed by health status, work life balance, education and skills, social connections, civic engagement, governance, environmental quality, personal security, and subjective well-being. The second component are the material conditions of life such as income and wealth, job and earning, and housing. Both components are more associated with the sustainability of well-being, human capital and social capital, but the latter component is more connected GDP of a country. Although, QoL might differ from nations to nations (Wish, 1986), the consideration of the access to basic services or covering the basic needs are always present in most analysis.

To capture the concept of QoL, well-being or deprivation, the use of indexes has been widely used in the literature (Decancq and Lugo, 2013; OECD, 2013; OECD, 2008). The indexes allow to compare, analyze and summarize a list of

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<sup>1</sup> Maslow (1975) classify QoL in physiological needs, health and security, ownership and love, and self-realization. Others consider first basic needs, then spiritual needs. However, there is not consensus between human needs.





indicators into only one indicator. The problem of using an index is divided in two main concerns: the variables to include in the index and the weights to compute the index.<sup>2</sup> The main idea of an index is to cover a good set of indicators that are related to what is expected to measure and it can be summarized into one index. The variables for the index will depend on the analysis to carry out, while the weight shows the relative importance of the components within that index (Athanasoglou, 2015). For example, Ivaldi et al., (2016), Węziak-Białowolska (2015) and Bérenger & Verdier-Chouchane (2007) analyze and compare QoL for a good set of countries. Instead, Popova & Pishniak (2016) only focus in Russia to analyze QoL using individual data of household. The dimensions used in this work cover from the availability of basic services to the environment and social-demographic aspects presented in cities. Similarly, Royuela et al., (2003) perform a specific analysis of QoL for the province of Barcelona. The index for QoL in this case is measured through the use of three main sub-indexes that are composed by individual opportunities, social equilibrium and community conditions of life. Each of these three sub-indexes are based on a large set of lower level sub-indexes. In another article, they use this indicator of QoL to identify urban zones with the same level of QoL.<sup>3</sup> Gómez-Salcedo and Galvis-Aponte (2013) build a Quality of Work index for Colombia. They focus on objective and subjective dimensions of life and work for this indicator. Boelhouwer (2013) focuses on building a living conditions index for the Netherlands, and so on.

However, the weights for an index are always in discussion as the final score of an index could be very sensible to its weights, e.g. we can think having access to sewage system can be more important for an individual that having access to the energy. But, it can be mostly subjective to each person. So, the general method is to allow the data to talk. This method includes usually PCA because the PCA combines all the shared variance of all the variables used in the analysis into only one indicator that measures the similar attributes.<sup>4</sup> But, there are also available different methodologies to build indexes (See OECD, 2008).

On the other hand, agglomeration effects framework implies a larger city size offers more benefits for their inhabitants. Royuela and Suriñach (2005) consider QoL as a function of city size and other characteristics.<sup>5</sup> At the end, in a free mobility framework, a given city size is the trade-off between the benefits and

<sup>2</sup> The basic structure of an index can be considered as,  $I = \sum \omega_i X_i$ , where  $\omega_i$  is the weights

associated to each variable X. For more detail, see Decancq & Lugo (2013).

<sup>3</sup> Dimitris (2013) shows a positive relationship between QoL and happiness.

<sup>4</sup> The PCA requires a good correlation of the variables considered in the analysis.

<sup>5</sup> To understand better the framework in which agglomeration effects work, see Rosenthal and Strange, (2004) or Combes and Gobillon, (2015).



cost of agglomeration with a standard local QoL. This part has been less studied in the literature, as the agglomeration effects has been focused more on productivity side of agglomeration (Combes and Gobillon, 2015; Holmes, 2010).

In literature of agglomeration economies, the lack of basic infrastructure is likely to handicap the benefits of agglomeration because the low coverage of basic needs also increases urban costs for the urban inhabitants such as higher transport cost, but also in terms of disease transmission, pollution, crime (Castells-Quintana, 2016). Thus, the lack of covering basic needs reduces the capacity of cities to develop, attract talent and investment.

The World Bank (2011) considers that access to basic services is fundamental to the basic work of cities. Duranton (2015) considers that urban policy in developing economies has two main concerns. The first is made cities work better by improving basic services such as sewerage or public transport. Second is to limit urbanization, especially to already crowded cities. This involves eliminating primate city favoritism and improving market access between cities and transport infrastructure. Mitra and Nagar (2018) explore the relationship between city size and a deprivation index for the Indian Cities. There is a clear negative relationship, but an important finding is that the deprivation starts to increase at some point for the largest cities.

Slums are a good example of the characteristics between the urbanization in the developed and developing world (Jedwab et al., 2014; Glaeser and Henderson, 2017). The idea of slums is the lack of basic services in urban areas. According to UN-Habitat (2003), a slum household is a group of individuals living under the same roof and lacking one or more of the following conditions: (1) access to safe water: sufficient amount of water (20 l/person/day), at an affordable price (less than 10 % of total household income), available without being subject to extreme effort (less than 1 h a day of walking time); (2) access to improved sanitation: access to an excreta disposal system either in the form of a private toilet or a public toilet shared with a reasonable number of people; (3) sufficient living area: fewer than three people per habitable room; (4) structural quality/durability of dwellings: a house built on a nonhazardous location and with a permanent structure adequate to protect its inhabitants from the extremes of climatic conditions; and (5) security of tenure: the right to effective protection by the State against arbitrary unlawful evictions.<sup>6</sup>

In addition, the UN-Habitat (2003) considers the slums as a result of a massive migration from rural areas of low-income households in cities. These households usually build their own informal dwellings in on a land-empty space that is indeed generally unsafe and unplanned for residential development. Together,

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<sup>6</sup> For more detail, see <https://unhabitat.org/>



with an incapacity of the city to cope with a diverse demand for social-economic needs. Indeed, the United Nations (2015) considers slums as a pre-phase of the development due to rapid urbanization in developing countries. In that case, these cities with the decades have adjusted to the presence of the consolidate slum settlements.<sup>7</sup> Consequently, the QoL in developing countries is an important concern because it is estimated that one third of the world urban population live either slum or squatter settlements (Brueckner, 2013; UNDP, 2005; Ooi and Phua, 2007).

Glaeser (2011) argues that slums might bring to economic opportunities for the low-income households who has migrated from the poorer areas, looking for employment opportunities of working in cities. These households are willing to live in slum areas in order to obtain benefits from the agglomeration (higher productivity, higher wages and larger number of amenities). Thus, people living in slums could improve their opportunities and improve their QoL either, moving to a better place or improve their current living standard. This goes with the idea that slums as ta pre-phase of the fast-growing economies, it is a temporal status of the economic development. Therefore, slums have an impact on economic growth, city size and QoL (United Nations, 2015). Brueckner (2013) studies the slums characteristics in Indonesia, showing that higher income and education lead to occupancy of dwellings with better structural housing characteristics, and this effect is reinforced with lower number of children.<sup>8</sup> However, in the best our knowledge, we did not find evidence of previous studies about the agglomeration effects on slums.

Latin America could be considered as a good example of a region with a high urbanization rate and lack of basic infrastructure (Jaitman, 2015). The most urbanized areas in Latin America are not highly correlated with the economic growth rates (Chen et al., 2014; Fay and Opal, 2000; Kim, 2008 and Bloom et al., 2008). We find experiences studying slums or deprived areas in Latin America. Durán and Condorí (2017) explores the most deprived areas in Argentina. Cabrera-Barona et al., (2016) explore deprived areas in Quito (Ecuador) showing that the most deprived areas are on the border of the city. Duque et al., (2012) apply different steps to identify slum areas in Colombia. Galiani et al., (2017) explore slums in El Salvador, Mexico and Uruguay. Their findings show that improving physical housing conditions have an important impact on household well-being. Marx et al., (2013) focus on specific slums in the cities of Mexico,

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<sup>7</sup> The relationship between health and living in slums is not analyzed in this paper, but there is evidence that improvement QoL has a real impact on the health of its people. We detail more in the related literature section.

<sup>8</sup> Some researchers consider that improving QoL has an evident improvement in mental health, dignity and pride (Devoto et al., 2012; Cattaneo et al., 2009).



Colombia, Peru and Venezuela. They argue that slums are the product of multiple market and policy failures (mainly governance and coordination problems) that obstruct slum dwellers' capital accumulation and human development opportunities. They also explain a trap poverty as the people born in slums lived in slum and if they move, they usually do to another slum.

## **1.2 Case of study and Data**

This work focuses on a specific case, Ecuador. It is a Latin-American country which is in the South sharing borders with Colombia, Peru and the Pacific Ocean. The main idea of this work is to analyze the slums index and urban size in Ecuadorean cities. Ecuador is a good case of study because it is a country considered as a low-income developing country with a rapidly urbanization from the 1960s and a large proportion of poverty and slums in urban areas. It is in the list of countries with slums (UN-Habitat, 2003). It is estimated that around 35% of the urban Ecuadorean population live in Slums.

The country has a population that is around 16 million with a geographical extension of 283.560 km<sup>2</sup>. The country is naturally divided into four natural regions: Coastal, Andean, Amazon and Galapagos islands. The urban concentration is around two main urban poles that concentrate most of the urban population; those are Guayaquil and Quito with more the 1.5 million of inhabitants. Finally, Ecuador presents a Gini index of around 0.45, which is relatively high. UN-Habitat (2003) presents some description of the slums characteristics of the two main cities, Guayaquil and Quito. The characteristics of the Guayaquil's slums are that they are informal settlements built on stilts over the tiled swamps on the border of the city. It is a similar experience that in Cartagena (Colombia). Instead, the low-income households have moved to the peripheral areas of Quito. These households live on irregular topography built from inadequate material as well located in the north and south of the city.<sup>9</sup> UN (2015) mentions that in the case of Guayaquil, there is evidence of improvement in the physical quality of the informal settlements and in the improvements in the socio-economic position of the households in the middle term.

This paper uses FUAs are the unit of analysis. FUAs cover the idea of integrated economic cities and are considered better to define the new aspect of cities. We use 28 FUAs (Functional Urban Areas) that cover the idea of

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<sup>9</sup> This characteristic of with the natural geography of the country because Guayaquil is in the coastal region surrounded by swamps, while Quito is located in the Andean region surrounded by mountains. UN-Habitat (2003) also mentioned the existence of slums in the city of Cuenca (the third largest one), Ambato, Manta, Puyo and Tena.





integrated economic cities.<sup>10</sup> Practically, we connect municipalities in an economic point of view, so we reduce partially the bias presented by living at the extremes of the cities and working in a different city where the workers live. In this aspect, there is a clear concentration of the population in the two main cities, Guayaquil and Quito, which absorb around 50% of the urban population (See Figure A4-1 for the FUAs and Figure A4-2 for the urban primacy of the FUAs, in the Appendix).

The period of analysis is for the years 2013 - 2016.<sup>11</sup> Information gathered from the quarterly local labor surveys (ENEMDU). Currently, the ENEMDU surveys consider a wider aspect individual characteristics than only labor ones, the questionnaire also includes a household's characteristic section. We only consider the last quarter sample of each year. We count for around 223 thousand observations for the period of analysis, and we only focused on people older than 14 years old. Thus, we keep 126 thousand observations.

We define our main dependent variable as an index that follows the slum characteristics developed by the UN-habitat (2015) to measure the lack of basic needs in households living in urban areas. We use a total of 10 variables to build the index. The ENEMDU surveys do not contain exactly the questions related to the slums as it is proposed in UN-Habitat (2003). Thus, we apply a similar definition to measure slums. We consider bad accessibility of the households, not access to toilet and lack of sewage system in the house, not fixed- line telephone, non-owner of the house, non-durable wall materials, non-durable floor materials, non-public water system, no pipe water, non-public power supply, and non-public garbage service. We avoid the use of overcrowding because the main specification will use people on the right side of the specification.

Table 4-1 present all the household's characteristic used to define the slum index. The less percentage is given by the public electricity around 1%, while the highest is presented by bas accessibility to the house, around 28% of the households. Table A4-1, in the Appendix, presents a broader description of the

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<sup>10</sup> From here to forward when we mention cities, we are referring to FUAs. The idea of FUAs is to capture the integrated cities in terms of local labor market. In a first step, urban cores based on high density population are identified, then they are connected using an economic link such as commuting. Finally, the hinterland is added. The hinterland is low-density areas that are not considered as urban cores, but they are economically connected to an urban core using the same economic link. In this case, as the country is not highly dense populated, we identify the FUAs using a population density of 500 inhab./km<sup>2</sup> and 25,000 inhabitants to be an urban core to have representative cities in each province, so maximizing the number of cities across the country. As there is not available commuting census in Ecuador, we use travel time as a substitute for commuting data to connect urban cores and define the hinterland of the FUAs. For more detail, please see Obaco et al., (2017).

<sup>11</sup> These surveys are digitalized and available at <http://www.ecuadorencifras.gob.ec/banco-de-informacion/>

variable definitions. In addition, higher heterogeneity is presented across cities. The higher heterogeneity is larger in some cities of the Andean region, but all the cities in the amazon present high level of slums characteristics.

*Table 4-1. Physical household's characteristics*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
City	Bad accessibility	No durable Walls material	No durable Floor material	No public water	No Toilet and Sewerage	No telephone line	No owner house	No pipe water	No public electricity	No Garbage collection
Ambato (1)	15%	2%	10%	6%	8%	35%	25%	1%	0%	5%
Babahoyo (2)	42%	20%	30%	23%	61%	78%	7%	12%	2%	18%
Chone (2)	36%	14%	37%	47%	31%	74%	8%	28%	6%	21%
Cuenca (1)	29%	8%	10%	6%	10%	27%	23%	1%	1%	6%
Daule (2)	68%	33%	44%	55%	70%	87%	2%	40%	1%	57%
Esmeraldas (2)	38%	10%	18%	6%	13%	51%	17%	4%	2%	5%
Fco. Orellana (3)	42%	47%	47%	15%	55%	63%	21%	13%	3%	5%
Guaranda (1)	51%	28%	39%	35%	53%	65%	11%	3%	2%	36%
Guayaquil (2)	14%	5%	7%	4%	19%	47%	15%	3%	1%	6%
Huaquilla (2)	54%	8%	7%	2%	27%	67%	10%	2%	1%	1%
La Libertad (2)	37%	10%	14%	5%	27%	70%	5%	5%	1%	2%
La Troncal (2)	49%	5%	4%	10%	21%	60%	22%	3%	0%	1%
Latacunga (1)	34%	3%	15%	24%	32%	56%	15%	2%	1%	22%
Loja (1)	28%	13%	13%	8%	12%	43%	21%	1%	2%	7%
Machala (2)	29%	6%	6%	9%	16%	51%	17%	4%	1%	4%
Manta (2)	18%	7%	10%	16%	23%	66%	12%	13%	0%	4%
Milagro (2)	39%	6%	5%	5%	78%	68%	9%	1%	1%	11%
Nueva Loja	43%	15%	14%	37%	33%	54%	24%	17%	2%	9%
Otavalo (1)	27%	13%	12%	10%	19%	54%	17%	0%	1%	7%
Portoviejo (2)	36%	11%	14%	14%	19%	46%	9%	8%	1%	4%
Puyo (3)	34%	21%	24%	6%	17%	40%	27%	2%	0%	2%
Quevedo (2)	37%	8%	8%	15%	70%	72%	13%	8%	1%	4%
Quito (1)	12%	3%	5%	4%	7%	28%	30%	0%	1%	6%
Riobamba (1)	21%	2%	12%	12%	13%	35%	17%	1%	0%	9%
Santa Rosa (2)	39%	5%	12%	3%	10%	68%	17%	0%	1%	3%
Santo Domingo (2)	49%	5%	6%	25%	23%	53%	22%	13%	1%	9%
Tena (3)	55%	25%	23%	25%	42%	52%	16%	5%	1%	8%
Tulcán (1)	14%	9%	15%	2%	5%	41%	28%	0%	1%	5%
Total	28%	9%	12%	11%	20%	47%	19%	4%	1%	8%

Note: Average of the period of analysis.

We build the index by identifying with dummy variables the households that follows each of these ten characteristics. To that matrix of dummies, we apply two approaches to build the index.

- We build the index by adding each dummy variable. In that case, this indicator goes from zero to ten, where zero is a household with the absence of slums characteristic and ten is a household with fully slum's characteristic.

The variance is given by  $u_2 = \frac{\sum_{i=1}^n \sum_{j=1}^n c(x_i, x_j)}{n^2}$ , where  $c(x_i, x_j) = 0, i = 1, 2, \dots, n$ . This approach considers evenly weights, meaning that not having any of these basic services is bad for the whole households where they do not have preferences among them.

- We use the PCA approach. This method involves to capture most of the variance of the ten variables into only one indicator. We use as an indicator the eigenvalues larger than one, and after rotating the principal components, we use the associated variance of each component weighted with the total variance of the components to build the final score of the index. We capture around 60% of the total variance with the four first components. The weight

associated with the first component is 39.81%, 25.25% of the second component, 17.98% of the third component and 16.96%. The final score is linear standardized between zero and one to make the visualization simpler.

The correlation between the two indexes is around 98%. Table 4-2 shows the descriptive statistics of the indexes. As for adding dummy variables (See part a, in Table 4-2), the Amazon region has the highest level of slum characteristics as it shows an index of around 2.39, while the Coastal region is presented in the second position with a slum index of around 1.65. The Andean present the better physical QoL with an average of 1.45. The average of the index is around 1.59 that is indicating that the Ecuadorian households present on average slum's characteristics. Finally, there has been an improvement across the years. However, the level is low, the differences within cities is larger than across cities. Similar results appear using PCA (See part b, in Table 4-2). We present some descriptive statistics of the indexes by cities in the Appendix (See Tale A4-2). We also present the scatter plots between the slum indexes and the city size in Figure A4-3 and Figure A4-4, in the Appendix.

*Table 4-2. Slum Index Descriptive Statistics*

a) Slum index based on aggregating dummies variables							
	2013	2014	2015	2016	Total	Obs.	% perc.
Andean	1.66	1.45	1.42	1.31	1.45	93,341	57.90%
Coastal	1.96	1.60	1.61	1.50	1.65	56,015	34.75%
Amazon	2.60	2.44	2.36	2.32	2.39	11,841	7.35%
Total	1.79	1.58	1.57	1.46	1.59	161,197	100.00%
b) Slum index based on PCA							
	2013	2014	2015	2016	Total	Obs.	% perc.
Andean	0.12	0.10	0.10	0.09	0.10	93,341	57.90%
Coastal	0.14	0.11	0.11	0.10	0.12	56,015	34.75%
Amazon	0.19	0.18	0.17	0.17	0.17	11,841	7.35%
Total	0.13	0.11	0.11	0.10	0.11	161,197	100.00%

### 1.3 Methodology

We follow the idea of Royuela & Suriñach (2005) that define QoL as a function of urban size and other factors. We use the slum indexes as an indicator of a physical QoL indicator, and we consider all the characteristics of the individuals inside of the households. The use of individual characteristics is considered to capture better the QoL (OECD, 2013). In addition, we will be able to analyze household data goes with the idea of comparing households across locations and over time to assess their QoL and city size (Duranton, 2014).<sup>12</sup>

<sup>12</sup> Duranton (2014) considers that most literature of agglomeration has focused on wages and productivity, where it is also interesting to analyze consumption, human capital acquisition and

However, we face some econometric concerns. The first one is to be able to control for some important characteristics of the households that could explain their physical QoL. In that case, a panel that allows to follow the movement of the households is not available. Thus, we can only evaluate the final QoL at the period that the survey is taken. In base on that, we can use a pool model. We do our best by including a good set of control related to the individual household's characteristics that would explain better their QoL condition for each household's individuals. Therefore, we define the main pool specification as the following.

$$Index(add)_{i,c,t} = \beta' X_{i,c,t} + \delta Lpop_{c,t} + Prov_c + Time_t + e_{i,c,t} \quad (1)$$

&

$$Index(pca)_{i,c,t} = \beta' X_{i,c,t} + \delta Lpop_{c,t} + Prov_c + Time_t + e_{i,c,t} \quad (2)$$

Where,  $I_{i,c,t}$  is the slum index for the household  $i$ , in city  $c$ , at time  $t$ . index(Add) is the slum index based on adding dummies and index(PCA) is the slum index under the Principal component analysis.  $X$  is a vector of household's characteristics of the people living in that household. We use gender, age, rural area within the FUAs, four levels of education (literacy or lower, primary, secondary, and university or higher), ethnic classification (indigenous, black, mulato, mestizo, white and others), economic classification of the person (formal, informal, housekeeper, not classified and not working), marital status (free-union, single, married, divorced, and widow), number of people younger than 15 years old in the household, and position in the family.<sup>13</sup> We also control migration categories; people who have not migrated, migrated lower than 1 year, between 1 and 2 years, 2 and 3 year, 3 and 5 years and 5 years or more.  $Lpop$  is the log of city population,  $Prov_c$  and  $Time_t$  are provinces and time fixed effects.<sup>14</sup>

The second main problem is caused by endogeneity between city size and QoL. To address endogeneity problems, we consider the instrumental variables approach. The literature suggests several instruments to treat endogeneity when the interest is city population (Combes et al., 2010; Combes et al., 2015). Ciccone and Hall (1996) propose the use of historical population as main

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QoL, and Combes and Gobillon (2015) also support that statement. OECD (2013) considers that well-being varies among individuals and thus cannot be captured only by measures at national level.

<sup>13</sup> We do not include income because there is more variability, while education level is more stable, and we believe better indicator to the economic level of the household. Both income and education level are strong correlated.

<sup>14</sup> In this case, the model can be interpreted as an increase in 1% in the FUAs population how many points will increase the slum index in  $\delta$  points in equation (1) and how many points will increase the slum index in  $\delta$  standard deviations in equation (2), where higher is worse living conditions and lower is better living conditions.





instrument. The idea under this assumption is that the historical population will have a direct effect on the current population, but not on the current QoL of the individual. The use of geographical characteristics is also suggested to use together with the historical variables (Combes et al., 2010). We propose the FUAs population in 1950 and the soil attribute related to each FUAs.

## 1.4 Results

Table 4-3 shows the results from estimating equation (1), that is the slums index based on adding dummy variables, these results are presented from the Columns (1) to (3). The Table 4-3 also shows the results from estimating equation (2), that is the slums index based on PCA. These are presented from Columns (4) to (6). In addition, Columns (1) and (4) are estimated on the OLS. The Columns (2), and (3) and the Columns (5) and (6) are estimated on IV estimates. These columns also show the Under-identification test, Weak identification test and Over identification test that carry out to convince that the instruments are good and not correlated with the error term. Finally, the Column (3) and (6) are the results when the two largest cities are excluded from the estimates.

As for the *slum's index(ADD)*, Column (1) shows a negative and significant relationship between city size and the slums index. The one percent of increasing city size, we would expect to reduce the slum index by 0.314, almost one third of the index. Column (2) shows the same results under the IV estimates. The result is the similar in magnitude in city size. Column (3) considers the same relationship in IV estimates when we exclude the two largest cities from the sample, Guayaquil and Quito. In this case, the parameter decreases to 0.18, it is almost one fifth of one point on the index. In this case, there is no evidence of congestion in the two largest cities for the period of study. Instead, they present stronger effect in reducing slums characteristics. As for the *slum's index(PCA)*, the Column (4) in Table 4-3 shows the OLS. Similarly, there is a negative relationship between slums and city size, which is significant at all statistical levels. We can interpret that by increasing one percent the city size, the slum index decreases to 0.025 standard deviation. Column (5) shows the same results under IV estimates. In Column (6), the two largest cities are excluded from the regression. It shows that the effect goes down to 0.013 standard deviation. Thus, in the slum index where the variance is composed by around 60% of the adding dummy variables the effects of agglomeration are the same.

To mention some interesting results from the socio-economic covariates in the analysis of slums, the education categories shows, was it was expected, that education presents the highest impact on the expected minimum QoL measures through the slum index. To have an idea, in column (1) the post-university



educated workers are expected to reduce in almost two points slums characteristics. Therefore, the higher the level of education, a better housing characteristic. Labor categories shows that formal workers are benefiting more with respect to the other labor categories. For example, in column (1), informal workers are having one third of increasing the slum index. Migration categories that measure how long are you living in the city where it was interviewed allow to identify the time to improve the QoL, even by moving to a different place or improving their housing characteristics. The base category are the people who have not moved. The people who have moved from one year or less have on average higher slums characteristics, and then it tends to reduce. After the second year, there seems not being so much differences in the next years. Marital status, ethnicities and position categories in the households are significant and available upon request. Rural dummy increases the slum index, female dummy and age identify that are also significant and negative, but the effect is almost zero effect on the slum indexes. The number of children in the household also increase the slum index, but this relationship is also very endogenous to conclude as a unified effect. Provinces and time dummy absorb the province characteristic and the improvement of the slums over time.

Table 4-3. Regression Analysis of the Slum indexes

VARIABLES	(1) OLS	(2) IV	(3) IV	(4) OLS	(5) IV	(6) IV
<i>Lpop</i>	-0.314*** (0.020)	-0.316*** (0.021)	-0.182*** (0.028)	-0.025*** (0.002)	-0.024*** (0.002)	-0.013*** (0.002)
<b>Education categories</b> (Literacy or lower as base)						
Primary education	-0.661*** (0.029)	-0.661*** (0.029)	-0.677*** (0.031)	-0.051*** (0.003)	-0.051*** (0.003)	-0.052*** (0.003)
Secondary education	-1.078*** (0.030)	-1.078*** (0.030)	-1.107*** (0.032)	-0.082*** (0.003)	-0.082*** (0.003)	-0.085*** (0.003)
University or higher	-1.419*** (0.031)	-1.419*** (0.031)	-1.466*** (0.034)	-0.103*** (0.003)	-0.103*** (0.003)	-0.107*** (0.003)
<b>Labor categories</b> (Formal sector as base)						
Informal sector	0.333*** (0.013)	0.333*** (0.013)	0.360*** (0.015)	0.026*** (0.001)	0.026*** (0.001)	0.028*** (0.001)
Housekeeper workers	0.269*** (0.031)	0.270*** (0.031)	0.353*** (0.039)	0.018*** (0.003)	0.018*** (0.003)	0.024*** (0.003)
Not classified	0.378*** (0.026)	0.378*** (0.026)	0.374*** (0.028)	0.029*** (0.002)	0.029*** (0.002)	0.029*** (0.002)
Not working	0.057*** (0.009)	0.057*** (0.009)	0.067*** (0.011)	0.006*** (0.001)	0.006*** (0.001)	0.006*** (0.001)
<b>Migration categories</b> (No migration as base)						
<i>1 year or lower</i>	0.317*** (0.034)	0.317*** (0.034)	0.292*** (0.036)	0.010*** (0.003)	0.010*** (0.003)	0.007*** (0.003)
<i>between 1 and 2 years</i>	0.253*** (0.045)	0.253*** (0.045)	0.257*** (0.050)	0.007*** (0.004)	0.007*** (0.004)	0.008*** (0.004)
<i>between 2 and 3 years</i>	0.261*** (0.048)	0.261*** (0.048)	0.263*** (0.054)	0.009*** (0.004)	0.009*** (0.004)	0.008*** (0.004)
<i>between 3 and 5 years</i>	0.244*** (0.033)	0.244*** (0.033)	0.271*** (0.037)	0.008*** (0.003)	0.008*** (0.003)	0.010*** (0.003)
<i>between 5 years or higher</i>	0.060*** (0.012)	0.060*** (0.012)	0.054*** (0.013)	0.0002 (0.001)	0.0002 (0.001)	-0.0004 (0.001)
Marital status categories	YES	YES	YES	YES	YES	YES
Ethnicity categories	YES	YES	YES	YES	YES	YES
Position in the family categories	YES	YES	YES	YES	YES	YES
Rural dummy	YES	YES	YES	YES	YES	YES
Age	YES	YES	YES	YES	YES	YES
Female dummy	YES	YES	YES	YES	YES	YES
Number of children	YES	YES	YES	YES	YES	YES
Province dummies	YES	YES	YES	YES	YES	YES
Time dummies	YES	YES	YES	YES	YES	YES
Constant	YES	YES	YES	YES	YES	YES
Observations	159,998	159,998	126,386	159,998	159,998	126,386
R-squared	0.409	0.409	0.414	0.385	0.385	0.390
Under identification test		0.00	0.00		0.00	0.00
Weak identification test		9246	6582		9246	6582
Over identification test		0.564	0.831		0.425	0.982

Standard errors clustered at household level in parentheses \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Characteristics related to the members of the household. The sample is restricted to people older than 14 years old. Columns (1), (2) and (3) use the slum index based on aggregation of dummies variables, while columns (4), (5) and (6) use the slum index based on PCA. Instruments used in Column (2), (3), (5) and (6) are log of FUA population in 1950 and Ph soil. Columns (3) and (6) are not including the two largest cities in the regression, Guayaquil and Quito.



## 1.5 Conclusions

In this paper, we have explored the relationship between city size and minimum quality of life (QoL) offered by urban areas in the developing world. We use Ecuador as a case of study and slums as an indicator of minimum physical quality in urban areas. We also cover the idea of Functional Urban Areas (FUAs) to avoid administrative boundaries. We build two indicators of slum' characteristics, both use the same 10 variables to cover the minimum physical characteristics in Ecuadorean households. But, the weights for the index are measured in two different ways. The first index is based on aggregating dummy variables and the other is based on Principal Components Analysis (PCA). In addition, we control for a set of socio-economic variables. We also consider instrumental variables (IV) approach to overcome the possible endogeneity issues expressed in the relationship between city size and slums. In both cases, we find a negative associated between city size and slum characteristics in Ecuadorian cities. Thus, larger cities tend to offer better QoL in both cases. We did not also find evidence of congestion when the two largest cities are excluded from the estimates as the magnitude of the effect is reduced. These results are robust on IV estimates.

This evidence shows that agglomeration effects seem to work in offering a better minimum of physical QoL for the case and period of study. This evidence supports some works related to agglomeration effects as in Glaeser (2011), UN-Habitat (2015) and Mitra and Nagar (2018), where a larger city in the developing world tends to offer a better QoL for their inhabitants, even in the consideration of slums. However, this evidence is weak in the sense that we are evaluating only the current period and short period, and this work did not count with a panel of households. Finally, we would like to highlight that we are not saying that slums are good for larger cities or willing to increase slums areas in larger cities. We would like to mention that in the case of study, Ecuador, the cities might be able to adapt the slums and might become part of their cities, improving their basic infrastructure as would be expected in the agglomeration economies literature.

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## Appendix of Chapter Four

*Table A4-1. Measures used for the Slum index*

N.-	Measure	Concept
1	No durable roof	Roof made of straw or worse
2	No durable walls	Walls made of wood or worse
3	No durable floor	Floor made of cane or worse
4	No piper water	Not access to water trough pipes
5	No public water supply	Not access to public water supply
6	No sewerage system	Not access to sewerage system
7	No electricity	Not access to electricity
8	No telephone line	Not having telephone line
9	No garbage collection	No sevice of garbage collection
10	No kitchen space	Not having an independent space to cook

Note: information gathered from the ENEMDU surveys of 2013, 2014, 2015, and 2016.

*Table A4-2. Slum index by city*

FUA	ADD		PCA		Freq.
	Mean	Std. Dev.	Mean	Std. Dev.	
Ambato	1.07	1.27	0.07	0.09	12,644
Babahoyo	2.94	2.16	0.22	0.19	2,692
Chone	3.02	2.25	0.26	0.23	596
Cuenca	1.21	1.38	0.08	0.11	13,912
Daule	4.57	2.74	0.38	0.25	603
Esmeralda	1.63	1.55	0.11	0.12	6,356
Fco. Orellana	3.09	2.09	0.23	0.19	2,222
Guaranda	3.23	2.28	0.25	0.19	3,834
Guayaquil	1.22	1.49	0.08	0.12	17,620
Huaquilla	1.79	1.36	0.11	0.11	964
La Libertad	1.77	1.49	0.12	0.12	5,902
La Tronca	1.76	1.40	0.11	0.10	1,505
Latacunga	2.02	1.82	0.15	0.15	7,046
Loja	1.48	1.60	0.10	0.13	4,716
Machala	1.42	1.46	0.09	0.12	9,361
Manta	1.70	1.62	0.12	0.14	4,353
Milagro	2.23	1.27	0.15	0.09	964
Nueva Loja	2.49	1.99	0.19	0.18	3,281
Otavalo	1.60	1.52	0.11	0.12	16,507
Portoviej	1.63	1.68	0.12	0.14	2,473
Puyo	1.73	1.57	0.12	0.12	3,416
Quevedo	2.36	1.54	0.16	0.13	2,921
Quito	0.97	1.18	0.06	0.09	16,153
Riobamba	1.23	1.43	0.08	0.11	5,644
Santa Ros	1.60	1.21	0.10	0.09	1,210
Santo Domingo	2.05	1.77	0.14	0.15	6,803
Tena	2.51	2.00	0.18	0.17	2,922
Tulcan	1.20	1.21	0.08	0.09	4,577
Total	1.59	1.65	0.11	0.13	161,197

*Figure A4-1. Ecuadorean FUAs Spatial Distribution*

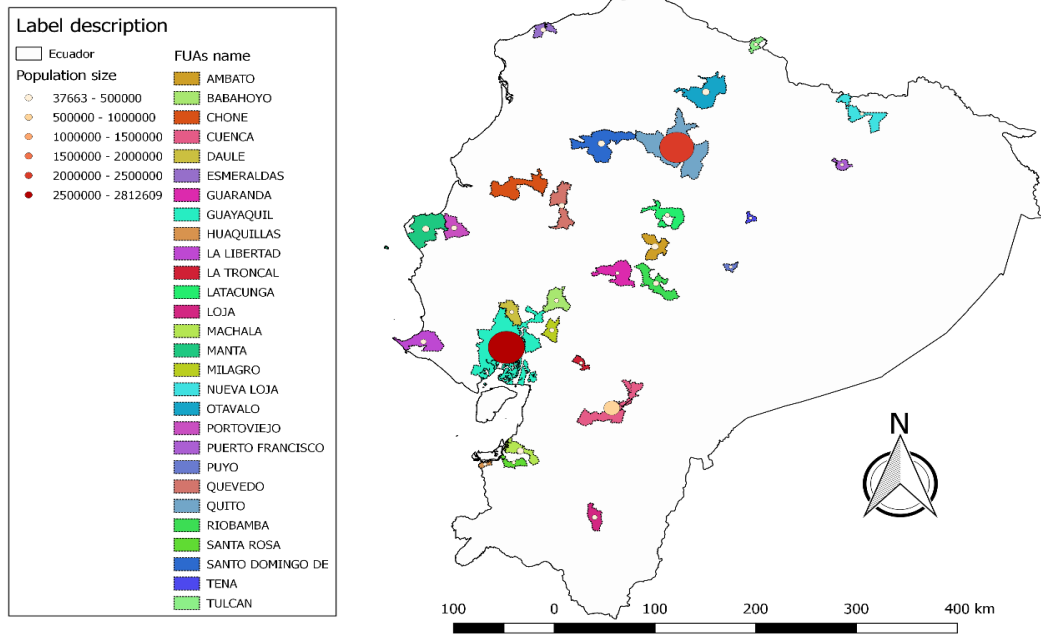


Figure A4-2. Ecuadorean Urban Primacy Structure

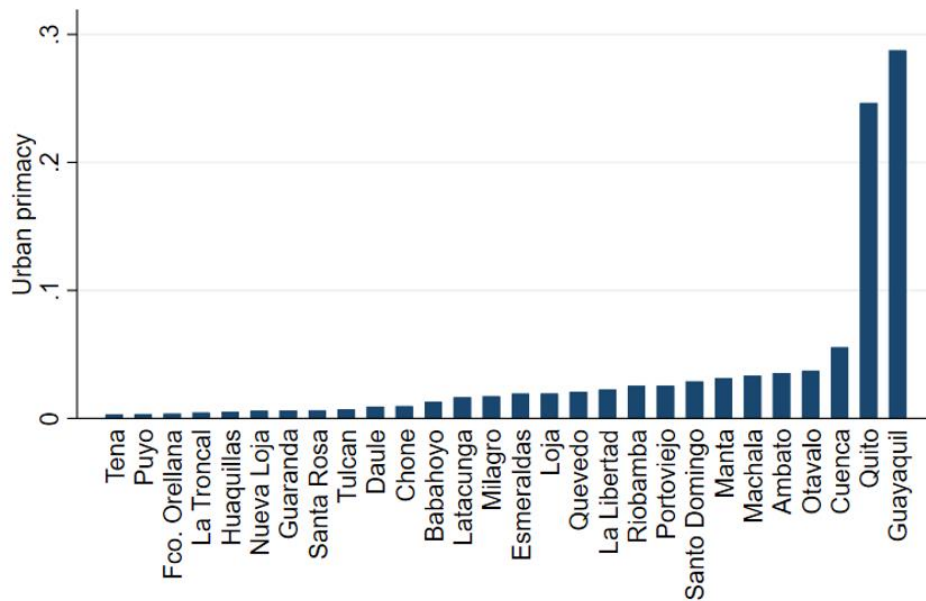


Figure A4-3. Average of Slum index (ADD) and City Size in Ecuador

