CAN SMALL CITIES FROM DEVELOPING COUNTRIES BE SMART CITIES? THE CASE OF ARGENTINA

María Verónica ALDERETE
IIESS, CONICET-UNS; Department of Economics, UNS,San Andres 800, Bahía Blanca, CP 8000, Argentina
mvalderete@iiess-conicet.gob.ar

Abstract
The objective of this paper is to analyze the smart cities in less developed countries such as Argentina. By means of a cluster analysis, cities are classified based on a national index of smart cities (ICI) and a set of socio-economic indicators. As a result, three groups of cities were obtained: "prosperous, large and smart cities", "poor, small and potentially smart cities" and "poor, medium size and smart cities". The three smartest cities (CABA, Córdoba and Bahia Blanca) belong to different clusters. CABA, which is the second smartest city, has the largest budget or economic resources and it is also the biggest city in the country. On the other side, Bahía Blanca that is "the smartest", it is a small and poor city. International smart cities indexes as Cities in Motion Index (CIMI) do not consider this last type of cities, which are non-global cities even though they are smart.
Keywords: smart cities; global cities; developing countries; cluster analysis.

1. INTRODUCTION

In recent years, the Smart cities concept has become a new parameter to examine the future of urbanism and cities. Cities' performance depends on a set of characteristics that go from technological aspects to those related to citizen participation. On the other side, many contemporary analyses are based on viewing smart cities as global cities (De Falco 2019). Global cities were part of a transnational phenomenon and they could be considered as emanations of new economic and technological processes worldwide. However, this international dimension of smart cities was not true for all cities, but only for global cities. Under this frame, we wonder: Are global cities the only capable of being smart cities? Is any place for non-metropolitan cities? Are smart cities similar in their local economic background? These are some questions that need to be answered as there is a growing demand to examine and measure urban dynamics to support the challenges of urban planning in less developed countries.

Cities are smart if they have achieved successful projects in their territories leading to sustainable development, economic prosperity and an enhanced quality of life (Hollands, 2008). Some definitions of smart city emphasize on productivity and competitiveness, and therefore, on the economic urban

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development smart cities should generate (Kourtit and Nijkamp 2012; Harrison and Donnely 2011). In cities from developed countries such as Edmonton (Canada) and San Diego (USA), with smart city strategies compatible with high-tech businesses (Hollands, 2008; National Geographic 2015), there is evidence of big-businesses leading the future of big cities and their urban development (Praharaj and Han 2019). This local economic prosperity is an indicator of smartness in cities from developed countries. And it is aligned with the vision that smart city places global corporations in the center of analysis by managing urban planning in selected cities and following a top-down urban development process.

However, in less developed countries, being smart could not necessarily imply being an economically prosperous city. For instance, the Connected Smart Cities ranking (Urban Systems 2021) in Brazil classifies cities based on population sizes. We can observe that cities from the southeast of Brazil are the best ranked cities independently of their population. In fact, three out of the best five cities from Brazil are located in the San Pablo state, and 67 out of the 100 smart cities are from the Southeast region (47 cities located in the state of San Pablo). Their definition of smart cities focuses on interconnectivity between the different dimensions of a smart city, where the performance in one dimension has an impact on the rest.

An analysis related to the Argentinean smart cities is developed in this article. Based on some international smart cities indexes, Buenos Aires (CABA from the Argentinean initials) is the top Latin American ranked city. CABA occupies the 98th position on the Smart City Index (SCI) 2021. In this respect, it is above Medellin (101), Mexico (108), San Jose (109) and Santiago de Chile (110). The last three places are occupied by: Bogota (116), San Pablo (117) and Rio de Janeiro (118). On the other side, based on the ranking of the Cities in Motion Index (CIMI) 2020, Buenos Aires is placed 77, Rosario 125 and Córdoba 13, which are other two Argentinean cities. Moreover, CABA, Córdoba and San Juan are the only three Argentinean cities mentioned in the Innovation City Index, which is not really a smart cities measure. Lastly, CABA is the only Argentinean city included in the Global Cities Index. As it can be seen from these smart cities indexes, many Argentinean cities are omitted.

On the other side, there is a national index for the capital cities in Argentina (together with Buenos Aires City and Bahía Blanca) named Indice de Ciudades Inteligentes (ICI) (Alderete 2021). Nevertheless, the index only covers a few cities from the country. The ICI index is compound of four dimensions: Environment, Governance, Society and ICT, and Mobility and Transport which are based on a set of indicators whose data emerges from official websites and national statistics. According to ICI, the third best positioned cities in Argentina are Bahia Blanca, CABA and Córdoba. CABA and Cordoba are well-known cities, with an international profile, and they are usually included in the Smart Cities rankings. In Buenos Aires, some of the smart city initiatives are the urban renovation, the Bus Rapid Transport system, and bike sharing. These initiatives are also seen in other Latin-American capitals such as Mexico, Bogotá,

and cities like Curitiba. Cordoba is also considered a smart city and is developing projects to improve its position. In Córdoba there is the smart city node, a collaborative working space that emerged as a joint initiative between the state (national and regional governments), the academy and private sectors. Besides, CorLab is a laboratory where the public-private articulation is critical to achieve a different city. One of the city's goals is having an innovation laboratory and the first Govtech investment fund for entrepreneurships around Latin America. On the other side, Bahía Blanca is a city of about 400 thousand inhabitants located in the southwest of Buenos Aires Province. Based on the Open Data Index (ODI) of the Open Knowledge Foundation, the city is at the top of the ranking 2021, becoming one of the most transparent cities in Argentina. During the last years, the city has changed the relationship between local government and citizens through the adoption of innovative actions and projects, a more transparent government, the opening of data, the implementation of practices to promote citizens' engagement and the adoption of new technologies (Quartucci 2021).

The main objective of this paper is to analyze the smart cities in Argentina; on the other side, to show the limited scope of international smart cities. One general contribution of the paper is to offer empirical evidence of smartness in cities from less developed countries. Based on data from a national index of smart cities (ICI), and a set of socio-economic indicators, we conduct a k means cluster analysis to distinguish among smart cities. We wonder if cities with a high smart city index score are all metropolitan or big/global cities. Is being a smart city a condition to be an economically and prosperous city? We want to offer taxonomy of capital cities of Argentinean provinces based on the ICI index. We also use data from CIMI although only a few cities from Argentina are included.

The paper is structured as follows. First, we describe the theoretical framework about the smart cities concept and its relation with global cities and socio-economic indicators. Secondly, the data and methodology are explained. Thirdly, we share and discuss the results obtained and finally, final remarks are provided.

2. LITERATURE REVIEW

2.1. About the smart city concept: the case of the Latin-American cities

The present paper conducts the analysis of the Smart cities concept of which there is not a unique definition. Nevertheless, two large views can be distinguished. Both views share the fundamental role of Information and Communication Technologies (ICT). However, while the first view is based on a techno-centric interpretation of the smart cities, the second has a larger and wider perspective, an holistic

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approach since it includes the first view together with the sustainability dimension (Lupiañez Villanueva and Faulí 2017; Mora et al. 2017).

The smart city concept is a broad and holistic term where the technology is a necessary condition but not sufficient to resolve problems, increase efficiency and improve the quality of life (Jolías and Prince 2016). The development of a smart city is not guaranteed by the technology per se (Anthopoulos and Tougountzoglou 2012; Lind 2012; Komninos 2009; Hollands 2008; Aurigi 2006). From this wider perspective, Albino et al. (2015) refers to the notion of sustainability that centers in the citizens and the local community's needs. Likewise, Komninos et al. (2013) and Caragliu et al. (2009) state a smart city requires investing in social capital, human capital, traditional transportation and modern ICT-based infrastructure. Moreover, a smart management of natural resources and citizen participation are needed. In this vein, the city can achieve a sustainable economic growth and improve its quality of life. Therefore, a smart city differs from a digital city.

Being smart indicates a specific strategic policy direction generally adopted by cities public agencies to distinguish their new policies and development programs (Yigitcanlar 2015). Cities associate smart with robust, successful projects in their jurisdictions aiming sustainable development, economic prosperity and an enhanced quality of life for its people. Moreover, "the economic dimension of sustainable urban development is related to the overall challenge of sustainable development, which includes economic, social, and environmental dimensions (Kumar and Dahiya 2017: 7)". For the purpose of this paper, a city would be considered "smart" if it applies ICT-based solutions to problems in four dimensions: environment, governance, society and ICT, mobility and transport. In these sense, it follows the baselines of the Smart City Index (SCI) methodology and in particular, Alderete (2021) for the Argentinean case.

While there are many studies on smart cities in the European sphere (Mora et al. 2017; Kourtit et al. 2012; Caragliu et al. 2011; Hollands 2008), the analysis for the Latin-American case, an in particular for Argentine, remains rare (Irazábal and Jirón 2021; Marchetti et al. 2019: Calderón et al. 2017). Most Latin-American economies are driven by cities. However, the region is plenty of inequalities at the city level. One of the main sources of inequality in the region is the informal labor although it plays a relevant role on employment (UN-HABITAT, Nairobi [2012]). While urban economies grow in an exceptional manner, a significant amount of urban workers in developing countries is involved in this vulnerable situation (Kumar and Dahija, 2017). This inequality, which is one of the most important in the world, precludes from urban prosperity. In this scene, the relationship between unemployment and inequality measures remains relevant to define the smart city concept in the region. In fact, one of the biggest challenges Latin-American cities share in developing smarter initiatives is inequality. Berrone et al (2019) states the large urban concentration in the LA region turns the cities' challenges into global challenges.

On the other side, De Falco (2019) provides a rich review of the transition from the concept of global cities to smart cities, and explains the relationship between the concepts in the European context. Most of the cities that are smart cities but not global are located in Northern Europe. They are characterized for being young, active cities, with a perspective focused on new urban technologies and environmental issues, independently of the investment of foreign funds in their territories (De Falco 2019). However, the resulting European scenarios and the related paradigms of course cannot be extended to other areas of the world where socio-cultural and economic differences would require a specific analysis. Akçura and Avci (2014), for instance, have sought an intersection between the technological variables, which are relevant to a smart city, and the economic and social variables related to a global city.

2.1. The relationship between smartness and socio-economic variables

Cities are abodes of prosperity, but their wealth depends on their population size and other factors. Statistics show that the city size matters a lot in GDP generation of a city in a country. In Europe, 67% of inhabitants live in medium-sized urban centres (smaller than 500000 inhabitants), while just 9.6 % are located in cities having more than five million inhabitants. In the USA, one out of five urban inhabitants lives in important cities having more than five million people. Thus, there is a strong indication that population size of a city matters with regard to its urban economy.

In respect to size of the city, Winters (2010) states that smart cities are usually small to medium size cities. At the same time, since young population is likely to move to these cities because of their high human capital, their population increases. Many Smart city indexes or rankings select the cities based on their population size. For instance in Canada's most sustainable Cities, Dritter Großstadtvergleich (Germany), Les villes Européennes: Analyse comparative (France). In Europe, medium size cities are the most important type of city in demographical terms. Since their characteristics are related to medium size, their challenges differ from the metropolitan cities with fewer resources and institutional capacity to respond to their critical population size. Therefore, differences based on population size exist; medium size cities are not capable of competing throughout the different economic activities and fields to become the best location for all industries (Giffinger et al. 2010). Medium cities have to focus on certain activities and should offer assets not available among metropolitan cities.

On the other side, a smart city usually becomes a large city since most of smart city cases and examples of smart cities correspond to smart transports which are related to large populations (Debnath et al., 2014). Moreover, large cities can attract more human capital (Elvery 2010), and can offer a higher infrastructure in terms of electricity, water and telecommunications. Large cities have a critical mass of ICT users which can promote a higher penetration of new digital services such as mobile apps for urban

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transport. On the other side, small cities are attractive as proper spaces for pilot studies. Time spends on infrastructure investments and implementation, such as street lightening or management of wastes, are smaller because of their size (Neirotti et al. 2014). Thus, there is no consensus in the literature about the relationship between smartness and population size.

A city's capacity to answer its citizen's demands is influenced by the Internal and the External Environments. The internal environment (city's assets and quality of life) considers the endogenous situation within a city while the external environment (social, economic, and competitive and political environments) refers to the comprehensive exogenous aspects that surround the city. The stability of this structure is critical for the city's development and attractiveness (Marchetti et al. 2019). The authors offer new indicators for a Latin America smart city context. In the case of the economic dimension, they propose as indicators: population living below national poverty line (%); inflation rate; development growth rate; unemployment rate; foreign trade % GDP; number of tourists per year; and number of patents per year.

On the other side, cities that are prone to increase wealth must be innovative and create the conditions to develop knowledge and creativity (Letaifa 2015; Musterd and Ostendorf 2004). Under this frame, a large amount and quality of employment is created and unemployment is not still the main urban problem. Capacities and skills to use computers have been influenced by the occupational status and opportunities to develop and accumulate cultural capital (Clayton and Macdonald 2013). Alvarez and Alderete (2019) analyze whether the greater diffusion of ICT use, characteristic of smart cities, has an influence on cities' unemployment rates. The authors state that there is a negative correlation between the unemployment rate and the level of smartness.

3. METHOD

3.1. Cluster analysis

We build a cluster analysis for grouping cities based on a smart cities index, economic data and demographic data. The cluster of k means is a multivalent statistical method that segments data to maximize similarities within groups and differences between groups. In other words, the method orders observations to achieve a natural association that is high between observations from the same group and low between observations from different groups. Suppose there is a set of cities (N elements) characterized by n variables Xj (, (j = 1,2,..., n), an algorithm of classification (cluster) is applied to group countries that are pretty similar between them. Besides, groups obtained are different as possible (Pérez López 2005).

There are two methods of grouping in cluster analysis, hierarchical and non-hierarchical techniques (partition). Hierarchical methods classify observations by the nearest distance among all pair of observations. They begin with a big number of clusters that becomes smaller as a cluster merges to another cluster. It is different from a non-hierarchical (partition) method that determines the number of clusters first and then finds the observations that have the nearest distance to the centroid of clusters (Rencher 2002).

3.2. Data

- Índice de Ciudad Inteligente (Smart Cities Index in English) for Argentina: is a smart city index for the capital cities in Argentina, together with Buenos Aires City (CABA) and Bahía Blanca. It offers information about 25 municipalities from Argentina. The index is compound of four dimensions: Environment, Governance, Society and ICT, and Mobility and Transport which are based on a set of indicators (Alderete 2021). Contrary to other smart city indexes, the ICI does not consider the economic dimension based on the assumption that economy and technology are strongly correlated in developing countries such as Argentina. In this respect, it follows the Smart City Index and is contrary to the Cities in Motion Index.

  Bahía Blanca, Córdoba and CABA are the three best positioned cities based on ICI. While Córdoba is only in the top of the governance dimension, CABA is leading in all the dimensions except for mobility and transport, and Bahía Blanca is among the three best positioned cities for each of the dimensions. Moreover, Bahía Blanca has the best score in the environment dimension together with CABA and Resistencia (Alderete 2021).

- Cities in Motion (CIMI): is an indicator annually published by the IESE Business School, University of Navarra. The CIMI has been built with the main goal of enabling cities' sustainability measurement. Besides, the CIMI index provides information about citizens' quality of life. The index supports the understanding of governments and the public by measuring the performances of cities based on 9 main dimensions: governance, urban planning, public management, the environment, international outreach and technology, social cohesion, mobility and transportation, human capital and the economy. In CIMI 2019, 26 Latin-American cities from 15 different countries were included: Argentina (Buenos Aires, Córdoba and Rosario), Bolivia (La Paz and Santa Cruz), Brasil (Belo Horizonte, Brasilia, Curitiba, Rio de Janeiro, Salvador and San Paulo), Chile (Santiago), Colombia (Bogotá, Cali and Medellín), Costa Rica (San José), Ecuador (Guayaquil and Quito), Guatemala (Guatemala), México (Ciudad de México), Panamá

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(Panamá), Paraguay (Asunción), Perú (Lima), República Dominicana (Santo Domingo), Uruguay (Montevideo) and Venezuela (Caracas).

When we examine the top ten cities in terms of performance for each of the 9 CIMI dimensions, Latin-American cities only appear among the best positions in the environment dimension. Moreover, Buenos Aires presents good results in terms of urban planning and environment, international outreach and governance. However, his bad economic performance is the main cause of not leading the ranking for Latin-American. The three best Latin-American cities are Montevideo (Uruguay), San José (Costa Rica) and Panamá (Panamá).

Socio-economic indicators:

- Population size: number of inhabitants settled in a city. Source: INDEC, Instituto Nacional de Estadísticas y Censo (National Institute of Statistics and Census), Argentine. https://www.indec.gob.ar/
- Unemployment rate: percentage of inhabitants of at least 15 years old without a job but that are actively looking for a job. Source: INDEC, Instituto Nacional de Estadísticas y Censo (National Institute of Statistics and Census), Argentine. https://www.indec.gob.ar/
- Economic resources: since population size is not an exact variable to measure a city's level of incomes or resources, we use the ratio tax collection/ current incomes 2019. This data corresponds to the province or region, and we assign it to the cities in each province. Information available at municipal level is missing for some municipalities except those with open data. Source: Fundación Libertad, Indice de Desempeño Provincial 2019 (Performance Index at Province Level), Argentine. https://libertad.org.ar/web/834/
- Unsatisfied Basic Needs (UBN): percentage of households with unsatisfied basic needs (potable water, number of rooms per inhabitants, among others). The higher this percentage is, the poorer and more unequal the city will be. Source: Instituto Nacional de Estadísticas y Censo (National Institute of Statistics and Census), Argentine. https://www.indec.gob.ar/
- Region: a categorical variable that represents the geographical regions in which Argentine is divided: Buenos Aires province (1), Centro (2), Cuyo (3), NEA (4), NOA (5), Patagonia (6).
- On the other side, the inflation rate and growth rate which are economic indicators proposed by Marchetti et al. (2019), have little variance among cities in Argentina. Therefore, they are not considered adequate to be included in the analysis.

4. DATA ANALYSIS AND RESULTS

We observe that ICI reaches a value of 58,37 on average for the 25 cities analyzed (Table 1). This value represents that 58,3 is the mean level of smartness among Argentinean cities, being a minimum of 35,4 and a maximum of 94,37.

We apply a k means clustering by using information about: ICI, population size, economic resources, unemployment rate, percentage of households under unsatisfied basic needs (UBN) and region. Table 1 shares the descriptive statistics of these variables.

TABLE 1 - DESCRIPTIVE STATISTICS

	N	Min	Max	Mean	Standard Dev.
ICI	25	35,43	94,37	58,3724	15,36091
Population size	25	46767	2890151	409438,4	594624,51
Economic resources	25	6,80	73,00	25,0280	15,03007
UBN	25	1,70	15,10	8,1928	3,24812
Unemployment rate	25	3,50	13,30	8,3520	2,53099

Source: The author.

We can also examine the bivariate correlation between the variables, before applying the clustering method. The smart city index is significantly and positively correlated with some of the socio-economic indicators such as population size and economic resources. On the other side, there is a significant and negative correlation between economic resources and UBN. The wealthier a city is, the lower the percentage of households with unsatisfied basic needs will be.

TABLE 2 - CORRELATION MATRIX

	ICI	population	resources	unemployment	UBN
ICI	1	,531**	,687**	,067	-,395
population	,531**	1	,702**	,263	-,206
resources	,687**	,702**	1	,298	-,463*
unemployment	,067	,263	,298	1	-,280
UBN	-,395	-,206	-,463*	-,280	1

**. Correlation is significant at 0,01 level (bilateral).

*. Correlation is significant at 0,05 level (bilateral).

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4.1. Cluster analysis

Based on the information provided by the dendrogram from the hierarchical method, we determine that three is the best number of clusters to classify the cities. Then, we apply a three means cluster analysis by using SPSS. Table 3 describes the profile of the centres of initial conglomerates.

TABLE 3 - CENTRES OF THE INITIAL CONGLOMERATES

	Conglomerate		
	1	2	3
ICI	80,39	90,22	66,33
Population size	1429604	2890151	46767
Economic resources	30,40	73,00	25,50
Region	2	1	6
UBN	5,80	6,00	8,40
Unemployment	11,40	9,40	4,00

Source: Own elaboration.

On the other side, the analysis of the centres of the final conglomerates exposes the general attitude of the three groups or conglomerates. Therefore, the profile of the cities that conforms each group, according to the values of the variables ICI, population size, economic resources, region, unemployment rate and UBN, are presented in Table 4:

TABLE 4 - CENTRES OF THE FINAL CONGLOMERATES BASED ON ICI

	Conglomerate		
	1	2	3
ICI	80,39	90,22	56,03
Population	1429604	2890151	257226,3
Economic Resources	30,40	73,00	20,54
Region	2	1	4
UBN	5,80	6,00	8,39
Unemployment	11,40	9,40	8,17
Argentinean city	Córdoba	CABA	Bahía Blanca
N	1	1	23

Source: Own elaboration.

From Table 4, we detect three different groups. Cluster 2 of relatively “prosperous, large and smart cities” corresponds to cities with the highest smart city index, and higher resources and population size than the rest. This result confirms previous findings mentioned in the empirical revision of a positive relationship between the variables (De Falco, 2019; Akçura and Avci, 2014). Moreover, cities from cluster 2 have medium to high unemployment rate and percentage of households with UBN. Although these last

variables are not statistically different according to ANOVA (Table 5), they are useful for comparison reasons. CABA corresponds to this cluster.

On the other side, cluster 3 is the "worst" cluster of "potentially smart, small and poor cities" with less level of smartness, low resources and the highest UBN. Most of the Argentinean capital cities are in this cluster together with Bahía Blanca. Although Bahia Blanca is the best ranked city based on ICI, its high unemployment rate together with its medium to small population size explains its location in cluster 3. These characteristics are contrary to a big/metropolitan or global city where new businesses emerged (Debnath et al. 2014; (Elvery 2010). Thus, not all smart cities are big cities or global cities (Marchetti et al., 2019).

In the middle, it is cluster 1 of "smart, medium size and poor cities" with a high (but not the highest) ICI index, high population, low percentage of households with UBN and the worst unemployment rates. Cordoba belongs to this cluster. This negative relationship between ICI and unemployment confirms Alvarez and Alderete (2019) finding. Finally, even though there are not significant differences in terms of UBN (unsatisfied basic needs) (Table 5), cluster 3 has a larger percentage of population with UBN, while cluster 1 has a lower percentage than the rest.

This type of clusters is part of the configuration of the inequalities demonstrated in most Latin American cities as stated by Marchetti et al, (2019) where there are smart cities such as Bahía Blanca which is not a metropolitan or global city and confronts with the disadvantages of insufficient economic resources, partially due to the federal fiscal policy.

TABLE 5: ANOVA

	Conglomerate		Error		F	Sig.
	Quadratic mean	Df	Quadratic mean	df		
ICI	812,597	2	183,536	22	4,427	,024
Population size	3863774431333,56	2	34469570337,31	22	112,092	,000
Resources	1346,761	2	120,077	22	11,216	,000
Region	6,407	2	3,174	22	2,019	,157
UBN	5,724	2	10,989	22	,521	,601
Unemployment	5,559	2	6,483	22	,857	,438

Source: The author. F tests have only a descriptive objective since conglomerates have been selected to maximize differences between cases (cities) from different conglomerates. Critical levels are not corrected so they cannot be interpreted as test of hypotheses of similarity among conglomerates.

4.2. Classification based on international SC indexes

There are two international smart cities indexes that include Argentinean cities in their sample: the Cities in Motion Index (CIMI) and the Smart City Index. In this section, since Argentinean cities included in CIMI are scarce to conduct a cluster analysis, we analyze them in a wider set of Latin-American cities. In the

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case of CIMI, the set includes 25 Latin-American cities (Table 6). We use the same variables as before, except for resources and UBN because data was missing for some LA cities.

TABLE 6 - CENTERS OF FINAL CONGLOMERATES BASED ON CIMI

	Conglomerates		
	1	2	3
CIMI	54,13	36,60	39,96
Unemployment	10,56	8,19	16,11
Population	2,92	3,04	5,28
N	5	13	7
Argentinean cities	CABA	Rosario Cordoba	
LA cities	Santiago Montevideo	Quito, Lima, México DF	San Pablo, Rio de Janeiro

Source: The author

We observe that clusters mainly differ in terms of the CIMI index, being cluster 1 a set of smarter cities than clusters 3 and 2. Cities from cluster 1 are CABA, Santiago, Montevideo, Bogota, San José and Panamá. The average size of population is not statistically different between groups of Latin-American cities. However, cities in cluster 1 and 2 are smaller than in cluster 3. Thus, cluster 1 is a set of smart and small cities with a medium unemployment rate. Cluster 2 is compound of small and less smart cities and lower unemployment rate. Finally, cluster 3 groups less smart and big cities with a high unemployment rate. Hence, Argentinean smart cities also differ in terms of population size and unemployment when using the CIMI index. Besides, CABA and Córdoba belong to different clusters similarly to the results obtained with ICI. In general, Argentinean cities are smaller than other Latin-American cities from cluster 3 and have different levels of smartness from high (cluster 1) to medium/low (cluster 2), independently of their small size. Although the objective of study are Argentinean cities, if we examine Latin-American cities we observe that San Pablo is less smart than CABA although is a larger metropolitan city.

Therefore, if we classify the cities based on an international smart city index, such as the CIMI, we obtain that CABA and Córdoba also belongs to different clusters in terms of unemployment rate (Table 7). Besides, CIMI does not consider the type of Latin-American cities as Bahia Blanca, among others, which are small and poor cities, and usually non-global cities.

TABLE 7: ANOVA

	Conglomerate		Error		F	Sig.
	Quadratic mean	fd	Quadratic mean	fd		
CIMI	560,569	2	17,483	22	32,065	,000
unemployment	143,075	2	7,879	22	18,160	,000
population	13,018	2	9,331	22	1,395	,269

Source: The author

In the case of the Smart City Index, there are very few Latin-American cities to employ a cluster analysis properly, and besides, CABA is the only Argentinean city in the list.

5. IMPLICATIONS

5.1. Theoretical Implications

International smart city indexes usually examine the case of metropolitan cities or global cities. Lack of attention is place on medium and small cities from less developed countries that usually offer good smart city initiatives but have an economic limitation, which is related to their size for some group of cities or international outreach. Although the Indice the Ciudades Inteligentes (ICI) or Smart Cities Index for Argentina shows Bahía Blanca as the smartest city in the country, this city is not included in other international indexes as the SCI, CIMI or Innovation Index.

In this paper we want to highlight that non metropolitan cities are less likely to appear in international indexes of smart city. These cities usually confront with a disadvantage context compare to metropolitan cities, especially in the economic field. Anyway, this reality does not preclude them from being innovative and smart. A particular case in Argentina is the city of Bahía Blanca, which is considered the smartest city based on ICI, and the most transparent city based on the Open Data Index (ODI), but it confronts with a poorer economic background. Hence, the heterogeneity among Argentinean smart cities in terms of economic and financial opportunities and social inequalities is important. This scenario pretends to be explained in this paper by sharing information about the level of smartness of Argentinean cities and clustering them based on some socio-economic indicators. As a result, we observe that it is not possible to classify smart cities into homogenous groups of urban socio-economic indicators. The disadvantage socio-economic context of some cities turns the smart city score obtained more relevant in comparative terms.

5.2. Managerial Implications

Bahía Blanca which is the smartest city on ICI, it is a small and poor city. International smart cities indexes do not consider this type of cities, which are usually non-global cities, even though they are smart. In Argentine, there is no economic data at the local level; for instance, there is missing data concerning the number of major global corporations, the value of a city's capital markets, the number of international conferences, and the flow of goods through ports and airports as listed in Akcura and Avci (2014). Based on this study we observe that there is a group of cities in which low smartness is correlated with high unemployment, high inequality and low economic resources; characteristics sometimes correlated with the population size. However, there is a set of cities where this correlation is negative. Hence, small but smart cities from developing countries should developed signaling methods to distinguish from small and not smart cities.

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Moreover, international smart city indexes do not include small and non-global cities from developing countries as Argentina. That is the reason why it is important to build national smart city indexes to include non-global cities which are independent of their size. International indexes can make a difference if they want to bring opportunities to cities from developing countries.

Moreover, information about the level of smartness of all types of cities is useful for technological enterprises to make a better decision of investment in less developed countries. On the other side, politician should reinforce the need of collecting local data which can be attractive for urban planning and promoting smart cities. They should also promote open data on the smart local initiatives and incentive local stakeholders to publish their local projects. Sustainable public policies at the local level are important not only for their environmental impact and urban development, but also for their effect on to value local market.

6. CONCLUSIONS

Three types of smart cities groups are identified in Argentina. From cluster analysis, the third best positioned cities (Bahia Blanca, CABA, and Córdoba) belong to different clusters in terms of economic resources and population size mainly. Therefore, CABA, which is one of the smartest cities in Argentina, has the largest budget or economic resources and it is also the biggest city in the country in terms of inhabitants. Moreover, they also belong to different geographic regions.

This paper cannot explain causality between the variables studied. Based on the clusters obtained, we observe that using population size and unemployment rate or UBN as proxies of economic local data, is not sufficient information to classify a city into smart. There are smart and large cities as well as smart and small cities. Smartness is not necessarily link to economic resources or population size. Based on ICI, on the one side, there is the cluster of “prosperous, large and smart cities”, and on the other side, the “smart, small and poor cities” cluster. We also use the CIMI index for Latin-American cities to confront the results and find smart cities of different sizes.

Among the limitations of the study is the small number of Argentinean cities analyzed which are the cities examined by the ICI index. Moreover, these cities are not exactly the same as those examined in the CIMI. Apart from that, this study can be replicated in cities from other Latin-American countries, such as Brazil and Chile. While Brazil publishes the Connected Smart Cities by Urban Systems, Chile has the Smart Cities Ranking (Ranking de Ciudades Inteligentes) of 2014, published by Fundación País Digital and the Universidad de Desarrollo, but it has not been published recently.

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