MIGRAÇÃO E ESCLEROSE URBANA: UMA ANÁLISE PARA MINAS GERAIS (1991-2010)

Migration and Urban Sclerosis: an Analysis for Minas Gerais (1991-2010)

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RESUMO

Esta pesquisa analisa em nível descritivo e exploratório a relação entre taxa de imigração e um conjunto de variáveis socioeconômicas caracterizadoras da “esclerose urbana”, conforme definida por Moore (1997), nas áreas mínimas comparáveis (AMCs) mineiras entre 1991 e 2010. Além da delimitação de agrupamentos *ad hoc* de AMCs propõe-se a análise multivariada de *cluters* para a definição de agrupamentos naturais, baseados naquelas variáveis, e a análise discriminante para validar esses grupos naturais, na averiguação da presença de esclerose urbana. Não é possível evidenciar que nas AMCs com as maiores taxas de imigração esteja presente a deterioração de indicadores socioeconômicos; quer sob a classificação *ad hoc*, quer sob a classificação por métodos multivariados. A pesquisa procura contribuir para o contínuo debate acerca dos efeitos líquidos do excesso imigratório, especialmente quanto à classificação das unidades de observação em termos de taxa de imigração.

Palavras-chave: imigração, esclerose urbana, deterioração de indicadores socioeconômicos, agrupamento ad hoc, métodos multivariados.

ABSTRACT

This research analyzes at a descriptive and exploratory level the relationship between immigration rate and a set of socioeconomic variables characterizing "urban sclerosis", as defined by Moore (1997), in the minimum comparable areas (AMCs) between 1991 and 2010. In addition to the delimitation of *ad hoc* groups of AMCs propose the multivariate analysis of clusters for the definition of natural clusters, based on those variables, and the discriminant analysis to validate these natural groups in the investigation of the presence of urban sclerosis. It is not possible to show that in the AMCs with the highest immigration rates the deterioration of socioeconomic indicators is present; either under *ad hoc* classification or under multivariate classification. The research seeks to contribute to the ongoing debate about the net effects of excess immigration, especially regarding the classification of observation units in terms of immigration rate.

Keywords: immigration, urban sclerosis, socioeconomic determinants, ad hoc clusters, multivariate methods.

1. INTRODUCTION

Migration is directly associated with the desire to improve the well-being of individuals in terms of economic prosperity, social conditions, security and quality of life; although the cases of forced migration cannot be ignored[1]. However, individual migration decisions can have both positive and negative effects, both on the leaving community and on the entering community, that were not deliberated by the migrant.

Theoretical approaches to the determinants and effects of migration emphasize the positive aspects of migration, such as the additional provision of creative talent in the host society (VIGDOR, 2013). For Clemens (2011), economists know little about the mechanisms and magnitude of externalities imposed on people living at the destination when migrants arrive. Some of them admit that the countries of origin of the migrants (and not the migrants themselves) are the owners of the positive externalities at the origin, but the destination countries do not own the negative externalities produced by the immigrants. However, "immigrants are responsible for their negative externalities in the destination" (CLEMENS, 2011, p.10).

Both origin and destination societies undergo transformations with the advent of migration. Many people in destination countries see migration as a threat to prosperity, identity and security, since the difficulty of social integration favors the maintenance of distinct and insulated cultures and religions, becoming a threat to security and social cohesion (CASTLES; HAAS; MILLER, 2013).

Brito and Souza (2005) emphasize that migrations, the result of economic and social imbalances in the regions of origin, end up reproducing them in the regions of destination. Moore (1997), for example, suggests that there is a common sense that the degeneration of some economic and social dimensions (per capita income, employment, poverty, crime and others) in large North American cities may be associated with the presence of immigrants. ; defined by him as "urban sclerosis".

The present study aims to evaluate, at an exploratory level, the relationship between immigration and urban sclerosis, in the minimum comparable areas (MCAs) of Minas Gerais in the period 1991-2010. The proposed method is a descriptive and exploratory procedure adapted from Moore (1997), based on mining AMCs initially classified as having high and low immigration. Given that Moore's (1997) clusters are ad hoc (henceforth called ad hoc clusters), we propose the application of

[1] Oliveira, Peixoto and Góis (2017) present a reflection on the refugee crisis in Europe, as an example of the influence of repulsion factors on migration attraction factors.

Cluster Analysis, to identify natural clusters, and of Discriminant Analysis, to assess the quality of these clusters, taking as a classifying-discriminatory criterion, a set of measures characterizing urban sclerosis (decrease in the employed population, in the level of per capita income, growth in the unemployment rate, in the proportion of the poor, in the rate of violent crimes and in the tax burden). The research seeks to contribute to the ongoing debate regarding the net effects of the presence of high immigration rates (immigration excess), especially regarding the classification of observation units in terms of immigration rate.

Minas Gerais is a state that during the 1940s and 1960s could not cope with the growing displacement of the population from rural areas and the natural growth of the population itself. In the 1970s, there was a change in the migratory profile, with a drop of almost 40% of migrants and an increase of 16% in immigrants, thus increasing the capacity of retention and migratory attraction, resulting from the industrialization policy and agricultural modernization of the state. In the following years, the phenomenon of return migration was observed, with an increase in the capacity of population retention and migratory attraction (AUGUSTO; BRITO, 2006).

The results show that, even at a descriptive and exploratory level, the method of grouping the AMCs influences the identification of the presence or absence of urban sclerosis. While ad hoc clustering identifies signs of degeneration of some social and economic dimensions, natural clustering does not.

In addition to this introduction, in section two there is a brief account of the theoretical and empirical literature on migration; section three deals with the methods used for the quantitative basis, and the database; section four reports the results found and section five, the final considerations.

2. THEORETICAL AND EMPIRICAL LITERATURES ON MIGRATION

Migration theories seek to explain the reasons that lead people to migrate and their effects on the societies of origin and destination. Santos et al. (2010) classify the main theories according to micro and macroeconomic aspects[2]. Those of a micro nature approach neoclassical theory as they give priority to the migrant's rational and individual decision[3], such as the Neoclassical Microeconomic Theory and the Theory of Human Capital. The macro approaches include the Neoclassical Macroeconomic Theory, based on the geographic differential of the labor market, and the Historical-Structural Approach, which conditions migration to economic inequality between regions, caused by the differential of supply and demand in the labor market.

In Neoclassical Microeconomic Theory, it is assumed that individuals are endowed with perfect information about income differentials between regions and act as rational beings prepared to order consumption baskets, aiming at maximizing the utility of their choices. Therefore, the decision to migrate takes into account a cost/benefit assessment. While the costs consist of the cost of transport, of moving, of the subjective cost of living away from the family, in addition to the cost of living in the chosen city, the benefits incorporate gains in terms of salary, personal satisfaction, improvement in the quality of life, between others. The migrant's destination is chosen by observing the places where his personal skill will be most rewarded, with prospects of positive returns (SANTOS *et al*., 2010).

For the Theory of Human Capital, individuals rationally assess the relationship between the costs and benefits of their various activities and habits, deferred in time, and determine the investment made in training, education and professional training, with the decision to migrate being subject to economic calculation, which can involve both the individual himself and the family entity.

Sjaastad (1962) apud Peixoto (2004) argues that migration can be seen as an investment made by the individual that increases his/her productivity, involves returns, but implies costs, such as: expenditure of time and money in the search for information, in training and learning, moving and adapting to a new language, culture and contact networks. However, there are benefits obtained due

[2] While there is a wide scope of migration theories, there is little intercommunication between them. The result of this fragmentation is that "our theoretical knowledge of migration is incomplete and incorrect, providing weak foundations for research and public policy" (MASSEY, 1990, p. 4).

[3] For Portes (1995), the emphasis given to rational action by neoclassicals would be questionable, as they do not consider economic action as being socially oriented; when the search for material gains must be related to the expectations of reciprocity in the course of social interaction within the migrant's conviviality group.

to the increase in income, resulting from the improvement of individual productivity, given the option of moving.

As for the macro approach, the Neoclassical Macroeconomic Theory explains migration from the geographical differentials of the labor market, taken as the primary inducer of migratory movements. The displacement starts from regions with an excess of labor in relation to capital and, therefore, lower wages, to regions with a shortage of labor and higher wages. Migratory flows would end when equilibrium is reached, with the elimination of wage differences (SANTOS *et al*. 2010).

Ravenstein (1885) apud Arango (1985) attributes the decision to migrate to a geographic binomial in which economic, social and labor advantages and disadvantages are observed in the place of origin, with expulsion factors, and in the place of destination, endowed with attractive factors[4]. The individual is seen as a rational being that aims to maximize profits and, in possession of information about the region in which he lives and the possible destination, he chooses or not the migratory route. The agent is able to compare the advantages and disadvantages of both locations, with regard to salary differences, the possibility of improving a job or finding a job, distance, linguistic and cultural differences.

Migration laws have an empirical character, according to geographic, social and economic dimensions. As for the geographical issue, most migrations are conditioned to short distances; long-distance migrants head to major commercial and industrial centers; migrations occur in a staggered manner, that is, a gradual movement between neighboring cities; the process of population dispersion and absorption have similar characteristics; each migratory current produces a compensating countercurrent[5]; the population of large cities grows more due to migration than due to vegetative growth. In the social aspect, women predominate in the short-distance migrant group; natives of cities are less likely to migrate than those from the countryside, and the majority of migrants are adults. Finally, in the economic sphere, the main cause of migration is the existing economic disparities; economic movement predominates among the reasons for migration and migrations tend to increase with economic development and progress in technology and transport (MUNIZ, 2009).

[4] This notion led to the creation of the Push-Pull model in 1876..

[5] For Ravenstein (1885) apud Muniz (2009), the migratory "currents and countercurrents" would be characterized by population movements of comings and goings: for every group of migrants displaced in a certain direction (current) there would be a movement of lesser intensity and in the opposite direction. (countercurrent), which could be represented by the so-called return migrants.

For Singer (1976, p. 217) in the historical-structural approach “migrations are always historically conditioned, being the result of a global process of change, from which they must not be separated”. Migration is correlated with the development of capitalism and what drives this act would be regional inequalities. Concentrated economic activities, resulting from the industrialization process, generate regional imbalances that result in migration. What induces migration is the demand for workforce and the search for better remuneration; the economic aspect being prioritized. Among the obstacles to migration are the low qualification of migrants, insufficient resources for displacement, an offer of urban work that, due to migration, would be lower than the demand, the fact that the demand for labor grows less than than the product and the marginalization of the migrant, which would result in the formation of an industrial reserve army, generating pressure on the wages of urban workers.

The theory of globalization, while belonging to the structuralist historical paradigm, identifies the connections between the advent of neoliberal globalization and international migrations. Castles, Haas and Miller (2013) understand that the migratory phenomenon is conditioned to the structural economic, social and political transformations that involve the history of globalization, as well as the process that encompasses its proliferation around the world in such an uneven way, factors that they have a different and direct influence on human mobility today.

The nature of migration's impact on the recipient economy and society is subject to controversy. Studies that identify and measure the benefits of immigration report the presence of an economic revitalizing effect, especially in central cities, as immigrants mitigate their economic decline by replacing native emigrant or retiring labor. Furthermore, immigrants expand the working age population; contribute to the expansion of the local labor market by introducing new demands for goods and services and new businesses, to the flexibilization of the labor market and government revenues; incorporate new skills into the human capital stock of host cities and countries; and others (MOORE, 1997; VIGDOR, 2013; OECD, 2014; BLAU; MACKIE, 2016).

Evidence of negative impacts on receiving locations generally refers to the displacement of low-skilled native workers; the reduction of the wage rate in certain industries or economic sectors, when immigrants expand the local supply of labor; by contributing to the “expulsion” of natives from certain urban areas; by imposing higher tax burdens[6], particularly as they come to enjoy local public goods and services; among others (MOORE, 1997; MURRAY; BATALOVA; FIX, 2006; BLAU; MACKIE, 2016).

[6] Blau and Mackie (2017) review the most recent empirical literature on the fiscal impacts of immigration.

In particular, immigration, although controversial, tends to be associated with criminality. There are reasons to suppose that immigrants engage in illicit activities to a greater degree than natives, because they face problems of acculturation and assimilation that most natives do not. In addition, they tend to settle in neighborhoods characterized by structural aspects associated with crime, such as generalized poverty, a higher proportion of low-skilled, unemployed or underemployed people, and ethnic heterogeneity (MARTINEZ JUNIOR; LEE, 2000; BIANCHI; BUONANNO). ; PINOTTI, 2012). On the other hand, Sampson (2008) states that a higher proportion of immigrants is correlated with less crime; communities with a concentration of immigrants tend to be safer. This is because they are shown to maintain more social ties and provide mutual economic support.

It should be noted that the aforementioned studies concern international immigration, but, keeping the necessary subtleties, such as the case of the illegal immigrant, which involves the most pressing issue of ethnicity and cultural insulation, which does not exist in relation to the national immigrant, many of the positive and negative effects reported, mainly in terms of economic aspects, may also be associated with national immigration.

In the vast empirical literature on the impacts of immigration, reviewed by Moore (1997), Borjas (1999), Martinez Junior and Lee (2000), Vigdor (2013) and Blau and Mackie (2016), the results of studies by Moore are selected. (1997) and Vigdor (2013). Moore (1997) addresses the impact of international migration on the economic and social dimensions of large cities. The issue concerns the assimilation of immigrants into the economy/society they enter, both in terms of the economic burden (opening/closing of businesses, level and growth of per capita income and the proportion of the poor, growth in unemployment) and fiscal, or regarding social (especially criminality) and cultural (according to the researcher, undesirable) transformations. In particular, he seeks to assess what he termed signs of “urban sclerosis”, evident in statistics, such as high crime rates, rising poverty levels, and job and business losses. Its focus is on verifying the debilitation generated by the immigrant's presence in the destination city.

Based on a study of the 25 most populous cities in the USA, with 200,000 inhabitants or more, in the years 1980 and 1994, the author contrasts nine variables (population growth, employment growth, variation in the unemployment rate, per capita income , per capita income growth, poverty rate, variation in the poverty rate, crime rate and tax burden) from high-immigration cities, with rates equal to or greater than 15%, to low-immigration cities, which present equal rates or less than 2.5%.

Moore (1997) shows that only the unemployment rate was higher in cities with high immigration. The higher the percentage of immigrant population in the city, the higher the employment growth, the higher the per capita income, the lower the poverty rate, in addition to lower crime rates and tax burden. Thus, it concludes that immigrants can contribute to the revitalization of North American cities. The migrant does not necessarily generate a process of "exporting poverty" from less developed regions to those with greater economic power and dynamism. These results do not suggest that immigrants lead to better urban conditions, nor that such conditions attract more immigrants. However, they refute the claim that the decline of these cities is caused by immigration.

Vigdor (2013) reports that foreign immigrants have contributed positively to the rebirth of middle-class North American cities. The individuals who arrive add a talented workforce, helping to bolster the industry's output, which protects jobs in this sector. For every thousand immigrants living in a municipality, 46 industrial jobs are created or preserved. In addition, they contribute to increasing real estate wealth, drive civic engagement through participation in their communities and the military, and encourage job creation through their entrepreneurship. The impact on the preservation of employment and real estate wealth translates not only into monetary increments in the economy and professional opportunities for families. It makes the local community live more successfully and prosperously, and can result in educational and employment opportunities for everyone, employers and employees alike, including foreigners who decide to live in the US.

In addition to other effects of migration, the issue of the quality of the migrant in the destination society is also often evaluated. By way of illustration, around 35% of immigrants within the OECD are over-skilled (highly educated) compared to natives (OECD/EUROPEAN UNION, 2015). In the Brazilian case and in terms of internal migration, most have low and intermediate levels of schooling; those with low education migrate guided by the characteristics of the place of destination and the others, by the conditions existing in the place of origin (PAIS, 2015). Although the aspect of migrant human capital qualification is pertinent and legitimate, it is not covered in this research.

3. DATABASE AND METHODS

We seek to evaluate, at an exploratory level, the relationship between migration and urban sclerosis, as defined by Moore (1997), in the minimum comparable areas (MCAs) of Minas Gerais in the period 1991-2010. A descriptive and exploratory procedure adapted from Moore (1997) is

proposed as a method, based on mining AMCs initially classified as having high and low immigration. Given that Moore's clusters are ad hoc, because they do not follow a classification criterion, we suggest the application of Cluster Analysis, to identify natural groups of AMCs, and of Discriminant Analysis, to assess the quality of these clusters, taking into account if the set of measures characterizing urban sclerosis, as a classificatory-discriminatory criterion.

Although the study is exploratory and does not seek to identify immigration as a determinant of urban "sclerosis", it is possible to frame it in the ecological approach, in the sense that the association between these measures occurs at the level of minimum comparable areas (MCA) and, consequently, it has a limitation of this approach: the unit of analysis is the AMC, whose attributes are represented and measured by proportions and rates, rather than the attributes of individuals. Thus, the evaluation and interpretation of the relationships between any two variables do not necessarily reflect situations of individuals.

3.1. Data base

Following Moore (1997), the socioeconomic variables to characterize "urban sclerosis" in the years 2000 and 2010 in the minimum comparable mining areas are: immigration rate (ti), population growth rate (p_tc), employment growth rate (te_tc), rate of change of unemployment rate (td_tc), per capita income (rpc), growth rate of per capita income (rpc_tc), percentage of poor (pob_p), growth rate of percentage of poor (pob_p_tc), violent crime rate (cv) and per capita tax burden (ctpc). Table 1 lists the variables, their legends, descriptions, construction method and information sources; some variables are in level and others in rate of change.

The patterns of migration flows can be measured from individual information, collected from the Demographic Census, regarding the origin of the person in relation to his current location. According to the definition used in the IBGE Demographic Census questionnaires (2000, 2010), a migrant is a person aged five years or older who declared, on a fixed date when the census was carried out, to reside in a different Federation Unit from the one in which was listed five years earlier.

An adequate indicator to capture the decline/rise of cities is the loss/gain of their population (MATA et al, 2007). Population growth rates (p_tc) are calculated to measure population variation by decade, based on the sizes of municipal populations in 1991, 2000 and 2010, collected from the Atlas of Human Development.

The employment rate suggests the degree of economic vitality in which cities are; higher rates would indicate economic dynamism and lower rates, the opposite. Employment growth indirectly captures the

creation of new businesses, as well as capital investments. Cities with a decline in the movement of economic activity tend to have employment declines. The growth rate of the proportions of employed persons is used[7] (te_tc) as a proxy for job creation; for the years 1991-2000, the rates were calculated from the amounts of employed persons collected from IPEADATA (based on the Demographic Census) and for the years 2000-2010, with amounts calculated as the sum of the proportions of persons employed in the commerce sectors , services and transformation of the Atlas of Human Development database. Note that different measures are not intertemporally compared.

Table 1 - List of variables and their descriptions

variable	subtitle	description	variable construction	origin
immigration fee	ti	percentage of immigrants in AMC	ratio between the number of immigrants and the population size of the AMC, multiplied by 100	census/IBGE
population growth rate	P_tc	population growth	percentage change in population size (population consists of residents in permanent private households)	Atlas of Human Development (ADH)
rate of change in the proportion of employed persons	Te_tc	percentage change in the proportion of employed persons; proxy for job creation	1991-2000: ratio between the number of employed persons and population size, multiplied by 100; 2000-2010: ratio between the number of people employed in the commerce, services and transformation sectors, and the population size, multiplied by 100	1991-2000: IPEADATA; 2000-2010: ADH
rate of change in the unemployment rate	Td_tc	percentage change in the unemployment rate	unemployment rate calculated from the unemployed population aged 16 and over (economically active)	SIM-DATASUS-Ministry of Health
average per capita income	rpc	proxy for average salary received by the population	ratio between the sum of the income of all individuals residing in permanent private households and the total number of these individuals (values in reais as of August 1, 2010)	ADH
rate of change in average per capita income	Rpc_tc	average income per capital growth	percentage change in average per capita income	idem
percentage of poor	Pob_p	poor population	ratio between the number of individuals, living in permanent private households, with a per capita household income equal to or less than R$140.00 per month (in reais as of August 2010), and the population size, multiplied by 100	idem
rate of change of the percentage of poor	Pob_p_tc	percentage change of poor	percentage change in the proportion of poor	idem
violent crime rate	cv	violent crime level	ratio between the number of occurrences of violent crimes (homicide, attempted murder, rape, robbery and armed robbery) and population size, multiplied by 100,000.	João Pinheiro Foundation
Tax Burden	ct	proxy for individual tax burden	ratio between the net revenue per capita (ratio between the value of the budget revenue of the municipal administration, deducting credit operations, and the total population) and the average per capita income (rpc)	João Pinheiro Foundation

[7] Persons who worked in the last 12 months prior to the Population Census reference date, or part thereof.

When there is an increase in the number of immigrants in a given municipality, there is concern about the possibility of the native population losing jobs and suffering a salary reduction. However, it is not possible to say that immigration causes unemployment among natives (MURRAY; BATALOVA; FIX, 2006) or that it has a generic and adverse impact on wages (PERI, 2014). To assess this aspect, we use the rate of change in the unemployment rate (td_tc), a measure of the variation between periods of the percentage of the population aged 16 and over, economically active, unemployed, collected from the DATASUS database of the Ministry of Health. , referring to the Demographic Censuses from 1991 to 2010.

According to Moore (1997), per capita income (rpc) is a reasonable proxy for average wages received by the population of cities, calculated as the ratio between the sum of the income of all individuals residing in permanent private households and the total number of individuals in the household (values in reais as of August 1, 2010). For him, variations in the immigration rate of a city impact the average income of individuals and, therefore, make the economy more (or less) dynamized. The growth rate of per capita income (rpc) is also used. Data is collected from the Atlas of Human Development.

The measure "percentage of poor" (pob_p) seeks to determine whether or not poverty is becoming more serious in the municipalities. To define poverty, the approach used is that of insufficient income[8]. According to Martini (2010), from this monetary point of view, individuals who do not reach a minimum level of consumption and income (poverty line) capable of satisfying basic needs are considered poor[9]. The Institute of Applied Economic Research (IPEA) and the João Pinheiro Foundation (FJP) associate cutting the poverty line with the minimum wage for the elaboration of the Municipal Human Development Index (HDI-M). Thus, the poverty line corresponds to the monthly per capita family income of half the minimum wage and the indigence line to the fourth part (CAON; MAGALHÃES; MOREIRA, 2011). The measure is given by the proportion of individuals living in permanent private households, with a per capita household income equal to or less than R$ 140.00 monthly, in reais as of August 2010. The rates of variation of these proportions are also calculated (pob_p_tc); both via data from the Human Development Atlas.

[8] There is no official poverty line in Brazil. The use of Gross Domestic Product per capita has limitations, since it does not assimilate inequalities in income distribution.

[9]The advantage of this approach is the possibility of measuring using a relatively homogeneous criterion between the surveys.].

A factor that can contribute to urban deterioration is the rise in crime, creating an atmosphere of insecurity, stimulating the exodus of companies and families (GLAESER, 1998). Variation of some measure characterizing the "level" of crime is used to assess the performance of this social aspect. Clemente, Rodrigues and Lírio (2015), using the homicide rate, show a positive immigration-crime relationship. In crime economics studies, it is customary to use an aggregate measure of crimes with a common nature (e.g. crime against life or property) or a measure of specific crimes (e.g. homicide). the indicator[10] of the selected crime level is the rate of violent crimes against the person, which is the ratio between the number of recorded occurrences of crimes against the person (homicide, attempted murder, rape, robbery and armed robbery, according to the characterization determined by the Brazilian Penal Code) and the population of the municipality, multiplied by 100 thousand, collected from the database of Fundação João Pinheiro.

It is assumed that municipalities with a high number of immigrants have a high tax burden. Once immigrants make use of municipal services, such as schools and hospitals in the places of destination, local and state authorities become responsible for bearing additional costs (BLAU; MACKIE, 2016). The ratio between the net revenue per capita (measured by the ratio between the value of the budget revenue of the municipal administration, deducting credit operations, and the total population) and the per capita income is used as a proxy for the individual tax burden (ct) , whose source is the João Pinheiro Foundation.

3.2. Methods

Since it is not possible to properly perform temporal evolution analyzes of variables that measure events in a given municipality when territorial and population changes are ignored, a solution is to use temporally invariant territorial units formed by municipalities that have undergone territorial changes (by annexation, dismemberment or both); grouping the data of the new municipality with those that previously belonged. The "minimum comparable areas" (MCAs) form a panel of geographic areas that allow comparisons at two or more points in time of social, economic and demographic

[10]Since not all occurrences of crimes are registered by victims at police stations, there is what specialists in the criminal area call underreporting. This makes room for the underestimation of the city's crime level. To avoid this, it is suggested to use crimes whose registration is mandatory, such as violent crimes, and crimes that are of interest to the victim, such as the case of car theft/theft in which there is the possibility of receiving paid insurance. Privileged here, violent crimes.

information at the municipal level; although it reduces the original number of municipalities (REIS et al, 2010).

In addition to this restriction, the measures present problems when the geographic units have a small population and a low number of occurrences of the investigated phenomena, especially when the magnitudes of their rates of variation are calculated, as in the cases of the measures “proportion of immigrants”, “rate of variation in the unemployment rate”, “rate of change in the proportion of employed persons” and “rate of violent crime”, data is transformed using spatial empirical Bayesian rates, as suggested by Carvalho et al (2011).

The spatial empirical Bayesian rate is the weighted sum of the raw rate (ratio between the event quantity and the population of the AMC, multiplied by 100 thousand) and the average rate of the immediate neighbors. This procedure adjusts the null cases according to the occurrences of the neighborhood, which allows the incorporation of spatial effects. Furthermore, this “spatial smoothing” does not significantly alter the magnitudes of measurements in the AMCs with high rates. The calculation of these Bayesian rates was performed using the queen matrix, as a neighborhood matrix, in the IPEA program IpeaGeo.

The justification for applying this transformation is based on the fact that 80% of the minimum comparable areas in the state of Minas Gerais have population sizes of less than 20,000 inhabitants and that the AMCs present regional differences in terms of economic aspects.

The observation units that do not follow the variability pattern of the others, because they are discrepant, distort the magnitudes of the measures of central tendency and dispersion. This demands verifying its influence on the distributions of the variables of interest. The method proposed by Johnson and Wichern (2007) is applied to detect outliers[11].

Moore (1997) analyzes the patterns of variables that characterize urban sclerosis and immigration to North American cities, classifying them into only two groups – high and low immigration, ignoring the remaining group. This partition of cities seems to have been ad hoc, insofar as he does not consider his choice. In this investigation the “ad hoc partition” is established by the first and tenth deciles of the distribution of proportions of immigrants in the AMC population.

[11] Generalized squared distances at a given percentile (threshold percentile) of a chi-square distribution (established by the sample size) are compared: observations with squared distances greater than the threshold percentile value are considered outliers (JOHNSON; WICHERN, 2007).

The 2000 and 2010 ad hoc partitions are identical in terms of numbers of AMCs, 70 AMCs with a low proportion of immigrants and 72 AMCs with high proportions of immigrants. “High immigration” (excess immigration) AMCs were considered to be those whose proportions of immigrants were greater than or equal to 25% for the year 2000, and 28% for 2010. “Low immigration” AMCs had proportions less than or equal to to 2.55% in 2000 and 3% in 2010.

Given that this ad hoc partition of AMCs to assess whether high immigration rates are associated with measures that characterize urban sclerosis is not supported by the underlying structure of the information matrix, it is suggested to verify whether the natural clusters reflect such characteristics. Cluster Analysis is applied to identify clusters considering the variables of interest, and Discriminant Analysis is applied to assess the quality of the classification established through cluster analysis.

Cluster Analysis (CA) is an exploratory method that seeks to identify, in a set of observation units, mutually exclusive groups of similar units, based on the heterogeneity of the distributions of the variables that characterize them. The measures characterizing the units of analysis – random vector with p variables – are used in the calculation of the measure of similarity or dissimilarity between them; of the distances between them. It is based on the distances that clustering techniques (hierarchical and non-hierarchical) classify observation units according to their similarities (JOHNSON; WICHERN, 2007; MINGOTI, 2007).

Discriminant Analysis (AD) is recommended to investigate phenomena where causal relationships are not very well understood. It will be performed in addition to cluster analysis to assess the quality of clusters in terms of classification error and discrimination capability. That is, verify that the AMCs were properly classified; otherwise, reclassifications, if necessary, are carried out according to the Lachenbruch method[12], which is the most used (MINGOTI, 2007; JOHNSON; WICHERN, 2007).

This study will identify groups of AMCs that are similar in terms of the ten variables mentioned above (TABLE 1). This procedure will make it possible to verify whether the groups with the highest proportions of immigrants show signs of urban sclerosis. The CA will be held for both the 1991-2000 and 2000-2010 periods. In addition, we will seek to identify which AMCs moved from group to group in the 2000-2010 period, based on the 1991-2000 classification. Before applying the AC and AD, tests of independence of variables (Wald test), equality of correlations (Lawley test) and multivariate normality (Henze-Zikler and Mardia tests (Skewness and Kurtosis) will be performed).

[12] This method identifies AMCs with a high probability of misclassification; so the calculated probabilities can guide reclassification decisions.

3.3. Descriptive Data Analysis

The state of Minas Gerais has, for the period 1991-2010, 721 minimum comparable areas and about 92% of them have a population of less than 50 thousand inhabitants; and at least three, more than 500 thousand inhabitants. For the entire period of analysis, the average proportion of immigrants in AMCs[13] was 6.5%, but with high dispersion[14]. None of the high-immigration AMCs has a population of over 50,000. On the other hand, those with more than 100 thousand inhabitants are, for the most part, with low immigration. In particular, the following AMCs recorded proportions above 100%: Sardoá, in 2000; Poté, Olímpio Noronha and Desterro de Melo, in 2010; for both years, Conquista, Ewbank da Câmara, Mirabela-Patis, São Sebastião do Oeste, Monte Sião, São José do Mantimento, Raul Soares-Vermelho Novo, Pedrinópolis, Turvolândia, Divinolândia de Minas, Umburatiba, Leandro Ferreira, Passabém, Glaucilândia -Oath and Consolation.

Population growth remained stable at 1.05%. While in the decade 1991-2000 there was an average decrease of 8% in the proportion of employed persons, in the following decade the reversal of the pattern led to an average growth of 5%. The opposite, as expected, occurred with the unemployment rate, but at different levels. In the period 1991-2000, even with the transformation of the variable, the average change in the unemployment rate was high and close to 453%. In the following period, it went to an average level of -35%. In both decades, per capita income grew and the proportion of poor people decreased, but with a greater decrease in 2000-2010, around 54%. The level

[13] The highest proportions occurred in Águas Vermelhas, Curral de Dentro and Divisa Alegre; Alpinópolis and São José da Barra; Mountain Support; Brasília de Minas, Campo Azul, Japanvar and Luislândia; Golden Waterfall; Caetanopolis; Cajuri; Camacho; New Chapel; Caranaiba; Caratinga, Entre Folhas, Imbé de Minas, Ipaba, Piedade de Caratinga, Santa Bárbara do Leste, Santa Rita de Minas, Ubaporanga and Vargem Alegre; Carmesia; Rich Gravel; Conquest; Consolation; Cordisland; crown; Coromandel; Desterro do Mello; Divinesia; Divino and Orizânia; Divinolândia de Minas; Golden Four; Ervalia; Chamber's Ewbank; Fame; São Gonçalo do Rio Preto; Itacarambi and São João das Missões; Glaucilândia and Oath; Duck's lake; little slab; Lamin; Leandro Ferreira; Freedom; wonders; Marlieria; Matias Barbosa; morning; Mirabella and Patis; Miraí and São Sebastião da Vargem Alegre; Mount Zion; Olympio Noronha; parrots; Take care; Golden Stone; Pedrinopolis; Pedro Teixeira; Perdigão; Tweety; Pirapetinga; Deep well; Bowl; meadows; President Kubitschek; Raul Soares and Vermelho Novo; Indaiabira, Montezuma, Rio Pardo de Minas, Santo Antônio do Retiro, Vargem Grande do Rio Pardo; Santana do Garambéu; Santana dos Montes; São Gonçalo do Abaeté and Varjão de Minas; São João da Mata; São José do Mantimento; São Sebastião do Oeste; São Sebastião do Rio Verde; Sardoá; Silveirania; Simon Pereira; Board; Teixeiras; tumbles; Tumiritinga; Cloudland; umburatiba.

[14] Variable with the highest coefficient of variation, greater than seven, both in 2000 and 2010, indicating that it is the most heterogeneous of the variables.

of violent crimes remained stable, close to 25.5 per 100,000 inhabitants. The average tax burden has doubled.

In short, the period 1991-2000 presented a profile of decline in the employed population, growth in the unemployment rate and a smaller decrease in the proportion of the poor. In the period 2000-2010, on the other hand, there was a reversal of this situation: growth in the employed population, decrease in the unemployment rate, greater decrease in the proportion of poor people and increase in the tax burden.

Without taking any criteria for classifying AMCs and under the criterion of "urban sclerosis" – increase in crime rates, increase in the level of poverty, loss of jobs and reduction in per capita income –, in general, their signs are partially found in the 1991-2000 decade, due to the fact that it was a period of reduction in the proportion of employed people (proxy for job creation and, indirectly, business) and increase in the number of unemployed.

The presence of higher discrepant values (outliers), especially in the variables "proportion of immigrants", "rate of change in the proportion of employed persons", "rate of change in the unemployment rate" and "rate of violent crimes" requires assessing the influence of these values in the measurements of position and dispersion. A total of 44 discrepant AMCs (6.10%) were detected for the year 2000 and 29 for the year 2010 (4.02%). Of these, thirteen remained discrepant in 2000 and 2010: Belo Horizonte, Betim, Cachoeira Dourada, Consolação, Contagem, Doresópolis, Grupiara, Ibitiúra de Minas, Nova Serrana, Onça do Pitangui, São Sebastião do Rio Preto, Serra da Saudade, Uberlândia. In particular, Contagem and Uberlândia have low immigration, Consolação and Cachoeira Dourada have high immigration, and Cajuri, although still having high immigration, ceases to be so in 2010.

The discrepant AMCs are distinguished more specifically in terms of the variables "proportion of immigrants", "rates of change in the proportion of employed persons", "rate of violent crimes" and "tax burden"[15]. In 2000, there are signs of urban sclerosis in these AMCs, differing only in terms of the

[15] For 2000, comparing the descriptive statistics of the discrepant AMCs and non-discrepant AMCs, it can be seen that in the discrepant AMCs the averages are higher in terms of the proportion of immigrants (7.93 times higher), the rate of change in the unemployment rate (3.51 times), the violent crime rate (2.73 times) and the tax burden (1.32 times); and lower in terms of the rates of change in the proportion of employed persons (0.20) and of the poor (0.71). The other variables are not significantly different. For 2010, in the discrepant AMCs, the averages are higher in terms of the proportion of immigrants (9.85 times higher), the growth rate of per capita income (1.44 times), the violent crime rate (2.17 times) and the tax burden (1.71); and lower in terms of the rate of change in the proportion of employed persons (0.44). The others are relatively similar.

rates of change in the unemployment rate (average growth of 1427%) and in the proportion of the poor (smaller decrease) and in terms of the level of crime; in 2010, such signs are less clear. In the discrepant AMCs, the unemployment rate decreased less than in the other AMCs and the violent crime rate is 2.17 times higher. However, per capita income grew 1.44 times higher than.

4. RESULTS AND DISCUSSION

This section presents the results for ad hoc clusters and natural clusters. The "smoothing" of the variables, transforming them into spatial empirical Bayesian rates, was applied to the variables "immigration rate", "rate of change in the percentage of employed persons", "rate of change in the unemployment rate" and "rate of unemployment". violent crimes".

4.1. Ad hoc groupings and Minimal Comparable Outliers Areas

The ad hoc partition, according to Moore (1997), who classifies AMCs only in terms of immigration rate, consists of three groups: low-immigration AMCs (immigration rates below 0.82% and 1.05%, of 2000 and 2010, respectively), the one with high immigration (with rates above 7.96% and 8.7%, respectively) and the group of other AMCs. For the data used (Minas Gerais AMCs and period 1991-2010), these limits are close to the first and last deciles of the distributions of immigration rates.

For the period 1991-2000, the low immigration group consists of the most populous MCAs and the high immigration group the least populous. In terms of homogeneity/heterogeneity (comparisons between coefficients of variation) of the distributions of the variables, the low-immigration group is more homogeneous in terms of the proportion of immigrants, the rates of change in the unemployment rate, per capita income and the proportion of poor people. . The high immigration group is more homogeneous in the variables "proportion of poor" and "rate of violent crimes".

The high-immigration group faced higher unemployment rate growth, lower per capita income level, higher level, but lower decrease in the proportion of the poor and higher tax burden. On the other hand, higher growth of the employed population and lower rate of violent crimes. In AMCs with low immigration, there was a lower growth in the employed population and in the unemployment rate and higher rate of violent crimes. On the other hand, a higher level of per capita income, a lower level, but a greater decrease in the proportion of the poor and a lower tax burden.

As for urban sclerosis, the signs are found (comparisons of the averages of the variables) for the high immigration group, due to the growth of the unemployment rate, lower level of per capita income, lower decrease in the proportion of poor people and higher tax burden; but lower rate of violent crimes.

In the period 2000-2010, the low-immigration group continued to consist of more populous AMCs and the high-immigration group, less populous. Comparisons of the coefficients of variation of the distributions of the variables show that the low immigration group is more homogeneous in terms of the proportion of immigrants, the rates of change in the unemployment rate and the proportion of poor people, and the tax burden. The high immigration group, for the level and growth of per capita income and proportion of the poor.

The high immigration group was characterized by having a lower level of per capita income, a higher proportion of poor people and a higher tax burden. However, higher growth in the proportion of the employed population, lower unemployment rate decline, higher per capita income growth, lower violent crime rate. Low immigration MCAs, lower growth in the proportion of employed persons, lower growth in per capita income, higher violent crime rate, but greater decline in the unemployment rate, higher per capita income level, lower level and greater decline in the proportion of poor and lower tax burden.

This picture, unlike what was found for the period 1991-2000, shows that few signs of urban sclerosis appear in both groups of AMCs, but together there are opposite signs of urban renewal.

Since there are discrepant AMCs, as they present discrepant values from the average of the AMCs, especially in the variables "immigration rate", "rate of change in the proportion of employed", "rate of change in the unemployment rate" and "rate of violent crimes ", it is important to investigate the signs of urban sclerosis in these AMCs. Of the 721 AMCs, 44 of them in 1991-2000 are discrepant (6.10%) and signs of urban sclerosis are found only in terms of the rate of change in the unemployment rate (increased by 1365%), the rate of change in the proportion of poor (reduced, on average, less (-28.20%)) than in non-discriminating MCAs (-40.39%) – lower poverty reduction –, and in terms of crime (2.55 times higher). On the other hand, the rate of change of employed persons grew by an average of 37%. In the other AMCs, there are signs of urban sclerosis only in terms of the variation in the unemployment rate (403%) and the violent crime rate (greater than 10/cmh).

For the following period 2000-2010, 29 are outliers (4.02%); therefore, decreasing in number compared to 1991-2000. Statistics on immigration rate, rate of change in unemployment rate, level of per capita income and percentage of poor people, violent crime rate and tax burden are sensitive to the presence of discrepancies. The AMCs with higher outliers show higher averages and standard deviations than the other AMCs in terms of immigration rate, level and growth of per capita income, violent crime rate and tax burden. And lower averages for the rate of change in the unemployment rate, in magnitude, and proportion of poor people. The only sign of urban sclerosis is due to the level of crime, which is 2.26 times higher in the discrepant AMCs. Therefore, it is not possible to identify an association between discrepant immigration rates and measures of urban sclerosis, even in this group of analysis units.

Therefore, the measures that configure urban sclerosis cannot be fully associated with high immigration in the minimum comparable areas of Minas Gerais in the period 1991 to 2010. However, as the classification criterion in ad hoc clusters presents a high rate of classification error (31.5% for 1991-2000 data and 29.55% for 2000-2010), according to the application of the discriminant analysis technique, since only one discriminant variable is considered – the immigration rate – it is convenient to find the natural groupings and to evaluate the high immigration-urban sclerosis association.

4.1. Natural groupings

The application of cluster analysis makes it possible to find natural clusters of comparable minimum areas based on the set of variables that characterize urban sclerosis. Discriminant analysis was applied only with the aim of evaluating the quality of the clusters generated by the cluster analysis, regarding the classification error and the ability to discriminate the AMCs. These techniques assume that the data were generated from a normal distribution.

The homogeneity and symmetry tests of the correlation matrices (Wald tests, proposed by Jennrich (1970), and Lawley tests, respectively), performed for the two periods (1991-2000, 2000-2010), allow rejecting their null hypotheses when 1% significance level. Therefore, they are matrices that do not have identical correlations between the variables. The normality tests (Mardia tests for asymmetry and kurtosis and the Henze-Zirkler test for multivariate normality), both for the original data and for the transformed data, indicate rejecting their null hypotheses (TABLE 1).

TABLE 1 - Hypothesis tests

time course	tests	original variables		transformed variables	
		values	p-value	values	p-value
1991-2000	Jennrich chi2(45)	2418,59	0,0000	-	-
	Lawley chi2(44)	2369,65	0,0000	-	-
	Mardia Skewness chi2(220)	90182,462	0,0000	9018,047	0,0000
	Mardia Kurtosis chi2(1)	5,09E+05	0,0000	11551,171	0,0000
	Henze-Zirkler chi2(1)	63284,591	0,0000	17089,881	0,0000
2000-2010	Jennrich chi2(45)	2273,34	0,0000	-	-
	Lawley chi2(44)	2224,3	0,0000	-	-
	Mardia Skewness chi2(220)	83123,733	0,0000	2822,971	0,0000
	Mardia Kurtosis chi2(1)	4,31E+05	0,0000	2025,509	0,0000
	Henze-Zirkler chi2(1)	28399,778	0,0000	3408,468	0,0000

Cluster analysis, for data from 1991-2000, based on the observation of dendrograms and partitions suggested by hierarchical techniques (via the Ward method and diagnosed by pseudo-F statistics and T2 statistics), allowed us to find the initial centroids for the application of the techniques non-hierarchical (k-means).

The partitioning achieved via k-means techniques suggests five groups (highest pseudo-F statistic) of AMCs. On the other hand, the application of the discriminant analysis, considering the partitions of this last technique and the discriminant variables (variables that characterize urban sclerosis), establishes five groups as the final partition (lowest error rate (1.16%)). However, there is a group with a single AMC (Municipality of Consolação); grouping considered inappropriate in the literature. The second most suitable partition is that of three groups (1.27% error rate). Even so, six AMCs from group 1 were classified as group 3 and four from group 3, as group 1. The reclassifications of these poorly classified AMCs by the Lachenbruch method allow reducing the error rate to 0.81% and establishing a partition final in which groups 1, 2 and 3 contain 612, 8 and 85 AMCs, respectively.

An important result is that the immigration rate is not relevant in the discriminant function, since the largest loads are in the discriminant variables per capita income, percentage of poor people, violent crime rate and tax burden. The groups are homogeneous (coefficients of variation closer to zero) in terms of population growth, per capita income, and rate of change in per capita income. Table 2 presents the descriptive statistics (mean, standard deviation and coefficient of variation) for each of the natural groups.

TABLE 2 - Descriptive statistics by natural group (1991-2000)

Grupos		ti	p_tc	te_tc	td_tc	rpc	rpc_tc	pob_p	pob_p_tc	cv	ct
1	média	4,43	1,06	9,35	291,39	370,92	57,13	32,77	-40,51	27,51	1,64
	dp*	8,51	0,14	18,37	187,23	143,72	33,89	16,86	17,81	34,33	0,94
	cv**	1,92	0,13	1,96	0,64	0,39	0,59	0,51	-0,44	1,25	0,57
2	média	2,59	1,04	6,50	4511,17	358,58	76,09	39,52	-31,12	29,12	1,61
	dp	1,56	0,12	21,11	1509,60	129,45	44,15	18,71	13,00	25,96	0,60
	cv	0,60	0,11	3,25	0,33	0,36	0,58	0,47	-0,42	0,89	0,37
3	média	21,62	1,08	56,56	1257,95	321,70	55,15	39,41	-34,31	22,94	1,79
	dp	144,23	0,14	74,04	507,49	130,82	32,60	18,71	21,48	19,95	0,93
	cv	6,67	0,13	1,31	0,40	0,41	0,59	0,47	-0,63	0,87	0,52
Total	média	6,46	1,06	14,94	453,74	364,92	57,11	33,63	-39,67	26,98	1,66
	dp	50,45	0,14	34,32	606,61	142,81	33,87	17,23	18,35	32,87	0,93
	cv	7,81	0,13	2,30	1,34	0,39	0,59	0,51	-0,46	1,22	0,56

Group 1 consists of the most homogeneous AMCs in terms of tax burden. They, on average, registered a lower growth in the unemployment rate, a higher level of per capita income, a lower percentage of the poor, a greater decrease in the percentage of poor people. Group 2, with only eight AMCs and more homogeneous in terms of immigration rate, population growth, percentage change in the unemployment rate and the percentage of poor people, registered a lower rate of immigration, lower growth in the proportion of employed persons, higher growth in the unemployment rate. , higher per capita income growth, lower proportion of poor people, higher violent crime rate. Group 3 has high immigration, higher growth in the proportion of employed persons over 1991-2000, lower level and growth of per capita income, higher proportion of the poor, lower violent crime rate. This group has more similar AMCs in terms of percentage variation in the proportion of employed persons and in the rate of violent crimes.

The identification of natural groupings does not make it possible to distinguish between high and low immigration groups. With the exception of group 2, the others contain AMCs of high and low immigration and group 3 only registers an average rate of 21.6% due to the outlier value of this variable for the AMC Consolação. Partial signs of urban sclerosis are found in groups 2 and 3; therefore it is not possible to say, for 1991-2000, that immigration is associated with urban sclerosis.

The creation of partitions using hierarchical and non-hierarchical techniques for data from the 2000-2010 period suggests six groups (which is the partition with the lowest error rate, 2.95%). However, there are two groups with few individuals (1 and 2 individuals). The second partition with the lowest error rate is the one that contains five groups, but the same problem remains and with the

same units of analysis (Consolação, Belo Horizonte and Nova Lima). Consolação is also isolated for four groups. The three-group partition has the highest error rate, 6.81%.

Compared to the 2000 partition, the groups became more homogeneous in terms of amounts of AMCs, 315, 288 and 118 AMCs for groups 1, 2 and 3, respectively (in 2000 they were 621, 8, 85). Again, the immigration rate is not relevant in the discriminant function and the greatest loads are on the discriminant variables, rates of change in the percentage of poor people, per capita income, and population size. Table 3 displays descriptive statistics for each of the natural groups.

TABLE 3 - Descriptive statistics by natural group (2000-2010)

Grupos		ti	p_tc	te_tc	td_tc	rpc	rpc_tc	pob_p	pob_p_tc	cv	ct
1	média	4,55	1,06	4,73	-38,06	546,20	39,76	10,37	-57,22	23,52	2,90
	dp*	7,28	0,11	11,24	28,45	58,68	23,72	4,43	13,70	21,16	1,76
	cv**	1,60	0,10	2,38	-0,75	0,11	0,60	0,43	-0,24	0,90	0,61
2	média	11,15	1,00	9,53	-31,48	355,45	52,82	26,55	-47,22	20,39	4,30
	dp	80,27	0,07	13,94	31,45	58,24	26,93	8,68	11,74	16,28	1,50
	cv	7,20	0,07	1,46	-1,00	0,16	0,51	0,33	-0,25	0,80	0,35
3	média	4,21	1,12	0,45	-41,49	785,94	42,57	5,66	-63,36	43,15	2,08
	dp	7,22	0,11	9,37	30,48	141,49	31,01	2,26	11,09	40,89	0,87
	cv	1,71	0,10	20,79	-0,73	0,18	0,73	0,40	-0,17	0,95	0,42
Total	média	7,13	1,05	5,95	-35,99	509,24	45,44	16,07	-54,23	25,49	3,32
	dp	51,10	0,11	12,56	30,22	169,45	26,98	10,74	13,93	25,22	1,76
	cv	7,16	0,10	2,11	-0,84	0,33	0,59	0,67	-0,26	0,99	0,53

Group 1 recorded an average immigration rate and tax burden similar to that of group 3, lower growth in per capita income, and is more homogeneous in terms of immigration rate and per capita income. Group 2 had a higher rate of immigration, higher growth in the proportion of employed persons, lower unemployment rate decrease, lower level and higher growth in per capita income, higher level and lower decrease in the proportion of the poor, lower violent crime rate and higher Tax Burden. It has less heterogeneous distributions in terms of the variation in the employed population and per capita income, and in terms of the percentage of poor people and the rate of violent crime and tax burden. Group 3 faced lower growth in the proportion of employed over 2000-2010, greater decline in the unemployment rate, higher level of per capita income, lower level and greater decline in the proportion of the poor, higher rate of violent crimes.

The association between high immigration and measures of urban sclerosis is less discernible, since using the clustering technique it is not possible to distinguish high and low immigration groups. In addition, signs of urban sclerosis are less clear in the period 2000-2010.

The use of the final partition of 2000 to classify the AMCs of 2010, in order to verify the transition of the AMCs from one group to another in that period, leads to a high error rate (29.55%). Therefore, thirteen reclassifications were carried out, but the error rates stabilize at around 12-13%, however, they remain high (those below 5% should be preferred). The final partition manages to distinguish a group of high immigration, but the descriptive statistics by groups show signs of urban sclerosis only in terms of crime level, but with a violent crime rate not very different from the other AMCs.

Excluding outliers makes the sample distributions closer to the normal distribution, but not in a statistically satisfactory way. However, it does not allow the identification of high and low immigration groups, as Cluster Analysis produces groups containing AMCs from all ad hoc immigration classes and presents approximate descriptive statistics.

The general conclusion is that it is not possible to show, for the minimum comparable areas of Minas Gerais in the period 1991-2010, associations between a high proportion of immigrants and the phenomenon “urban sclerosis”, indicated by the deterioration of the variables of interest. These results are in line with those found by Moore (1997) for international immigration in the USA. Because it is not a research that prioritizes the issue of causality, but only at an exploratory level, the evidence does not allow us to refute the implications established by Martinez Junior and Lee (2000), Murray, Batalova and Fix (2006), Bianchi, Buonanno and Pinotti (2012), Sampson (2008) and Blau and Mackie (2016).

5. FINAL CONSIDERATIONS

The objective of this exploratory research was to evaluate the relationship between migration and urban sclerosis, as defined by Moore (1997), in the 721 minimum comparable areas of Minas Gerais in the period 1991-2010. The proposed methodology was to compare Moore's descriptive procedure, however adapted, based on Minas Gerais AMCs initially classified as having high and low immigration, with natural groupings based on a set of measures that potentially characterize urban sclerosis (decrease in the employed population, per capita income, growth in the unemployment rate,

in the proportion of the poor, in the violent crime rate and in the tax burden), using Cluster and Discriminant Analysis.

As for the ad hoc grouping, the measures that allow configuring the presence of urban "sclerosis" cannot be fully associated with high immigration; including for the discrepant AMCs in terms of immigration fees. For natural groupings, it is also not possible to associate a high proportion of immigrants and the deterioration of socioeconomic measures. Therefore, these results do not contradict those found by Moore (1997), for international immigration in the USA. Both in the 1990s and in the following decade, high and low immigration groups cannot be distinguished.

One of the contributions of this research is the application of multivariate analyzes to identify groups of observation units from a set of variables, instead of reporting solely to the variable "immigration rate". Therefore, resorting to a less subjective classification criterion. However, some of its limitations should be noted, such as not discussing the selection of variables; ignore the disadvantages inherent in the use of comparable minimum areas (for example, the reduction of the sample size); consider the potential effects of external immigration similar to those of internal immigration (disregarding the influence of cultural diversity on the adaptation process in the destination society); the geographic scope is limited to the state of Minas Gerais; the definition of migrant includes only the cases of individuals emigrated from another unit of the federation; ignore, in the case of Minas Gerais, the phenomenon of the return migration movement. Garcia and Miranda-Ribeiro (2005) show that 25% of the population that entered this Federation Unit, between 1990-2000, had no connection with return migration, that is, 75% of migrants were, in fact, remigrated or their companions (spouses, children and/or other relatives).

In terms of future advances, it is suggested to deepen the debate regarding the relevance of the concept of urban sclerosis, as well as the variables that characterize it; expand the geographic scope; replicate the methodological strategy to the 2020 Demographic Census data, when available.

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