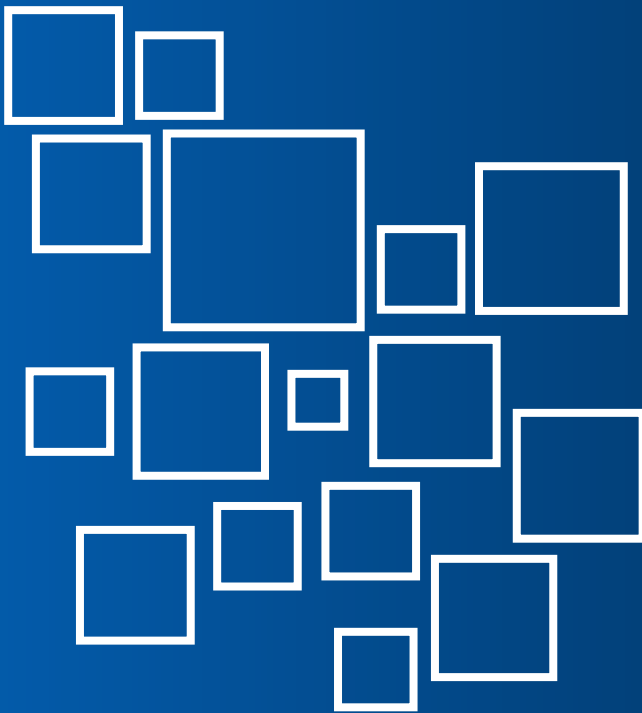


ISSN 1022-4057



Português

English

Español

ECONOMIC ANALYSIS OF LAW REVIEW

abde
Associação Brasileira
de Direito e Economia

 Universidade
Católica de Brasília

 EDITORA
universa

www.ealr.com.br

Economic Analysis of Law Review

Land subdivision legislation in Brazil—guilty of promoting insecure housing tenure?¹

Legislação de parcelamento do solo no Brasil – culpada de promover a insegurança da posse das moradias?

Paulo Coelho Avila²

UCB

RESUMO

A Lei Federal de Parcelamento do Solo para fins urbanos aprovada em 1979, e sua implementação pelos governos locais contribuiu para o aumento da informalidade habitacional entre 1980 e 2000, um período de grandes mudanças nos cenários demográfico, econômico e social no Brasil. Análises econométricas de dados censitários em painel de corte transversal e séries temporais relativos à insegurança da posse da moradia sugerem que a regulação sobre o parcelamento do solo teve um importante papel no crescimento da informalidade habitacional no Brasil, a despeito de fatores demográficos e econômicos. Isso é mais percebido quando leis municipais aumentaram os requisitos oriundos da lei federal. Argumentamos que critérios mais rigorosos para aprovação e registro de parcelamentos do solo urbano elevaram os custos e os riscos para que essa atividade ocorresse de modo formal, em um cenário de declínio econômico. Tal fato restringiu a elasticidade da oferta de solo regular para a demanda habitacional de baixa renda ao induzir o parcelamento de solo informal de modo a eliminar os custos e a burocracia envolvida na atividade formal.

Palavras-chave: parcelamento do solo, regulação do uso do solo, moradia informal, insegurança da posse do solo, assentamentos informais.

JEL: R28, R31, R38.

ABSTRACT

The Brazilian federal legislation on land subdivision approved in 1979 and its local implementation by municipalities contributed to increase housing informality from 1980 to 2000, a period of marked changes in the economic, demographic, and social scenarios. Econometric analysis of a cross-sectional and time-series panel of censuses data regarding insecure housing tenure suggests that regulations on land subdivision played an important role in the growth of housing informality in Brazil, regardless demographic and economic factors. This was most noticeable when local ordinances overregulated land subdivision parameters. We argue that stricter and more demanding requirements for approval and registration of land developments increased costs and risks for subdividing land formally within a scenario of economic downturn. This constrained formal land supply elasticity for the low-income housing demand which probably forced developers into informality to eliminate the costs and red tape involved in developing land formally.

Keywords: land subdivision; land use regulations; housing informality; insecure land tenure; informal settlements.

R: 14/05/15 **A:** 07/08/15 **P:** 20/02/16

¹ This research was partially sponsored by the Lincoln Institute of Land Policy – LILP. The findings and conclusions expressed herein do not necessarily reflect the official views and policies of the Lincoln Institute of Land Policy. Possible shortcomings and interpretations are entirely the author's responsibility.

² E-mail: avilapc@gmail.com.

1. Introduction

Since 1988, when the current Federal Constitution of Brazil came into force, Brazil has been making great efforts at the federal level to improve its regulatory framework on urban development. The Brazilian constitution includes two articles that establish general principles on urban development and present the so-called “master plan” as the basic tool for the management of urban policy. This tool is mandatory for all municipalities with 20,000 inhabitants or more.

In 2001, the Brazilian National Congress passed federal law no. 10257, also known as the “Statute of the City,” which provides legal tools to manage urban development by local governments. One of them is land regularization that received specific treatment in the 3rd chapter of Law no. 11977 (approved in 2009), wherein it prescribes a comprehensive set of procedures to regularize informal urban settlements.³ This chapter was extracted from a bill proposed at the National Congress in 2000 that attempts to modify Brazilian federal law no. 6766 of 1979, which regulates land subdivision for urban use.

Brazil has invested many resources to construct an exhaustive normative framework that seeks to manage urban development under the logic of “command and control.” Normative land use controls often do not have the capacity to coordinate existent resources in territories under a positive agenda for urban development in the long-term. These controls have proven to be counterproductive in complex environments under fast transformation by imposing strict and inflexible norms. In addition, normative controls require huge institutional structures and resources to enforce law and punish non-compliant behaviors. In Brazil, most municipalities lack appropriate structure and resources as part of efficient urban governance.

The set of controls on urban development available for municipalities in Brazil has been used for several purposes, since for promoting a balanced mix of land uses, for protecting natural resources from the urban expansion or to coordinate densities with infrastructure provision. However, in some cases, these controls have not been efficient in correcting market failures and in achieving a Pareto-efficient pattern of land use, because individual responses to the legal constraints can produce unpredicted effects. Even so, policymakers continue to identify “market imperfections” and urge stricter laws without questioning whether interventions have made things better or worse (Mills, 2000).

Major research on the effects of urban regulations in real-estate markets is focused on the impacts of zoning, greenbelts, land-use controls, and minimum design parameters. Ohls, Weisberg & White (1974), for example, analyzed the effects of zoning restrictions on land markets and found that, whether these are used to achieve a Pareto-efficient pattern of land use or fiscal objectives, land prices are invariably affected. Bertaud and Malpezzi (2001) argue that, although land use regulation may often be reasonable when considered individually, in practice, it may result in higher housing prices. Glaeser and Gyourko (2002) also indicate that zoning controls in several US communities are responsible for creating a kind of “zoning tax,” because they have pushed housing prices far above construction costs.

In his study on privately planned communities, Fischel (2000) asserts that zoning regulations have restricted construction of additional housing units and other land use changes, thereby increasing housing prices for the entire metropolitan area (Reichman, 1976; Black & Hoben, 1985; Pollakowski & Wachter, 1990 and Fischel, 2000). Similarly, Pendall (2000)

³ Informality refers to either slums or irregular developments. Slums are human settlements resulted from spontaneous or organized occupation of vacant or underutilized land within urban areas. Irregular developments are usually located in peripheral urban areas and are products of land subdivision that fails to comply with urban regulations. Both lack infrastructure provision and secure land tenure very often. Nevertheless, housing informality can also include situations where households live in invaded houses, abandoned buildings, or other places under insecure conditions of housing tenure.

demonstrated that some land use controls contained in zoning laws covering 25 of the largest U.S. metropolitan areas imposed constraints on housing supply, affordability, and other conditions that could help promote racial inclusion.

In Brazil, empirical literature focusing on the effects of urban legislation on housing and land markets is relatively scarce, even considering that the norms used to manage urban development over time were unable to enhance affordable housing supply for low-income people. Most studies adopt a sociological approach to suggest the role of the urban normative framework associated with the country's social inequalities in creating an exclusionary urban order that worsens social exclusion and housing informality (Rolnik, 1997 and 1999; Maricato, 1996, 1999 and 2000; Martins, 2003).

Studies using empirical evidence show that urban regulations may have some impacts on the increase of informal housing in Brazil. Lall, Wang and Da Mata (2006) found that the adoption of more flexible patterns of urbanization resulted in higher growth in formal housing stock. However, this was followed by higher population growth from migration, thereby constraining the formal housing supply response, which in turn exacerbated the slum formation. Biderman (2008) found evidence that urban regulations induce housing informality, showing that the largest impact comes from zoning laws, followed by master plans and urban boundary laws in second and third positions.

This paper intends to discuss an important topic in Brazil regarding the effects of urban legislation on the affordable housing supply and housing informality growth. By using census data and econometric analyses, it discusses whether Brazilian federal law no. 6766 on land subdivision (approved in 1979), and the local laws created thereafter, achieved the objective of controlling urban expansion in important Brazilian cities by irregular developments or, by the contrary, it contributed to create constraints on affordable housing supply, increasing informality.

We found that the new federal law ordinances constrained housing supply in a context of intense urban growth and economic decline from 1980 to 2000 in Brazil. In this scenario, access of low-income population to the formal housing market was restrained, increasing informality. In addition, adoption of stricter urban controls may have introduced more limitations in the supply of affordable housing for low-income households.

2. Brazilian Regulations on Land Subdivision and Housing Supply

In Brazil, housing for low-income groups is basically supplied by peripheral urban developments for single family detached housing. Plots acquired by downpayments and via installment payments have been the most common way in which low-income families solve their housing needs throughout the years. Brazilian law on land subdivision (approved in 1979) intended to discipline urban expansion caused by peripheral developments and to protect plots buyers, by imposing several demands for developing land and selling plots.

The new law created new requirements as a minimum plot size of 125 m² (1,345.50 ft².) with a minimum frontage of 5 m (16.4 ft.) and a compulsory donation of 35% of land for public use in streets, green areas and public facilities. In addition, it limited land subdivision only within urban boundaries and conversion of rural land to urban use must have previous agreement from the federal authorities dealing with the agrarian reform and the metropolitan authority. While these restrictions are expected to limit urban sprawl, they limit housing supply as well, which result in much more expensive housing (Mills, 2000).

The law imposed new procedures marked by excessive complexity to license and register real estate also increased. Several costly certificates on land ownership and criminal records of both the developer and the landowner is required to register developments and plots,

some of them involving twenty-years records. If any of these certificates are missing, the registration process is interrupted.

For titling plots, the law also requires previous construction of the road system, the rainwater drainage system, and all additional requirements set by the municipal government. Municipal implementation of federal law very often increased the demands for developing land, especially with respect to urban design parameters and infrastructure provision.

“The Institutional Profile of Brazilian Municipalities” (MUNIC), a survey conducted by the Brazilian Institute of Geography and Statistics (IBGE), showed in the editions of 1999 and 2005 that, after federal law no. 6766/79, about 1,650 municipalities created or revised their own laws on land subdivision between 1980 and 2000. In Brazil, until 2000, laws on land subdivision were the principal instrument to manage urban development, followed by zoning legislation and master plans, especially in the largest urban areas (Fig. 1).

Among the municipalities that created new laws on land subdivision, 622 adopted stricter land subdivision standards, identified when the municipality has a minimum plot size greater than 125 m². In the 545 most urbanized areas in Brazil, about 64% of them adopted stricter standards.

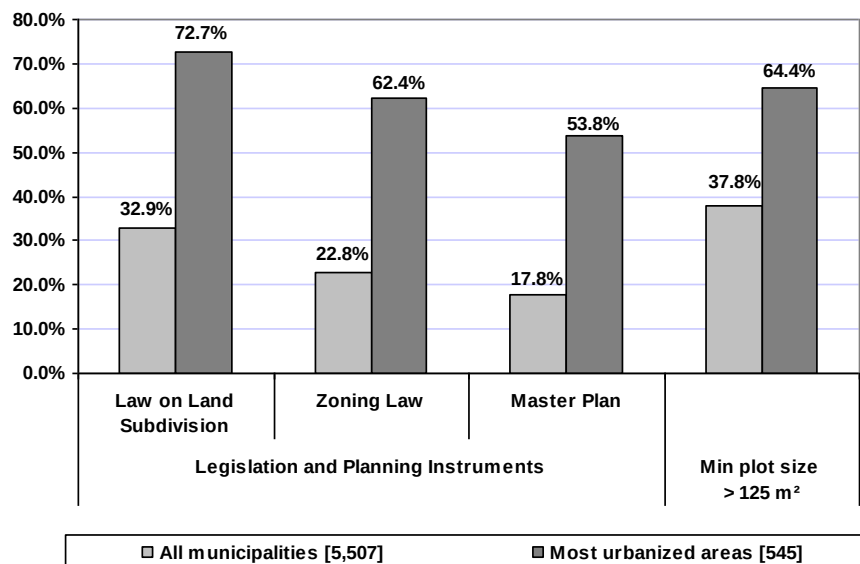


Fig. 1 – Planning instruments in Brazil, 2000.

Source of data: Brazilian Institute of Geography and Statistics (1999, 2001, 2005).

According to the new law, before selling plots the developer must register the development and conclude the required infrastructure facilities, which had to be finished in two years.⁴ This virtually blocked developers to implement land subdivision in stages by progressively reinvesting revenues in infrastructure construction. This pushed them to support business in a period when real-interest rates were extremely volatile ex-post and the risk of depre-

⁴ In 1999, Federal Law 9,785 revised some of these settings by transferring to the local governments the amount of compulsory land allocation for public use and extending the time for building infrastructure up to 4 years.

ciation of the patrimony was high, thereby affecting the economic feasibility of the investments (Avila, 2007).

The demands set by federal legislation to subdivide land increased the risks and the uncertainty of business due to time-consuming caused by bureaucratic and obstructive procedures to approve and to register projects. In Brazil, the process for approval and registration of land developments can normally take more than five years.

The level of the real-interest rates expected in a period of great volatility in both short- and long-term affect the opportunity cost of the undesired retention of real-estate capital, affecting the pricing formation. The increase in housing prices to compensate the volatility of real-interest rates imposed barriers to low-income buyers in a period of decreasing power of the salaries and scarce housing financing because of the debacle of the National Housing Bank (BNH) in 1986.

After the end of the BNH, the number of financed housing units dropped by more than 50% from about 261,875 per year between 1970 and 1984 to 121,756 per year between 1985 and 1990 (Pontual, 1995). This happened when urban household formation was still growing and thereby constraining the capacity of people to access formal housing.

Between 1980 and 2000, census data shows that the intensity of population growth decreased. However, in terms of household formation, urban households continued to present high growth rates, mainly in the mid-sized cities, that is, the ones with more than 100,000 inhabitants. In this period, while the urban households growth in Brazil and in the metropolitan areas was, respectively, about 3.8% and 3.4% per year, in the mid-sized cities it was about 4.5% per year. As a result, the Brazilian urbanization ratio increased from 68% to 81% in the period.

It is supposed that, by facing wrong economic incentives to formally subdivide land in a context of high housing demand and critic economic conditions, small and medium developers shift to informality in order to get rid of the costs imposed by legal constraints, which hampered economic feasibility of their businesses.

Patterns of Land use and Curves of Indifference of Housing and Amenities

Urban design standards adopted to achieve better living conditions is not a bad idea in itself. Without government intervention, critical public facilities such as parks, open spaces, major infrastructure, and urban services will not be provided, whereas the private sector cannot profitably produce and sell under certain market conditions (Dowall & Clark, 1996).

However, an ethical question arises when urban legislation arbitrarily imposes spatial patterns elsewhere that reflect particular values and worldviews as if they were shared by all social groups, neglecting different housing demands and effects upon housing affordability. Different social groups has different social expectations which, in turn, imply different residential needs and land uses preferences.

Since land is the main input in housing production, different patterns of land allocation among different land uses affect housing supply elasticity and prices, and thus the way how housing supply will meet housing demand of different social groups. As land supply is fixed, constraints on housing supply by allocating more land per residential plots and more land for amenities such as green spaces, broader streets, and sidewalks, cause limitations on housing supply relatively to housing demand, raising housing prices.

From the theory of consumer choice, a household has to find the affordable consumption of housing and amenities that maximize his utility. Figure 2 shows a negative-slopped curve U^* that indicates how land can be allocated to produce a mix of residential plots for single-family homes for low-income households and other uses. Along the curve, the house-

hold is equally satisfied with the set of amenities and housing obtained from possible different spatial arrangements.

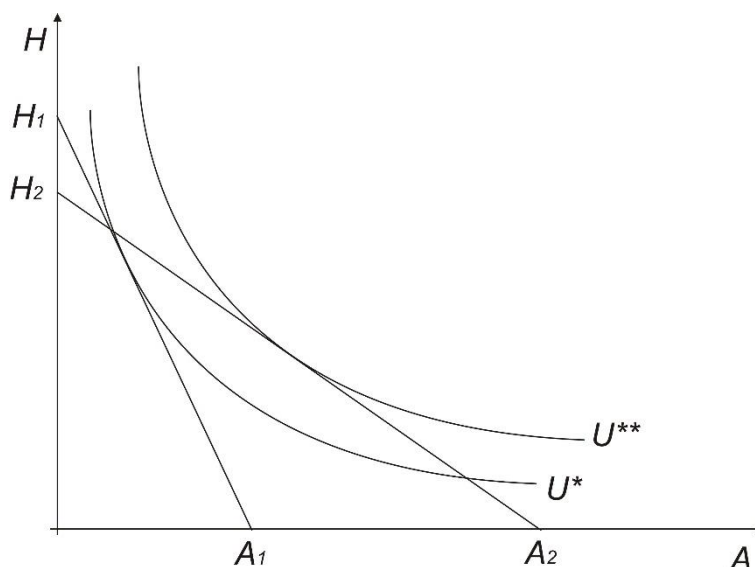


Fig. 2 – Land allocation curve to produce housing and amenity and budget restriction lines

Source: Author's own construction.

The challenge is to find a combination of consumption of housing and amenities that maximizes utilities of the low-income households, according to their budget constraints. Figure 2 also shows a line of budget restriction for the low-income household. The point where this line finds the curve U^* is the optimal choice of this group, that is, the point where land allocation produces an adequate mix of affordable housing H_1 and amenities A_1 .

Glaeser, Kahn and Rappaport (2000) indicate that the income elasticity of demand for land is less than 0.4, and probably the strongest component of the income elasticity of demand for land is the preference of high-income households to live in single-family detached housing. They suggest that in US, richer individuals do not care about owning large quantities of land themselves, rather they desire living in lower density communities, which may have fewer social problems and better public amenities.

Brueckner, Thisse and Zenou (1999) by comparing the case of Paris and Detroit show that when the center of the cities has a strong amenity advantage over the suburbs such as parks, good shops, museums, and so on, the rich are likely to live at central locations.

The pattern of location of different income groups in the Brazilian cities can give support to this argument. While the high income households are located very often in the more dense central areas, the periphery of the Brazilian cities are occupied by low income families, where there is a great amount of disamenities, such as lack of infrastructure, scarcity of public green areas in spatial arrangements characterized by small plots, mixed land use and high densities, as well as occurrence of high criminal records.

However, when it is observed the pattern of location of single family detached housing typology according to the household income, in the Brazilian cities it is noticed that richer families prefer low density areas in farthest locations from the city center, where a set of

amenities are present, such as large plots, collective green spaces, exclusive residential land use and, very often, access controls provided by private security.

As such, assuming that the income elasticity of demand for land of high-income households is greater than that for the low-income households, U^* shifts to U^{**} (Fig. 2). Developments to satisfy expectations of high-income families are designed to produce larger plots for few single-homes units and more amenities, implicating in low-density neighborhoods. The line of budget restriction finds U^{**} at the point that is the optimal choice for high-income households, where amenities $A_2 > A_1$ and housing units produced $H_2 < H_1$.

The optimum combination of residential plots and amenities according to the respective budget restriction of the low- and high-income groups can be represented by the supply and demand curves shown in Figure 3. Demand curves of low-income (D_1) and high-income households (D_2) reflect their willingness to pay for housing and amenities.

As developers allocate land to supply an adequate mix of residential plots and other land uses to respond to households' expectations, the supply curves S_1 and S_2 are the responses given to satisfy the demand curves D_1 and D_2 . The equilibrium prices that high-income and low-income are willing to pay for the combined mix of housing and other land uses, reflecting U^* and U^{**} and their respective budget restrictions return prices $P_2 > P_1$.

By imposing more land consumption per plot, strict design parameters reduce elasticity of housing supply for the low-income families and the supply curve S_1 is shifted to S^* , returning a housing quantity $H^* < H_1$ at the price $P^* > P_1$. Minimum design parameters do not affect S_2 , because high-income consumers are willing to pay housing prices $P_2 > P^*$ in spatial arrangements where urban standards are even greater than those set by regulations.

Depending on the economic context, the resulting price P^* exceeds the payment capacity of the low-income households. At this point, developers decide if they should shift to informality, develop land by ignoring land use ordinances thereby getting rid of regulatory "taxes" or if they orient their business to the high-income submarket that can afford more expensive housing prices by following regulations.

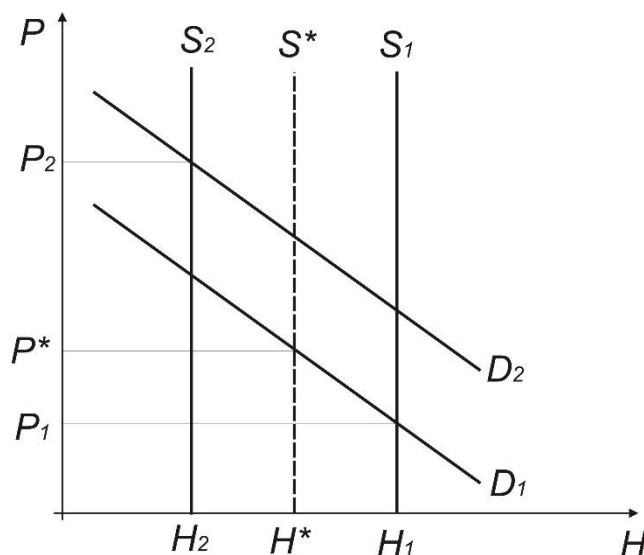


Fig. 3 – Housing demand and supply curves for different groups

Source: Author's own construction.

According to the spatial pattern of housing location per income in the Brazilian cities, we can expect that if developers subdivide cheap land at the urban periphery for low-income families, probably they will shift to informality in order to produce affordable housing typologies for this group.

3. Housing Informality in Brazil

Dowall (2006) suggests a system that combines three dimensions to categorize settlements and housing units as either formal or informal: (1) access to urban services, (2) physical condition of dwellings, and (3) secure land title. Features (1) and (2) greatly vary between cases and time periods. Both housing and settlements can gradually improve in tandem with the budget of the poorer population and public programs on slum upgrading. Over time, the informal housing stock constantly changes through additions, resettlements, and upgrading (Dowall, 2006).

Insecure property rights is *de rigueur*, a prevalent characteristic of housing informality within slums or irregular developments, although not exclusively. In Brazil, insecure housing tenure also affects families living in housing complexes built by public programs, in invaded houses, tenements, abandoned buildings, and similar places where housing tenure is not protected.

According to the survey of Institutional Profile of Brazilian Municipalities of 2011, about 57% of the 5,565 municipalities reported to have slums or irregular developments. These municipalities contained about 87% of the Brazilian population. Despite this scenario, Brazil continues to lack a comprehensive survey of housing informality.

In the lack of a comprehensive data on informality, researchers very often use census data on substandard (or subnormal) agglomerations to study slums and informal settlements in Brazil. This information is available only from the census of 1991, 2000, and the last census of 2010. Substandard agglomeration is not an official definition of slums, rather a kind of “special census sector” used by the IBGE to estimate the costs of the survey, since it requires specific treatments for data collection. The IBGE defines them as those with at least 51 housing units that (i) occupy private or public land without permission of the landowner; (ii) are arranged in a dense and disorganized pattern, and (iii) lack public services.

These data present some problems. It is greatly based only on slums with more than 50 dwellings, ignoring smaller slums and irregular developments. The MUNIC survey from 1999 found that about 44% of all 5,507 municipalities had irregular developments, while only 28% of them had slums.

The census from 1991 recorded about 1.56 million households in substandard agglomerations and, in 2000, the number of such households reached 1.64 million. According to the results of the 2010 census, about 3.2 millions households were located in substandard agglomerations, or 6% of the Brazilian population. However, IBGE warns that these data cannot be directly compared, because in 2010 the survey adopted a different methodology for data collection.

Housing without access to infrastructure, particularly sewage systems, is also used as proxy to informality, because this problem is predominant in informal settlements. Feler and Henderson (2008) suggest that localities in Brazil carried out intentional strategies throughout the years by combining exclusionary housing restrictions and low provision of public infrastructure services in informal housing sectors in order to discourage migrants to settle in the city. They argue that, until the late 1980s, it was basically illegal for localities to provide public infrastructure to informal settlements as an intentional and strategic “policy” to discourage

in-migration of low-educated people. This happen, even when localities have sufficient conditions to provide basic infrastructure services to all houses in their jurisdiction.

In Brazil, legal restrictions block public investments in settlements where land property issues are unsolved, even when it is occupied by low-income population. In addition, in privately developments, developers are supposed to provide public infrastructure services according to the law. However, if the settlement is under a land regularization process led by the public authorities, public investments in infrastructure are allowed.

Public programs targeting infrastructure provision have indeed improved access to water and sanitation services throughout the years in Brazil. From 1970 to 2000, while the amount of urban households increased by 263%, provision of drinking water and sanitation increased by 499% and 802%, respectively.

In 2010, about 92% of households had connections to public systems of drinking water, while sanitation was provided to 63.5% of Brazilian households. In 1970, these ratios were 54.4% and 22.6%, respectively. During this period, public investments in infrastructure benefited informal settlements because of initiatives of slum upgrading. Nevertheless, very often these initiatives have left the individual titling issues unsolved.

Brazilian censuses also provide data about the conditions of housing occupancy, identifying whether housing is owned, rented, or lent. In addition, data on owned housing inform whether land was also privately owned. This is the information that gets closer to measure informality, but it is not totally precise. Responses referring to owned land associated with owned houses or owned land may reflect the perception of interviewers regarding possession of their residences, but not a real or official situation of secure property tenure. This information is available only from the 1991 and 2000 censuses and was discontinued in 2010.

Data on the conditions of housing occupation also provide information classified as “other conditions,” referring to the cases where housing is neither privately owned nor rented or lent by an employer or a private owner. Basically, this classification refers to households that have no secure property rights, that is, people who live in invaded housing, squatters, abandoned warehouses, stores, garages, and similar situations.

The structure of distribution and the thread of variation over time of the variables described above can capture the effects imposed by land subdivision regulations on the formal housing supply. As such, this paper limits its analyses from 1980 and 2000. It is assumed that in 2000, the effects of federal law on land subdivision were consolidated in urban areas. In addition, after 2000, many municipalities started to implement programs on land regularization, which could impact our analyses. Finally, best information regarding informal land occupation was discontinued in 2010, as stated before.

In order to compare data it was necessary to standardize the different municipal bases of the three census in Minimum Comparable Areas (MCAs) by aggregating back the municipalities split from 1980 to 2000. Thus, a consistent municipal base was obtained with 3,720 MCAs that reflects the entire country. Moreover, a subsample of 628 MCA's was defined for the largest urban areas formed by the urban agglomerations and metropolitan areas that had in 2000: (i) urban population above 50,000 inhabitants, (ii) urbanization rate of at least 50%, and (iii) a municipal GDP 75% dependent of industrial and commercial activities (see Appendix A).

Information available from the 1980, 1991, and 2000 censuses on housing lacking access to general sewerage system or an acceptable way to dispose sewage, e.g. concrete septic tanks, shows that this problem increased by 44% in Brazil from 1980 to 2000, after approbation of federal law on land subdivision. In the largest urban areas, the increase was by 27.6%. In relative terms, the share of housing without access to sewage systems decreased from 1980 to 2000. In 2000, about 72% of urban housing had access to sewage systems in Brazil, while

in 1980 it was 59%, while in the largest urban areas this share increased from 67% to 79%. The share of housing with access to sanitation services improved better in the whole country.

However, when the household's average income is considered, it is observed that the participation of low-income households (up to 5 monthly minimum salaries) in the share of housing without access to sanitation services increased between 1991 and 2000 from 53.8% to 63.5% in Brazil and from 53.5% to 60.7% in metropolitan areas (Fundação João Pinheiro, 2001).

Data on owned housing without land ownership, places not rented, granted by employer, or built on third-parties land show that between 1991 and 2000 the amount of housing characterized by insecure tenure increased by 23.8% in the country and by 19% in the largest urban areas. In relative terms, the share of housing with insecure tenure in the largest urban areas was slightly worse. In 2000, these areas presented 7.4% of their houses with no secure tenure, while in the whole country this proportion was 7%. In 1991, these shares were, respectively, 8.5% and 7.7%.

Note that both housing without access to sanitation or lacking secure tenure became more decentralized from 1980 to 2000 (Fig. 4), that is, housing presenting these problems spread out in Brazil beyond the great urban centers.

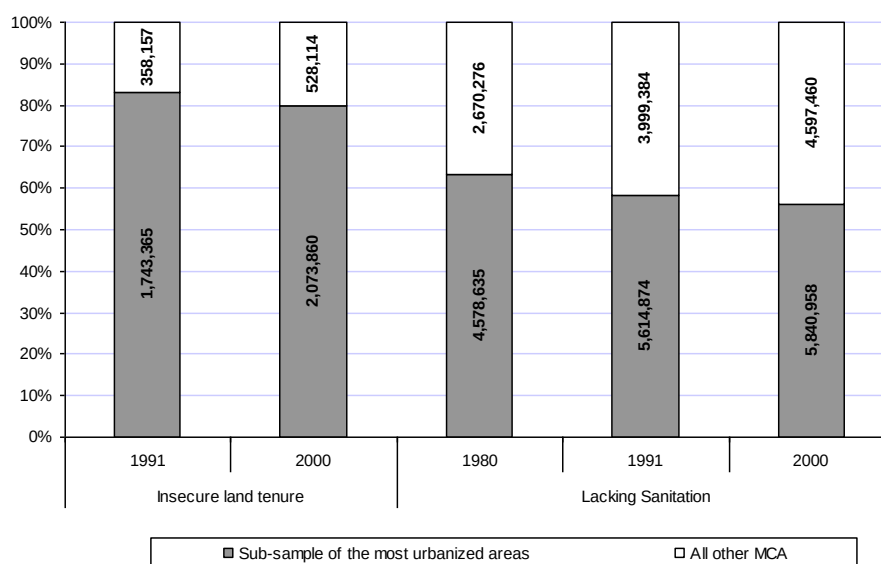


Fig. 4 – Concentration of housing lacking secure tenure or access to sewerage infrastructure in the most urbanized areas in Brazil

Source of data: Brazilian Institute of Geography and Statistics (1970, 1980, 1991, 2000).

4. Aggregated Impacts of Subdivision Laws on The Insecure Housing Tenure

Housing informality results from market factors that affect housing supply and demand over time. Considering the whole stock of housing that lacks secure tenure in a country, it can be represented by a standard cross-sectional time-series model, or panel data, in which

housing informality is dependent on a set of market factors and specific features of the cities that affect the housing market equilibrium throughout the years.

Panel data models are used to analyze a particular subject between multiple cases (cross-section) periodically observed at two or more time periods. From repeated observations of multiple cases over time, it is possible to study the dynamics of the subject by using the differences between them and within them. The technique of panel data analysis improves the quality of estimates by controlling for omitted variables that are constant over time, even when they are unobserved.

Equation (1) represents the stock of housing without secure tenure Y of a city (i) at time (t) as function of a vector $X_{i,t}$ of K factors and a set of unobserved city-specific attributes α_i . The attributes α_i , also called fixed effects or city-specific heterogeneity effects such as geographic features or regional location, for example, that differ between cases but are constant over time within cases. Also, in equation (1) is added the time variation error $\varepsilon_{i,t}$ regarding unobserved factors that affect the dependent variable and change over time.

$$Y_{i,t} = \beta \cdot X_{i,t} + \alpha_i + \varepsilon_{i,t} \quad t = 1, 2, 3 \quad (1)$$

The independent variables in $X_{i,t}$ are taken in natural logarithms when appropriate, allowing interpretation of their coefficients as elasticities. The panel dataset was organized with data from the census of 1980, 1991, and 2000 comprising of 20 years after the approbation of federal law no. 6766 in 1979, which is enough to identify its possible effects on the growth of housing informality.

In the lack of suitable information on housing informality for the 3 periods analyzed, the dependent variable was defined with census data on insecure conditions of housing occupation for the subsample of 628 MCA's of the largest urban areas as described in the previous section.

The panel dataset also included independent variables controlling for demographic, social, and economic factors that change over time: the share of urban households within the MCA in each period that measures the tread of urban housing growth when differences are taken, the log of number of urban population living with average income below a half minimum wage, the share of occupied labor force relative to the economically active population, the log of the residential real-estate value – obtained by dividing the total value of the residential capital stock by the number of urban households –, and the log of the housing stock lacking sanitation.

According to federal law 6766, under-serviced developments not only blocks registration of their plots. As suggested by Feler and Henderson (2008), they also can indicate strategic policies of local governments to intentionally do not provide infrastructure services in areas where the poor and low-educated people live. This would be a mean to make living conditions unpleasant in these areas, in order to discourage in-migration of low-educated households, even when would have enough resources to provide infrastructure services to all houses in their jurisdiction.

All data were obtained from the respective census, while data on residential capital was calculated by the Institute for Applied Economic Research (IPEA), adjusted in 2000 prices by the IGP-DI (General Price Index), a Brazilian inflation index.

After organizing dataset in panel, a binary variable was added in order to identify those MCA that adopted local law on land subdivision during the 1980's, just after approbation of federal law in 1979. This dummy, which is not differentiated in calculations, captures the effect of local constraints on land subdivision activity created by municipalities under the

influence of federal law. In this model, it is supposed that adoption of federal law ordinances locally to subdivide land may have caused ex-post impacts on the housing informality increase.

Other dummies were defined in extra calculations by splitting the MCAs into those with ordinary laws on land subdivision and those with strict regulations. MCA with overregulation are those with minimum plot size above the standard of 125 m² set by federal law. This variable does not measure exactly if minimum lot sizes above the standard have a higher caused the increase of informal housing development. It is assumed that the MCA that approved its own law on land subdivision and increased federal regulations, had more propensity and instruments to enforce local and federal laws.

The year in which each municipality approved its own law on land subdivision was obtained from the "Institutional Profile of Brazilian Municipalities" surveys from 1999 and 2005. From our sample of 628 MCAs, we obtained 357 MCAs that created their own laws along the 1980's, while 299 of them increased the demands of federal law. Data collected were organized in a not-balanced panel with 1,886 cross-section observations.

The approach used to construct the panel was similar to that in the literature on natural experiments, with one important exception: the same units forming the cross-section treatment, that is, the ones that adopted specific laws on land subdivision, and the control groups appear together in each time-period (Wooldridge 2006).

Statistical tests (Lagrange and Hausman) indicated cross-sectional/time-series model with fixed effects as the best estimation approach, in order to fit time-series information reflected in changes between cases. Fixed-effects transformation subtracts each unit's average value from each observation in eliminating the fixed effects and the specific heterogeneity of cities that affect both the dependent and the independent variables.

Wooldridge test for autocorrelation showed a non-significant test statistic or inexistence of panel-level serial correlation. A table with correlation coefficients of the continuous variables of panel data is available upon request from the author. Tests of collinearity between independent variables showed low values of the Variance Inflation Factors (VIF), 1.17–2.60, with a mean VIF of 1.78 and Tolerance of 0.4271–0.8166. These results indicate no collinearity between variables, although condition number reached 50.7.

Tests revealed the existence of heteroscedasticity. These results are available upon request from the author. Because groupwise heteroskedasticity cannot be efficiently estimated with OLS fixed-effects models, regressions were calculated by cross-sectional/time-series generalized least squares (FGLS) technique.

Analysis of Results

Table 1 presents the results of the first set of FGLS regressions, which include a unique dummy for the 357 MCAs that adopted laws on land subdivision in the 1980's. Control variables were progressively added to assess the power of the impact of land subdivision regulations in the presence of other factors. Hence, column 1 shows estimates of the effect of laws on land subdivision in the presence of urban poverty and the share of employed urban work force; the second column introduces demographic factors; and the third column presents the complete estimation, adding residential capital value variable, and the amount of housing without access to sanitation.

Coefficient estimates presented the expected signs and are statistically significant at 95% confidence level. Positive effects on the increase of insecure housing tenure were observed from the growth of urban households, population under poverty line, residential capital

value, and housing lacking sanitation. A negative effect comes from the growth of occupied labor force relative to the economically active population.

These results allow us to conclude that the formal housing sector could not respond efficiently to the low-income housing demand, which was greatly served by informal housing market in a period of intense formation of new urban households. The positive variation on the real-estate values was responsible for a strong effect on the increase of insecure conditions of housing occupation. Increasing housing prices impair the access of low-income families to formal housing, especially after the end of the National Housing Bank of Brazil, the main source of public housing financing.

Tab. 1. Panel data of cross-section time series with fixed effects for insecure conditions of housing occupation in urban areas – 1980, 1991, and 2000

Generalized Least Squares (FGLS) - All MCAs with subdivision law

Dependent Variable:			
Ln of insecure conditions of housing occupation	(1)	(2)	(3)
Number of Observations	1,772	1,772	1,772
Number of Groups	622	622	622
Constant	4.138	0.460	-3.992
<i>Std. Err.</i>	0.257	0.209	0.239
<i>(P > z)</i>	(0.000)	(0.028)	(0.000)
Law on land subdivision (357 MCA's)	0.603	0.490	0.323
<i>Std. Err.</i>	0.036	0.039	0.035
<i>(P > z)</i>	(0.000)	(0.000)	(0.000)
Ln of population under poverty line	0.666	0.542	0.342
<i>Std. Err.</i>	0.005	0.007	0.104
<i>(P > z)</i>	(0.000)	(0.000)	(0.000)
Share of employed population	-6.011	-3.706	-3.279
<i>Std. Err.</i>	0.262	0.235	0.223
<i>(P > z)</i>	(0.000)	(0.000)	(0.000)
Share of urban households		3.233	1.361
<i>Std. Err.</i>		0.045	0.075
<i>(P > z)</i>		(0.000)	(0.000)
Ln of residential capital value			1.325
<i>Std. Err.</i>			0.036

$(P > z)$	(0.000)
Ln of housing lacking sewage	0.387
<i>Std. Err.</i>	0.012
$(P > z)$	(0.000)

Note: Coefficients are statistically significant at 95% confidence level and were obtained from author's calculations using Stata statistical software.

In addition, the increase on housing lacking infrastructure as a measure to identify the lack of policies pro-poor is certainly a factor that affected the increase of insecure conditions of housing occupation. On the other hand, as more people are employed, the chances to afford housing prices and access formal housing markets are improved.

The municipalities that created or edited their own laws on land subdivision during the 1980's experienced a greater increase on their stock of housing under insecure conditions of occupation in 2000 than did the municipalities without the law. As the controls were added to calculations, the strength of this variable to explain the increase in housing informality decreased, which is expected. This effect remains significant as a factor that explains variation on housing informality.

A second set of calculations repeating the strategy of adding the control variables progressively was made by splitting the municipalities with ordinary law on land subdivision (58 cases) and the ones with stricter regulations on land development (299 cases).

Tab. 2 shows that estimates for the control variables repeated the same results shown in Tab. 1. Municipalities with stricter laws on land subdivision presented a stronger effect on the increase in the housing stock with insecure tenure when compared with the municipalities that adopted only an ordinary law. Again, it is supposed that municipalities that adopt more demanding regulations are more determined to enforce local and federal controls on land subdivision.

By adding controls on the real-estate values and on housing lacking sanitation infrastructure, the power of both the dummies to explain housing informality increase practically became equalized, with a slight superiority for the ordinary laws on land subdivision. One possible explanation is that municipalities that adopt stricter regulations could have more organized institutional structures not only to enforce stricter law but also to promote other efficient housing policies.

Tab. 2. Panel data of cross-section time series with fixed effects for insecure conditions of housing occupation in urban areas – 1980, 1991, and 2000

Generalized Least Squares (FGLS) - All MCAs with subdivision law (split)

Dependent Variable:			
Ln of insecure conditions of housing occupation	(1)	(2)	(3)
Number of Observations	1,772	1,772	1,772
Number of Groups	622	622	622
Constant	4.135	0.424	-3.984

<i>Std. Err.</i>	0.259	0.209	0.240
<i>(P > z)</i>	(0.000)	(0.043)	(0.000)
Ordinary law on land subdivision (58 MCA's)	0.500	0.292	0.345
<i>Std. Err.</i>	0.106	0.062	0.070
<i>(P > z)</i>	(0.000)	(0.000)	(0.000)
Stricter law on land subdivision (299 MCA's)	0.624	0.533	0.319
<i>Std. Err.</i>	0.0408	0.040	0.039
<i>(P > z)</i>	(0.000)	(0.000)	(0.000)
Ln of population under poverty line	0.666	0.543	0.342
<i>Std. Err.</i>	0.006	0.008	0.010
<i>(P > z)</i>	(0.000)	(0.000)	(0.000)
Share of employed population	-6.005	-3.670	-3.289
<i>Std. Err.</i>	0.269	0.235	0.226
<i>(P > z)</i>	(0.000)	(0.000)	(0.000)
Share of urban households		3.231	1.362
<i>Std. Err.</i>		0.045	0.079
<i>(P > z)</i>		(0.000)	(0.000)
Ln of residential capital value			1.325
<i>Std. Err.</i>			0.036
<i>Std. Err.</i>			(0.000)
Ln of housing lacking sewage			0.387
<i>Std. Err.</i>			0.013
<i>(P > z)</i>			(0.000)

Note: Coefficients are statistically significant at 95% confidence level and were obtained from author's calculations using Stata statistical software.

The role of good urban governance and an adequate institutional structure to formulate and implement adequate urban and housing policies deserve more attention in future researches. In addition, the results of the econometric calculations are sensitive, depending on the hypotheses and specifications of the model.

The results found here suggest a strong relation between the adoption of local laws on land subdivision during the 1980's, under the influence of federal law approved in 1979, and the growth of housing informality in the subsequent years, especially in cities that adopted more demanding regulations. Thus, we conclude that the increase of insecure conditions of housing occupation in Brazil may have been influenced by adopting many demanding regulations on land development.

5. Final remarks

Federal law no. 6766/79 was intended to control the rise of precarious developments at the peripheries of the Brazilian great cities. After its approval however, a severe economic crisis affected both demand and supply housing market in Brazil, which, combined with the new law, impaired access of low-income population to formal housing.

The new law on land subdivision constrained formal land supply elasticity for the low-income housing demand. Stricter and more demanding requirements for approval and registration of land developments within a scenario of economic downturn increased costs and risks for subdividing land formally, thus increasing housing prices. From restraining economic feasibility to formally produce residential plots for low-income population, developers may have driven their businesses to informality or to the high-income households.

Economic, demographic, and other market factors combined with land subdivision regulations were statistically significant in explaining housing informality increase in Brazil from 1980 to 2000. The objective of the law to control the growth of irregular land subdivisions was, therefore, ineffective and may even have produced the opposite effect – help to increased housing informality in Brazil.

The revision of federal legislation on land subdivision have been discussed in the Brazilian National Congress since 2000, and there is no perspective to be passed soon. Under the clamor of the 2011 Rio de Janeiro landslide disasters that claimed the lives of about 1,000 people, the federal government approved in 2012 the law 12,608 to monitor occurrence of climatic disasters. The new law also compels municipalities with risky areas to define land use parameters to subdivide land when expanding their urban boundaries. In other words, this law repeats regulations already present in federal law on land division.

Informal occupation of risky areas and the unsatisfactory performance of the low-income housing sector in Brazil is caused not by the lack of stricter regulations on urban development. There are some signs that it is a result of the institutional fragilities of the public sector of the Brazilian municipalities combined with legal constraints that do not take into account the distinct conditions of the different social groups to access land and housing in Brazil.

More than spending too much efforts and resources to develop new command and control legislation, it would be better if urban policies in Brazil would target in more articulated and cooperative behaviors between the public and the private sectors, under a positive agenda for urban development.

References

- Avila, P. (2007). Land use regulation and the informal production of the city: Implications of the Federal Law 6,766/1979 in increasing informality in Brazilian cities. *Lincoln Institute of Land Policy Research Report*, Cambridge, MA.
- Bertaud, A. & Malpezzi, S. (2001). Measuring the costs and benefits of urban land use regulation: A simple model with an application to Malaysia. *Journal of Housing Economics*, 10, pp. 393–418.
- Biderman, C. (2008). Regulation and informal settlements in Brazil: A quasi-experiment approach. *Lincoln Institute of Land Policy Research Report*.
- Brueckner, J., Thisse, J., & Zenou, Y. (1999). Why is central Paris rich and downtown Detroit poor?: An amenity-based theory. *European Economic Review*, 43(1), pp. 91–107.

- Dowall, D. (2007). Brazil's urban land and housing markets: How well are they working? In *Land policies and their outcomes*, G. K. Ingram. and Y-H. Hong, eds. Cambridge, MA: Lincoln Institute of Land Policy.
- Dowall, D. & Clark, G. (1996). A Framework for Reforming Urban Land Policies in Developing Countries. *Urban Management Programme Discussion Paper*. The World Bank, Washington..
- Feler, L. & Henderson, J. (2008). Exclusionary policies in urban development: How underservicing of migrant households affects the growth and composition of Brazilian cities. *NBER Working Paper 14136*, Cambridge, MA: National Bureau of Economic Research.
- Fischel, W. (2000). Zoning and land use regulation. In Boudewijn, B. and De Geest, G. (Eds.). *Encyclopedia of Law and Economics*, Volume II. Civil Law and Economics, Cheltenham, Edward Elgar. pp 403–428.
- Fundação João Pinheiro (2001). *Deficit Habitacional no Brasil 2000*. Centro de Estatísticas e Informações. Belo Horizonte: Fundação João Pinheiro. Brazil.
- Glaeser, E. & Gyourko, J. (2002). The impact of zoning on housing affordability. *NBER Working Paper 8835*, Cambridge, MA: National Bureau of Economic Research.
- Glaeser, E., Kahn, M. & Rappaport, J. (2000). “Why do the Poor Live in Cities?”. *NBER Working Paper 7636*, Cambridge, MA: National Bureau of Economic Research.
- Lall, S., Wang, H. & Da Mata, D. (2006). *Do urban land regulations influence slum formation? Evidence from Brazilian cities*. Paper prepared for the World Bank. Program grant “Dynamics of Slum Formation and Strategies to Improve Lives of Slums Dwellers”, Washington, DC.
- Maricato, E. (1996). *Metrópole na periferia do capitalismo: Ilegalidade, desigualdade e violência*. São Paulo: Hucitec.
- Maricato, E. (1999). A terra é um nó na Sociedade Brasileira. Também nas cidades. *Cultura Vozes*, 93(6), pp. 7–22.
- Maricato, E. (2000). Urbanismo na periferia do mundo globalizado: Metrópoles Brasileiras. São Paulo em Perspectiva. *Revista da Fundação Seade*, 14(4), pp. 21–33.
- Martins, M. (2003). Efetividade e permanência da regularização em assentamentos urbanos precários. *Revista de Direito Imobiliário - RDI*, 55, pp. 263–273.
- Mills, E. (2000). A thematic history of urban economic analysis. *Brookings-Wharton Papers on Urban Affairs 2000* ix-xiv (pp 1-38), DOI: 10.1353/urb.2000.0008.
- Ohls, J. , Weisberg, R. & White, M. (1974). The effects of zoning on land value. *Journal of Urban Economics*, 1(4), pp. 428–444.
- Pendall, R. (2000). Local land use regulation and the chain of exclusion. *Journal of the American Planning Association*, 66(2), pp. 125–142.
- Pontual, R. (1995). A questão habitacional no âmbito do sistema financeiro da habitação. In, *Indicadores sociais—uma análise da década de 1980*. Diretoria de Pesquisas. Rio de Janeiro: IBGE.
- Rolnik, R. (1997). *A cidade e a lei: Legislação, política urbana e territórios na cidade de São Paulo*. Second edition. São Paulo: Studio Nobel: Fapesp. Coleção cidade aberta.
- Rolnik, R. (1999). Regulação urbanística e exclusão social no estado de São Paulo: Mitos e verdades. *Revista de Direito Imobiliário*, 46, pp. 126–133.
- Serra M., Dowall, D., Motta, D. & Donovan, M. (2004). *Urban Land Markets and Urban Land Development: An Examination of Three Brazilian Cities: Brasília, Curitiba and Recife*. Institute of Urban and Regional Development. University of California at Berkeley. Working Paper 2004-03.
- Wooldridge, J. (2006). *Introdução à econometria: uma abordagem moderna*. Souza, R. C. & Ferreira, J. A., Trad. São Paulo: Pioneira Thomson Learning.

APPENDIX A

The Brazilian municipal base in 1980, 1991 and 2000 is different having, respectively, 3,991, 4,491 and 5,507 municipalities. In order to allow comparing data of the three census, the municipal base was standardized by aggregating in Minimum Comparable Areas (MCA) those municipalities split over time. As such, a consistent municipal base of 3,720 MCA's for 1980, 1991 and 2000 was obtained.

This set of MCA's include all types of municipalities, that is, the smallest municipalities dependent of the agricultural activities and the largest urban areas with a robust urban economy. In order to purge the dataset from the former, a three step strategy was adopted. Firstly, by using information available from IBGE and IPEA, the Institute for Applied Economics Research, a dataset of 264 urban agglomerations and metropolitan areas that include 743 MCA's was obtained. In step 2, it was selected from this dataset of 264 urban agglomerations those that had simultaneously urban population above 50,000 inhabitants, urbanization rate of at least 50% and a municipal GDP that was dependent from urban economic activities at a rate of 75% at least, that is, the agricultural sector had to be responsible for 25% or less of the GDP. This operation resulted in a sample of 187 urban agglomerations.

In the step 3, the 187 urban agglomerations obtained in the step 2 were separated into their 628 MCA's. This strategy is aimed to define a sample of cities located in systems of consistent urban development, qualified to capture the effects of laws on land subdivision in systems experiencing intense urban growth and crescent housing demand. The sub-sample of 628 MCA's thus obtained includes the largest urban areas of all 27 state capitals, municipalities of metropolitan areas and integrated regions of economic development defined by the Brazilian census of 2000 and other urban agglomerations identified in step 2.