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The Brazilian Housing Program *Minha Casa Minha Vida*: Effect on Urban Sprawl

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Abstract

We analyze the impacts on the urban form of a large Brazilian public housing program—*Programa Minha Casa Minha Vida* (PMCMV). Our aim in this paper is to determine whether the program impacts urban sprawl and its trend. We analyze 18 metropolitan areas using satellite images and other datasets to compare municipalities where the program was more intense with municipalities where the program produces housing below the median. First, we compare the urban footprint in 2005 and 2015. Second, we compare the trend from 1995 to 2005 with that from 2005 to 2015. The conclusion is that the program itself has no significant impact on urban sprawl. However, the number of units built does have an impact on the spatial pattern of the urban footprint. Cities were infilling faster before the program was implemented. The program is currently under revision and we suggest that it can be improved by shifting the incentives to converge to more centralized development of the land leading to more compact cities.

Keywords: urban sprawl; spatial pattern of city growth; location of social housing; PMCMV; Brazil.

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Introduction

The Brazilian Housing Subsidy Program "*Programa Minha Casa Minha Vida*"[1] (PMCMV) was created in 2009 and has been the largest housing program ever implemented in Brazil. According to *Caixa Econômica Federal* (CEF), the bank invested more than US$60 billion[2] building 4.4 million housing units (HU) from 2009 up to 2016. This is the same amount built from 1964 to 1986 by the previous housing subsidy program (SFH). The "*Faixa* 1"[3] program can be considered as a social housing program since the subsidy amounts to 88% of the total investment or more. This is the subject of this study.

Despite the magnitude of the PMCMV, some scholars have been critical of several aspects of its implementation. Among them, Cardoso and Jaenisch (2014) criticize the institutional design of the program, where real estate developers play a major role in *Faixa 1* while local administrators have just a minor stake on the program design. Nevertheless, this partnership between real estate developers and local governments implies immediate benefits for both sides. The developers have a captive demand guaranteed by a population that now has access to the formal housing market through an unprecedented volume of public investment and local governments benefit politically and electorally from the pork provided to voters without significantly compromising the local budget.[4]

Another usual source of criticism is the location of the settlements. Since, in the *Faixa 1,* the final consumer has almost no influence on the development, this would be a (wrong) decision of the other stakeholders—Caixa Econômica Federal, the city, and the construction company. The objective of this research is to test if the PMCMV *Faixa 1* has an impact on urban sprawl in 18 Brazilian Metropolitan Regions (Belém, Belo Horizonte, Brasília, Campinas, Cuiabá, Curitiba, Florianópolis, Fortaleza, Goiânia, Manaus, Palmas, Porto Alegre, Rio de Janeiro, Santos, São Luis, São Paulo, Teresina and Vitória), totalizing 304 municipalities and covering all five large regions of Brazil (South, Southeast, North East, North and Mid West).

We analyze the effects of the PMCMV on (a) urban sprawl and (b) its trend comparing: (1) municipalities that received investment with municipalities not selected to the program, and (2) the number of housing units produced for the municipalities in the selected metropolitan areas. To do so, we first compare the urban footprint in 2005 and 2015 and then the change in trend from 1995 to 2005 with that from 2005 to 2015. The conclusion is that the program itself has no significant impact on urban sprawl. Municipalities that received investments from the program

[1] "My House My Life."
[2] More than R$294 billion.
[3] *Faixa* (Range) 1 meaning the part of the program focused on the lowest income bracket.
[4] Although the local government is supposed to guarantee public services such as water, sewer, schools, etc. it is just mandatory to guarantee 3 services. Usually the municipality chooses to provide water, street lighting and pavement that involve a not very significant investment and many times are furnished by a non-local company (private or owned by the State).

did not sprawl more than municipalities that did not receive those investments. However, the number of units does have an impact on the spatial pattern of the urban footprint. Municipalities with more units increase the use of the land at a larger rate than municipalities with less (or no) units built. This is not a clear indication that the program is causing sprawl, but it is evidence that the program does have an impact on the urban footprint.

Housing subsidy programs have been criticized for other aspects besides their impact on the urban form. Angel (2000) suggests that public housing is often an example of government failure, particularly the public housing policy that gives subsidies directly to developers (the supply side). This argument is difficult to hold since incidence theory states that subsidizing the demand, or the supply, should not impact the burden of the subsidy; elasticity should define the division of the burden. Angel's argument is that subsidizing developers gives them an ex-post monopoly in such a way that they end up capturing the full amount of the subsidy. Furthermore, Angel argues that usually this policy does not consider all elements of welfare from the individual perspective since it gives no voice to the final user. Such programs usually consider just the construction of units ignoring infrastructure, services such as health and education, transportation, leisure and job location. This scenario results in high costs to the government and to the dweller (ex-post). Sometimes, in extreme cases, dwellers end up vacating the housing. Finally, the author states that subsidies for developers require exhaustive scrutiny that usually is not easy to implement and may be costly. In this paper we will not consider these potential shortcomings of the PMCMV. Instead, we concentrate on the potential impact of the program on the urban form.

Programa Minha Casa Minha Vida (PMCMV)

The Brazilian Social Housing Program (PMCMV) was created in 2008, with the enactment of the Federal Law number 11.977, and it has been the largest housing program ever implemented in Brazil. It was implemented in three stages. The first stage started in 2009, the second in 2011 (Law n.12.424), and the third stage was planned to begin in 2016 but did not start until 2017. According to CEF, the federal public bank responsible for the Program, the PMCMV made total estimated investments of R$318 billion (almost US$100 billion) and contracted around 4.4 million housing units (HU) up to September 2016 in all twenty-six Brazilian states and in Brasília Federal District (FD).

The PMCMV accepts families with monthly income up to ten minimum wages,[5] which are distributed in three brackets (*Faixas*). Bracket 1 (*Faixa* 1) accepts families with household income up to 3 minimum wages and in phase 2 of the program, the price ceiling per unit varied from 54 to 76,000 Brazilian Reais (US$17 to 23,000) depending on the location of the development.[6] *Faixa* 2 accepts families with total income between three and six minimum wages; and *Faixa* 3 accepts families with total income between six and ten minimum wages.

[5] The Brazilian minimum wage in 2016 was R$937 (US$288 considering the 12/30/2016 exchange rate of R$3,2585).
[6] State capitals and municipalities in the metropolitan areas of Campinas, Santos and Jundiai were assigned with the highest ceiling (Portaria No. 168 April 12, 2013, Ministry of Cities).

Both *Faixas* 2 and 3 are funded with FGTS[7] resources, which are intermediated by CEF and the price *ceiling* per unit was 170.000 Brazilian Reais (US$52.000) for both brackets.

Table 1a: Housing Units Produced by Bracket and Region

Region	*Faixa* 1	*Faixa* 2	*Faixa* 3	Total
Midwest	150,023	298,703	53,441	502,167
Northeast	702,749	459,287	89,307	1,251,343
North	219,829	53,191	24,658	297,678
Southeast	489,706	801,255	290,505	1,581,466
South	196,503	524,678	80.853	802,034
Total	1,758,810	2,137,114	538,764	4,434,688

Source: Ministério das Cidades, 11/14/2016, https://esic.cgu.gov.br

Table 1b: Investment (R$ thousands) in Housing Units by Bracket and Region

Region	*Faixa 1*	*Faixa 2*	*Faixa 3*	Total
Midwest	6,894.74	27,003.70	4.168.50	38,066.94
Northeast	30,920.20	38,053.98	7,113.40	76,087.58
North	10,195.62	4,447.70	1,951.22	16,594.54
Southeast	27,207.18	72,345.12	26,509.59	126,061.90
South	7,576.87	46,873.88	7,189.75	61,640.50
Total	82,794.61	188,724.39	46,932.46	318,451.45

Source: Ministério das Cidades, 11/14/2016, https://esic.cgu.gov.br

Faixa I, the subject of this analysis, targets the poorest families with total income up to three minimum wages. Around 40% of PMCMV units contracted up to September 2016 were directed to *Faixa* I families, a total of 1.8 million units. Some of the main characteristics of such units (Caixa Econômica Federal, 2014) are: social housing with subsidized monthly installments, which cannot exceed 10% of total family monthly income with a minimum amount of R$50 per month, payable in 120 months. There is no entry fee during construction. The mortgage installments are indexed by TR (*Taxa referencial*[8]). Insurance for Death and Permanent Disability (*Morte e Invalidez Permante–MIP*) and Physical Damage to the Unit Estate (*Danos Físicos ao Imóvel - DFI*) are not charged. The total subsidy can reach up to 92% of the property value and it represents at least 38% of the total amount invested with a low interest rate and no dwelling risk assessment.[9] The resources for the *Faixa I* come from the FDS (Social Development Fund)[10] or FAR (Housing Fund from the Federal Budget).[11]

Undoubtedly, PMCMV plays an important role impacting the Brazilian social housing gap. Subsidies are very high, enabling the supply of social housing to the lower income segment of the population. Despite the ambitious scale of the program and the magnitude of the housing deficit, recent studies (Cardoso and do Lago, 2013; Marques and Rodrigues, 2013; Lima Neto,

[7] Fundo de Garantia por Tempo de Serviço - Work Length Assurance Fund.
[8] TR, official reference interest rate.
[9] This is a "naive" account just multiplying the amount to be paid by 120 and comparing to the value of the house ex-ante.
[10] Fundo de Desenvolvimento Social.
[11] Fundo de Arrendamento Residencial.

Krause, and Furtado, 2015) point out some negative aspects of the program implementation. Probably the main concern is the peripheral locations of the projects. These locations are typically associated with poor urban integration and are inadequately served by basic infrastructure such as public transit and public utilities. The distance of projects from jobs and education facilities ends up generating a significant impact on intra-urban mobility, among several other costly consequences, such as the lack of health facilities, parks, libraries, shops, etc. In sum, the (bad) location of the projects may induce an inequality of opportunities to the residents.

Especially in big cities and in metropolitan areas, the high cost of urbanized land is considered the main driver for the decision on project location. Ferreira (2012) found that many projects are located outside the urban areas or on the fringe of cities, a situation observed all over the country. According to him, the PMCMV does not take advantage of the vacant land inside the urban area already served with public facilities, public transit and amenities in general. The retention of empty and idle land in areas with infrastructure aggravates the scenario, imposing even higher costs to the access of urban land.

Additionally, according to Cardoso and Jaenisch (2014), the institutional design of the Program presents some other flaws. In the case of *Faixa* 1, the local governments are expected to supply basic infrastructure and help with projects approval and licensing. Additionally, local governments may endow the land and concede tax exemption as incentive to the project.[12] Since municipalities want to attract these projects, they let the real estate developer choose cheap available land where to locate the project. Sometimes the municipalities also define areas of especial social interest (ZEIS)[13] (Rufino, 2015), thereby reducing urban regulations to facilitate project implementation.

One of the main concerns in the literature is that developers end up deciding the location where the units will be built, as well as their building characteristics. Since housing price is almost always at the ceiling level, the revenue of developers depends only on total costs. Thus, they maximize profits with low quality projects, minimizing land costs by choosing distant locations where there is lack of basic urban infrastructure. This kind of arrangements works well because the partnership between developers and local governments brings benefits for both sides: the developers have an ensured demand from a population that will have access to inexpensive formal housing through an unprecedented volume of public investment; and local governments benefit politically and electorally from the visibility of such a large investment.

In brief, the political economy behind the program is perverse. The municipality has an incentive to build as many units as possible since this would be a pork for voters. Caixa Economica wants to produce as many units as possible since they have to execute the budget. From the developer's perspective, considering that this is a profitable business, they will be interested in maximizing the number of units taking into account that the construction industry typically exhibits constant return to scale and construction costs do not vary significantly with location. Moreover, the developer bears no credit risk, as Caixa Economica takes on the full credit risk. Considering that

[12] Local government has also a key role in the *Faixa* I, particularly in the cadastre and selection of beneficiaries, which are preferably chosen through a lottery mechanism among registered families.
[13] Zona Especial de Interesse Social.

there is virtually no alternative in the market (PMCMV crowd out any other attempt in this niche of the market) the demand is captive. The perverse consequence is that the lower the price of land, the better for those three main actors (local government, developer and financier). As is well known, the land is cheaper in the outskirts of the city.

The shortage of available land in neighborhoods with better infrastructure and urban services leads housing developers to search peripheral locations to develop housing projects financed by PMCMV (Cardoso, Aragão, and de Sousa Araujo 2011). Considering the minor role of local governments in the PMCMV implementation and the wide discretion experienced by private developers, the Program may be generating a new wave of peripheral occupation in Brazilian cities, with the well-known negative consequences of this form of city grow and use of space. Some empirical analyses corroborate this hypothesis with respect to segregation. Cardoso, de Souza Araújo and Jaenisch (2013) analyzed the distribution pattern of the PMCMV projects in Rio de Janeiro metropolitan area and highlighted its preponderant peripheral location. Pequeno (2013), carried out a similar exercise for Fortaleza metropolitan area reaching similar conclusions. The data reported by Mercês (2013) and Moysés et al. (2013) indicate the peripheral pattern of the developments in Belém and Goiânia, respectively.

Ferreira (2012) conducted a survey on the PMCMV housing production and found that many buildings are located outside the urban area or on the fringes of cities throughout Brazil. This pattern was identified in most of the surveyed cities. The author argues that this pattern of urban location misses opportunities inside the urban area where there are already public facilities, services, transit and infrastructure in general. Similarly, Lima Neto, Krause and Furtado (2015) emphasize that, in large cities and metropolitan areas, developments would be even more problematic due to the high cost of land. These authors also demonstrated that the distance from the city center of PMCMV developments have increased from the first phase (2009) to second phase (2011) of the program.

Rufino (2015) also reported the location of new developments in consolidated peripheries and in non-urbanized areas, creating new peripheral frontiers. According to him, PMCMV new developments were located in discontinuous urban fringe, often beyond the existing urban area. Through this leapfrog pattern of location, the PMCMV projects are also responsible for an expansion of the suburbs in territories with poor infrastructure. The consequences of this development within the periphery might exacerbate segregation and isolation of the poor in the city.

Marques and Rodrigues (2013) studied the PMCMV peripheral location in the São Paulo Metropolitan Area (SPMA) and their data confirmed previous analysis that *Faixa* 1 developments are located far from the city center also in SPMA. However, they also noted that the PMCMV produces houses less isolated than previous public housing programs (CDHU[14] and COHAB[15]) in the SPMA. They concluded that PMCMV follows the metropolitan segregation pattern. Additionally, the authors also noted that the surrounding characteristics of *Faixa* I developments have more infrastructure deficiencies than noticed in previous housing programs.

[14] São Paulo State Company of Housing and Urban Development.
[15] São Paulo Metropolitan Housing Company.

Urban Sprawl

Urban planners around the globe are usually very critical of urban sprawl. The usual argument[16] is that this phenomenon implies excessive consumption of agricultural land and, consequently, reduces open space and farmland, hurting the environment. Sprawled urban structure is generally associated to negative economic and aesthetic consequences.[17] Excessive urban sprawl generates traffic congestion and air pollution due to long commuting in sprawled cities. Growth at the urban fringe depresses the incentive for redevelopment of land closer to the city center leading to decay of downtown areas. Also, some critics claim that spreading people towards the periphery reduces social interaction leading to isolation. In developed countries, there is also a link between sprawl and obesity (Brueckner, 2001; Glaeser and Kahn, 2004).

The potential consequences of urban sprawl might be different in Latin American cities where the poor live in the periphery. The overconsumption of land is at least reduced in a city where the poor live in the periphery. A possible consequence might the opposite: excess density in the periphery as observed in Moscow for instance.[18] The environmental consequences of sprawl will likely be minimized as well since the poor use more public transit than the rich. The main problem with sprawl in Latin American cities is probably isolation, a phenomenon hardly seen in the US[19] but rather worrisome in Latin American cities.

The second noticeable difference in Latin American cities is housing informality. Clustered informality in the periphery means that urban regulation, public utilities and services are initially neglected. Informality changes the urban equilibrium adding another option in the housing market following a different regulatory framework. Informality is actually one of the main symptoms of the social housing gap in Latin America. Programs such as the MCMV intends to furnish public utilities and services to the poor that would move from an informal settlement to the formal one. In theory, the new settlement might have public utilities and services solving one of the main concerns regarding informality. In practice that is not what we observe.

There are two sets of causes which explain why there might be more sprawl than would be socially desirable in Latin American cities. The first set relates to possible market failure. Open space is a public good and exhibits positive externalities. The private market equilibrium would imply in less open space that would be socially desirable. Also, another mile of commuting represents a cost for all drivers but the individual driver does not internalize this cost, resulting in more distant location than it would be socially desirable (Small and Verhoef, 2007). Those arguments are certainly sound from a theoretical perspective. However, we should consider that if population and income are growing we expect cities to sprawl. As a matter of fact, McGrath (2005) shows that the usual suspects explain a big chunk of sprawl in the US (meaning population, income growth, agricultural rent and commuting costs) making it debatable if there is excess sprawl or not in the US.

[16] Brueckner (2011).
[17] Clawson, 1962; Bahl, 1968; Archer, 1973; Mills and Hamilton, 1993; Hall, 2002.
[18] The Moscow case however is very likely the result of government failure as discussed below.
[19] Brueckner and Largey (2008) find the opposite evidence: social interaction is higher, not lower, in less dense areas.

According to Angel (2012), in big cities or metropolitan areas, urban expansion cannot be avoided, and denying it can be costly and destructive. He argues that planning for expansion can also be costly since it requires the acquisition of land, infrastructure investment, and most difficult, it needs forecasting the future pattern of growth. However, it is less costly than repairing the lack of previous planning. Urban expansion ought to be designed in advance and requires governments to engage in long-term planning. However, the political equilibrium makes it difficult to plan for the long run. In Brazilian cities, the term of local governments is four or eight years (when there is re-election) making it difficult to benefit electorally from investment in planning. This lack of planning can contribute to a dysfunctional urban sprawl. For instance, Burchfield et al. (2006) identified that unincorporated areas on the urban fringe encourage sprawl.

The second set of causes for urban sprawl provide the most convincing evidence. Government failure would be one of the main drivers of urban sprawl. The first distortion is related to the way urban infrastructure is financed. Usually sewer, streets, roads, parks, schools, etc. are funded with general taxes, sometimes taxes collected by state or the national government. It means that the actual user of the land on the fringe faces just part of the costs of public infrastructure, distorting their location decision towards more distant sites. In other words, suburban residents do not have to pay the "true" marginal cost of providing infrastructure to their houses. For instance, Baum-Snow (2007) shows that investment in freeways (paid by the State and the Federal Government) spurred suburbanization in the US over the period 1950-1990.

This is the main concern of this paper. We want to check if the production of social housing by the government did spur sprawl. In the case of the PMCMV all the incentives privilege the acquisition of land for the lowest possible price. The question is why the local government, which usually faces a large part of the infrastructure cost, was also aligned with this policy. One answer is that the local government is a minor player in the development decision. The developer and Caixa Econômica Federal were the main players in most project decisions, including location, and they certainly do not face the infrastructure costs (Cardoso, Aragão and de Sousa Araujo 2011). However, there is some evidence that the local government actually does not provide all the infrastructure needed. In this case, the local government would be also interested in the lowest land price available in the city.

If the government is not providing the basic infrastructure, the whole program might be questioned. The main reason why most Latin American countries need a large social housing program is related to the fact that a large share of urban dwellers live in precarious settlements lacking sewer, streets, etc. If the new PMCMV settlements do not have those infrastructure elements, why the program exists in the first place? If the only benefit is titling the house, why not distributing titles to precarious (untitled) settlements instead of investing in such programs? So, if it is true that the PMCMV projects lack infrastructure, this is a major government failure that considerably compromises public policy.

This paper is concerned with another consequence of government failure: the location of the housing projects. If the local government plays a minor role in the location decision or if it does not have to face the cost of distant location in the short run, the political equilibrium may induce too much sprawl. The whole population will reduce the welfare through the increased traffic congestion and the reduction in farmland at the fringe. The beneficiaries of the project themselves will be potentially located further from jobs, schools, and other public services transferring the costs of excessive extension to the housing project dwellers. In this paper, we attempt to measure if the program has indeed induced more sprawl than would be desirable. We use the fact that if a municipality receives few or no investment from the program, the housing gap must be filled with informal housing that in theory must respect the household location decision otherwise there would be no buyer for the land.

The majority of literature on sprawl has also dealt with the problem of measurement. Initially sprawl was confused with density. The literature on density, however, usually confuses its causes and consequences. In part, this is related to the fact that sprawl is difficult to measure. Galster et al. (2001) develops a conceptual and operational definition of eight dimensions of urban sprawl. The alternative envisioned in Clawson (1962) and applied by Burchfield et al. (2006) and Angel et al. (2011), uses satellite images as a source of information for creating meaningful indicators of sprawl and density. The main assumption is that a clear conceptual and operational definition can facilitate research on the causes and consequences of sprawl and spatial distribution.

Density alone cannot determine if the urban development is compact or not. The average density is a proxy for the intensity of land use in the city. There are usually three different concepts involved in sprawl: density, centralization and continuity. Sprawl is generally related to low levels of any of these concepts. Decentralization is an attempt to measure how population and employment are spread throughout the metropolitan area. Density measures how population and employment are centered in high-density areas. Continuity attempts to check if people and/or jobs surround population and employment. In principle, there could be decentralized, continuous dense urban areas; centralized discontinued dense urban areas; etc. In this paper we are interested in understanding the dynamic pattern of land use, meaning how it evolves over time. A city may use open land leapfrogging the urbanized area, extending it or even infilling open space that is available inside the urban footprint. This is a different way to look at the data—as opposed to using density—that has been explored recently in the literature.

Considering the specific Brazilian situation, the overall land area occupied by urban localities is not in itself a critical issue (Ojima, 2007). What is critical is the widespread lack of a shared and proactive vision for urban growth, even when there is a professed faith in master plans (Martine and McGranahan, 2010). Beyond the potential environmental negative consequences, un-oriented rapid urban growth can lead to much higher social and financial costs than would have been the case if proactive measures had been put in place, further aggravating the persistent phenomenon of urban informality (Smolka and Larangeiras, 2008). The negative consequences of the peripheral expansion in Brazilian metropolitan areas are evident: vast territories occupied by a monofunctional low-income residential urban fabric, incomplete urban infrastructure, and lack of urban amenities and services. If the largest social housing program ever implemented in Latin America is increasing this perverse trend there is something intrinsically wrong with the program. The moment to examine this issue is perfect since the program is now under revision by the federal government.

Dataset and Methodology

Input Data

The research covers eighteen Metropolitan Areas (Belém, Belo Horizonte, Brasília, Campinas, Cuiabá, Curitiba, Florianópolis, Fortaleza, Goiânia, Manaus, Palmas, Porto Alegre, Rio de Janeiro, Santos, São Luis, São Paulo, Teresina and Vitória). Those metropolitan areas comprise 304 municipalities and all five macro regions (North, Northeast, Southeast, Midwest and South) are represented (Appendix 1). Our first step was estimating the metrics proposed by Angel et al. (2011). We have not included in the analysis three important metropolitan areas (Recife, Salvador and Natal) due to the poor quality of the satellite images for the period of interest. Input data are multi-spectral images at three points in time 1995 (t_0), 2005 (t_1), and 2015 (t_2). The selection of these points in time come from the fact that the first year of the PMCMV was 2009, so the change in the urban landscape from 2005 to 2015 capture the relation between sprawl and the program. Also, we use 2000 and 2010 census data, so it is a good idea to have the census at the median point of the landscape metrics. The first period serves as a previous control for the trend in the municipalities chosen to receive investments from the program, thus it necessarily needs the same interval to make the two periods more comparable.

The use of satellite images represents an opportunity to recover the historical evolution of urban areas expansion. Nevertheless, there are limitations that must be considered in the scope of the analysis. The most critical limitation is the impossibility to qualitatively differentiate the uses and densities of the urban development directly from the images. This is particularly critical when the use of low/medium spatial resolution historical satellite imagery is mandatory. In these cases, the image can only give us sharp indication that certain area changed the status from non-built-up in a T moment to a built-up area in a T+1 moment. The new generation earth observation satellites present technological advances in spatial and spectral image resolution that can overcome these analytical limitations and expand the analytical possibilities for a new research agenda.

The calculation of the landscape metrics used a geocomputational tool produced for this specific end. It works as a plug-in for the open source TerraView Spatial Analysis (TV) software, which was developed by the Brazilian National Institute for Space Research (INPE).[20] In its actual stage of implementation, TV allows the user to perform image segmentation, attributes extraction, normalization and classification with a raster image. The software uses C++ language and is built on the TerraLib/GIS library of classes and functions. The tool has an interface for non-expert end users that allows the selection of the satellite image, classification and the extraction of urban sprawl metrics in an automatic mode following the Angel et al. (2011) methodology.

In brief, the image classification process has three parts. The first stage starts with the raw multispectral LANDSAT images classification process identifying three land cover classes: built-up (or impervious surfaces), non-built-up and water. Different algorithms and methods of image classification can be used for this end with potentially distinct outcomes (Gao Yan et. al,

[20] Instituto de Pesquisa Espaciais.

2006). In this work, we use an object-based classification method with a region-growth segmentation algorithm. For the complete specification of the digital images processing procedures and images descriptions see Appendix 2. The results for the accuracy assessment for each classification process can be found in Appendix 3.

The second part of the classification process consists in the identification of the spatial context of a pixel considering the incidence of different types of land cover in its neighborhood. The threshold distance that defines the extent of the "neighborhood" adopted the concept formulated by Clawson (1962). This author proposes the use of fine resolution aerial image dataset in the analysis of residential development. Burchfield et al. (2006), considering the evidence that residential development almost never leapfrogs over more than one kilometer, defines one kilometer as the relevant scale to conduct their analysis. Angel et al. (2011) note that one kilometer corresponds to a ten minutes walking distance. Considering this distance threshold, it is possible to calculate a new raster image through the reclassification of the built-up pixels into three different subclasses and non-built-up pixels into another three classes of open space. The reclassification follows the definition presented in Table 2.

Once the images are reclassified according to the pixel attributes, the next step is defining the city footprint that includes urban and suburban pixels, their fringe open space pixels, and the captured open spaces pixels surrounding the pixels inside the footprint. The city footprint is key for estimating the way the city is growing over time. This is exactly the third step in the classification process. In this stage, the algorithm searches specifically those pixels which were not built-up in t_0 and became built-up in t_1. An overlay operation between the two rasters generates new raster datasets containing the characteristics of new development pixels according to the definition in Table 3. We calculated two new developments datasets for each metropolitan region: one for the variation between 1995 and 2005 and another dataset for the new developments happening between 2005 and 2015.

Table 2: Intermediary Pixels Typologies

Metric	Definition
Urban Built-up	Pixels that have a majority of built-up pixels within their walking distance circle
Suburban Built-up	Pixels that have 10–50% of built-up pixels within their walking distance circle
Rural Built-up	Pixels that have less than 10% of built-up pixels within their walking distance circle;
Fringe Open Space	All non-built-up pixels that are within 100 meters from an Urban or Suburban Built-up pixel;
Captured Urbanized Open Space	All open space clusters that are fully surrounded by built-up and fringe open space pixels and are less than 200 hectares in area.
Exterior Open Space	All fringe open space pixels that are less than 100 meters from the open countryside. It surrounds the entire city footprint

Source: Angel, Parent, and Civco (2012).

The classification process generates a set of eight images for each metropolitan area. Three images containing the input land cover pixels (built-up, non-built-up and water) for each period. Three images with reclassified pixels (urban, suburban, rural built-up and fringe, captured and exterior open space). Two images containing new development pixels for each interval (infill, extension and leapfrog). The software also calculates two synthetic indexes for each period: the openness index and the edge index (Angel et al., 2011).

Table 3: New Developments Typologies

Metric	Definition
New development	Built-up pixels existing in the land cover for t_1 but not t_0
Infill	New development occurring within the t_1 urbanized open space
Extension	Non-infill new development intersecting the t_1 urban footprint
Leapfrog	New development not intersecting the t_1 urban footprint

Source: Angel, Parent, and Civco (2007).

Using the new development images, we estimate the area of each class of pixels by municipality overlaying administrative boundaries and the respective classified image. The software developed especially for this research also performs this calculation. For each municipality included in our analysis, the final metric of interest gives the area associated with different types of new development pixels (infill, extension and leapfrog). This information constitutes our dependent variable as discussed below.

The second dataset comes from administrative records of the Ministério das Cidades.[21] This dataset contains information for each development of the program including amount invested, numbers of units, location and the date of the contract with the developer. This information was used to compute the quantity of units contracted per municipality and its characteristics. Finally, a set of municipal social demographic data, such as poverty, population, schooling, housing deficit from 2000 and 2010 was included to control for differences among municipalities that might bias our results.

Another control included in the analysis refers to the geomorphological configuration of the terrain in the fringe of the urban footprint: the ruggedness of the terrain. According to Burchfield et al. (2006) a rugged terrain naturally encourages scattered development. In contrast, high mountains in the urban fringe are likely to make development more compact. This information was calculated from SRTM[22] digital elevation model (DEM) in meters. The ruggedness of the terrain was measured as the standard deviation of the land elevation in kilometers. The procedure to this calculation includes the definition of a 1 km buffer around each urban footprint for a given period. We use this buffer to clip the DEM and overlap it to municipal boundaries, enabling the estimation of the standard deviation of the terrain elevation in the fringes of the urban footprint in each of the municipalities.

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[21] Ministry of Cities.

[22] NASA's Shuttle Radar Topography Mission.

Finally, we used electoral data from Tribunal Superior Eleitoral (Superior Electoral Court) and financial data from Secretaria do Tesouro Nacional (National Treasury - Ministry of Finance) as additional control variables, expecting that the political affiliation of the mayor and the local financing capacity could interfere in the probability of having PMCMV projects approved by the federal government. We also used the number of voters as a proxy for the population since the population estimates for 2015 might be bias as discussed in the next section.

The description of the variables included in the analysis and descriptive statistics can be found in Appendix 4.

Empirical Strategy

The main focus of this paper is to test weather the PMCMV indeed induced more sprawl. Although there are many case studies showing that the location of the settlements was frequently in the periphery (Cardoso, de Souza Araújo, and Jaenisch, 2013; Pequeno, 2013; Mercês, 2013; and Moysés et al., 2013), the location of the poor in Brazilian cities is often in the periphery. We consider that the program would be inducing more sprawl if its location is more peripheral than the location defined by the beneficiary choice of location with no government interference. More specifically, the paper tests if the program has induced more leapfrog or less infill on the cities where it was implemented or not. The very fact that there are many developments far away from the city center is not enough to say that the Program is actually causing sprawl. The correct question to be asked is: if there was no social housing program at all, would the poor choose housing closer to the city center? We approach this question with different strategies as discussed below.

First, we need to define sprawl. Our definition is based on the new development metrics presented above. We define that leapfrog is a sign of sprawling while infilling is a sign of compact city. Extension is the usual way a city grows. If PMCMV is inducing sprawl, it will impact positively leapfrog and/or negatively the rate of infilling and might have no impact on extension. The second question is how we measure the municipality adherence to PMCMV. We attempt two different approaches. First, we compare municipalities that have at least one development approved with municipalities that have not received any investment from the program. The problem with this approach is that it does not take into account the intensity of the program. Municipalities adding 0.1% to the housing stock, for instance, will be the same as municipalities adding 10% to its initial stock of housing. Another approach is using the number of units produced by the PMCMV in the municipality as our proxy for the intensity of the program in the municipality. We first run variations of the following regression:

$$y_i = b_0 + dD_i + b_1x_{1,i} + b_2x_{2,i} + \ldots + b_kx_{k,i} + u_i \quad (1)$$

Where y_i is the (logarithm of) metric for land use dynamics (leapfrog, extension or infill) for city I; D_i is the variable of interest that might be a dummy indicating if the city received any investment from the PMCMV or the natural logarithm of the number of units contracted by the municipalities from 2009 to 2015 plus one; $x_{1,i}$ through $x_{k,i}$ are control variables from 2010 census, and u_i is a spherical error with the desirable properties.

It is straightforward to see that d in specification (1) measures the correlation between the urban landscape dynamic and the PMCMV. If d is significant and positive, the program is correlated with the metric. However, we are far from testing if the program is causing sprawl. We do not know, for instance, if municipalities that are selected for PMCMV are exactly those that were leapfrogging more for other reasons not observable (by the analyst). In this case, a positive correlation might be a sign that the PMCMV chooses cities with more vacant land. If this is indeed the case, we would expect that PMCMV would choose cities with more leapfrog, more extension and more infill since all these variables would be proxying for vacant land in the city.

We adopt a different model to check if the PMCMV has changed the trend in the dynamics of land use in the city. We adopt a difference in difference (DID) approach using the change in land use from 1995 to 2005 and from 2005 to 2015 to check if the program has changed the trend of the land use dynamics in the city. More formally we run variations of the following specification:

$$y_{i,t} = b_0 + d_1 D_i + d_2 t_t + d_3 t_t D_i + b_1 x_{1,i,t} + b_2 x_{2,i,t} + \ldots + b_k x_{k,i,t} + u_{i,t} \qquad (2)$$

Where we are now indexing in time because we pooled information from 2000 and 2010 (including the rate of sprawl from 1995 to 2005 (t_0) and from 2005 to 2015 (t_1)), so all variables follow the same definition in both periods. The only new variable is t_t, a dummy variable that takes value 0 if new development variable is between 1995 and 2005, and takes value 1 if new development variable is between 2005 and 2015. In time 0, the control variables are from 2000 Census and in time 1 from 2010 Census. In this model d_3 will represent the potential impact of the program in changing the trend in land use dynamics. This coefficient, under some circumstances, will be the impact of the program on sprawl.

Results

We first run regressions using specification (1) defining the (presence of the) program by a dummy variable. There is no significant difference in the dynamic of land use between municipalities that received the program and municipalities that did not receive it. This is reasonable since we do not expect that a small number of units (compared to the housing stock) would have any impact on the landscape. The fact that the dummy did not show any significant effect suggests that the Program is correlated to sprawl just when it is sizeable in the municipality. Full regression results using the dummy variable as the (independent) variable of interest are presented in Appendix 5.

Table 4 presents results from specification (1) using the natural logarithm of the land use dynamics metric (leapfrog, extension or infill) as the dependent variable and the natural logarithm of the number of units produced by the PMCMV in the municipality from 2009 to 2015 as the measure of the PMCMV intensity. It is clear that there is a strong correlation between the number of units produced and leapfrog, extension or infill. The correlation is very stable when we add (observable) control variables to the specification.

Table 4: OLS Estimation – Coefficients of Leapfrog, Extension and Infill over total new development X MCMV HU

MCMV HU	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Leapfrog	0.41***	0.43***	0.43***	0.41***	0.41***	0.36***	0.34***	0.35***	0.35***
	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)
Extension	0.40***	0.43***	0.42***	0.40***	0.40***	0.35***	0.33***	0.31***	0.31***
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.07)	(0.07)	(0.07)	(0.06)
Infill	0.65***	0.70***	0.70***	0.64***	0.64***	0.62***	0.62***	0.60***	0.60***
	(0.10)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)

Note: Significance Level: 10% (*), 5% (**) e 1% (***). Standard deviation in parenthesis.
Source: Demographic Census 2010, National Treasury and authors classification of land use patterns using satellite imaging.

In specifications (1) through (5) we added socio-demographic variables and the coefficients are very stable for any dependent variable. It is noticeable that the coefficient on infill is larger than the coefficients observed for leapfrog or extension (around two standard deviation larger meaning that this difference might be significant). On specification (6) (and onward) we added open space area as a control variable and we can notice a reduction in the magnitude of the coefficients although probably not significant.

The control variables (see full results in Appendix 5) have the expected sign: poor cities leapfrog less than rich ones, as we can see from the negative coefficient on the percentage of poor and on the positive coefficient on the tax revenue. Cities with more elderly sprawl less. One curious result though is that the housing deficit has no correlation with leapfrog suggesting that inappropriate housing (the basis for housing deficit estimation) does not leapfrog on average. Cities growing faster also leapfrog more, which is totally compatible with other evidences and the theory. This is the only non-physical characteristic of the municipality that does matter for leapfrog in the most complete specification. The proportion of open space in the beginning of the period is negatively correlated with leapfrog and, as seen in Bushfield et al. (2006), ruggedness correlates positively with leapfrog.

For extension, the correlation with the dummy variable is significant in some specifications but not for more complete specification. So, once again, just having the program is not sufficient for inducing extension. We have observed the same result for leapfrog when the dependent variable is extension: there is a stable and large correlation between the number of units produced by the PMCMV. The magnitude of the correlation is very close to the magnitude observed for leapfrog. Once again the coefficients have the expected sign, but open space is the single more relevant variable to determine the level of extension. The new finding is that the level of ruggedness does not influence the rate of extension.

The cross section result might be interpreted as a sign that the PMCMV (when sizeable) is indeed making municipalities to leapfrog and extend more than other identical municipalities as far as we control for all possible confounders. It is however difficult to believe that we can indeed control for all confounding factors. What is making us even more suspicious about the causal effect of the program on sprawl are the results observed for infill. The qualitative result is very much the same observed for the sprawl variables: no significance for the dummy variable, but a large and significant magnitude when the variable of interest is the number of units. The magnitude of the correlation is stable and actually considerably higher than the magnitude observed for leapfrog or extension.

Given that the main confounder that might be driving the results is the availability of land (and consequently the land price), we focus on possible controls for those variables on Table 5. We first control for *Faixa* 2 and 3 developments taking place in the municipality in specification (10). We might be confounding the other brackets of the program with the impact of *Faixa 1* if there is correlation between the production of housing in different brackets. It might be the case if there are gains of scale for the developer. As a matter of fact, adding this control reduces the magnitude of the coefficients especially for extension and infill (more than 3 standard deviations). In specification (10) infill has the same magnitude as leapfrog and extension is not significant. Actually, the coefficients are not so precisely estimated anymore.

Table 5: OLS Estimation – Coefficients of Leapfrog, Extension and Infill over total new development X MCMV HU

metric	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Leapfrog	0.28**	0.20*	0.19*	0.19*	0.19*	0.19*	0.19*	0.19**
	(0.11)	(0.11)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)
Extension	0.11	0.01	-0.03	-0.03	-0.03	-0.03	-0.03	-0.04
	(0.07)	(0.06)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Infill	0.26***	0.18**	0.18**	0.18**	0.17**	0.17**	0.17**	0.18**
	(0.09)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)

Note: Significance Level: 10% (*), 5% (**) e 1% (***). Standard deviation in parenthesis.
Source: Demographic Census 2010, National Treasury and authors classification of land use patterns using satellite imaging.

On specification (11) we control for infill when the dependent variable is leapfrog or extension and control for leapfrog when the dependent variable is infill. On specification (12) we control for infill and extension when the dependent variable is leapfrog; for infill and leapfrog when the dependent variable is extension, and for extension and leapfrog when the dependent variable is infill. The idea is that those variables are proxies for available land, exactly our argument of why we are suspicious in interpreting the results in Table 4. The coefficients are reduced further (around one standard deviation) as well as the precision of the estimates.

On variable specification (13) we control for the distance to the center as a proxy for land price; on specification (14) through (17) we test different land use regulations in the cities: urban perimeter law, zoning law, building code and law of land parceling, respectively. In most of these cases, the coefficient does not change, just the law of land parceling has very small effect reducing the degree of extension as well as it increases a bit the degree of infilling, indicating that municipalities that have this law tend to expand less and infill more.

Another way to approach this problem is to estimate if the program affected the rate at which cities were changing their pattern of land use as discussed on section 4.2. When we look at the change in the dynamics of land use, we notice at a first glance that the program has no correlation with the trend in new land developments. The rhythm of leapfrog, extension and infill observed from 1995 to 2005 was not significantly changed from 2005 to 2015. Cities that picked up more units of the social housing program were leapfrogging and infilling faster than other cities (Table 6).

If we just look at the magnitude of the coefficients, leapfrog has now the largest magnitude and extension and infill are, if something, negative. As a matter of fact on specification (9) both infill as extensions are negatively significant suggesting that there might be something happening when we look at the change in trend. On specification (9) we add number of voters as a proxy for population in a DID design we will be controlling for population growth. Number of voters seems to be a better proxy for population than the official projections when there are chocks such as a large amount of new housing development. This is evidently the very case we are studying: a considerable increase in the stock of housing due to a public intervention. Given this result we proceed and test our proxies for land supply on Table 7.

Table 6: Dif-in-Dif – Coefficients of Infill, Extension and Lepafrog X MCMV HU

Metric	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Leapfrog	0.20	0.20	0.25	0.25	0.24	0.24	0.23	0.18	0.10
	(0.16)	(0.16)	(0.15)	(0.15)	(0.15)	(0.16)	(0.15)	(0.15)	(0.16)
Extension	-0.10	-0.10	-0.08	-0.07	-0.08	-0.08	-0.09	-0.03	-0.22**
	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.10)	(0.09)	(0.09)
Infill	-0.14	-0.13	-0.13	-0.10	-0.13	-0.14	-0.14	-0.15	-0.41***
	(0.14)	(0.13)	(0.13)	(0.13)	(0.13)	(0.13)	(0.12)	(0.13)	(0.13)

Note: Significance Level: 10% (*), 5% (**) e 1% (***). Standard deviation in parenthesis.
Source: Demographic Census 2010, National Treasury and authors classification of land use patterns using satellite imaging.

Table 7: Dif-in-Dif – Coefficients of Infill, Extension and Lepafrog X MCMV HU

Metric	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Leapfrog	0.13	0.17	0.19	0.19	0.19	0.18	0.18
	(0.16)	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)
Extension	-0.07	-0.09	-0.08	-0.08	-0.08	-0.07	-0.07
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
Infill	-0.26**	-0.25**	-0.25**	-0.25**	-0.24**	-0.24**	-0.24**
	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)

Note: Significance Level: 10% (*), 5% (**) e 1% (***). Standard deviation in parenthesis.
Source: Demographic Census 2010, National Treasury and authors classification of land use patterns using satellite imaging.

When we add the other metrics to control for the supply of land in the city, the coefficient on infill is significant and negative for any other specification. Nothing changes for leapfrog and extension. Combining all those results we may say that the PMCMV was selecting cities that were leapfrogging and infilling faster. However, the program has probably changed the trend for infilling, reducing its pace. A reduction in the pace of infilling is one way to increase sprawl. It is likely that good locations inside the city were just ignored by developers and City Hall.

Conclusion

The PMCMV has been the largest social housing program in Latin America in many decades. Hoever, the traditional subsidy program might have some shortcomings: not providing adequate urban infrastructure and choosing inappropriate locations for the settlements. The paradox is that this is the very reason the program actually exists. There are very few people living on the streets. The housing deficit is mainly due to the lack of infrastructure and remote location.

In this paper we investigate if there are some signs that the PMCMV was indeed increasing the location problem. Our results show that the PMCMV invests more in leapfrogging and infilling cities. Those are likely cities with a larger supply of land. The leapfrog trend in the city however was not changed, so settlements were not changing this trend. However, those cities were infilling faster and before the program was implemented. It means a reduction in the opportunities of the poor inside the urban footprint. Note that this is not a contradiction; it is possible to reduce opportunities inside the urban footprint but not change the rate of leapfrog even when keeping extension also constant. The new settlements are not so far away on average, but there is vacant land that is not being used for social housing purposes.

The PMCMV probably needs to change the institutional arrangement that favors almost free and low quality housing. There might be some smart program that would be able to develop settlements in better locations. The reduction in the rate of infilling suggests that it is possible. It is important to notice that infilling does not mean increasing downtown use. It is possible and usually efficient to infill inside a peripheral area. This is certainly the main challenge a public officer has to face currently dealing with social housing. The program is not producing any new units due to budget constraint. It is the perfect timing to rethink the program, including a mechanism for which the incentives will converge to more centralized development of the land leading to more compact cities.

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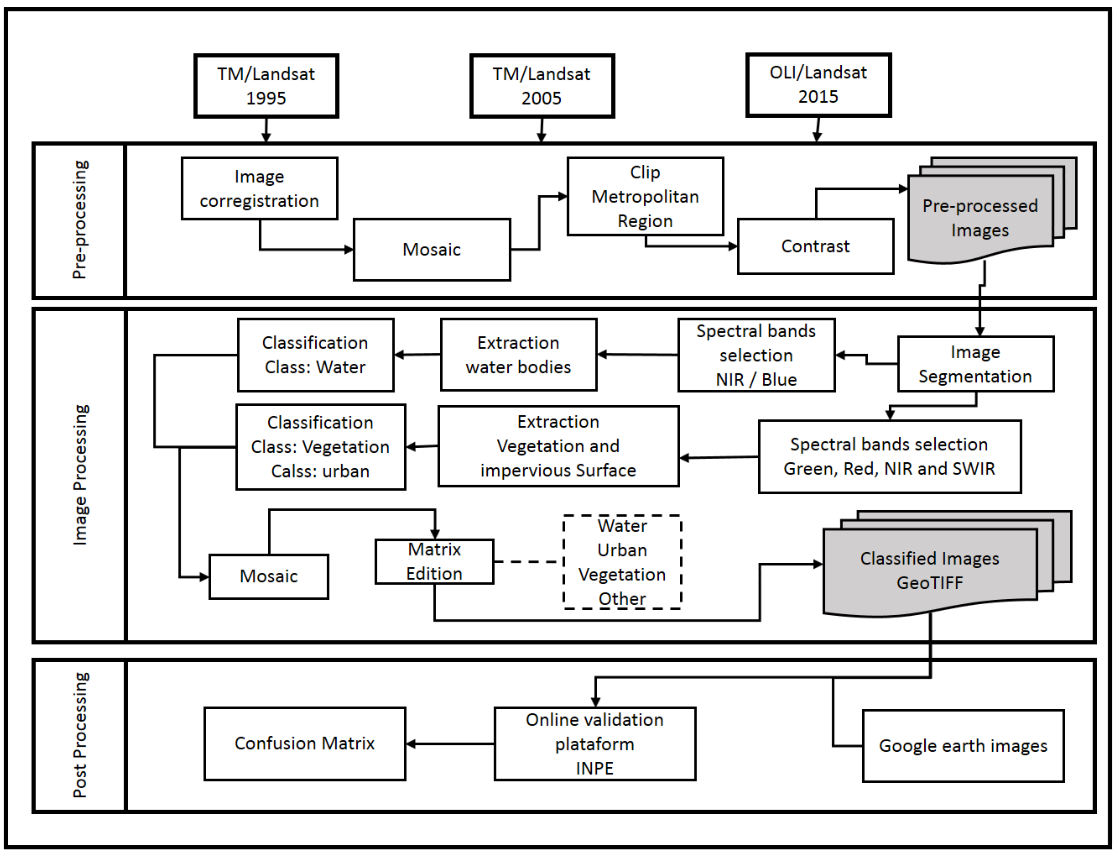
Appendix 1. Metropolitan Regions Included in the Analysis

Appendix 2. Image Classification Procedures

This appendix presents the methodological procedures used in the satellite image classification stage of the work. The classification aims to produce landcover information for 18 metropolitan regions in Brazil for three different periods: 1995, 2005 and 2015. For this work, we selected images from NASA's Landsat Program, including images obtained by the sensors TM/Landsat 5 and OLI/Landsat 8. The software used to perform the classification was the opensource SPRING – 5.3 (Camara et al, 1996). In some processes, ENVI 4.7 and TerraView 4.2.2 were also used. The classification process was structured in 3 stages: 1) pre-processing; 2) image processing and, 3) validation (post-processing). Figure 1 shows the steps included in each stage.

Figure 1 – Image classification flowchart



Pre-processing: This stage involves the preparation for data input, consisting in the corregistration of the images, image mosaic, region of interest clipping and the contrast of the spectral bands. Specifically: (a) The corregistration aims to secure geo-positional accuracy for the images overlap in subsequent periods using the orthorectified OLI/Landsat 8 as reference. After the acquisition of control points, a first-degree polynomial transformation was applied to resample the images using nearest neighborhood interpolation; (b) The mosaic was applied for those metropolitan regions covered by more than one Landsat scene; (c) The region of interest clipping used the administrative boundaries of each metropolitan region as mask to avoid unnecessary processing; and (d) The spectral band contrast enables a better visualization of features on the earth surface.

Image Processing: The objective in this stage is to depict the landcover information from the multispectral Landsat images through a digital processing procedure. To reach this objective, we used a binary method: supervised image classification and visual interpretation. The classification is structured in 4 classes: hydrography, vegetation, urban area and others (Table 1). The classification is oriented for the minimum mappable area of 3.5 hectares, based on the identifiable targets on TM/Landsat – 5 and OLI/Landsat – 8, also in accordance to the classification reference protocol developed by the TeraClass project (EMBRAPA and INPE, 2008).

The digital image processing follows 3 stages to detach the spatial pattern of each landcover class, namely: (1) identification of water bodies; (2) identification of vegetation and urban areas; and (3) visual interpretation of the images. In short, the Bhattacharya Distance Classifier that uses the Bhattacharyya distance to assign each region to the corresponding class and visual edition of the extracted classes.

1) **Identification of water bodies**: Object-oriented image classification requires previous image segmentation. In this work, we applied the Region Growth method for the segmentation. In the sequence, we conducted the extraction of spectral attributes using the spectral bands which corresponds to the blue and near infrared wavelengths, training the algorithm with a sample of regions (supervised classification).

2) **Identification of vegetation and urban areas**: Subsequently to the identification of the regions corresponding to water bodies, the segmented image is classified with the attributes extractions using the spectral bands corresponding to the green, red, near infrared and short-wavelength infrared wavelengths. Using selected samples to train the algorithm we detached the regions associated to urban areas and vegetation patches.

3) **Visual Interpretation**: After the supervised classification procedure, the detached landcover regions were reunited through a mosaic technique. This mosaic was then treated with a manual edition tool according to a visual interpretation protocol where classes incorrectly associated to one of the three landcover classes (urban, water, vegetation) were assigned to a new class "other." This new class will be merged with the vegetation class for the calculation of the sprawl indexes.

Post Processing: To validate the result of the classification process, we used an integrate platform associated to Google Earth high resolution images containing images for the three periods. The validation is done using a collection of proportionally distributed sample points in the image for all the classes. The validation uses the "online platform for validation" (Adami et al., 2012) that cross check the information with the images available at Google Earth. Using this comparison as parameter, a confusion matrix is calculated for each classified image giving the level of accuracy of the entire process.

List of Landsat Images

Satellite / Sensor	Metropolitan Region	Image date
LC82230612015214LGN00	Belém	02/08/2015
LT52230611995191CUB00	Belém	10/07/1995
LT52230612004248CUB00	Belém	04/09/2004
LT52180732006026CUB00	Belo Horizonte	26/01/2006
LC82180732015243LGN00	Belo Horizonte	31/08/2015
LC82180742015243LGN00	Belo Horizonte	31/08/2015
LT52180731995252CUB00	Belo Horizonte	09/09/1995
LT52180741995220CUB00	Belo Horizonte	08/08/1995
LT52180742006026CUB00	Belo Horizonte	26/01/2006
LT52200712005213COA01	Brasília Goiânia	01/08/2005
LT52210702006143CUB00	Brasilia Goiania	23/06/2006
LC82200712015337LGN00	Brasilia Goiania	03/12/2015
LC82210712015264LGN00	Brasilia Goiania	25/02/2015
LC82210722015264LGN00	Brasilia Goiania	21/09/2015
LC82220712015191LGN00	Brasilia Goiania	10/07/2015
LC82220722015287-SC20160218091650	Brasilia Goiania	14/10/2015
LT52200711995154CUB00	Brasilia Goiania	03/06/1995
LT52200721996157CUB0	Brasilia Goiania	05/06/1996
LT52200722005213COA01	Brasilia Goiania	01/08/2005
LT52210701995353CUB00	Brasilia Goiania	19/12/1995
LT52210702006143CUB00	Brasilia Goiania	23/05/2005
LT52210711995161CUB00	Brasilia Goiania	10/06/1995
LT52210712005124CUB02	Brasilia Goiania	04/05/2005
LT52210721995225CUB00	Brasilia Goiania	13/08/1995
LT52210722005204COA00	Brasilia Goiania	23/07/2005
LT52220711995296CUB00	Brasilia Goiania	23/10/1995
LT52220712005211CUB01	Brasilia Goiania	30/07/2005
LC82260722015219LGN00	Cuiabá	07/08/2015
LC82270712015242LGN00	Cuiabá	30/08/2015
LT52270712005134CUB01	Cuiabá	14/05/2015
LT52270711996206CUB02	Cuiabá	24/07/1996
LT52260722005175COA00	Cuiabá	24/06/2005
LT52260721995148CUB00	Cuiabá	28/05/1995
LT52260711995148CUB00	Cuiabá	28/05/1995
LC82260712015219LGN00	Cuiabá	07/08/2015
LT52260712005223COA01	Cuiabá	11/08/2005
LC82210782015280LGN00	Curitiba	07/10/2015
LT52200782005245COA00	Curitiba	02/09/2005
LT52210772004330COA0	Curitiba	25/11/2004
LC82200772015241LGN00	Curitiba	25/08/2015
LC82200782015241LGN00	Curitiba	29/08/2015
LC82210772015264-SC20160218094232	Curitiba	21/09/2015
LT52200771995314CUB00	Curitiba	10/11/1995
LT52200772005053COA00	Curitiba	22/02/2005
LT52200781994199CUB00	Curitiba	18/07/1994
LT52210771995017CUB00	Curitiba	17/01/1995
LT52210781995113CUB00	Curitiba	23/04/1995
LT52210782006031COA00	Curitiba	31/01/2006
LT52200792005213CUB00	Florianópolis	01/08/2005
LT52200791995138CUB00	Florianópolis	18/05/1995
LC82200792014238LGN00	Florianópolis	26/08/2014
LC82160632015213LGN00	Fortaleza	01/08/2015
LT52170632006195CUB00	Fortaleza	14/07/2006
LC82170632015220LGN00	Fortaleza	08/08/2015
LT52160631993216CUB00	Fortaleza	04/08/1993
LT52160632006204CUB00	Fortaleza	23/07/2006
LT52170631995229CUB00	Fortaleza	17/08/1995
LC82310612015254LGN00	Manaus	11/09/2015
LC82300612015343LGN00	Manaus	09/12/2015
LC82300622015167LGN00	Manaus	16/06/2015
LC82310622015254LGN00	Manaus	11/09/2015

LC82310632015254LGN00	Manaus	11/09/2015
LC82320622014290LGN00	Manaus	17/10/2014
LT52300611995240CUB00	Manaus	28/08/1995
LT52300612005267CUB00	Manaus	24/09/2005
LT52300621996307CUB00	Manaus	02/11/1996
LT52300622004233CUB01	Manaus	30/08/2004
LT52310611995215CUB01	Manaus	03/08/1995
LT52310612005274CUB00	Manaus	01/10/2005
LT52310621995279CUB00	Manaus	06/10/1995
LT52310622005210CUB00	Manaus	29/07/2005
LT52310631995215CUB01	Manaus	03/08/1995
LT52310632005210CUB00	Manaus	29/07/2005
LT52320621995238CUB00	Manaus	26/08/1995
LT52320622005217CUB00	Manaus	05/08/2005
LC82220672015335LGN00	Palmas	01/12/2015
LC82220682015335LGN00	Palmas	01/12/2015
LT52220681995168CUB00	Palmas	17/06/1995
LT52220682005163CUB00	Palmas	12/06/2005
LT52220671995136CUB00	Palmas	16/05/1995
LT52220672005307CUB00	Palmas	03/11/2005
LT52210802005124CUB02	Porto Alegre	04/05/2005
LT52210812005124CUB01	Porto Alegre	04/05/2005
LC82210802015056LGN00	Porto Alegre	25/02/2015
LC82210812015056LGN00	Porto Alegre	25/02/2015
LT52210801995097CUB00	Porto Alegre	07/04/1995
LT52210811995097CUB00	Porto Alegre	07/04/1995
LC82170762015284LGN00	Rio de Janeiro	11/10/2015
LT52170761994274CUB00	Rio de Janeiro	01/11/1994
LT52170762005240COA00	Rio de Janeiro	28/08/2005
LT52200622004163CUB00	São Luis	11/06/2005
LC82200622015193LGN00	São Luis	16/10/2015
LC82210622014245LGN00	São Luis	02/09/2014
LT52200621995170CUB00	São Luis	19/06/1995
LT52210621994126CUB00	São Luis	06/05/1994
LT52210622006175CUB03	São Luis	24/06/2004
LC82190762015266LGN00	São Paulo Santos Campinas	23/09/2015
LC82190772014215LGN00	São Paulo Santos Campinas	03/08/2014
LC82200762015225LGN00	São Paulo Santos Campinas	13/08/2015
LT52190761994032CUB00	São Paulo Santos Campinas	01/02/1994
LT52190762006257CUB01	São Paulo Santos Campinas	14/09/2006
LT52190771995179CUB00	São Paulo Santos Campinas	28/06/1995
LT52190772005126COA00	São Paulo Santos Campinas	06/05/2005
LT52200761995122CUB00	São Paulo Santos Campinas	02/05/1995
LT52200762005149CUB02	São Paulo Santos Campinas	29/05/2005
LC82190642015218LGN00	Teresina	06/08/2015
LT52190632005302CUB00	Teresina	29/10/2005
LT52190631995259CUB00	Teresina	16/09/1995
LC82190632015298LGN00	Teresina	25/10/2015
LT52190642006161CUB01	Teresina	10/06/2006
LT52190641996150CUB00	Teresina	29/05/1996
LC82150742015350LGN00	Vitória	16/12/2015
LT52150741995215CUB00	Vitória	03/08/1995
LT52150742005290CUB00	Vitória	17/10/2005

Source: http://landsat.usgs.gov/

Appendix 3. Confusion Matrix for Image Classification: Accuracy Assessment

RM Belém – 1995

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	99.0	1.0	0.0	0.0
	Others	0	98.0	2.0	0.0
	Vegetation	0.0	1.0	99.0	0.0
	Hydrography	0.0	0.0	0.0	100.0

RM Belém – 2005

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	99.0	1.0	0.0	0.0
	Others	0.0	1.0	99.0	0.0
	Vegetation	0.0	99.0	1.0	0.0
	Hydrography	0.0	0.0	0.0	100.0

RM Belém – 2015

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	91.0	8.0	1.0	0.0
	Others	0.0	100.0	0.0	0.0
	Vegetation	0.0	0.5	99.5	0.0
	Hydrography	0.0	0.0	0.0	100.0

RM Belo Horizonte – 1995

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	96.0	4.0	0.0	0.0
	Others	1.0	95.0	4.0	0.0
	Vegetation	0.0	9.3	90.7	0.0
	Hydrography	0.0	0.0	4.0	96.0

RM Belo Horizonte – 2005

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	97.4	1.3	1.3	0.0
	Others	4.0	83.0	13.0	0.0
	Vegetation	0.0	4.6	94.8	0.6
	Hydrography	0.0	2.0	4.0	94.0

RM Belo Horizonte – 2015

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	96.7	2.0	1.3	0.0
	Others	2.0	89.0	9.0	0.0
	Vegetation	0.0	12.0	88.0	0.0
	Hydrography	0.0	0.0	4.0	96.0

RM Brasília – 1995

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	97.0	3.0	0.0	0.0
	Others	0.0	98.0	2.0	0.0
	Vegetation	0.0	2.5	97.5	0.0
	Hydrography	0.0	8.0	0.0	92.0

RM Brasília – 2005

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	97.0	3.0	0.0	0.0
	Others	0.0	100.0	0.0	0.0
	Vegetation	0.0	0.5	99.5	0.0
	Hydrography	0.0	2.0	0.0	98.0

RM Brasília – 2015

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	98.0	2.0	0.0	0.0
	Others	0.0	98.0	2.0	0.0
	Vegetation	0.0	0.5	99.5	0.0
	Hydrography	0.0	6.0	0.0	94.0

RM Campinas- 1995

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	98.0	2.0	0.0	0.0
	Others	0.0	98.0	2.0	0.0
	Vegetation	0.0	6.0	94.0	0.0
	Hydrography	0.0	6.0	0.0	94.0

RM Campinas- 2005

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	98.0	2.0	0.0	0.0
	Others	0.0	97.0	3.0	0.0
	Vegetation	0.0	5.0	95.0	0.0
	Hydrography	0.0	6.0	0.0	94.0

RM Campinas- 2015

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	100.0	0.0	0.0	0.0
	Others	0.0	97.0	3.0	0.0
	Vegetation	0.0	1.0	99.0	0.0
	Hydrography	0.0	4.0	0.0	96.0

RM Cuiabá – 1995

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	100.0	0.0	0.0	0.0
	Others	0.0	88.4	11.6	0.0
	Vegetation	0.0	7.0	93.0	0.0
	Hydrography	0.0	0.0	0.0	100.0

RM Cuiabá – 2005

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	100.0	0.0	0.0	0.0
	Others	0.0	95.8	4.2	0.0
	Vegetation	0.0	6.0	94.0	0.0
	Hydrography	0.0	0.0	2.5	97.5

RM Cuiabá – 2015

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	100.0	0.0	0.0	0.0
	Others	0.0	93.4	6.6	0.0
	Vegetation	0.0	7.0	93.0	0.0
	Hydrography	0.0	0.0	5.0	95.0

RM Curitiba – 1995

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	93.4	3.3	3.3	0.0
	Others	2.0	81.0	17.0	0.0
	Vegetation	0.0	7.0	92.0	1.0
	Hydrography	0.0	0.0	4.0	96.0

RM Curitiba – 2005

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	95.4	1.3	3.3	0.0
	Others	2.0	80.0	15.0	3.0
	Vegetation	0.0	6.0	93.5	0.5
	Hydrography	0.0	4.0	4.0	92.0

RM Curitiba – 2015

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	94.1	3.3	2.6	0.0
	Others	0.0	85.0	15.0	0.0
	Vegetation	0.0	5.0	94.5	0.5
	Hydrography	0.0	0.0	12.0	88.0

RM Florianópolis – 1995

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	98.8	1.2	0.0	0.0
	Others	0.0	0.0	2.8	97.2
	Vegetation	0.0	3.0	96.0	1.0
	Hydrography	0.0	2.0	2.0	96.0

RM Florianópolis – 2005

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	95.0	2.5	2.5	0.0
	Others	0.0	95.7	4.3	0.0
	Vegetation	3.0	3.0	97.0	3.0
	Hydrography	0.0	0.0	2.0	98.0

RM Florianópolis – 2015

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	97.5	2.5	0.0	0.0
	Others	0.0	94.3	5.7	0.0
	Vegetation	0.0	3.0	96.0	1.0
	Hydrography	0.0	0.0	2.0	98.0

RM Fortaleza – 1995

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	97.0	3.0	0.0	0.0
	Others	0.0	86.0	13.0	1.0
	Vegetation	0.0	3.0	97.0	0.0
	Hydrography	0.0	0.0	1.6	98.4

RM Fortaleza – 2005

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	97.0	3.0	0.0	0.0
	Others	2.0	88.0	10.0	2.0
	Vegetation	0.0	3.5	96.0	0.5
	Hydrography	0.0	0.0	1.6	98.4

RM Fortaleza – 2015

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	92.0	5.0	3.0	0.0
	Others	3.0	81.0	14.0	2.0
	Vegetation	0.0	8.5	90.5	1.0
	Hydrography	0.0	3.3	1.6	95.1

RM Goiania – 1995

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	97.4	2.0	0.6	0.0
	Others	0.0	88.7	11.3	0.0
	Vegetation	0.0	12.0	88.0	0.0
	Hydrography	0.0	0.0	12.0	88.0

RM Goiania – 2005

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	98.7	1.3	0.0	0.0
	Others	0.0	91.4	8.6	0.0
	Vegetation	0.0	10.0	90.0	0.0
	Hydrography	4.0	2.0	6.0	88.0

RM Goiania – 2015

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	98.1	0.6	1.3	0.0
	Others	1.3	90.1	8.6	0.0
	Vegetation	0.0	8.0	92.0	0.0
	Hydrography	0.0	0.0	10.0	90.0

RM Manaus- 1995

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	97.0	3.0	0.0	0.0
	Others	0.0	100.0	0.0	0.0
	Vegetation	0.0	2.0	98.0	0.0
	Hydrography	0.0	0.0	0.0	100.0

RM Manaus – 2005

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	98.0	2.0	0.0	0.0
	Others	0.0	98.0	2.0	0.0
	Vegetation	0.0	0.0	100.0	0.0
	Hydrography	0.0	0.0	0.0	100.0

RM Manaus – 2015

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	99.0	1.0	0.0	0.0
	Others	0.0	100.0	0.0	0.0
	Vegetation	0.0	1.0	99.0	0.0
	Hydrography	0.0	0.0	0.0	100.0

RM Palmas – 1995

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	98.7	1.3	0.0	0.0
	Others	0.0	91.7	8.3	0.0
	Vegetation	0.0	5.0	95.0	0.0
	Hydrography	0.0	0.0	2.0	98.0

RM Palmas – 2005

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	100.0	0.0	0.0	0.0
	Others	0.0	95.8	4.2	0.0
	Vegetation	0.0	4.0	96.0	0.0
	Hydrography	0.0	0.0	0.0	100.0

RM Palmas – 2015

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	100.0	0.0	0.0	0.0
	Others	0.0	97.5	2.5	0.0
	Vegetation	0.0	2.0	98.0	0.0
	Hydrography	0.0	0.0	0.0	100.0

RM Porto Alegre – 1995

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	97.0	3.0	0.0	0.0
	Others	0.0	93.0	6.0	1.0
	Vegetation	0.0	5.0	94.0	1.0
	Hydrography	0.0	0.0	0.0	100.0

RM Porto Alegre – 2005

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	96.0	2.0	2.0	0.0
	Others	0.0	80.0	20.0	0.0
	Vegetation	1.0	5.0	93.0	1.0
	Hydrography	0.0	1.0	1.0	98.0

RM Porto Alegre – 2015

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	93.0	4.0	3.0	0.0
	Others	1.0	79.0	17.0	3.0
	Vegetation	0.0	8.0	90.0	2.0
	Hydrography	0.0	2.0	4.0	94.0

RM Rio de Janeiro- 1995

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	98.0	2.0	0.0	0.0
	Others	0.0	94.0	6.0	0.0
	Vegetation	0.0	1.0	99.0	0.0
	Hydrography	0.0	0.0	0.0	100.0

RM Rio de Janeiro- 2005

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	100.0	0.0	0.0	0.0
	Others	0.0	97.0	3.0	0.0
	Vegetation	0.0	0.0	100.0	0.0
	Hydrography	0.0	0.0	0.0	100.0

RM Rio de Janeiro- 2015

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	100.0	0.0	0.0	0.0
	Others	0.0	98.0	2.0	0.0
	Vegetation	0.0	0.0	0.0	100.0
	Hydrography	0.0	0.0	0.0	100.0

RM Santos- 1995

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	100.0	0.0	0.0	0.0
	Others	0.0	98.0	2.0	0.0
	Vegetation	100.0	0.0	0.0	0.0
	Hydrography	0.0	0.0	0.0	100.0

RM Santos- 2005

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	100.0	0.0	0.0	0.0
	Others	0.0	98.0	2.0	0.0
	Vegetation	0.0	0.0	100.0	0.0
	Hydrography	0.0	2.0	0.0	98.0

RM Santos- 2015

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	99.0	1.0	0.0	0.0
	Others	0.0	2.0	0.0	98.0
	Vegetation	0.0	0.0	100.0	0.0
	Hydrography	0.0	2.0	0.0	98.0

RM São Luis – 1995

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	94.0	3.0	3.0	0.0
	Others	2.0	83.0	10.0	5.0
	Vegetation	0.0	6.6	90.8	2.6
	Hydrography	0.0	0.0	1.0	99.0

RM São Luis – 2005

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	95.0	3.0	2.0	0.0
	Others	0.0	83.0	6.0	11.0
	Vegetation	0.0	3.3	93.4	3.3
	Hydrography	0.0	0.0	2.0	98.0

RM São Luis – 2015

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	94.0	4.0	2.0	0.0
	Others	2.0	84.0	5.0	9.0
	Vegetation	0.0	5.3	92.7	2.0
	Hydrography	0.0	0.0	3.0	97.0

RM São Paulo – 1995

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	100.0	0.0	0.0	0.0
	Others	0.0	99.0	1.0	0.0
	Vegetation	0.0	0.0	100.0	0.0
	Hydrography	0.0	0.0	0.0	100.0

RM São Paulo – 2005

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	99.0	1.0	0.0	0.0
	Others	0.0	98.0	2.0	0.0
	Vegetation	0.0	0.0	100.0	0.0
	Hydrography	0.0	0.0	0.0	100.0

RM São Paulo – 2015

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	100.0	0.0	0.0	0.0
	Others	0.0	98.0	1.0	1.0
	Vegetation	0.0	0.0	100.0	0.0
	Hydrography	0.0	0.0	0.0	100.0

RM Teresina – 1995

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	98.0	1.0	1.0	0.0
	Others	0.0	94.0	6.0	0.0
	Vegetation	0.0	6.0	94.0	0.0
	Hydrography	0.0	0.0	4.0	96.0

RM Teresina – 2005

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	98.0	0.0	2.0	0.0
	Others	1.3	94.1	4.6	0.0
	Vegetation	0.0	4.6	95.4	0.0
	Hydrography	0.0	4.0	6.0	80.0

RM Teresina – 2015

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	98.0	0.0	2.0	0.0
	Others	0.0	94.0	6.0	0.0
	Vegetation	0.0	8.0	92.0	0.0
	Hydrography	0.0	0.0	4.0	96.0

RM Vitória- 1995

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	100.0	0.0	0.0	0.0
	Others	0.0	100.0	0.0	0.0
	Vegetation	0.0	1.0	99.0	0.0
	Hydrography	0.0	0.0	0.0	100.0

RM Vitória- 2005

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	100.0	0.0	0.0	0.0
	Others	0.0	99.0	1.0	0.0
	Vegetation	0.0	1.0	99.0	0.0
	Hydrography	0.0	2.0	0.0	98.0

RM Vitória- 2015

	Reference				
Classification %		Urban Area	Others	Vegetation	Hydrography
	Urban Area	100.0	0.0	0.0	0.0
	Others	0.0	99.0	1.0	0.0
	Vegetation	0.0	0.0	100.0	0.0
	Hydrography	0.0	2.0	0.0	98.0

Appendix 4. Variables and Descriptive Statistics

The final dataset includes the following variables:

- $Newdevelopment_i$ is percentage of municipal new urban development typology (leapfrog, extension or infill) between 2005 and 2015, measured in m^2 over the total new development, which is the sum of leapfrog, extension and infill urban development. Data is the calculated metrics from Landsat images processed;

- $MCMV_i$ is the dummy PMCMV municipal presence since its launch, 2009 up to 2015. Data source is the Ministry of Cities;

- HU_MCMV_i is the total municipal PMCMV Housing Units (HU) contracted;

- $Poverty_i$ is the proportion of municipal population of individuals with per capita household income equal to or less than R$140.00 per month (US$79.60)[24]. Data source: IBGE Census;

- $Revenue_i$ is the per capita municipal tax revenue in R$. Data source: Ministry of Finance - National Treasure;

- $Over60_i$ is the municipal proportion of inhabitants over 60 years old over the total local population. Data source: IBGE Census.

- $Deficit_i$ is the proportion of municipal urban housing deficit[25] in 2010 over the total municipal stock urban household. Data source: Viana et al. (2015);

- $Openspace_i$ is proportion of municipal open space over its total area less urbanized area, measured in m^2. Open space is municipal rural open space less municipal captured open space and urbanized open space. Data source is the calculated metrics from Landsat images processed and IBGE Census;

- $Ruggedness_i$ is the metric of the fringe terrain elevation of each municipality in meters, measured as the standard deviation of the land elevation in kilometers. Data is the calculated metrics from SRTM images processed;

- Pop_i is the proportion of annual geometrical population growth rate between 2000 and 2010. Data source: IBGE Census.

[24] The universe of individuals is limited to those living in permanent private households.

[25] The housing deficit is calculated as the sum of four components: poor households (sum of improvised and rustic homes), family cohabitation (sum of rooms and secondary families living with intention to constitute an exclusive home), excessive onus on urban rent and increased density of rented homes. The components are calculated sequentially, in which the verification of a criterion is conditional upon the non-occurrence of the above criteria. The calculation method ensures that there is no double counting of households, except for the co-existence of any of the criteria and one or more secondary cohabiting families (Viana et al. 2015).

Variable Statistics

	Time 1					Time 2				
Variable	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
Lnleapfrog	304	9.7	6.0	0.0	16.6	304	10.6	5.4	0.0	16.8
Lnextension	304	12.7	4.9	0.0	18.7	304	13.2	4.2	0.0	18.4
Lninfill	304	8.1	6.1	0.0	16.9	304	9.8	5.5	0.0	17.3
Percentile leapfrog	304	0.2	0.3	0.0	1.0	304	0.2	0.2	0.0	1.0
Percentile infill	304	0.1	0.1	0.0	0.9	304	0.1	0.1	0.0	0.9
Percentile extension	304	0.6	0.3	0.0	1.0	304	0.6	0.3	0.0	1.0
Dummy mcmv	304	0.0	0.0	0.0	0.0	304	0.7	0.4	0.0	1.0
In hu mcmv	304	0.0	0.0	0.0	0.0	304	4.6	3.2	0.0	10.5
Poverty	304	0.3	0.2	0.0	0.8	304	0.1	0.1	0.0	0.5
Lnschool	304	2.2	0.1	1.7	2.4	304	2.3	0.1	2.0	2.4
Over 60	304	0.1	0.0	0.0	0.2	304	0.1	0.0	0.0	0.2
Deficit hab.	174	0.1	0.1	0.0	0.6	304	17.5	26.9	6.1	356.2
Open space	304	-0.9	0.2	-1.3	0.0	304	-0.9	0.2	-1.3	0.0
Lnrevenue	294	4.2	1.3	0.4	7.5	293	5.1	1.0	1.6	7.8
Lnroughness	265	3.4	0.8	0.8	5.6	288	3.5	0.7	0.7	5.5
Pop	304	2.9	3.5	-3.8	46.2	304	1.9	1.2	-1.3	6.1

Source: the authors.

Appendix 5. Full Regression Results

Table 1: OLS Estimation – Coefficients of Leapfrog, Extension and Infill X MCMV HU

MCMV HU	espec. 1	espec. 2	espec. 3	espec. 4	espec. 5	espec. 6	espec. 7	espec. 8	espec. 9	espec. 10	espec. 11	espec. 12	espec. 13	espec. 14	espec. 15	espec. 16	espec. 17
Leapfrog	0.41***	0.43***	0.43***	0.41***	0.41***	0.36***	0.34***	0.35***	0.35***	0.28**	0.20*	0.19*	0.19*	0.19*	0.19*	0.19*	0.19**
	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.11)	(0.11)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)
Extension	0.40***	0.43***	0.42***	0.40***	0.40***	0.35***	0.33***	0.31***	0.31***	0.11	0.01	-0.03	-0.03	-0.03	-0.03	-0.03	-0.04
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.07)	(0.07)	(0.07)	(0.06)	(0.07)	(0.06)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Infill	0.65***	0.70***	0.70***	0.64***	0.64***	0.62***	0.62***	0.60***	0.60***	0.26***	0.18**	0.18**	0.18**	0.17**	0.17**	0.17**	0.18**
	(0.10)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)

Note: Significance Level: 10% (*), 5% (**) e 1% (***). Standard deviation in parenthesis.

Table 2: Dif-in-Dif – Coefficients of Infill, Extension and Leapfrog X MCMV HU

t2lnmcmv	espec. 1	espec. 2	espec. 3	espec. 4	espec. 5	espec. 6	espec. 7	espec. 8	espec. 9	espec. 10	espec. 11	espec. 12	espec. 13	espec. 14	espec. 15	espec. 16
Leapfrog	0.20	0.20	0.25	0.25	0.24	0.24	0.23	0.18	0.10	0.13	0.17	0.19	0.19	0.19	0.18	0.18
	(0.16)	(0.16)	(0.15)	(0.15)	(0.15)	(0.16)	(0.15)	(0.15)	(0.16)	(0.16)	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)
Extension	-0.10	-0.10	-0.08	-0.07	-0.08	-0.08	-0.09	-0.03	-0.22**	-0.07	-0.09	-0.08	-0.08	-0.08	-0.07	-0.07
	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.10)	(0.09)	(0.09)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
Infill	-0.14	-0.13	-0.13	-0.10	-0.13	-0.14	-0.14	-0.15	-0.41***	-0.26**	-0.25**	-0.25**	-0.25**	-0.24**	-0.24**	-0.24**
	(0.14)	(0.13)	(0.13)	(0.13)	(0.13)	(0.13)	(0.12)	(0.13)	(0.13)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)

Note: Significance Level: 10% (*), 5% (**) e 1% (***). Standard deviation in parenthesis.

Table 3: OLS Estimation – Leapfrog/total new development X MCMV dummy

	espec. 1	espec. 2	espec. 3	espec. 4	espec. 5	espec. 6	espec. 7	espec. 8	espec. 9	espec. 10	espec. 11	espec. 12	espec. 13	espec. 14	espec. 15	espec. 16
MCMV	0.02	-0.00	-0.00	-0.00	-0.00	-0.02	-0.02	-0.00	-0.00	0.00	0.02	0.02	0.02	0.02	0.02	0.02
Dummy	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Poverty		0.37***	0.24*	0.24*	0.01	0.05	0.10	0.39**	0.30*	0.20	0.01	0.06	0.05	0.09	0.11	0.10
		(0.11)	(0.12)	(0.12)	(0.14)	(0.14)	(0.16)	(0.17)	(0.17)	(0.17)	(0.14)	(0.14)	(0.14)	(0.14)	(0.15)	(0.15)
School			-0.36**	-0.37**	-0.37**	-0.40**	-0.40**	-0.20	-0.13	-0.10	-0.24	-0.25*	-0.28*	-0.26*	-0.24*	-0.24*
			(0.16)	(0.16)	(0.16)	(0.16)	(0.17)	(0.18)	(0.18)	(0.17)	(0.14)	(0.14)	(0.15)	(0.15)	(0.15)	(0.15)
Over 60				0.18	0.17	0.05	-0.04	-0.19	0.57	0.39	0.07	0.21	0.22	0.27	0.27	0.27
				(0.49)	(0.49)	(0.48)	(0.48)	(0.51)	(0.54)	(0.52)	(0.43)	(0.44)	(0.44)	(0.44)	(0.44)	(0.44)
Hab.					0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
deficit					(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Open space						-0.22***	-0.25***	-0.27***	-0.23***	-0.17**	-0.29***	-0.27***	-0.26***	-0.27***	-0.27***	-0.27***
						(0.06)	(0.06)	(0.08)	(0.08)	(0.08)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
Revenue							0.02	0.01	0.00	0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
							(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Roughness								0.06***	0.06***	0.05***	0.05***	0.05***	0.05***	0.05***	0.05***	0.05***
								(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Voters									3.96***	3.03***	3.05***	2.96***	3.02***	3.11***	3.07***	3.06***
									(1.04)	(1.03)	(0.84)	(0.84)	(0.84)	(0.84)	(0.84)	(0.85)
Infill										-0.38***	-0.46***	-0.49***	-0.48***	-0.50***	-0.50***	-0.50***
										(0.09)	(0.07)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
Extension											-0.46***	-0.46***	-0.46***	-0.46***	-0.46***	-0.46***
											(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Dist_center												-0.03	-0.03	-0.03	-0.02	-0.02
												(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Perimeter													0.03	0.02	0.01	0.01
													(0.02)	(0.02)	(0.02)	(0.02)
Zoning														0.05*	0.04	0.04
														(0.03)	(0.03)	(0.03)
Building_code															0.03	0.03
															(0.03)	(0.03)
Installment																-0.00
																(0.03)
		**		*												
Interc.	0.19*	0.15***	0.99**	0.98**	0.98***	0.87**	0.76**	0.07	-0.15	-0.06	0.53	0.85**	0.92**	0.84*	0.76*	0.76*
	(0.02)	(0.03)	(0.38)	(0.38)	(0.37)	(0.37)	(0.38)	(0.43)	(0.42)	(0.41)	(0.34)	(0.42)	(0.43)	(0.43)	(0.44)	(0.44)
R^2	0.00	0.04	0.06	0.06	0.09	0.14	0.15	0.16	0.21	0.26	0.51	0.51	0.51	0.52	0.52	0.52
n	286	286	286	286	286	286	276	260	260	260	260	260	260	260	260	260
F test	0.34	5.85	5.57	4.20	5.42	7.32	6.53	6.03	7.27	8.75	23.22	21.46	19.92	18.84	17.65	16.48

Note: Significance Level: 10% (*), 5% (**) e 1% (***). Standard deviation in parenthesis.

Table 4: OLS Estimation – Leapfrog X MCMV HU

	espec. 1	espec. 2	espec. 3	espec. 4	espec. 5	espec. 6	espec. 7	espec. 8	espec. 9	espec. 10	espec. 11	espec. 12	espec. 13	espec. 14	espec. 15	espec. 16	espec. 17
MCMV HU	0.41***	0.43***	0.43***	0.41***	0.41***	0.36***	0.34***	0.35***	0.35***	0.28**	0.20*	0.19*	0.19*	0.19*	0.19*	0.19*	0.19**
	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.11)	(0.11)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)
Poverty		-4.99*	-7.82**	-7.75**	-10.24***	-8.88***	-6.27*	0.95	-0.56	1.40	0.39	0.49	-0.32	-0.54	-0.91	0.08	-0.45
		(2.73)	(3.09)	(3.09)	(3.62)	(3.36)	(3.73)	(4.13)	(4.11)	(4.31)	(4.19)	(3.82)	(3.92)	(3.94)	(3.97)	(3.99)	(4.03)
School			-8.01*	-7.73*	-7.74*	-9.05**	-10.36**	-6.79	-5.49	-5.86	-5.97	-0.25	0.12	-0.32	-0.53	-0.01	0.15
			(4.17)	(4.18)	(4.18)	(3.87)	(4.13)	(4.39)	(4.35)	(4.35)	(4.21)	(3.92)	(3.94)	(3.99)	(4.00)	(4.00)	(4.00)
Over 60				-11.53	-11.58	-17.15	-23.46**	-25.92**	-12.05	-7.14	0.95	-4.30	-6.39	-6.06	-6.36	-7.10	-6.84
				(12.72)	(12.70)	(11.79)	(11.89)	(12.28)	(13.04)	(13.44)	(13.17)	(12.03)	(12.25)	(12.27)	(12.29)	(12.24)	(12.24)
Hab. deficit					0.02	0.02	0.02	0.01	0.01	0.01	0.02	0.03**	0.03**	0.03**	0.03**	0.03**	0.03**
					(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Open space						-9.56***	-10.06***	-9.76***	-9.01***	-8.97***	-8.65***	-4.19**	-4.37**	-4.17**	-4.01**	-4.31**	-4.10**
						(1.39)	(1.40)	(1.97)	(1.96)	(1.95)	(1.89)	(1.84)	(1.85)	(1.87)	(1.88)	(1.88)	(1.89)
Revenue							0.59	0.61	0.39	0.40	0.33	0.30	0.30	0.27	0.29	0.33	0.31
							(0.38)	(0.39)	(0.40)	(0.39)	(0.38)	(0.35)	(0.35)	(0.35)	(0.35)	(0.35)	(0.35)
Roughness								1.01**	1.01**	0.99**	0.76	0.63	0.60	0.58	0.62	0.63	0.62
								(0.48)	(0.47)	(0.47)	(0.46)	(0.42)	(0.42)	(0.42)	(0.43)	(0.43)	(0.43)
Voters									71.49***	71.46***	84.34***	49.25**	49.60**	50.74**	48.76**	46.84**	43.77*
									(25.01)	(24.96)	(24.38)	(22.76)	(22.77)	(22.84)	(23.02)	(22.94)	(23.18)
Faixa 2&3 HU										0.20	-0.08	-0.23*	-0.21	-0.22	-0.20	-0.20	-0.18
										(0.14)	(0.15)	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)
Infill											0.30***	0.01	0.01	0.02	0.02	0.01	-0.00
											(0.07)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
Extension												0.76***	0.76***	0.75***	0.76***	0.76***	0.77***
												(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)
Dist_center													0.52	0.48	0.46	0.57	0.59
													(0.57)	(0.58)	(0.58)	(0.58)	(0.58)
Perimeter														0.48	0.59	0.45	0.51
														(0.62)	(0.65)	(0.65)	(0.65)
Zoning															-0.54	-0.90	-0.56
															(0.74)	(0.76)	(0.85)
Building_code																1.31*	1.45*
																(0.73)	(0.74)
Installment																	-0.76
																	(0.81)
Interc.	8.57***	9.13***	27.61***	28.17***	28.20***	23.22**	23.23**	11.54	7.49	6.86	6.44	-7.15	-13.37	-11.85	-11.01	-14.43	-14.62
	(0.55)	(0.63)	(9.63)	(9.65)	(9.64)	(8.95)	(9.21)	(10.25)	(10.20)	(10.19)	(9.87)	(9.20)	(11.49)	(11.67)	(11.74)	(11.84)	(11.84)
R^2	0.05	0.06	0.08	0.08	0.08	0.22	0.24	0.16	0.19	0.19	0.24	0.37	0.38	0.38	0.38	0.39	0.39
n	286	286	286	286	286	286	276	260	260	260	260	260	260	260	260	260	260
F test	15.97	9.73	7.78	6.04	5.18	12.97	11.92	5.93	6.33	5.94	7.31	12.34	11.45	10.65	9.96	9.62	9.11

Note: Significance Level: 10% (*), 5% (**) e 1% (***). Standard deviation in parenthesis.

Table 5: Dif-in-Dif – Leapfrog X dummy MCMV

	espec. 1	espec. 2	espec. 3	espec. 4	espec. 5	espec. 6	espec. 7	espec. 8	espec. 9	espec. 10	espec. 11	espec. 12	espec. 13	espec. 14	espec. 15	espec. 16
t2	-0.21	-0.38	0.01	-0.03	0.18	0.21	0.65	1.28	-0.19	0.04	0.77	0.90	0.89	0.89	1.01	1.17
	(0.91)	(0.93)	(0.93)	(0.94)	(0.96)	(0.97)	(0.91)	(0.96)	(1.13)	(1.13)	(1.08)	(1.08)	(1.09)	(1.09)	(1.10)	(1.11)
mcmv	0.39	0.48	0.17	0.30	0.28	0.30	-0.18	0.01	-0.03	-0.43	-0.46	-0.48	-0.49	-0.49	-0.45	-0.46
	(0.76)	(0.76)	(0.76)	(0.76)	(0.76)	(0.76)	(0.71)	(0.76)	(0.76)	(0.78)	(0.74)	(0.74)	(0.74)	(0.74)	(0.74)	(0.74)
t2mcmv	1.55	1.53	1.77*	1.61	1.58	1.54	1.51	1.50	1.08	1.34	1.52	1.61	1.61	1.61	1.59	1.54
	(1.07)	(1.07)	(1.06)	(1.07)	(1.07)	(1.07)	(1.00)	(1.05)	(1.06)	(1.06)	(1.01)	(1.01)	(1.01)	(1.02)	(1.01)	(1.01)
Poverty		-1.39	-0.91	3.50	3.60	4.25	6.35**	10.40***	11.56***	12.21***	11.35***	11.85***	11.86***	11.75***	12.17***	12.36***
		(1.59)	(1.59)	(2.26)	(2.26)	(2.65)	(2.50)	(2.83)	(2.85)	(2.86)	(2.72)	(2.74)	(2.75)	(2.80)	(2.81)	(2.82)
Voters			46.56***	44.88***	38.78***	38.97***	23.18*	24.49*	28.23**	26.85**	17.42	17.42	17.41	17.26	16.53	15.56
			(11.43)	(11.68)	(13.17)	(13.19)	(12.49)	(13.51)	(13.53)	(13.50)	(12.88)	(12.87)	(12.88)	(12.91)	(12.91)	(12.95)
Revenue				0.84***	0.86***	0.83***	1.01***	1.00***	0.99***	0.95***	0.87***	0.87***	0.88***	0.88***	0.89***	0.90***
				(0.30)	(0.30)	(0.30)	(0.28)	(0.31)	(0.31)	(0.31)	(0.29)	(0.29)	(0.30)	(0.30)	(0.30)	(0.30)
Over 60					-11.60	-11.92	-21.16*	-24.06**	-17.33	-13.30	-17.26	-13.94	-13.92	-13.96	-14.73	-15.14
					(11.57)	(11.60)	(10.92)	(11.73)	(11.99)	(12.10)	(11.50)	(11.79)	(11.81)	(11.82)	(11.82)	(11.83)
School						1.39	0.65	2.76	2.98	2.49	5.94*	5.23*	5.28*	5.27*	5.70*	5.50*
						(2.98)	(2.79)	(3.23)	(3.21)	(3.21)	(3.08)	(3.13)	(3.17)	(3.17)	(3.18)	(3.19)
Open space							-9.75***	-8.46***	-8.38***	-8.45***	-4.62***	-4.51***	-4.52***	-4.48***	-4.41***	-4.48***
							(1.12)	(1.64)	(1.64)	(1.63)	(1.63)	(1.63)	(1.64)	(1.65)	(1.65)	(1.65)
Roughness								0.59	0.57	0.52	0.53	0.57	0.57	0.58	0.56	0.54
								(0.37)	(0.37)	(0.37)	(0.35)	(0.35)	(0.35)	(0.35)	(0.35)	(0.35)
Faixa 2&3 HU									0.32**	0.22	0.06	0.03	0.03	0.03	0.03	0.01
									(0.13)	(0.14)	(0.13)	(0.13)	(0.13)	(0.13)	(0.13)	(0.14)
Infill										0.11**	-0.12**	-0.12**	-0.12**	-0.12*	-0.13**	-0.13**
										(0.05)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Extension											0.61***	0.60***	0.60***	0.60***	0.61***	0.61***
											(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
Dist_center												-0.61	-0.61	-0.62	-0.54	-0.52
												(0.49)	(0.49)	(0.49)	(0.50)	(0.50)
Perimeter													-0.07	-0.04	-0.14	-0.21
													(0.60)	(0.61)	(0.62)	(0.62)
Zoning														-0.12	-0.33	-0.66
														(0.58)	(0.60)	(0.68)
Building_code															0.92	0.81
															(0.63)	(0.64)
Installment																0.67
																(0.69)
Intercept	9.16**	9.46*	8.02***	3.40*	4.38**	1.29	-5.63	-11.92	-13.10*	-12.85*	-21.97***	-14.28	-14.38	-14.26	-16.44*	-16.28*
	(0.64)	(0.73)	(0.83)	(1.85)	(2.09)	(6.93)	(6.54)	(7.79)	(7.76)	(7.74)	(7.45)	(9.66)	(9.71)	(9.74)	(9.84)	(9.84)
R^2	0.02	0.02	0.05	0.06	0.06	0.06	0.18	0.12	0.13	0.14	0.22	0.23	0.23	0.23	0.23	0.23
n	572	572	570	553	553	553	553	500	500	500	500	500	500	500	500	500
F test	3.50	2.81	5.63	5.72	5.05	4.44	12.96	6.53	6.53	6.40	10.77	10.13	9.43	8.83	8.46	8.04

Note: Significance Level: 10% (*), 5% (**) e 1% (***). Standard deviation in parenthesis.

Table 6: Dif-in-Dif – Leapfrog X MCMV HU

	espec. 1	espec. 2	espec. 3	espec. 4	espec. 5	espec. 6	espec. 7	espec. 8	espec. 9	espec. 10	espec. 11	espec. 12	espec. 13	espec. 14	espec. 15	espec. 16
t2	0.04	-0.13	0.18	0.03	0.16	0.18	0.60	1.48*	0.48	0.60	1.30	1.43	1.42	1.42	1.56	1.70*
	(0.83)	(0.85)	(0.85)	(0.86)	(0.89)	(0.89)	(0.84)	(0.89)	(1.05)	(1.05)	(1.00)	(1.01)	(1.01)	(1.01)	(1.02)	(1.03)
lnmcmv	0.21*	0.21*	0.15	0.15	0.14	0.14	0.10	0.13	0.13	0.06	0.03	0.02	0.02	0.02	0.03	0.03
	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.10)	(0.11)	(0.11)	(0.12)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)
t2lnmcmv	0.20	0.20	0.25	0.25	0.24	0.24	0.23	0.18	0.10	0.13	0.17	0.19	0.19	0.19	0.18	0.18
	(0.16)	(0.16)	(0.15)	(0.15)	(0.15)	(0.16)	(0.15)	(0.15)	(0.16)	(0.16)	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)
Poverty		-1.22	-0.83	3.58	3.64	4.28	6.24**	10.48***	11.43***	11.95***	11.13***	11.61***	11.62***	11.50***	11.92***	12.11***
		(1.55)	(1.56)	(2.23)	(2.23)	(2.62)	(2.47)	(2.81)	(2.85)	(2.86)	(2.72)	(2.75)	(2.76)	(2.81)	(2.82)	(2.82)
Voters			44.02***	42.21***	38.75***	38.94***	23.34*	24.19*	26.82**	26.22*	17.13	17.21	17.21	17.03	16.26	15.29
			(11.41)	(11.68)	(13.13)	(13.14)	(12.45)	(13.48)	(13.53)	(13.51)	(12.89)	(12.88)	(12.90)	(12.93)	(12.93)	(12.96)
Revenue				0.83***	0.85***	0.82***	1.00***	0.98***	0.98***	0.95***	0.88***	0.88***	0.88***	0.88***	0.89***	0.90***
				(0.29)	(0.29)	(0.30)	(0.28)	(0.31)	(0.31)	(0.31)	(0.29)	(0.29)	(0.29)	(0.30)	(0.30)	(0.30)
Over 60					-6.72	-7.04	-16.57	-20.20*	-15.90	-13.09	-16.97	-13.80	-13.79	-13.85	-14.63	-15.04
					(11.61)	(11.64)	(10.97)	(11.77)	(11.98)	(12.09)	(11.49)	(11.79)	(11.81)	(11.82)	(11.82)	(11.82)
School						1.38	0.69	2.88	3.10	2.72	6.10**	5.41*	5.43*	5.42*	5.86*	5.64*
						(2.95)	(2.77)	(3.21)	(3.20)	(3.21)	(3.08)	(3.13)	(3.16)	(3.17)	(3.18)	(3.18)
Open space							-9.64***	-8.64***	-8.53***	-8.55***	-4.73***	-4.63***	-4.63***	-4.59***	-4.52***	-4.58***
							(1.11)	(1.63)	(1.63)	(1.63)	(1.63)	(1.63)	(1.64)	(1.65)	(1.65)	(1.65)
Roughness								0.65*	0.63*	0.57	0.57	0.61*	0.61*	0.61*	0.60*	0.57
								(0.37)	(0.37)	(0.37)	(0.35)	(0.35)	(0.35)	(0.35)	(0.35)	(0.35)
Faixa 2&3 HU									0.25*	0.19	0.02	-0.01	-0.01	-0.01	-0.01	-0.02
									(0.14)	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)
Infill										0.09	-0.14**	-0.14**	-0.14**	-0.13**	-0.15**	-0.15**
										(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Extension											0.61***	0.60***	0.60***	0.60***	0.61***	0.61***
											(0.08 (	0.08)	(0.08)	(0.08 (	0.08 (	0.08)
Dist_center												-0.58	-0.58	-0.59	-0.50	-0.49
											(	0.49)	(0.49)	(0.49 (	0.50 (	0.50)
Perimeter													-0.03	0.00	-0.09	-0.16
													(0.60)	(0.61 (	0.62 (	0.62)
Zoning														-0.13	-0.35	-0.68
														(0.58 (	0.60 (	0.68)
Building_code															0.92	0.82
														(	0.63 (	0.64)
Installment																0.68
															(	0.69)
Intercept	8.53**	8.84**	7.57***	3.06*	3.63*	0.60	-6.47	-13.33*	-14.27*	-13.94*	-22.80***	-15.46	-15.50	-15.37	-17.61*	-17.40*
	(0.58)	(0.70)	(0.79)	(1.80)	(2.06)	(6.84)	(6.46)	(7.72)	(7.72)	(7.71)	(7.42)	(9.66)	(9.71)	(9.74)	(9.85)	(9.85)
R^2	0.04	0.04	0.06	0.07	0.07	0.07	0.19	0.13	0.13	0.14	0.22	0.23	0.23	0.23	0.23	0.23
n	572	572	570	553	553	553	553	500	500	500	500	500	500	500	500	500
F test	7.12	5.49	7.40	7.18	6.20	5.44	13.96	7.17	6.85	6.50	10.84	10.17	9.47	8.87	8.49	8.08

Note: Significance Level: 10% (*), 5% (**) e 1% (***). Standard deviation in parenthesis.

Table 7: OLS Estimation – Extension/total new development X MCMV dummy

	espec. 1	espec. 2	espec. 3	espec. 4	espec. 5	espec. 6	espec. 7	espec. 8	espec. 9	espec. 10	espec. 11	espec. 12	espec. 13	espec. 14	espec. 15	espec. 16
MCMV	0.06*	0.08**	0.08**	0.08**	0.08**	0.05	0.04	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.03
Dummy	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Poverty		-0.35**	-0.42***	-0.42***	-0.31*	-0.23	-0.18	-0.36*	-0.37*	-0.42**	-0.27	-0.26	-0.26	-0.20	-0.20	-0.16
		(0.14)	(0.16)	(0.16)	(0.18)	(0.17)	(0.19)	(0.21)	(0.21)	(0.21)	(0.17)	(0.18)	(0.18)	(0.18)	(0.18)	(0.19)
School			-0.22	-0.21	-0.21	-0.28	-0.27	-0.33	-0.32	-0.31	-0.37**	-0.38**	-0.40**	-0.36**	-0.36**	-0.37**
			(0.21)	(0.21)	(0.21)	(0.19)	(0.21)	(0.22)	(0.22)	(0.22)	(0.18)	(0.18)	(0.18)	(0.18)	(0.18)	(0.18)
Over 60				-0.27	-0.27	-0.55	-0.79	-0.70	-0.61	-0.70	-0.41	-0.38	-0.37	-0.27	-0.27	-0.28
				(0.62)	(0.62)	(0.57)	(0.58)	(0.61)	(0.65)	(0.66)	(0.54)	(0.55)	(0.56)	(0.55)	(0.56)	(0.55)
Hab.					-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	0.00	0.00	0.00	0.00	0.00	0.00
deficit					(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Open space						-0.51***	-0.52***	-0.29***	-0.29***	-0.26**	-0.38***	-0.38***	-0.37***	-0.38***	-0.38***	-0.39***
						(0.07)	(0.07)	(0.10)	(0.10)	(0.10)	(0.08)	(0.08)	(0.09)	(0.08)	(0.09)	(0.09)
Revenue							0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
							(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Roughness								-0.00	-0.00	-0.01	0.03	0.03	0.03	0.02	0.02	0.02
								(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Voters									0.48	0.03	2.24**	2.22**	2.28**	2.42**	2.42**	2.56**
									(1.27)	(1.30)	(1.08)	(1.08)	(1.09)	(1.08)	(1.08)	(1.09)
Infill										-0.18	-0.46***	-0.46***	-0.46***	-0.50***	-0.50***	-0.50***
										(0.11)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)
Leapfrog											-0.73***	-0.73***	-0.73***	-0.74***	-0.74***	-0.73***
											(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
Dist_center												-0.01	-0.01	-0.01	-0.01	-0.01
												(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Perimeter													0.02	0.00	0.00	-0.00
													(0.03)	(0.03)	(0.03)	(0.03)
Zoning														0.07**	0.07**	0.04
														(0.03)	(0.04)	(0.04)
Building_code															0.00	-0.01
															(0.03)	(0.03)
Installment																0.05
																(0.04)
Interc.	0.57**	0.61**	1.11**	1.12**	1.12**	0.86*	0.84*	1.26**	1.23**	1.28**	1.24***	1.33**	1.38**	1.25**	1.25**	1.23**
	(0.03)	(0.03)	(0.48)	(0.48)	(0.48)	(0.44)	(0.46)	(0.51)	(0.52)	(0.52)	(0.42)	(0.53)	(0.54)	(0.54)	(0.55)	(0.55)
R^2	0.01	0.03	0.04	0.04	0.04	0.20	0.21	0.08	0.08	0.09	0.39	0.40	0.40	0.41	0.41	0.41
n	286	286	286	286	286	286	276	260	260	260	260	260	260	260	260	260
F test	3.35	4.89	3.63	2.76	2.48	11.81	10.30	2.77	2.47	2.49	14.71	13.44	12.42	11.98	11.14	10.62

Note: Significance Level: 10% (*), 5% (**) e 1% (***). Standard deviation in parenthesis.

Table 8: OLS Estimation – Extension X MCMV HU

	espec. 1	espec. 2	espec. 3	espec. 4	espec. 5	espec. 6	espec. 7	espec. 8	espec. 9	espec. 10	espec. 11	espec. 12	espec. 13	espec. 14	espec. 15	espec. 16	espec. 17
MCMV HU	0.40***	0.43***	0.42***	0.40***	0.40***	0.35***	0.33***	0.31***	0.31***	0.11	0.01	-0.03	-0.03	-0.03	-0.03	-0.03	-0.04
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.07)	(0.07)	(0.07)	(0.06)	(0.07)	(0.06)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Poverty		-8.61***	-11.32***	-11.24***	-9.71***	-8.25***	-6.86***	-3.69	-4.33	1.16	-0.14	-0.23	0.08	0.02	0.50	0.36	0.89
		(2.06)	(2.32)	(2.32)	(2.72)	(2.29)	(2.52)	(2.75)	(2.76)	(2.68)	(2.30)	(2.09)	(2.15)	(2.16)	(2.17)	(2.20)	(2.21)
School			-7.65**	-7.32**	-7.32**	-8.72***	-9.30***	-6.94**	-6.40**	-7.43***	-7.56***	-6.20***	-6.33***	-6.44***	-6.09***	-6.16***	-6.25***
			(3.13)	(3.13)	(3.13)	(2.64)	(2.79)	(2.92)	(2.92)	(2.70)	(2.31)	(2.11)	(2.13)	(2.15)	(2.15)	(2.16)	(2.15)
Over 60				-13.42	-13.39	-19.33**	-23.26***	-22.93***	-17.10*	-3.36	6.96	6.74	7.52	7.60	7.90	8.01	7.67
				(9.53)	(9.53)	(8.03)	(8.03)	(8.16)	(8.75)	(8.36)	(7.22)	(6.59)	(6.71)	(6.73)	(6.70)	(6.72)	(6.69)
Hab.					-0.01	-0.01	-0.01	-0.02**	-0.02**	-0.02**	-0.02**	-0.02***	-0.02***	-0.02***	-0.02***	-0.02***	-0.02***
deficit					(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Open space						-10.22***	-10.46***	-6.73***	-6.42***	-6.31***	-5.90***	-3.93***	-3.86***	-3.80***	-3.95***	-3.89***	-4.04***
						(0.94)	(0.95)	(1.31)	(1.31)	(1.21)	(1.04)	(0.99)	(1.00)	(1.01)	(1.01)	(1.01)	(1.01)
Revenue							0.26	0.20	0.11	0.13	0.04	-0.03	-0.04	-0.04	-0.07	-0.08	-0.06
							(0.25)	(0.26)	(0.27)	(0.25)	(0.21)	(0.19)	(0.19)	(0.19)	(0.19)	(0.19)	(0.19)
Roughness								0.51	0.51	0.46	0.16	-0.01	0.00	-0.01	-0.07	-0.07	-0.06
								(0.32)	(0.32)	(0.29)	(0.25)	(0.23)	(0.23)	(0.23)	(0.23)	(0.24)	(0.23)
Voters									30.08*	29.99*	46.41***	27.23**	26.99**	27.31**	29.37**	29.53**	32.12**
									(16.79)	(15.52)	(13.37)	(12.49)	(12.51)	(12.56)	(12.57)	(12.59)	(12.62)
Faixa 2&3 HU										0.56***	0.20**	0.22***	0.21***	0.21***	0.19**	0.19**	0.16**
										(0.09)	(0.08)	(0.07)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
Infill											0.38***	0.31***	0.31***	0.31***	0.31***	0.31***	0.32***
											(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Leapfrog												0.23***	0.23***	0.23***	0.23***	0.23***	0.23***
												(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Dist_center													-0.20	-0.21	-0.18	-0.20	-0.22
													(0.32)	(0.32)	(0.32)	(0.32)	(0.32)
Perimeter														0.13	-0.03	-0.01	-0.07
														(0.34)	(0.35)	(0.36)	(0.36)
Zoning															0.70*	0.75*	0.39
															(0.40)	(0.42)	(0.46)
Building_code																-0.19	-0.33
																(0.40)	(0.41)
Installment																	0.78*
																	(0.44)
Interc.	11.26***	12.24***	29.88***	30.54***	30.53***	25.21***	25.42***	21.99***	20.28***	18.52***	17.99***	16.52***	18.84***	19.22***	17.95***	18.44***	18.46***
	(0.42)	(0.47)	(7.23)	(7.23)	(7.23)	(6.10)	(6.22)	(6.81)	(6.85)	(6.34)	(5.42)	(4.94)	(6.21)	(6.31)	(6.33)	(6.42)	(6.40)
R^2	0.08	0.13	0.15	0.16	0.16	0.41	0.43	0.26	0.26	0.37	0.54	0.62	0.62	0.62	0.63	0.63	0.63
n	286	286	286	286	286	286	276	260	260	260	260	260	260	260	260	260	260
F test	25.07	22.05	16.95	13.25	10.84	32.31	29.03	10.75	10.00	14.87	26.95	33.99	31.33	29.00	27.48	25.70	24.58

Note: Significance Level: 10% (*), 5% (**) e 1% (***). Standard deviation in parenthesis.

Table 9: Dif-in-Dif – Extension X dummy HU

	espec. 1	espec. 2	espec. 3	espec. 4	espec. 5	espec. 6	espec. 7	espec. 8	espec. 9	espec. 10	espec. 11	espec. 12	espec. 13	espec. 14	espec. 15	espec. 16
t2	0.85	-0.06	0.38	0.43	0.77	0.74	1.19*	0.74	-1.97***	-1.19**	-1.20**	-1.12**	-1.07*	-1.07*	-1.12**	-1.20**
	(0.72)	(0.72)	(0.72)	(0.73)	(0.75)	(0.75)	(0.66)	(0.62)	(0.69)	(0.59)	(0.56)	(0.56)	(0.57)	(0.57)	(0.57)	(0.57)
mcmv	1.97***	2.45***	2.33***	2.26***	2.23***	2.20***	1.70***	1.48***	1.42***	0.06	0.13	0.12	0.13	0.13	0.12	0.13
	(0.60)	(0.59)	(0.58)	(0.59)	(0.59)	(0.59)	(0.52)	(0.49)	(0.46)	(0.40)	(0.38)	(0.38)	(0.38)	(0.38)	(0.38)	(0.38)
t2mcmv	-0.36	-0.49	-0.44	-0.45	-0.51	-0.47	-0.50	-0.41	-1.19*	-0.29	-0.51	-0.46	-0.46	-0.44	-0.44	-0.41
	(0.85)	(0.83)	(0.82)	(0.83)	(0.83)	(0.83)	(0.73)	(0.67)	(0.65)	(0.55)	(0.53)	(0.53)	(0.53)	(0.53)	(0.53)	(0.53)
Poverty		-7.25***	-6.38***	-6.75***	-6.59***	-7.37***	-5.15***	-2.94	-0.79	1.40	-0.62	-0.31	-0.35	-0.03	-0.22	-0.32
		(1.23)	(1.22)	(1.75)	(1.75)	(2.05)	(1.81)	(1.81)	(1.74)	(1.49)	(1.44)	(1.45)	(1.45)	(1.48)	(1.49)	(1.49)
Voters			34.88***	37.58***	27.92***	27.69***	11.06	13.17	20.07**	15.41**	10.97	10.95	10.96	11.37*	11.60*	12.05*
			(8.81)	(9.07)	(10.20)	(10.21)	(9.07)	(8.64)	(8.25)	(7.02)	(6.69)	(6.68)	(6.68)	(6.69)	(6.69)	(6.71)
Revenue				0.00	0.04	0.07	0.26	0.27	0.26	0.13	-0.03	-0.03	-0.03	-0.05	-0.05	-0.06
				(0.23)	(0.23)	(0.23)	(0.21)	(0.20)	(0.19)	(0.16)	(0.15)	(0.15)	(0.15)	(0.16)	(0.16)	(0.16)
Over 60					-18.35**	-17.97**	-27.70***	-19.65***	-7.23	6.48	8.68	10.53*	10.46*	10.57*	10.87*	11.07*
					(8.96)	(8.98)	(7.93)	(7.50)	(7.31)	(6.29)	(5.98)	(6.12)	(6.12)	(6.12)	(6.13)	(6.13)
School						-1.68	-2.46	-4.37**	-3.96**	-5.64***	-6.05***	-6.43***	-6.57***	-6.52***	-6.68***	-6.57***
						(2.30)	(2.03)	(2.06)	(1.96)	(1.67)	(1.59)	(1.61)	(1.62)	(1.62)	(1.63)	(1.63)
Open space							-10.27***	-6.16***	-6.01***	-6.26***	-4.86***	-4.78***	-4.73***	-4.84***	-4.85***	-4.80***
							(0.81)	(1.05)	(1.00)	(0.85)	(0.83)	(0.83)	(0.83)	(0.84)	(0.84)	(0.84)
Ruggedness								0.19	0.16	-0.02	-0.11	-0.08	-0.08	-0.09	-0.08	-0.07
								(0.24)	(0.22)	(0.19)	(0.18)	(0.18)	(0.18)	(0.18)	(0.18)	(0.18)
Faixa 2&3 HU									0.58***	0.26***	0.23***	0.21***	0.21***	0.20***	0.20***	0.21***
									(0.08)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
Infill										0.38***	0.36***	0.36***	0.36***	0.35***	0.36***	0.36***
										(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Leapfrog											0.17***	0.16***	0.16***	0.16***	0.16***	0.16***
											(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Dist_center												-0.35	-0.36	-0.35	-0.38	-0.38
												(0.26)	(0.26)	(0.26)	(0.26)	(0.26)
Perimeter													0.20	0.12	0.16	0.19
													(0.31)	(0.32)	(0.32)	(0.32)
Zoning														0.36	0.45	0.61*
														(0.30)	(0.31)	(0.35)
Building_code															-0.36	-0.31
															(0.33)	(0.33)
Installment																-0.34
																(0.36)
Intercept	10.98***	12.55***	11.29***	11.26***	12.82***	16.53***	9.24*	16.22***	14.03***	14.90***	17.03***	21.34***	21.62***	21.19***	22.02***	21.92***
	(0.51)	(0.56)	(0.64)	(1.43)	(1.62)	(5.36)	(4.75)	(4.98)	(4.74)	(4.02)	(3.83)	(4.94)	(4.96)	(4.97)	(5.02)	(5.02)
R^2	0.03	0.09	0.11	0.12	0.12	0.12	0.32	0.14	0.23	0.44	0.50	0.50	0.50	0.50	0.51	0.51
n	572	572	570	553	553	553	553	500	500	500	500	500	500	500	500	500
F test	6.76	14.12	14.07	12.08	11.01	9.70	28.96	8.08	13.10	32.46	37.48	35.00	32.66	30.74	29.02	27.45

Note: Significance Level: 10% (*), 5% (**) e 1% (***). Standard deviation in parenthesis.

Table 10: Dif-in-Dif – Extension X MCMV HU

	espec. 1	espec. 2	espec. 3	espec. 4	espec. 5	espec. 6	espec. 7	espec. 8	espec. 9	espec. 10	espec. 11	espec. 12	espec. 13	espec. 14	espec. 15	espec. 16
t2	1.04	0.10	0.40	0.41	0.65	0.63	1.07*	0.49	-1.68***	-1.14**	-1.24**	-1.15**	-1.11**	-1.11**	-1.16**	-1.23**
	(0.64)	(0.64)	(0.64)	(0.65)	(0.68)	(0.68)	(0.59)	(0.56)	(0.63)	(0.55)	(0.52)	(0.52)	(0.53)	(0.52)	(0.53)	(0.53)
lnmcmv	0.50***	0.52***	0.48***	0.47***	0.46***	0.46***	0.42***	0.33***	0.33***	0.05	0.04	0.04	0.04	0.04	0.03	0.04
	(0.09)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.07)	(0.07)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
t2lnmcmv	-0.10	-0.10	-0.08	-0.07	-0.08	-0.08	-0.09	-0.03	-0.22**	-0.07	-0.09	-0.08	-0.08	-0.08	-0.07	-0.07
	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.10)	(0.09)	(0.09)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
Poverty		-6.70***	-5.93***	-6.51***	-6.40***	-7.31***	-5.23***	-2.94*	-0.87	1.34	-0.63	-0.31	-0.36	-0.04	-0.22	-0.33
		(1.17)	(1.18)	(1.70)	(1.70)	(2.00)	(1.75)	(1.75)	(1.71)	(1.49)	(1.44)	(1.46)	(1.46)	(1.48)	(1.49)	(1.49)
Voters			29.94***	32.04***	25.92***	25.65**	9.15	11.74	17.46**	14.92**	10.59	10.63	10.63	11.07*	11.31*	11.77*
			(8.63)	(8.90)	(9.99)	(10.00)	(8.83)	(8.42)	(8.13)	(7.03)	(6.70)	(6.69)	(6.70)	(6.70)	(6.70)	(6.72)
Revenue				-0.02	-0.00	0.04	0.23	0.23	0.23	0.13	-0.03	-0.03	-0.03	-0.05	-0.05	-0.06
				(0.22)	(0.22)	(0.23)	(0.20)	(0.19)	(0.19)	(0.16)	(0.15)	(0.15)	(0.15)	(0.16)	(0.16)	(0.16)
Over 60					-11.91	-11.44	-21.51***	-14.92**	-5.57	6.37	8.53	10.39*	10.32*	10.45*	10.74*	10.95*
					(8.84)	(8.86)	(7.78)	(7.35)	(7.20)	(6.29)	(5.98)	(6.12)	(6.13)	(6.12)	(6.13)	(6.13)
School						-1.96	-2.68	-4.41**	-3.93**	-5.54***	-5.99***	-6.37***	-6.52***	-6.47***	-6.64***	-6.52***
						(2.25)	(1.96)	(2.00)	(1.92)	(1.67)	(1.58)	(1.61)	(1.62)	(1.62)	(1.63)	(1.63)
Open space							-10.20***	-6.42***	-6.20***	-6.26***	-4.85***	-4.77***	-4.72***	-4.83***	-4.84***	-4.79***
							(0.78)	(1.02)	(0.98)	(0.85)	(0.83)	(0.83)	(0.83)	(0.84)	(0.84)	(0.84)
Ruggedness								0.29	0.23	0.00	-0.09	-0.07	-0.07	-0.08	-0.07	-0.06
								(0.23)	(0.22)	(0.19)	(0.18)	(0.18)	(0.18)	(0.18)	(0.18)	(0.18)
Faixa 2&3 HU									0.55***	0.27***	0.24***	0.22***	0.22***	0.21***	0.21***	0.22***
									(0.08)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
Infill										0.37***	0.36***	0.36***	0.36***	0.35***	0.35***	0.36***
										(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Leapfrog											0.16***	0.16***	0.16***	0.16***	0.16***	0.16***
											(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Dist_center												-0.35	-0.36	-0.35	-0.38	-0.38
												(0.26)	(0.26)	(0.26)	(0.26)	(0.26)
Perimeter													0.21	0.13	0.16	0.20
													(0.31)	(0.32)	(0.32)	(0.32)
Zoning														0.36	0.44	0.61*
														(0.30)	(0.31)	(0.35)
Building_code															-0.35	-0.30
															(0.33)	(0.33)
Installment																-0.35
																(0.36)
Intercept	10.22***	11.92***	10.91***	11.08***	12.10***	16.42***	8.94*	15.18***	13.15***	14.53***	16.82***	21.16***	21.45***	21.04***	21.86***	21.73***
	(0.45)	(0.53)	(0.60)	(1.37)	(1.57)	(5.20)	(4.58)	(4.83)	(4.64)	(4.01)	(3.82)	(4.94)	(4.97)	(4.98)	(5.03)	(5.04)
R^2	0.09	0.14	0.16	0.16	0.17	0.17	0.36	0.19	0.26	0.44	0.50	0.50	0.50	0.50	0.51	0.51
n	572	572	570	553	553	553	553	500	500	500	500	500	500	500	500	500
F test	19.66	23.70	20.97	17.64	15.40	13.56	34.61	11.41	15.20	32.54	37.50	35.02	32.68	30.76	29.03	27.47

Note: Significance Level: 10% (*), 5% (**) e 1% (***). Standard deviation in parenthesis.

Table 11: OLS Estimation – Infill/total new development X MCMV dummy

	espec. 1	espec. 2	espec. 3	espec. 4	espec. 5	espec. 6	espec. 7	espec. 8	espec. 9	espec. 10	espec. 11	espec. 12	espec. 13	espec. 14	espec. 15	espec. 16
MCMV	0.02	0.03*	0.03*	0.03*	0.03*	0.03*	0.03	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.02
Dummy	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Poverty		-0.28***	-0.24***	-0.24***	-0.25***	-0.25***	-0.28***	-0.33***	-0.27**	-0.29**	-0.25**	-0.11	-0.10	-0.04	-0.04	-0.03
		(0.07)	(0.08)	(0.08)	(0.09)	(0.09)	(0.11)	(0.12)	(0.12)	(0.12)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)
School			0.09	0.10	0.10	0.11	0.14	0.14	0.10	0.08	-0.00	-0.05	-0.04	-0.01	-0.01	-0.01
			(0.11)	(0.11)	(0.11)	(0.11)	(0.12)	(0.13)	(0.12)	(0.12)	(0.12)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)
Over 60				-0.35	-0.35	-0.32	-0.23	-0.01	-0.49	-0.52	-0.43	-0.04	-0.04	0.04	0.04	0.04
				(0.32)	(0.32)	(0.32)	(0.33)	(0.35)	(0.37)	(0.36)	(0.34)	(0.34)	(0.34)	(0.33)	(0.33)	(0.34)
Hab.					0.00	0.00	0.00	-0.00	-0.00	-0.00	0.00	0.00	0.00	0.00	0.00	0.00
deficit					(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Open space						0.04	0.04	0.19***	0.17***	0.15***	0.05	0.08	0.07	0.05	0.05	0.05
						(0.04)	(0.04)	(0.06)	(0.06)	(0.06)	(0.06)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Revenue							-0.01	-0.01	0.00	0.00	0.00	-0.00	0.00	-0.00	-0.00	-0.00
							(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Ruggedness								-0.03**	-0.03**	-0.03**	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
								(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Voters									-2.46***	-2.44***	-1.21*	-1.29*	-1.33**	-1.09*	-1.10*	-1.06
									(0.71)	(0.71)	(0.69)	(0.66)	(0.66)	(0.66)	(0.66)	(0.66)
Extension										-0.06	-0.18***	-0.17***	-0.17***	-0.18***	-0.18***	-0.18***
										(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Leapfrog											-0.30***	-0.29***	-0.29***	-0.29***	-0.29***	-0.29***
											(0.05)	(0.05)	(0.05)	(0.04)	(0.05)	(0.05)
Dist_center												-0.07***	-0.07***	-0.06***	-0.06***	-0.06***
												(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Perimeter													-0.01	-0.03	-0.03*	-0.03*
													(0.02)	(0.02)	(0.02)	(0.02)
Zoning														0.07***	0.07***	0.06**
														(0.02)	(0.02)	(0.02)
Building_code															0.01	0.01
															(0.02)	(0.02)
Installment																0.01
																(0.02)
Interc.	0.09*	0.11***	-0.11	-0.09	-0.09	-0.07	-0.10	0.12	0.26	0.33	0.44	1.26***	1.21***	1.05***	1.03***	1.03***
	(0.02)	(0.02)	(0.25)	(0.25)	(0.25)	(0.25)	(0.26)	(0.29)	(0.29)	(0.29)	(0.27)	(0.32)	(0.33)	(0.32)	(0.33)	(0.33)
R^2	0.00	0.05	0.06	0.06	0.06	0.07	0.06	0.11	0.15	0.16	0.27	0.33	0.33	0.36	0.36	0.36
n	286	286	286	286	286	286	276	260	260	260	260	260	260	260	260	260
F test	1.01	8.15	5.69	4.56	3.64	3.24	2.52	3.84	4.91	4.71	8.48	9.97	9.24	9.73	9.06	8.50

Note: Significance Level: 10% (*), 5% (**) e 1% (***). Standard deviation in parenthesis.

Table 12: OLS Estimation – Infill X MCMV HU

	espec. 1	espec. 2	espec. 3	espec. 4	espec. 5	espec. 6	espec. 7	espec. 8	espec. 9	espec. 10	espec. 11	espec. 12	espec. 13	espec. 14	espec. 15	espec. 16	espec. 17
MCMV HU	0.65***	0.70***	0.70***	0.64***	0.64***	0.62***	0.62***	0.60***	0.60***	0.26***	0.18**	0.18**	0.18**	0.17**	0.17**	0.17**	0.18**
	(0.10)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
Poverty		-14.71***	-15.08***	-14.84***	-13.24***	-12.63***	-11.57***	-6.80*	-5.90	3.40	2.57	2.57	2.42	2.81	2.62	3.05	2.30
		(2.47)	(2.82)	(2.77)	(3.25)	(3.20)	(3.55)	(3.91)	(3.93)	(3.68)	(3.14)	(3.15)	(3.24)	(3.24)	(3.27)	(3.30)	(3.33)
School			-1.05	-0.10	-0.10	-0.68	-1.43	2.87	2.10	0.35	5.67*	5.67*	5.74*	6.51**	6.39*	6.60**	6.75**
			(3.80)	(3.75)	(3.75)	(3.69)	(3.93)	(4.15)	(4.16)	(3.71)	(3.22)	(3.22)	(3.25)	(3.26)	(3.27)	(3.28)	(3.27)
Over 60				-38.21***	-38.17***	-40.66***	-41.67***	-42.04***	-50.37***	-27.09**	-24.69**	-24.66**	-25.03**	-25.30**	-25.44**	-25.71**	-25.13**
				(11.39)	(11.39)	(11.23)	(11.30)	(11.62)	(12.47)	(11.46)	(9.80)	(9.82)	(10.02)	(9.98)	(10.00)	(10.01)	(9.98)
Hab. deficit					-0.01	-0.01	-0.01	-0.01	-0.02	-0.02	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
					(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Open space						-4.28***	-4.83***	-0.80	-1.25	-1.08	3.44**	3.47**	3.44**	3.03*	3.11**	2.94*	3.16**
						(1.32)	(1.33)	(1.86)	(1.87)	(1.67)	(1.50)	(1.52)	(1.53)	(1.54)	(1.55)	(1.56)	(1.56)
Revenue							0.20	0.07	0.20	0.23	0.14	0.14	0.14	0.20	0.21	0.22	0.20
							(0.36)	(0.37)	(0.38)	(0.34)	(0.29)	(0.29)	(0.29)	(0.29)	(0.29)	(0.29)	(0.29)
Ruggedness								0.87*	0.87*	0.80**	0.46	0.46	0.45	0.49	0.52	0.52	0.51
								(0.45)	(0.45)	(0.40)	(0.34)	(0.35)	(0.35)	(0.35)	(0.35)	(0.35)	(0.35)
Voters									-42.98*	-43.13**	-64.61***	-64.97***	-64.87***	-66.44***	-67.34***	-67.66***	-70.95***
									(23.90)	(21.29)	(18.33)	(18.54)	(18.58)	(18.52)	(18.66)	(18.66)	(18.73)
Faixa 2&3 HU										0.95***	0.55***	0.55***	0.55***	0.56***	0.57***	0.57***	0.59***
										(0.12)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)
Extension											0.72***	0.71***	0.71***	0.71***	0.71***	0.71***	0.72***
											(0.07)	(0.08)	(0.08)	(0.08)	(0.09)	(0.09)	(0.09)
Leapfrog												0.01	0.01	0.01	0.01	0.00	-0.00
												(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Dist_center													0.09	0.17	0.17	0.22	0.24
													(0.48)	(0.48)	(0.48)	(0.48)	(0.48)
Perimeter														-0.92*	-0.86	-0.92*	-0.82
														(0.51)	(0.53)	(0.53)	(0.54)
Zoning															-0.28	-0.44	0.02
															(0.61)	(0.63)	(0.70)
Building_code																0.60	0.78
																(0.61)	(0.62)
Installment																	-1.04
																	(0.67)
Interc.	6.66***	8.32***	10.74	12.62	12.61	10.38	10.54	1.95	4.39	1.40	-11.86	-11.81	-12.92	-15.62	-15.19	-16.76*	-16.92*
	(0.52)	(0.57)	(8.78)	(8.65)	(8.65)	(8.53)	(8.75)	(9.70)	(9.75)	(8.69)	(7.56)	(7.58)	(9.50)	(9.58)	(9.64)	(9.77)	(9.74)
R^2	0.13	0.23	0.23	0.26	0.26	0.29	0.30	0.26	0.27	0.42	0.58	0.58	0.58	0.59	0.59	0.59	0.59
n	286	286	286	286	286	286	276	260	260	260	260	260	260	260	260	260	260
F test	44.27	42.52	28.28	24.79	20.00	18.98	16.11	11.12	10.33	18.35	31.29	28.57	26.27	24.84	23.13	21.74	20.72

Note: Significance Level: 10% (*), 5% (**) e 1% (***). Standard deviation in parenthesis.

Table 13: Dif-in-Dif – Infill X dummy HU

	espec. 1	espec. 2	espec. 3	espec. 4	espec. 5	espec. 6	espec. 7	espec. 8	espec. 9	espec. 10	espec. 11	espec. 12	espec. 13	espec. 14	espec. 15	espec. 16
t2	2.23**	0.21	0.64	0.68	1.73**	1.81**	1.97**	1.89**	-2.06**	-0.60	-0.54	-0.58	-0.65	-0.65	-0.44	-0.33
	(0.90)	(0.83)	(0.83)	(0.83)	(0.83)	(0.83)	(0.82)	(0.87)	(0.97)	(0.83)	(0.82)	(0.83)	(0.84)	(0.83)	(0.82)	(0.83)
mcmv	2.63***	3.71***	3.66***	3.64***	3.53***	3.59***	3.40***	3.67***	3.58***	2.53***	2.48***	2.48***	2.45***	2.41***	2.42***	2.41***
	(0.74)	(0.68)	(0.68)	(0.67)	(0.65)	(0.65)	(0.65)	(0.68)	(0.65)	(0.55)	(0.55)	(0.55)	(0.56)	(0.55)	(0.55)	(0.55)
t2mcmv	-0.52	-0.81	-0.81	-0.73	-0.89	-0.98	-1.00	-1.24	-2.38***	-1.50*	-1.38*	-1.41*	-1.40*	-1.29*	-1.29*	-1.31*
	(1.05)	(0.95)	(0.95)	(0.95)	(0.92)	(0.92)	(0.91)	(0.94)	(0.90)	(0.77)	(0.77)	(0.77)	(0.77)	(0.77)	(0.76)	(0.76)
Poverty		-16.21***	-15.67***	-14.09***	-13.60***	-11.86***	-11.06***	-8.93***	-5.80**	-5.21**	-4.37**	-4.54**	-4.47**	-3.27	-2.48	-2.33
		(1.41)	(1.42)	(2.00)	(1.95)	(2.28)	(2.27)	(2.54)	(2.43)	(2.07)	(2.10)	(2.13)	(2.13)	(2.15)	(2.15)	(2.16)
Voters			30.30***	38.47***	9.28	9.80	3.83	2.26	12.33	-2.54	-1.30	-1.31	-1.34	0.28	-0.76	-1.37
			(10.21)	(10.34)	(11.35)	(11.35)	(11.34)	(12.14)	(11.55)	(9.87)	(9.85)	(9.86)	(9.87)	(9.80)	(9.72)	(9.75)
Revenue				0.35	0.46*	0.39	0.46*	0.36	0.34	0.15	0.21	0.21	0.22	0.16	0.17	0.18
				(0.26)	(0.26)	(0.26)	(0.26)	(0.28)	(0.26)	(0.23)	(0.23)	(0.23)	(0.23)	(0.23)	(0.22)	(0.23)
Over 60					-55.46***	-56.33***	-59.82***	-54.33***	-36.22***	-30.86***	-31.81***	-32.85***	-32.73***	-31.63***	-32.32***	-32.56***
					(9.97)	(9.98)	(9.92)	(10.53)	(10.23)	(8.70)	(8.68)	(8.91)	(8.92)	(8.85)	(8.78)	(8.79)
School						3.74	3.46	3.83	4.43	7.36***	7.72***	7.94***	8.16***	8.11***	8.66***	8.52***
						(2.56)	(2.53)	(2.90)	(2.74)	(2.34)	(2.34)	(2.38)	(2.40)	(2.38)	(2.37)	(2.37)
Open space							-3.69***	0.44	0.66	5.11***	4.75***	4.71***	4.63***	4.12***	4.12***	4.07***
							(1.01)	(1.48)	(1.40)	(1.23)	(1.24)	(1.24)	(1.25)	(1.25)	(1.24)	(1.24)
Ruggedness								0.53	0.47	0.36	0.39	0.37	0.38	0.35	0.33	0.31
								(0.33)	(0.31)	(0.27)	(0.27)	(0.27)	(0.27)	(0.27)	(0.26)	(0.26)
Faixa 2&3 HU									0.85***	0.42***	0.42***	0.43***	0.43***	0.41***	0.39***	0.38***
									(0.11)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)
Extension										0.74***	0.78***	0.78***	0.78***	0.76***	0.75***	0.75***
										(0.05)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Leapfrog											-0.07**	-0.07**	-0.07**	-0.07*	-0.07**	-0.07**
											(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Dist_center												0.20	0.21	0.24	0.35	0.36
												(0.38)	(0.38)	(0.37)	(0.37)	(0.37)
Perimeter													-0.32	-0.60	-0.73	-0.78*
													(0.46)	(0.46)	(0.46)	(0.46)
Zoning														1.29***	0.92**	0.71
														(0.44)	(0.45)	(0.51)
Building_code															1.45***	1.38***
															(0.47)	(0.48)
Installment																0.44
																(0.52)
Intercept	5.74***	9.26***	8.14***	5.97***	10.67***	2.37	-0.25	0.89	-2.30	-12.69**	-14.13**	-16.58**	-17.04**	-18.02**	-21.20***	-21.09***
	(0.63)	(0.65)	(0.74)	(1.63)	(1.80)	(5.96)	(5.94)	(7.00)	(6.63)	(5.68)	(5.70)	(7.37)	(7.40)	(7.35)	(7.35)	(7.36)
R^2	0.06	0.24	0.25	0.27	0.31	0.31	0.32	0.26	0.34	0.52	0.53	0.53	0.53	0.54	0.54	0.54
n	572	572	570	553	553	553	553	500	500	500	500	500	500	500	500	500
F test	11.99	44.20	37.09	32.92	34.18	30.24	28.95	16.76	22.43	44.32	41.49	38.49	35.92	34.76	33.86	32.00

Note: Significance Level: 10% (*), 5% (**) e 1% (***). Standard deviation in parenthesis.

Table 14: Dif-in-Dif – Infill X MCMV HU

	espec. 1	espec. 2	espec. 3	espec. 4	espec. 5	espec. 6	espec. 7	espec. 8	espec. 9	espec. 10	espec. 11	espec. 12	espec. 13	espec. 14	espec. 15	espec. 16
t2	2.47***	0.30	0.58	0.55	1.45**	1.49**	1.65**	1.53**	-1.46*	-0.31	-0.20	-0.27	-0.33	-0.33	-0.11	-0.04
	(0.77)	(0.71)	(0.72)	(0.72)	(0.73)	(0.73)	(0.72)	(0.76)	(0.86)	(0.75)	(0.74)	(0.75)	(0.75)	(0.75)	(0.75)	(0.75)
lnmcmv	0.79***	0.84***	0.82***	0.80***	0.77***	0.77***	0.75***	0.74***	0.74***	0.52***	0.51***	0.52***	0.52***	0.50***	0.50***	0.50***
	(0.10)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
t2lnmcmv	-0.14	-0.13	-0.13	-0.10	-0.13	-0.14	-0.14	-0.15	-0.41***	-0.26**	-0.25**	-0.25**	-0.25**	-0.24**	-0.24**	-0.24**
	(0.14)	(0.13)	(0.13)	(0.13)	(0.13)	(0.13)	(0.12)	(0.13)	(0.13)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)
Poverty		-15.46***	-15.07***	-13.77***	-13.37***	-11.85***	-11.12***	-8.82***	-5.96**	-5.37***	-4.46**	-4.73**	-4.67**	-3.59*	-2.79	-2.68
		(1.29)	(1.31)	(1.86)	(1.82)	(2.14)	(2.12)	(2.39)	(2.33)	(2.02)	(2.05)	(2.07)	(2.08)	(2.10)	(2.10)	(2.10)
Voters			21.48**	28.79***	5.91	6.36	0.50	-1.03	6.86	-5.15	-3.79	-3.85	-3.86	-2.31	-3.35	-3.83
			(9.59)	(9.73)	(10.73)	(10.72)	(10.70)	(11.49)	(11.08)	(9.62)	(9.60)	(9.60)	(9.61)	(9.56)	(9.48)	(9.51)
Revenue				0.30	0.39	0.33	0.40	0.28	0.28	0.12	0.19	0.18	0.19	0.14	0.15	0.16
				(0.24)	(0.24)	(0.24)	(0.24)	(0.26)	(0.25)	(0.22)	(0.22)	(0.22)	(0.22)	(0.22)	(0.22)	(0.22)
Over 60					-44.46***	-45.23***	-48.81***	-45.13***	-32.24***	-28.41***	-29.41***	-31.04***	-30.95***	-30.00***	-30.71***	-30.91***
					(9.49)	(9.50)	(9.43)	(10.03)	(9.81)	(8.48)	(8.46)	(8.67)	(8.68)	(8.63)	(8.56)	(8.56)
School						3.26	3.00	3.70	4.36*	7.06***	7.45***	7.80***	7.98***	7.93***	8.49***	8.38***
						(2.41)	(2.38)	(2.73)	(2.62)	(2.28)	(2.27)	(2.31)	(2.33)	(2.32)	(2.30)	(2.31)
Open space							-3.62***	-0.15	0.16	4.42***	4.01***	3.96***	3.90***	3.45***	3.45***	3.41***
							(0.95)	(1.39)	(1.34)	(1.20)	(1.21)	(1.21)	(1.22)	(1.22)	(1.21)	(1.21)
Ruggedness								0.70**	0.63**	0.46*	0.50*	0.48*	0.48*	0.46*	0.43*	0.42
								(0.31)	(0.30)	(0.26)	(0.26)	(0.26)	(0.26)	(0.26)	(0.26)	(0.26)
Faixa 2&3 HU									0.75***	0.38***	0.37***	0.39***	0.39***	0.37***	0.36***	0.35***
									(0.11)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)
Extension										0.69***	0.73***	0.73***	0.73***	0.71***	0.71***	0.71***
										(0.05)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Leapfrog											-0.08**	-0.07**	-0.07**	-0.07**	-0.08**	-0.08**
											(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Dist_center												0.31	0.32	0.35	0.46	0.47
												(0.37)	(0.37)	(0.36)	(0.36)	(0.36)
Perimeter													-0.26	-0.51	-0.64	-0.68
													(0.44)	(0.45)	(0.45)	(0.45)
Zoning														1.15***	0.79*	0.62
														(0.42)	(0.44)	(0.50)
Building_code															1.43***	1.38***
															(0.46)	(0.46)
Installment																0.35
																(0.51)
Intercept	4.19***	8.11***	7.34***	5.56***	9.36***	2.17	-0.49	-0.92	-3.72	-12.77**	-14.38***	-18.26**	-18.63***	-19.46***	-22.65***	-22.53***
	(0.54)	(0.59)	(0.66)	(1.50)	(1.68)	(5.58)	(5.55)	(6.59)	(6.33)	(5.51)	(5.53)	(7.16)	(7.19)	(7.16)	(7.16)	(7.17)
R^2	0.17	0.34	0.34	0.36	0.38	0.39	0.40	0.34	0.39	0.55	0.55	0.55	0.55	0.56	0.57	0.57
n	572	572	570	553	553	553	553	500	500	500	500	500	500	500	500	500
F test	39.71	72.94	59.31	51.05	48.57	42.80	40.60	24.82	28.57	48.95	45.98	42.72	39.84	38.29	37.29	35.21

Note: Significance Level: 10% (*), 5% (**) e 1% (***). Standard deviation in parenthesis.