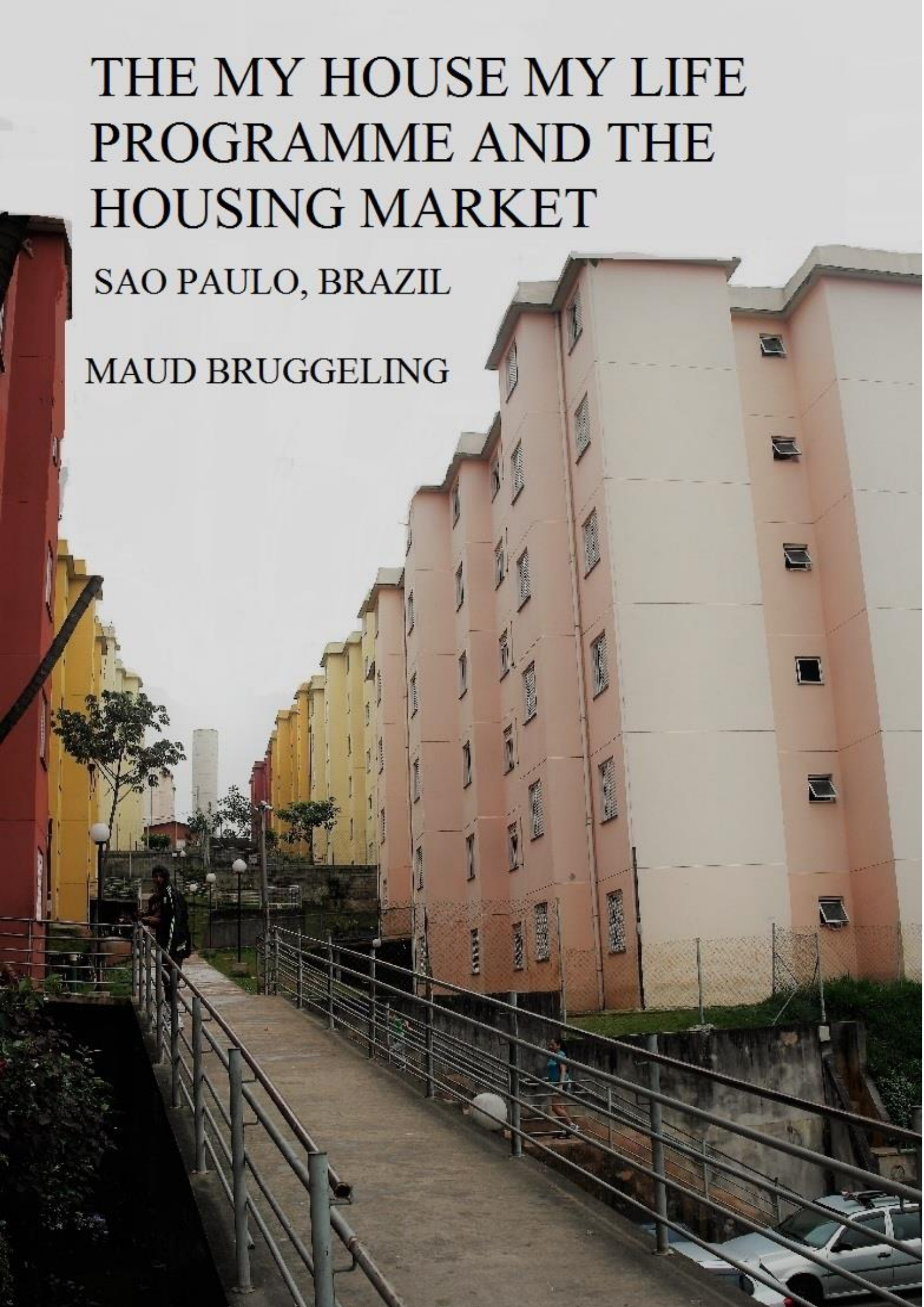
THE MY HOUSE MY LIFE PROGRAMME AND THE HOUSING MARKET

SAO PAULO, BRAZIL

MAUD BRUGGELING



Implications of the My House, My Life programme on the housing market in São Paulo, Brazil.

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Summary

Social housing is initiated in circumstances where people do not have enough money to afford reasonable quality houses. Governments intervene to supply these social houses (Nguyen, 2005). However, local oppositions argue that property prices are negatively affected by neighbouring social housing developments. Earlier research shows mixed results, some concluding that social housing developments may, indeed, negatively affect property prices (Preez and Sale, 2013; Nguyen, 2005). This study evaluates the implications of the My House My Life (MHML) developments in the ABC region (Brazil) and their effect on the nearby housing market.

From 2009 till 2014, the Brazilian government launched a social housing programme to address its housing deficit. The programme is confronted with the challenge of building homes for millions of people in a short time frame (UN Habitat, 2013). The programme is developed in three groups:

- The first group is for the lowest household's incomes (zero till three minimum wage)
- The second group is for households earning three to six times the minimum wage.
- The third group is for households earning up to ten times the minimum wage.

Scientific literature about the location of social housing is addressed by Needham and de Kam (2004), they argue that the process of land acquisition for social housing is important and can force social housing to deprived locations. The study of Lee, Culhane and Wachter (1999), on a multitude of different social housing programs in Philadelphia, found that a 35 percent decline of surrounding property prices could occur when social housing was located in suburban rather than urban neighbourhoods. This is due to large differences in property prices between social housing and neighbouring houses (Lee, Culhane, Wachter 1999).

Rolnik (2014) suggests that in two metropolitan areas, São Paulo and Campinas, the cost of land has forced the developments of the MHML programme to locations deprived of suitable land for construction or sometimes to locations with difficult access regarding infrastructure, trade and services. Furthermore, hedonic pricing models show that property prices can negatively be affected by nearby social housing units (Nguyen, 2005). However, there are many ways to reduce this effect from occurring; for instance by developing social housing units that are compatible within the neighbourhood, with good quality and design or through rehabilitation (Lee, Culhane, and Wachter, 1999; Cummings and Landis, 1993; Santiago, Galster, and Tatian, 2001; Galster, Tatian, and Smith; 1999).

In this study, the quality-, the design-, the compatibility-, accessibility- and the proximity to slums of - the MHML developments are evaluated through primary empirical research and secondary sources. In addition, the distance to the MHML developments and the effect of slums is being measured using a hedonic pricing model. Results show that there is a difference between the quality and design of the different groups. Group one developments already show cracks in the construction and have different colours than the buildings in the host neighbourhood. However, the quality and design of group two and three is comparable, these groups do not have notable designs and did not show failures in the construction.

A hedonic analysis is performed, however interpretation of the results is difficult. 362 Launch prices (new real estate development prices) are analysed in the hedonic pricing model and these prices are analysed with 36 and 55 MHML developments. The results show that, when analysing the average effect of the MHML developments, the effect of the MHML programme is only significant for the distance between 501-1000m when including the distance to slums. A second model shows a significant negative effect on property prices for group one developments (one should know that only a small number of developments are analysed in group one) between 101 till 500m and 1001 till 2000m. Group two also shows a significant negative effect for property prices between 0 till 100m of MHML developments. Performing this research with data from launch prices is a big flaw; this is a valuable lesson in further research. However, same results may occur using transaction prices.

Preface

Two years ago I had the opportunity to go to Vietnam to research the influence of climate change on property prices. While working on this research I became inspired by the slums that surrounded my apartment in Ho Chi Minh City. Living in close proximity to the slum made me realise that a large amount of Vietnam's citizens lived within these slums, often in poor conditions. I wanted to know what the government did to prevent this from happening. However, due to time limitation I never got around to it.

Two years later, I got the chance to go to Brazil to investigate the social housing programme MHML. While driving to my new house, I noticed many slums; similar to ones I had seen in Vietnam two years before. However, never had I seen so many! To be given the opportunity to research a programme that aims to decrease slums was unique in my experience, especially in a country where slums are almost normality.

During my research, the Federal University of the ABC (UFABC) region has been of tremendous help as the research presented itself with many difficulties regarding language, getting to know the local laws and regulations, and familiarising myself with the social housing programme. Despite these obstacles many people were willing to support me during my process. Especially Jeroen Klink, my research professor at the UFABC, Ricardo Pereira, Kauanna Hino, and Kaio Nogueira.

I also had much help from my University in the Netherlands. I therefore would like to thank my thesis supervisor Frans Sijtsma for keeping me on schedule and focussed. Furthermore, I would like to thank Ashley Klapwijk because she was always willing to help me.

Finally, I would like to thank my Luuk Bruggeling and, my roommate Loes Hoogkamer who were always ready to assist me with my English. Lastly, I would like to thank Robin Junker who was always there for me during this process.

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1. Introduction

1.1 Motivation

The past decades have been characterized by urbanization, population growth, and fast rising economies. In the 1990's, less than four out of ten people in the world lived in cities. Nowadays, more than five out of ten of the world's population lives in urban areas and, by 2050; seven out of every ten people are expected to live in such areas (World Health Organisation (WHO), UN-Habitat 2010). Urbanization usually occurs due to economic development, however; the current urbanizing trend is accompanied by poverty (WHO et al., 2010). Poverty in urban areas often manifests itself in the development of slums. Slums are an increasing problem all around the world; therefore, the United Nations introduced a millennium goal: "achieve by 2020 a significant improvement in the lives of at least hundred million slum dweller" (UN-Habitat, 2015). To improve the lives of slum dwellers a government has many options. One of them is to meet the needs of low-income households for decent housing at an affordable price. This can be accomplished by establishing a social housing sector. Providing social housing allows for housing mortgages- and incentives for promoting private sector involvement in social housing provision for low-income households.

Brazil is one of those countries where urbanization has increased dramatically in recent years. While in the 1950's only 35 percent of its population lived in cities, currently this number has risen to 80 percent of its population (UN Habitat, 2013). This dramatically strong trend of urbanization has caused decent housing shortages in urban areas. 11,4 Million people, seven percent of the total urban population in Brazil (2010), live in slums. Therefore, in 2009, Brazil introduced a social housing programme called 'My House, My Life (MHML)'. The programme aims to improve the access to housing for the low-income population and to create new demands in employment-intensive sectors. The programme uses special mechanisms as an incentive for the private sector to build houses for low-income groups (UN Habitat, 2013). This included new financial systems with which the beneficiary could acquire a new house.

The MHML programme was created to tackle the problems that accompany urbanization in Brazil. The stimulation of local economic development is the primary effect of the MHML programme. By trading informal housing for formal housing the economy is triggered (UN Habitat, 2017). However, the programme was confronted with some early criticism. Architect Luciana Correa de Lago, argued that MHML programme often led to social housing units of poor quality on cheap land, far from city centres and without proper transportation (Rio Times, 2011). Rolnik (2014) argued that this is due to the high cost of the land which has forced the MHML developments to deprived locations of infrastructure, trade, and services. Furthermore, land in or near city centres is even more difficult to acquire. An example is the ABC region (São Paulo), due to its limited availability of land (Klink and

Lourdes Pereira Fonseca, 2016). The scarcities of land forces the MHML developments to small limited plots near the 'regular' housing market or far from city centres. Developing the MHML programme near the 'regular' housing market could cause a problem since the surrounding housing market could negatively be affected by the construction of social housing, as Ellen et al., (2007) witnessed in New York City. They argued that real estate prices in New York City declined due to negative spill over effects from the construction of new social housing.

The topic of this master thesis is to study both the relative locations of the MHML programme as well as the implications of the MHML programme for the surrounding 'regular' housing market in the ABC region of São Paulo.

1.2 Context

From 2009 to 2014, the Brazilian government launched a social housing programme to address its housing deficit. The programme is confronted with the challenge of building houses for millions of people in a short time frame. In this approach the government acts primarily as a financier, guaranteeing subsidised credit to low-income families and low-interest financing to construction companies. A few guidelines regarding size and configuration of the houses are set by the government, however the construction companies can more or less decide where and how to build. The programme has two main goals: to increase houses for low-income households and to create direct demand in an employment intensive sector (UN Habitat, 2013). Furthermore, the programme is developed in three groups:

- Group one is for the lowest household's incomes (up to R$1.395; USD 754*[1])
- Group two for households earning three to six times the minimum wage (between R$1.395 and R $2.790; equivalent to USD 754 and USD 1.508*)
- Group three is for households earning up to ten times the minimum wage (between R$2.790 and R$4.650; equivalent to USD 1.508 and USD 2.513*).

Between 2012 and 2016 the average income in Brazil was R $2049.62 (Trading economist, 2016). Someone with an average wage can apply for a house in group two or three, note that the MHML programme works with households income, which means that a family (household) cannot earn more that the previously discussed wages.

This research will focus on the ABC region located between São Paulo city and the port of Santos. The region experienced rapid urban growth after companies, like Volkswagen, settled in the area as

* Based on the currency in 2009, (UN-Habitat, 2013).

they were drawn to the area's evolving infrastructure. These companies created manufacturing clusters as companies move in. The greater ABC region has seven municipalities and 2,55 million inhabitants (Urban economics, 2016). Figure 1 shows a map of the greater ABC region.

Figure 1. The Greater ABC Region, made up of the cities of Diadema(1), São Caetano do Sul(2), Santo Andre(3), Maua(4), Ribeirao Pires(5), Rio Grande da Serra(6) and São Bernardo do Campo (7), is in the south of the metropolitan region of São Paulo. http://www.the-report.com/reports/brazil/education-in-brazil/transforming-brazils-industrial-heartland/.

1.3 Literature review

Needham and de Kam (2004) address the location of social housing in the Netherlands in 2004 and argue that the process of land acquisition for social housing is important otherwise a social housing unit may be unattractive. They measure this using three methods: the price paid for land (which could results in low quality houses), the location (closeness to schools, shops and, public transport) and, density and layout (densities which are not desirable). If one of these assumptions is not met the social housing unit may be unattractive (Needham and de Kam, 2004).

In the Journal of planning literature, Nguyen (2005) argues that land acquisition and the influence of a social housing programme on the housing market can have both negative and positive effects on the values of surrounding property prices (Nguyen, 2005). To examine this possible effect Nguyen (2005) suggests two methods: using a comparison method (comparing a neighbourhood with social housing to a neighbourhood without social housing) or using a hedonic pricing model in combination with Geographic Information System (GIS). A careful review of these hedonic price studies shows that property prices are negatively affected by nearby social housing units. Cummings and Landis (1993) argue that if property prices are genuinely affected by social housing units, the closer the units, the more negative the effect can be. Yet, their results do not acknowledge this and, thus, leave confusion that a negative relationship exists. However, in the same article Cummings and Landis (1993) concludes that the quality and design of the social housing structure is a stronger predictor of property prices than proximity to it.

Research problem

It is evident, from the review of the literature that the effect of social housing on property prices has been evaluated, but there is a need for further research. Nguyen (2005) argues that the majority of study sites are located in older cities in developed countries, it is interesting to see if similar patterns exist in Brazil, where seven percent of the urban population lives in slums. Lastly, it is interesting to examine the effect of the MHML programme differentiated by the groups, within the programme, because every group has its own income class. This could contribute to the discussion about the effect of social housing on property prices (Nguyen, 2005).

Research aim

The aim of this research is to examine the implications of the MHML programme in terms of the surrounding housing market, using a location analysis as an identification of the neighbourhoods.

1.4 Research question and sub-questions

The research question

What implications did the MHML programme have on the property prices of the surrounding regular housing market in the ABC region?

The sub-questions and methodologies

1. What does scientific literature say about the location of social housing and about the effect of a social housing programme on the housing market?

This sub-question will be answered on the basis of literature (Nguyen, 2005; Lee, Culhane, and Wachter, 1999; Preez and Sale, 2013; Cummings and Landis, 1993; Santiago, Galster, and Tatian, 2001; Galster, Tatian, and Smith; 1999). The main orientation will be on the implications of social housing programmes on the housing market. What does literature say about the effects and what is the best way to research the effect of a social housing programme on the housing market?

2. Where are the MHML developments located in relation to infrastructure, agglomerations, and amenities and how is the quality and design of the MHML developments?

This sub-question is answered by descriptive data. The research will use GIS to analyse where the MHML developments are located. This analysis shows how far the programme is from agglomerations, infrastructure and amenities. The distances per project are evaluated with the separation of the different groups and compared to the average outcomes from the GIS data. The quality and design are evaluated through empirical research and secondary sources.

3. What are the implications of the MHML programme on nearby property prices?

Another GIS analysis will be performed to show the distances (which are divided in ranges (0-100, 101-500m, 501-1000m, 1001-2000m and >2001m) from the MHML programme to the housing market. After which a hedonic pricing model is developed, the first model of the analysis is shown below:

1) $$P = \alpha + \beta 1 i.N + \beta 3X + \varepsilon$$

Where: P represents the launch price of a property (new real estate development prices), $i.N$ is a dummy variable for the neighbourhood, X are the housing characteristics (the number of floors per unit, the number of bedrooms, the number of bathrooms per unit, the number of garage per unit, the number of elevators per building, the number of blocs per developments, the usable floor space per unit, the number of units in one building and, the total area per development) and ε is the error term. In the second model a dummy variable regarding distance to a MHML development is included.

2) $$P = \alpha + \beta 1 i.N + \beta 2 i.D + \beta 3X + \varepsilon$$

$i.D$ Is the dummy variable distance. Equation three includes the distance to slums.

3) $$P = \alpha + \beta 1 i.N + \beta 2 i.D + \beta 3X + \beta 4S + \varepsilon$$

3) $$P = \alpha + \beta 1 i.N + \beta 2X + \beta 3S + \beta 4G1.D + \beta 5G2.D + \beta 6G3.D + \varepsilon$$

In model 4 the MHML developments are analysed in the three groups.

Data

The data will be a combined dataset. The data will be collected from Brazilian Company of Heritage Studies System (EMBRAESP); this is an open data source in Brazil, which shows the launch prices of new developments. The dataset contains information about launch prices during the period 1985 and 2013, organized according to the size, prices, housing characteristics, the developer, builder and location and contains, in total, 16.935 property prices. The analysis is performed for the period between 2012 and 2013 because data on the MHML developments is from 2009 – 2011, and for the ABC region, Brazil. The EMBRAESP data set therefore, after separation, contains 369 property prices. The data will be combined with data from the MHML developments in the ABC region collected from Caixa Econômica Federal (CEF). This data is from 2009 till 2011 and the data shows information about 61 project developments in the ABC region. This data contains information

regarding the developer of the MHML programme. The data informs about which of the three groups the housing units was developed for, when the development took place and where the project was developed. Thus, the implications of 60 MHML developments are measured with 369 launch prices.

Furthermore, the MHML dataset will be combined with data on amenities, infrastructure and slums. The data regarding the proximity of amenities for MHML developments is collected by a Google maps search performed by UFABC students earlier this year (assigned by professor Klink); the data regarding slums is collected from the open data source IBGE (Instituto Brasileiro de Geografia e Estatística) and the infrastructural data is collected from São Paulo Urbanismo (a department of the São Paulo government).

2. Context

2.1 Brazil

Brazil is the largest country in South and Central America; the country is known for its large amount of natural resources and is favoured due to its geographical location. Brazil has more than 7,000 km of Atlantic coast and is bordered by 11 out of the 13 countries in South America (UN Habitat, 2013).

Brazil experienced intensive urban growth during the 1950's, 1960's and 1970's when annual urbanization rates were 5,3 percent, 5,1 percent and 4,4 percent, respectively. In one generation the country transformed from an agrarian-based population into an urban society (UN Habitat, 2013). The increase of urban growth has continued over the years, as in 2010 around 85 percent of the inhabitants in Brazil lived in cities (UN Habitat, 2013).

The urbanization outpaced the development of infrastructure, basic services and housing alternatives in cities. In urbanized areas the gap between the poor and the rich is visible, as wealthier people have noticeably better access to infrastructure and housing (UN Habitat, 2013). Henceforth, areas occupied by the poor show a lack of public investment and precarious housing conditions. Historically, instead of diminishing such gaps, the urban planning practice has either neglected or contributed to the urban fragmentation and the socio-spatial exclusion of the poor in Brazil (UN Habitat, 2013).

Between 2003 and 2014 Brazil's economic and social development was lifted as 29 million people were raised out of poverty (Worldbank, 2016). During the same time span the income level of the poorest 40 percent of the population increased, on average, 7,1 percent (in real terms) as to 4,4 percent income growth for the whole population (Worldbank, 2016). Nonetheless, it shows that between 2015 and 2016 the rate of reduction of poverty and inequality has stagnated (Worldbank, 2016).

2.2 My House My Life Brazil

When the global financial crisis hit Brazil it generated market uncertainty and it slowed the construction industry (UN-Habitat, 2013). It back dropped the underlying political decision of the Brazilian government to place housing production at the core of the political agenda. However, it simultaneously stimulated a new programme: the My House My Life (MHML) programme that was designed to create new direct demand in employment-intensive sectors and improve the access to housing (Klink and Lourdes Pereira Fonseca, 2016).

The implementation of the programme depended on overcoming obstacles such as the non-engagement of the private sector in social housing, the high price of urban land, the limited capacity of municipal administrations and the bureaucracy for project approval (UN-habitat, 2013). The

programme stimulated the private sector for low-income housing production. And in order to engage the developers, the government had designed a system of subsidy relocation and housing finance. The construction sector received fiscal enticement and institutional changes to boost and speed up project approval (UN-habitat, 2013).

The MHML programme has two sub-programmes: the National Urban Housing Programme – (Programa Nacional de Habitação Urbana) and the National Rural Housing Programme – (Programa Nacional de Habitação Rural). The National Urban Housing programme has the ambition to support the production or acquisition of new housing in urban areas for families with monthly incomes up to 10 minimum wages. The Rural Programme offers subsidy and finance mechanisms for construction, acquisition or refurbishment of housing units for farmer families and rural workers with annual income of up to R $60,000 (USD 32,450*) (UN-Habitat, 2013). The scope of this research will only be on the National Urban Housing Programme. By establishing the selection at 10 minimum wages, the MHML Programme enabled an extensive coverage of income ranges, including the poorest and the middle class. The beneficiaries can be divided into three groups:

Group one comprising households with an income from zero to three minimum wages (up to R $1,395; USD 754*[2])
Group two comprising households with an income from three to six minimum wages (between R $1,395 and R $2,790; equivalent to USD 754 and USD 1,508*)
Group three includes households with an income from six up to ten minimum wages (between R $2,790 and R $4,650; equivalent to USD 1,508 and USD 2,513*).

The benefits offered by MHML can take the form of subsidies, housing financing with special interest rates, and tax exemptions. The properties within the programme have a price ceiling of R$190.000. For the poorest households, comprising group one, the subsidy is between 60 and 90 per cent of the property price - and risk of eviction in the event of default is zero. For groups two and three, the government established a guarantor fund to assure payment in case of default of subprime borrowers (Klink and Lourdes Pereira Fonseca, 2016). The programme started in April 2009 and ended in 2014 due to political and economic reasons.

Now, in 2017, there are some critical views about the programme. One of the critical views is the affordability. When adding the service costs for the condominiums, the average affordability of the MHML developments passes the range to nearly 40% of a household income. However, risk of eviction in the event of default is zero. It is noted, finally, that the commitment of income is severely

* Based on the currency in 2009, (UN-Habitat, 2013).

worrying adding the cost of water, electricity and gas (Rolnik, 2014). So, although, the 'rent' may be a fixed part of beneficiary's income, the extra costs are worrying (Rolnik, 2014).

Another critical point is the design of the programme, there is a possibility for construction companies to be fully contracted within the programme and use resources from the programme for its construction, advertising and marketing. However, at the same time, it can be marketed to families that earn more than ten minimum wages, per month or R $ 5,000.00. This is due to the inconsistencies between contracting units and financing units. Contracted units are units within the MHML programme that meet all technical requirements and maximum sales value pre-defined by the Federal Government. Housing developments are contracted within the MHML programme after analysis by qualified financial institutions (CEF). When the social houses meet all the requirements they will be contracted as MHML projects. Financed units are contracted units, which are appointed to households earning up to ten minimum times the income ranges. Thus, it is possible for a housing unit to be contracted, developed and accounted for in the MHML programme statistics however, it can be financed for another beneficiary. This beneficiary does not meet the requirements of the programme and therefore this development will not be included in the number of units financed in this current study.

2.3 The ABC region

The greater ABC Region is part of the São Paulo Metropolitan Region. Over the last decades the ABC region experienced rapid growth in population, which, for a large part is due to industrialization and a strong migration from the rural population (Arcanjo, 2016). The growth was accompanied by low investments in urban policies, which ultimately led to socially unequal cities that were surrounded by a peripheral region constituted of slums (Arcanjo, 2016).

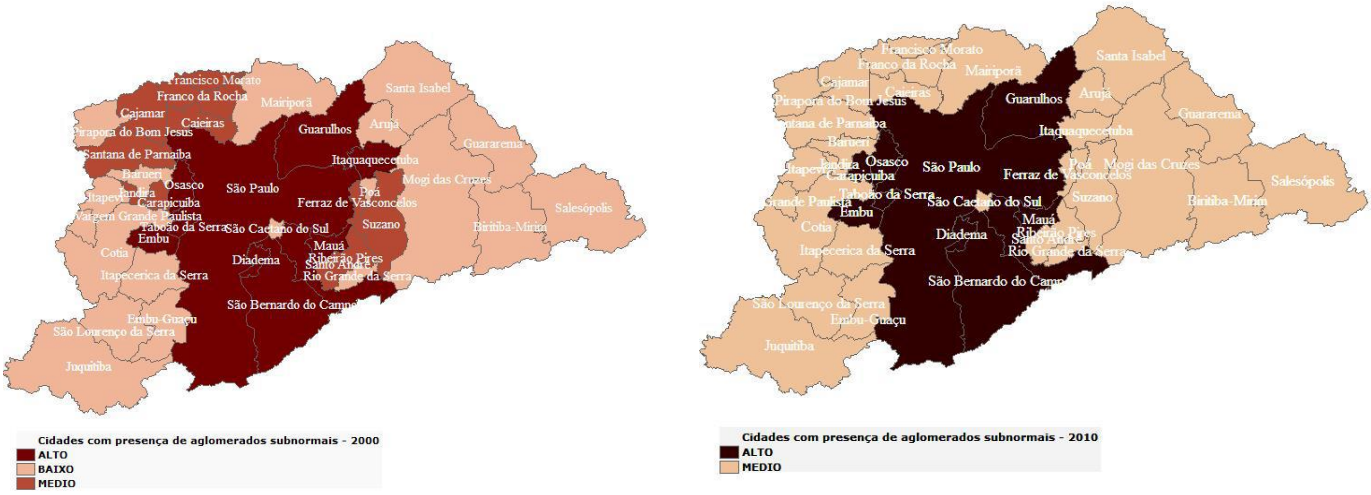

Figure 2.1 The year 2000 (left). Figure 2.2 The year 2010 (right) cities with High or very high presence of slums agglomerates metropolitan region of São Paulo (Klink and Lourdes Pereira Fonseca, 2016).

Figure 2.1 and 2.2 illustrate that, from 2000 till 2010 the presence of slums has stayed stable in the ABC region.

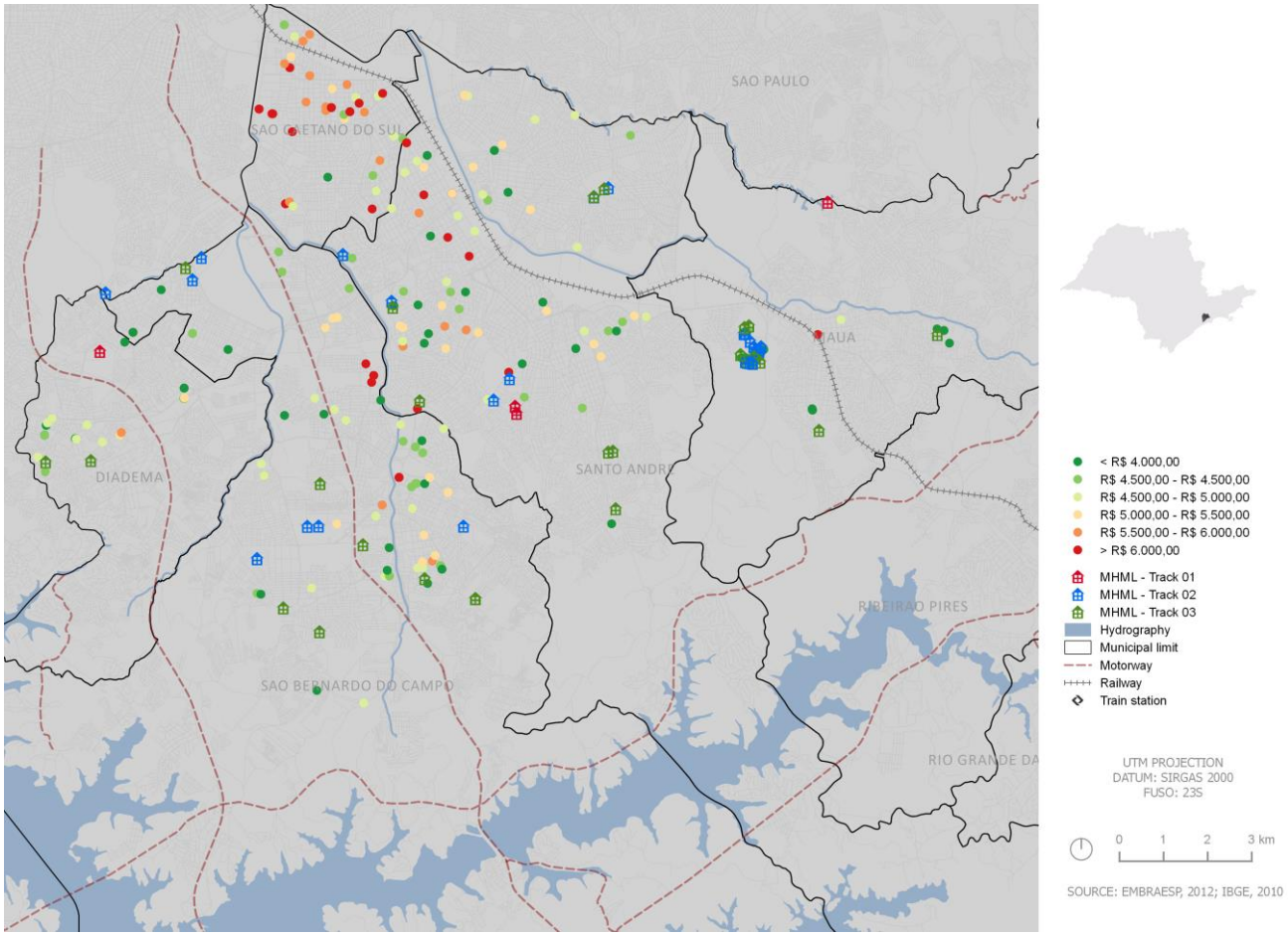

Figure 3. Real estate launch prices per square meters in reals between 2011-2013 (EMBRAESP) and MHML groups (CEF) in the ABC region, Brazil

Figure 3 shows the launch price (new real estate development prices) per square meter for the ABC region between 2011 and 2013. The data shows that in the neighbourhood of São Caetano do Sul the launch price per square meter is highest.

As a result of the increase in bank financing (Klink and Lourdes Pereira Fonseca, 2016) new players joined the real estate market. These new real estate developers, who were based outside the ABC region and were mostly large publicly held companies, increased the development in the region from a thousand units launched in 2004 to more than eleven thousand units in 2011 (Arcanjo, 2016). On the other hand, launch prices (calculated per m) rose from an average of R $ 3,000.00 in the year 2000 to R $ 4,250.00 in 2011 (Arcanjo, 2016).

2.4 The MHML programme in the ABC region

The ABC region was an interesting region for the MHML developments due to the limited availability of land (Klink and Lourdes Pereira Fonseca, 2016).

The MHML programme increased the supply of houses in the ABC region. The programme launched 19.222 units in the ABC region. The year 2012 was the most dynamic year with 5075 releases. The housing production programme exclusively concentrated on the four largest cities of the region: Santo André, São Bernardo do Campo, Diadema and Maua. São Bernardo do Campo got the biggest influx of the MHML programme with 5837 releases between 2009 and 2014. The cities of Maua, Santo André and Diadema launched respectively 5278, 4998 and 3174 units.

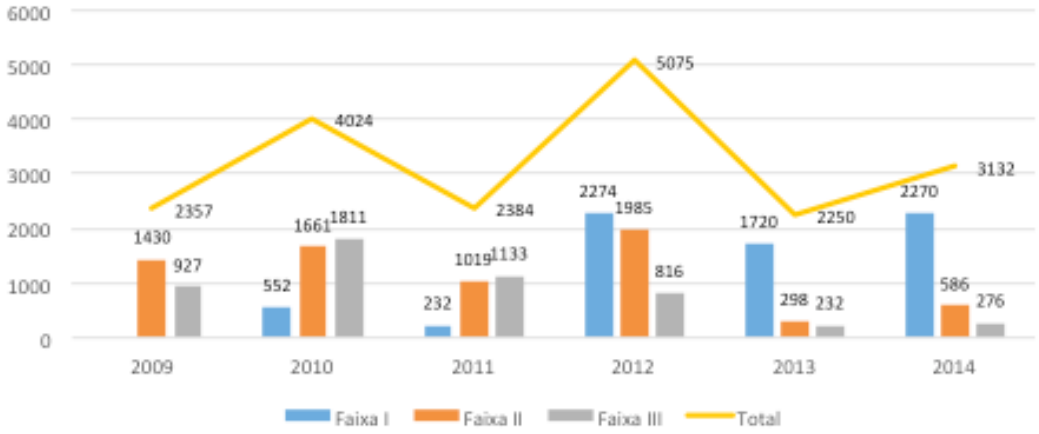

Figure 4. Developments per group in the ABC region. Faixa 1 is group one, faixa 2 is group two, faixa 3 is group three (Arjanco, 2016).

Figure 4 shows the developments per group in the ABC region. Generally, the graph illustrates that in the early years of the MHML developments group one developments were low. Two reasons can be brought forward to explain the lower rate of production. First of all, because this group involves a focused effort from the government (subsidies etc). Secondly, there is a need to register before you can apply for a house and it will adjust its supply to the registration process.

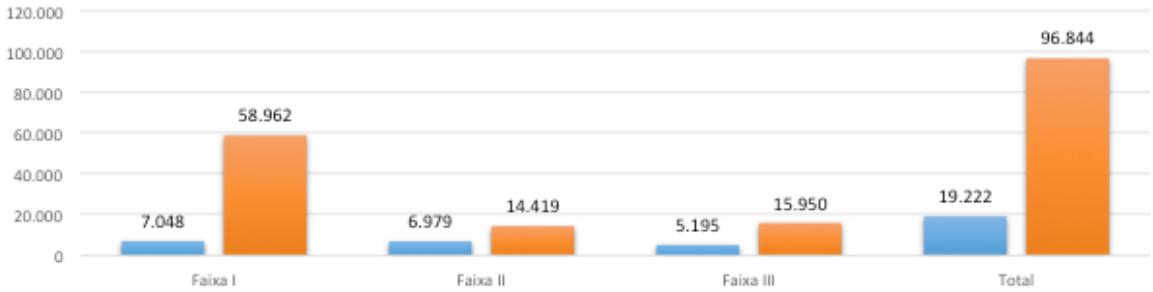

Figure 5. Deficit versus MHML developments, ABC region (Klink and Lourdes Pereira Fonseca, 2016)

Figure 5 illustrates the compliance of the program to reduce the housing deficit in the region. Although the highest absolute number of units produced is in group one, its share in reducing the deficit is relatively small (7048 to 58.962, which is 11.95%). Therefore, the contribution of the programme for the lowest income group (group one) is relatively low, while the MHML contribution is relatively high in groups two and three (a production of 6979 units for a shortfall of 14.419 within group two and 5,195 units in group three with a 15.950 deficit).

From its start until its end in 2014, the MHML programme realised 2,75 million housing units of which 1,5 million were made in groups two and three. However, housing units could be launched within the MHML, but were eventually funded to borrowers outside the programme. In the ABC region, the contracting of units totalled 12.174 in group one and two, distributed in 86 projects between 2009 and 2014. However, when analysing the disbursement of resources, Klink and Lourdes Pereira Fonseca, (2016) verified that only 6.148 units, or 50,50%, were financed to the beneficiaries with income levels up to ten minimum income wages..

3. Literature review

This chapter will answer the sub-question, w*hat does scientific literature says about the location of social housing and about the effect of a social housing programme on the housing market?*

3.1 Understanding how land is acquired

Rolnik (2014) shows that in the two metropolitan areas (São Paulo and Campinas), the cost of land has forced the developments of the MHML programme to move to deprived locations, or occasionally, to locations with problematic infrastructure and difficult access to trade and services. How this happened, can better be understood by the social housing supply process. Needham and de Kam (2004) wrote about this process and argue that social housing cannot be built without land. Needham and de Kam (2004) argue that land should be purchased in a manner that does not result in low quality housing or poor locations. They suggest that there is a clear reason for the difficulties regarding land acquisition: considering the sale price paid in relation to the construction costs, the providers can afford very little for land. If the providers of social housing are in competition with other land buyers, they will get either no land or only the land that others do not want, or land under unattractive conditions. This is the reason why public sectors often support the providers in acquiring building land.

Needham and de Kam (2004) show three ways why land acquisition is important:

1. Price: it is desirable that the developer should not have to pay a high price for the land because the quality of the construction may otherwise decline.
2. Location: the housing area has a particular location with respect to schools, shops, open space, public transport, etc. It is desirable that the weak economic position of the developer in the land market does not result in social housing being built in unattractive locations.
3. Density and layout: also necessary is that the weak economic position of the developer in the land market does not lead to social housing being built at densities which are higher than the developer thinks are desirable, on plots which are too small, or high-rise developments where no-one wants to live.

If the developer cannot acquire building land that meets the three quality standards, then beneficiaries of the social housing may find the dwellings unattractive.

3.2 The influence of social housing on the housing market

There has been a surge of studies on the topic of how social housing relates to property prices (Nguyen, 2005; Preez and Sale, 2013). Partly, this is due to the desire of social housing supporters and

scholars to counter claim the argument that social housing will decline property prices, but also because there is more data available.

There are two main methodologies in the literature that are being used in testing the effect of proximity to social housing projects. One methodological approach is to locate neighbourhoods that contain social housing units and compare these with neighbourhoods with the similar characteristics, but which do not have social housing units. The next step is then to compare the property prices in neighbourhoods that do contain social housing with those neighbourhoods that do not contain social housing. Despite the fact that there are a variety of different social housing types examined, all studies using this approach suggest that there is either no statistic significant difference in property prices between the test and control area or that social housing has a positive effect on nearby property prices (Nguyen, 2005).

The second methodological approach is to examine the influence of social housing on nearby property prices by the use of a hedonic pricing model. A review of these hedonic price studies points towards the conclusion that property prices can negatively be affected by nearby located social housing units. Galster and Tatian (1998), examined the effect of social housing units on nearby property prices in Baltimore County (United States of America) at varying proximities. The authors found that within a 500-foot ring of the housing market, lower concentrations of social housing units are associated with positive effects on property prices. However, larger concentrations of units, either within 500, 1,000, or 2,000 feet of the housing market and particularly within the 500-foot, are associated with negative effects on property prices.

Nguyen (2005) argues that the majority of study sites are located in older cities in developed countries. Preez and Sale (2013) is the only relevant study that examined the effect of social housing in a least developed country. They evaluated a project in South Africa, argued that there is a negative effect between social housing and property prices. They studied 170 single-family houses, using the proximity as a function. Their results show a negative effect between the social houses in the Nelson Mandela Bay and the property prices of single-family houses.

However, there are several actions that social housing suppliers can take to reduce the probability that nearby property prices fall. One way to reduce this is suggested by Cummings and Landis (1993), as they argue that the quality and design of the social housing structure is a better predictor of property prices than proximity is. Cummings and Landis (1993) show that if property prices are genuinely affected by the social housing units, the closer the units are the more the negative effect can be. Yet, their results do not acknowledge this and thus leave confusion to whether a negative relationship between social housing and property prices exists.

Simultaneously, there is research that discusses the possibility for social housing to actually increase property prices in neighbourhoods. For example in areas that contain deserted, neglected or physically deteriorating properties. Santiago et al., (2001) studied rehabilitated social housing in Denver, United States of America. The chosen sites for the rehabilitation were more likely to be located in degrading areas. By rehabilitating these houses, property prices significantly increased due to the difference between the quality of the rehabilitated housing and the existing housing in the neighbourhood.

Lee et al., (1999) argue that the compatibility of a social housing unit with the host neighbourhood may also have an effect on property prices. Their study, on a multitude of different social housing programs in Philadelphia (United States of America), found that a thirty five percent decline of property prices could be present when social housing was located in suburban versus urban neighbourhoods. If there are large differences in property prices between social housing and neighbouring houses, it could negatively affect surrounding property prices.

3.3 The determinants of property prices

Other relevant factors, or characteristics, should be determined to perform the hedonic pricing model. These characteristics, to determine the property prices, normally include structural, environmental and neighbourhood characteristics. The ideal hedonic pricing model features all housing attributes that matter to homebuyers. Unfortunately, it is almost impossible to include all attributes that are relevant to homebuyers' decisions. Figure 6 contains the top 20 characteristics used to specify hedonic pricing equations in previous studies. It furthermore presents the number of times the characteristic have been used, and the number of times its estimated coefficient has been positive, negative or insignificant (Sirmans, MacDonald, Macpherson, Zietz, 2006).

Variable	Appearances	Number of times positive	Number of times negative	Number of times insignificant
Lot size	52	45	0	7
Ln lot size	12	9	0	3
Square feet	69	62	4	3
Ln square feet	12	12	0	0
Brick	13	9	0	4
Age	78	7	63	8
Number of stories	13	4	7	2
Number of bathrooms	40	34	1	5
Number of rooms	14	10	1	3
Bedrooms	40	21	9	10
Full baths	37	31	1	5
Fireplace	57	43	3	11
Air conditioning	37	34	1	2
Basement	21	15	1	5
Garage spaces	61	48	0	13
Deck	12	10	0	2
Pool	31	27	0	4
Distance	15	5	5	5
Time on market	18	1	8	9
Time trend	13	2	3	8

Figure 6. Top 20 characteristics appearing most often in hedonic pricing model studies (Sirmans et al., 2006)

3.4 Hypothesis

Two hypotheses are drafted after the literature review. The hypotheses are still in a broad perceptive and are further expanded in the following chapters..

1. *The locations of the MHML developments, in the ABC region, have poor access to amenities.*

Needham and de Kam (2004) show the importance of location regarding amenities and infrastructure. Amenities and infrastructure are in this case the same Needham and de Kam (2004) point out; schools, shops and public transport. Poor access to amenities in the case of the ABC region, like Rolnik (2014) suggests, will be evaluated with this hypothesis.

2. *The MHML developments have negative implications on property prices*

Preez and Sale (2013) showed, in their research, that neighbouring property prices could decrease due to social housing developments. Their research took place in South - Africa, if the same effect took place in South-America will be evaluated by this hypothesis.

4 Methodology and data

This methodology section describes the approach conducted in this research. It details the strategy and explains why the strategy has been chosen. The data section describes the available data, delimitations, restrictions, the GIS data, the independent and dependent variable, and lastly the data summary.

4.1 Methodology

Chapter 3.1 and 3.2 of the literature review identified variables that could indicate the effect of social housing on the nearby housing market. These variables are shown in figure 7 and, are evaluated in this thesis. The quality and design of social housing units, suggested by Cummings and Landis (1993), can positively affect the housing market. Lee, Culhane and Wachter (1999) evaluated the compatibility. Needham and de Kam (2004) address accessibility and the importance of distance to social housing units is addressed by Galster and Tatian (1998). These earlier researches are combined in this thesis and an extra variable is included: the slums. The variable is included due to the fact that it contributes to the context of Brazil and could possibly be an unidentified factor that could influence property prices.

These variables are investigated using a mixed method. The quality, design, compatibility, accessibility and slums are evaluated by the use of a location and field research (supported by a Google maps search). After the first analysis the distance to the MHML developments and the effect of slums is being measured using a hedonic pricing model.

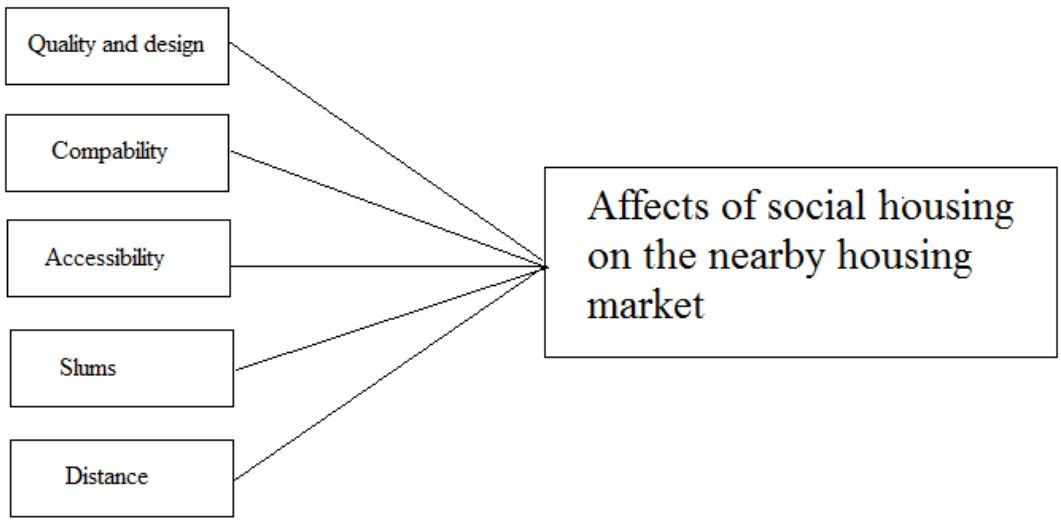

Figure 7. Variables which could indicate the effect of social housing on the housing market.

Advances in Geographic Information Systems (GIS) have enabled more sophisticated spatial analyses on how social housing relates to property prices. These sophisticated spatial analyses can better control for mediating factors that influence the relationship between social housing and nearby property prices (for example, distance to -infrastructure, -amenities, -social housing, etc.). These mediating factors are combined in a hedonic pricing model and hence give a more in-depth result of the influence of a social housing programme.

A hedonic pricing model shows what households pay for a property and it reveals the price paid for the properties' characteristics. Following Rosen (1974), a particular property is described by (1):

1) $Z^1, Z^2, Z^3, \ldots. Zn$

The Z terms are the characteristics of property Z. Furthermore; an assumption of a hedonic pricing model is the belief that homebuyers place a value on the characteristics of a house Rosen (1974). If social housing would cause a negative effect on property prices, the hedonic pricing model would capture the financial impact of locating near to a social housing unit, while controlling for other relevant factors. The hedonic pricing function, for this research is specified as:

1) $$P = \alpha + \beta 1 i.N + \beta 3X + \varepsilon$$

Where: P represents the launch price of a property (new real estate developments), $i.N$ is a dummy variable for the neighbourhood, X are the housing characteristics (the number of floors per unit, the number of bedrooms, the number of bathrooms per unit, the number of garage per unit, the number of elevators per building, the number of blocs per developments, the usable floor space per unit, the number of units in one building and, the total area per development) and ε is the error term. In the second model a dummy variable regarding distance is included.

2) $$P = \alpha + \beta 1 i.N + \beta 2 i.D + \beta 3X + \varepsilon$$

$i.D$ is the dummy variable distance. Galster and Tatian (1998) suggest the influence of ranges when analysing the effects of social housing. Therefore, the next step is to analyse the MHML developments and their proximity (in ranges) to the real estate market. The ranges are: 0-100, 101-500m, 501-1000m, 1001-2000m and >2001m.

3) $$P = \alpha + \beta 1 i.N + \beta 2 i.D + \beta 3X + \beta 4S + \varepsilon$$

Seven percent of the total urban population in Brazil (2010) lives in slums. If these slums have effect on launch prices is measured in model three.

4) $$P = \alpha + \beta 1 i.N + \beta 2X + \beta 3S + \beta 4G1.D + \beta 5G2.D + \beta 6G3.D + \varepsilon$$

Model four separates the different groups: $G1.D$ is group one and the distance to MHML developments, $G2.D$ is group two and its distance to MHML developments and $G3.D$ is group three and the distance to MHML developments.

4.2 Data

This research is performed in Brazil, where real estate data is scarce. Therefore, a collection of data on real estate launch prices is used. The data set contains information about real estate launch prices during the period 1985 and 2013, organized according to the size, prices, housing characteristics, the developer, builder and neighbourhood. However, only data between 2012 and 2013 will be used in this research due to the timeframe of MHML developments. The data is collected from information regarding real launch prices from the Brazilian Company of Heritage Studies System (EMBRAESP). The dataset from EMBRAESP contains information about the state São Paulo, but this research only focuses on the ABC region and therefore the other municipalities are deleted from the dataset. In total this results in the dataset from EMBRAESP having 369 observations and these observations will be analysed with MHML developments.

The EMBRAESP dataset only contains information about the real estate launch prices (new real estate development prices) these prices are also given as an average price. For every variable only the average values are available; garage, bedrooms, etc. This is a restriction of the dataset. An overview of the variables of the EMBRAESP data set is shown in appendix 3.

The data will be combined with data from the MHML developments in the ABC region (CEF). This data is from 2009-2014 and, the data shows information about 112 MHML developments in the ABC region. The dataset from the MHML developments (CEF) will start from 2009 till 2011: in this period 60 MHML developments are developed. This data contains information regarding the developer of the MHML programme, which group the development is constructed in and, when the development took place etc.

4.3 GIS Data

GIS Data has been collected twice: for the evaluation of the accessibility to MHML development and, for the distance from the MHML development to the 'regular' housing market. The distances are based on the distance used by Galster and Tatian (1998), which are: 0-100m, 101-500m, 501-1000m, 1001m-2000m and more than 2001. Between 2009 and 2011 there were 60 MHML developments, however the GIS data only shows the closest MHML development. It is very likely that the EMBRAESP data set will be within one or more range of distance from a few MHML, as one can see in figure 8. The GIS data chooses the shortest distance between the two analysed developments,

which gives 36 MHML developments. The GIS map is shown in figure 8. Some developments are marked over each other because they have the same address.

However, for the analysis it is desirable to have more observations and therefore another analysis is performed. This analysis is performed using the MHML developments per group as the dependent variable in GIS. Now, the GIS system looks at the closest EMBRAESP data and because these observations are fewer, almost all the MHML developments can be taken into account (appendix six shows how this works for group one developments). By doing this method 55 MHML developments can be analysed. However, these distances can only be used in their own groups and not as average values, like the 36 MHML developments previously.

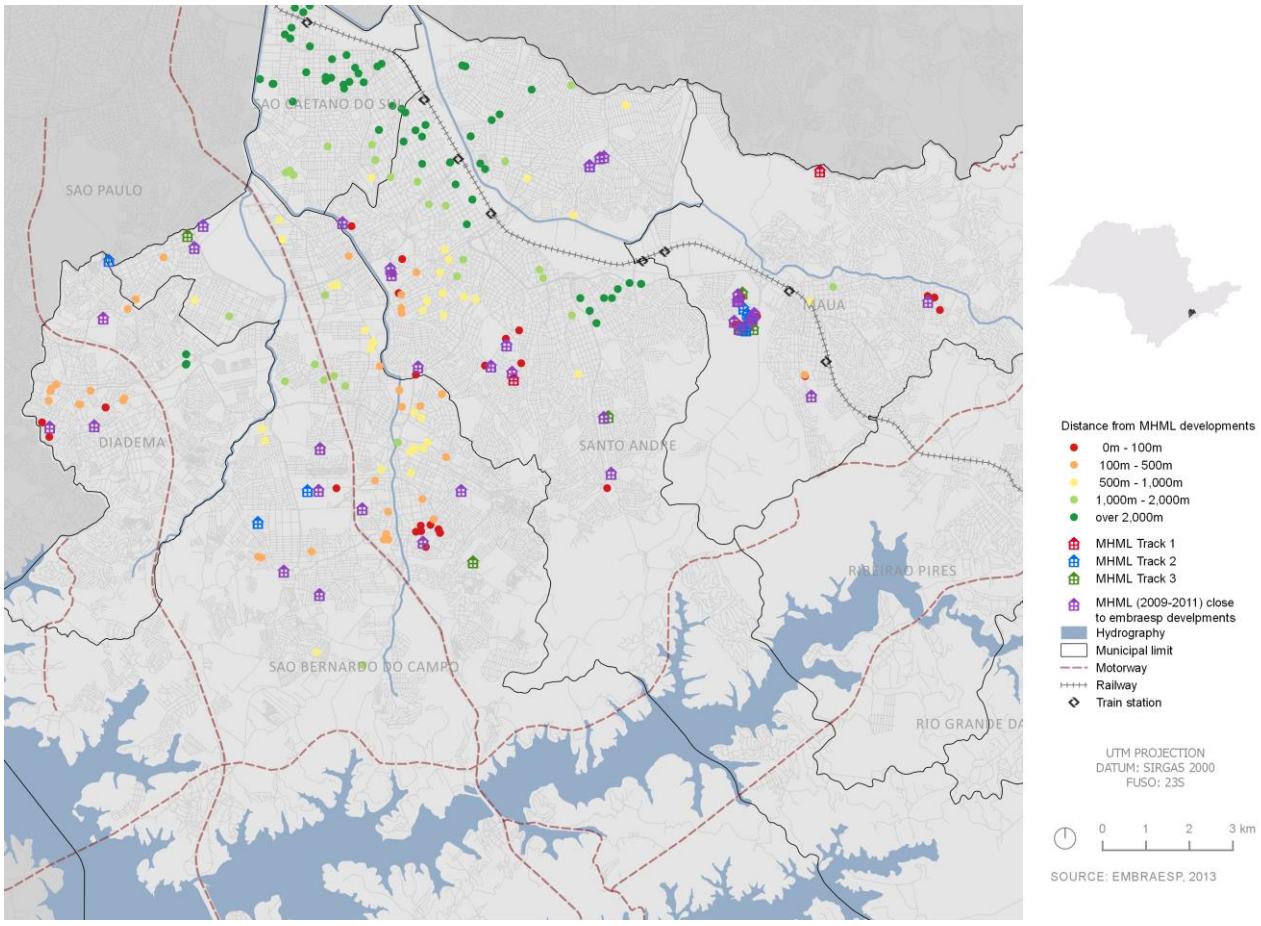

Figure 8. Distance from new developments (EMBRAESP) to social housing developments (MHML).

4.4 Dependent variable.

The dependent variable in this research is the launch price of new developments (EMBRAESP data). A histogram of the dependent variable is shown in figure 9.1 and 9.2.

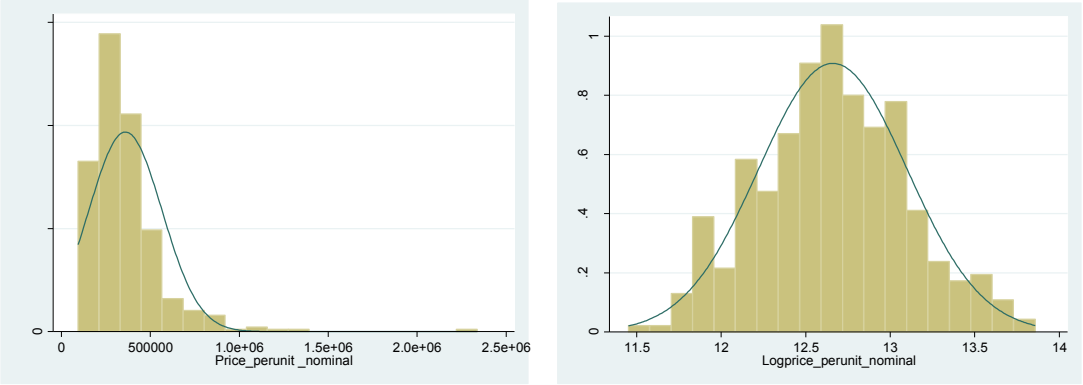

Figure 9.1 and figure 9.2 The normal distribution shown in a graph. Without a logartihm (figure 9.1) and with a logarithm (figure 9.2).

The dependent variable is not normally distributed and has a right tale (figure 9.1). Transforming the variable into the natural logarithm of the variable helps to regularize the dependent variable. Therefore, values higher than R $ 1.075.626, (the highest one percent) have been deleted and the dependent variable is transformed into a logged variable (figure 9.2).

4.5 Independent variable

The independent variables explain the dependent variable. In this research the following independent variables are used: the number of bedrooms, the number of bathrooms per unit, the number of garage per unit, the usable floor space per unit, these characteristics are observed most often in hedonic pricing models based on Sirmans et al., (2006). However, this research only contains condominiums and therefore the following characteristics are also taken into account: the number of elevators per building, the number unit per floor, the number of blocs per developments, the number of units in one building and, the total area per development. Moreover, the distance ranges to MHML developments, the different MHML developments groups, and the distance to slums are also dependent variables.

The location is analysed by the use of a dummy variable for the municipalities.

The number of units per building, the number of units per floor and the usable floor space per unit are not normally distributed and therefore these variables are transformed into logged variables. However, the number of units per floor did not have any observations in three cases and therefore these three observations were deleted from the dataset. The total number of observations is therefore 362 real estate launch prices. Furthermore, the distance to slums is also an independent variable, this variable is plotted in a GIS map. The GIS map is shown in figure 10.

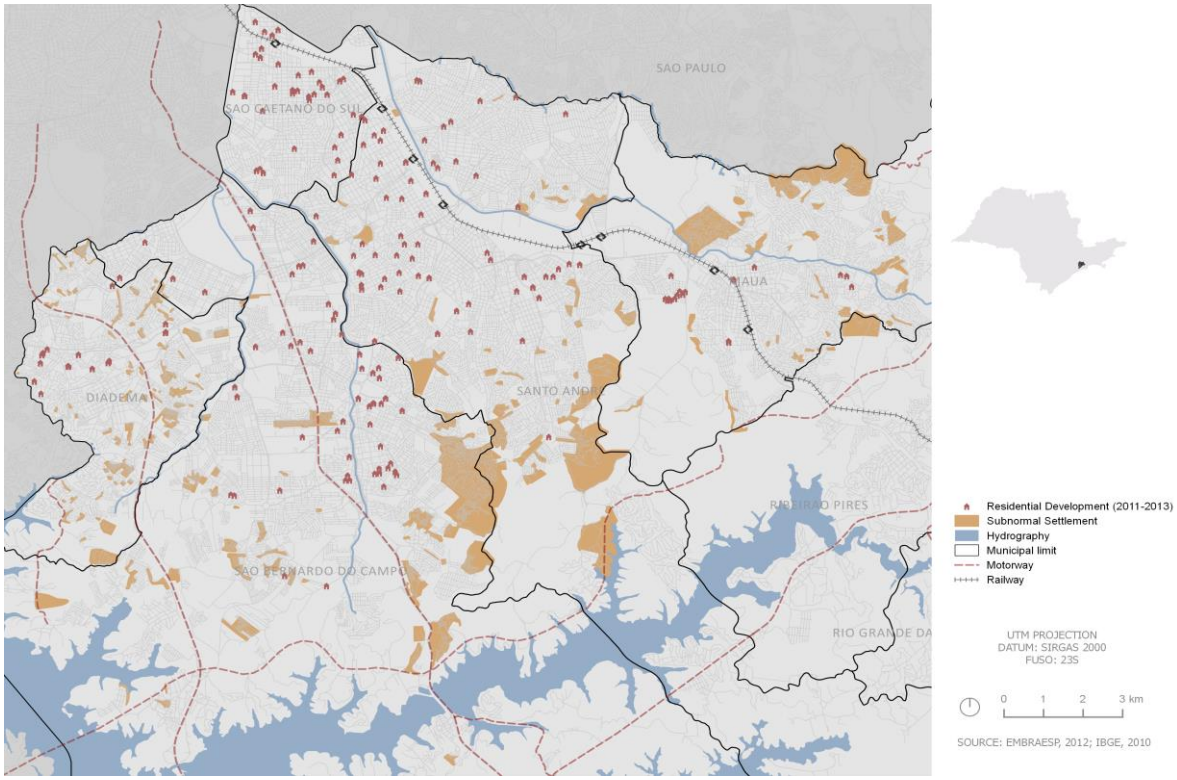

Figure 10. The proximity of slums to real estate launches (EMBRAESP).

4.6 Data summary

There are two summaries which can be shown from the data, the first one is the summary of the MHML social housing developments and their groups and, the second data summary is from the EMBRAESP data set: the houses in the neighbourhood. The variables are discussed previously.

The MHML dataset:

	Model 1 Obs	Model 2 Obs
Group one	2	4
Group two	15	25
Group three	19	26

Figure 11. Data summarized from the MHML developments collected from the dataset from CEF.

The data set from EMBRAESP:

Municipality	**Freq.**	**Percent**	**Cum.**
Diadema	45	12.43	12.43
Maua	32	8.84	21.27
Santo Andre	111	30.66	51.93
São Bernardo do Campo	97	26.8	78.73
São Caetano do Sul	77	21.27	100
Total	362	100	

Figure 12.1 The dummy variable; municipality summarized (EMBRAESP)

Variable	Obs	Mean	Std.	Min	Max
(L) Launch price	362	12.66011	0.440742	11.45105	13.85771
(L) Number of units per floor	362	6.290055	2.530996	0	20
Bedrooms	362	2.392265	0.694853	1	4
Bathrooms	362	1.718232	0.598381	1	4
Garage	362	1.447514	0.709068	0	6
Elevator	362	1.98895	1.49788	0	8
Number of blocks in the development	362	0.831492	0.738196	0	8
(L) Usable floorspace	362	4.206289	0.349286	2.923162	5.257495
(L) Total unit	362	3.935747	0.993723	0.693147	6.448889
Total area	362	9245.766	7905.475	94.62	58833
Distance to slums (meters)	362	1722.407	1230.982	43.8	5388.81

Figure 12.2 The variables used in this regression analysis (EMBRAESP and IBGE).

4.7 Model assumptions

There are four principal assumptions for performing a regression analysis:

1. Linearity of the relationship between the dependent variable and the independent variables
2. Statistical independence of the error terms
3. Homoscedasticity (constant variance of residues)
4. Normal distribution of residues

If any of these assumptions is violated the results can be inefficient, biased or misleading.

The analysis is performed including estimating the standard errors using the robust Huber-White sandwich estimators. With the robust option, the point estimates of the coefficients are exactly the same as in Ordinary Least Squares (OLS), but the standard errors take into account issues concerning heterogeneity and lack of a normal distribution.

Multicollinearity may be a property of predictor variables, which reduces the validity of the model. Whether multicollinearity occurs in OLS regressions can be checked using the variance inflation factor (VIF). After each regression the VIF estimator is performed, the results can be found in appendix 4. The highest VIF is shown for the usable floor space per unit for all model estimates and the number of elevators is second, but because these are control variables, and not a variables of interest they can stay in the model. Moreover, no variable exceeded the value of 10 and therefore, all the variables can stay in the model.

The linearity in the parameters is measured by a scatterplot, this plot is shown appendix 5. The regression model is linear if the residues adopt a random shape. The negative and positive residues are substantially balanced around the zero line of the plot. This study, therefore, meets the assumption of linearity.

5 Results

In this chapter two sub-questions will be answered: *Where are the MHML developments located in relation to infrastructure, agglomerations, and amenities and how is the quality and design of the MHML developments? And, what are the implications of the MHML programme on nearby property prices*?

5.1 Location analysis

The quality, design, compatibility, accessibility, and slums are evaluated through empirical research and secondary sources. The accessibility to MHML developments and proximity of the developments to slums is first analysed after which the quality, design, and compatibility are evaluated.

Observations

Before starting with the identified variables, a first observation is drafted from the researchers own experience. Previously to the MHML development, the area in Maua (map 14, the cluster in Maua) was deserted. However, due to the new MHML developments, a primary school was developed and a sport field for the children was created.

Accessibility and slums

The quality of accessibility to amenities and infrastructure in the ABC region, like Rolnik (2014) suggests, will be tested with a GIS analysis and some quantitative comparisons. The same will be done for the proximity of slums. The means and standard deviations of the variables will be used to support the GIS analysis and are shown in figure 13.

Slums

Figure 14 shows how far MHML developments are located from slums. The first observation is that the map shows a large amount of slums and that these slums are scattered across the ABC region. The table shows us that the farthest slum is located 1531 meters from a MHML development, and this MHML development is developed in group two. The closest abnormal agglomeration is 191 meters and is also developed in group two. The average distance of a slum to a MHML development is 779m.

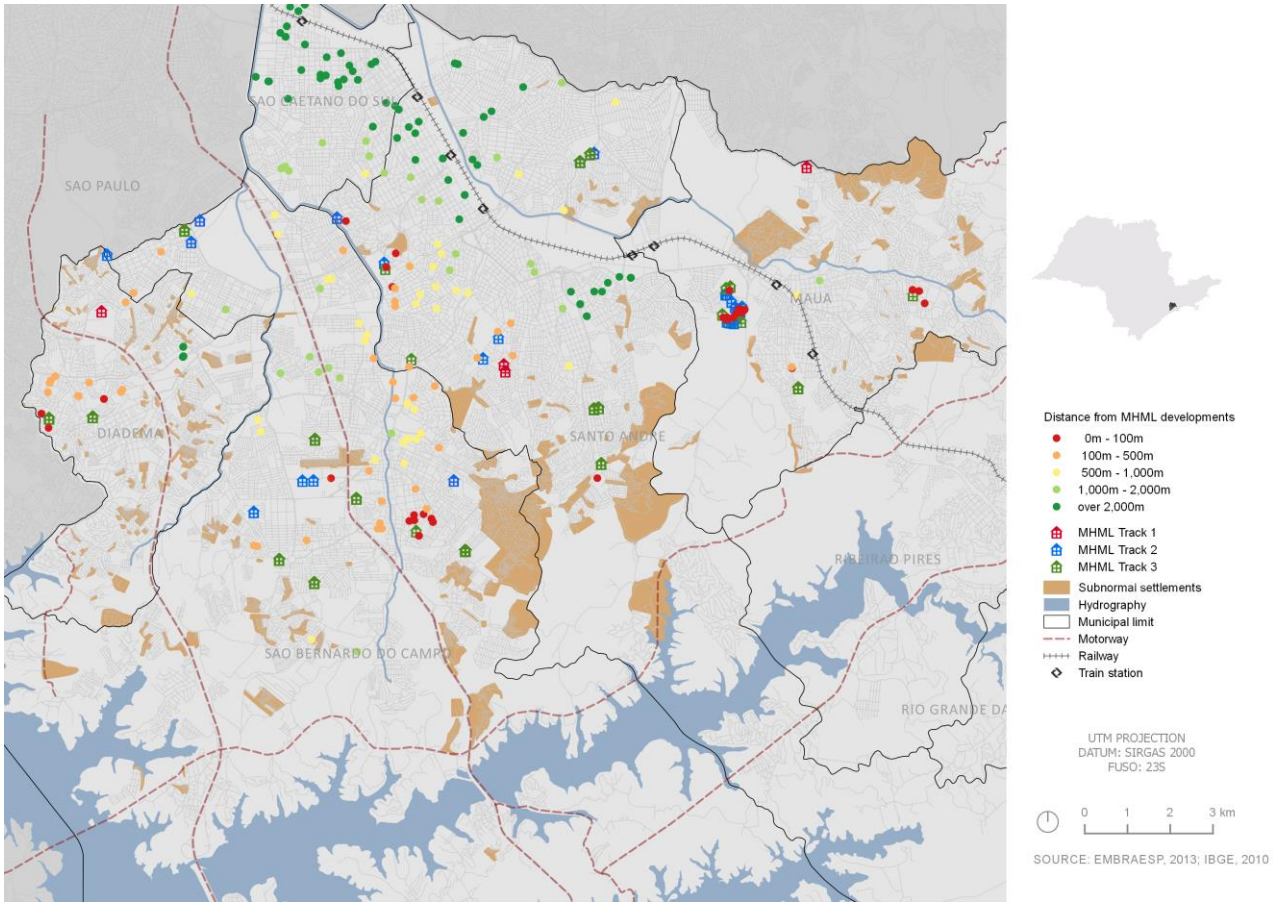

Figure 14. Slums, MHML developments and real estate launches .

	Total			Group one			Group two			Group three		
Variable	Obs	Mean	Std.	Obs	Mean	Std.	Obs	Mean	Std.	Obs	Mean	Std.
Slums	60	779	282	4	653	212	27	792	291	29	784	285
Infrastructure												
Bus terminal	60	3771	1664	4	3079	893	27	3991	1393	29	3661	1955
Train station	60	4025	2819	4	4670	2437	27	3387	2715	29	4530	2924
Amenities												
Centre	60	1177	886	4	1525	287	27	1314	914	29	1001	896
Hospital	60	1964	815	4	1950	574	27	1959	902	29	1970	781
Crèche	60	1013	418	4	1455	510	27	1088	405	29	881	370
Primary school	60	389	217	4	449	417	27	441	187	29	332	203
Museum	60	2952	1449	4	3551	2013	27	2849	1281	29	2966	1551
High school	60	830	538	4	460	411	27	1051	490	29	675	526
Shopping centre	60	2162	968	4	2190	291	27	2258	906	29	2069	1089
Park	60	3422	2395	4	4207	2690	27	2902	2176	29	3798	2533
Theatre	60	1756	1014	4	2399	649	27	1567	839	29	1842	1169

Figure 13. Average distance in total and per group to infrastructure, amenities and slums

Amenities

Figure 15 contains the amenities for the MHML developments. There are nine amenities reviewed; the most notable ones are being discussed. Figure 13 shows that distances to amenities are comparable with each other and there is no notable difference between the groups. However, looking at the distance between the city centre and the different groups reveals that group two and three both are located further from city centres (2800m), group one is closest (1300m). The average distance to city centres is 1177m.

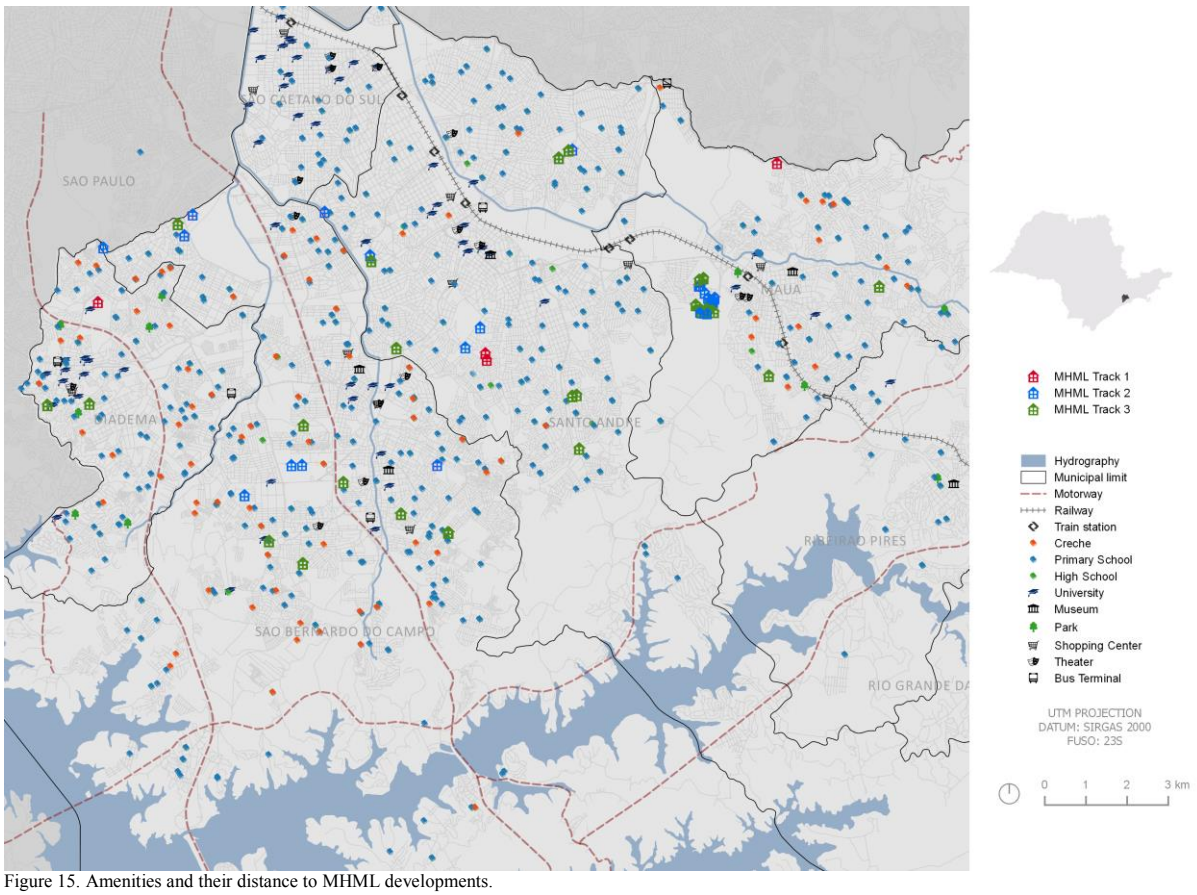

Figure 15. Amenities and their distance to MHML developments.

Infrastructure

The last map illustrates the infrastructure in the region (figure 16). The map shows one railway in the ABC region. The average distance to the train station is 4025 meter. The closets MHML development is 857 (group three) from the train station (appendix 1); the farthest is 9653m (group three). The closest bus terminal is 750m (group three) and the farthest bus terminal is 7545m (group three). The maximum and minimum values are only observed in group three developments, this may be because this group has the most observations. Only the bus terminals are included in this analysis, not bus stops, note that there is a difference between a bus stop and a bus terminal. Data on bus stops was not available at the time of this research.

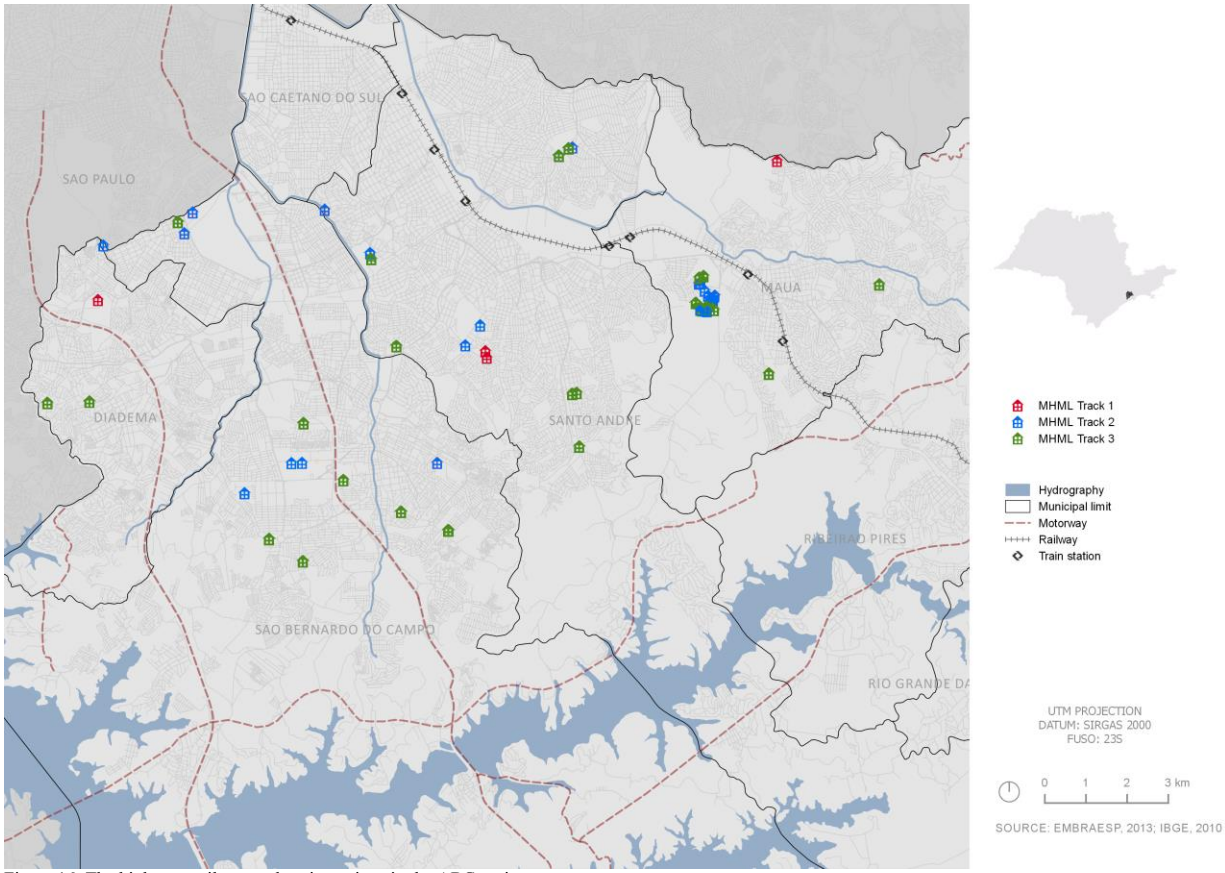

Figure 16. The highway, railway and, train stations in the ABC region.

The first part of the location analysis shows that the results from this research are comparable with the results from Klink and Lourdes Pereira Fonseca (2016). They argued that the MHML developments, in the ABC region, did not show poor access.

Quality, design and compatibility.

Appendix 2 illustrates the quality and design of two group one developments, three group two developments and three group three developments, a small review is shown in figure 17. The field research showed that the design of group two and group three, in comparison to the host neighbourhood, is good. The quality of the buildings is also good, when compared to other buildings in the street. However, looking at the design and quality of group one shows that there is a big difference between group one and group two and three. Group one developments have been quickly deteriorated, as condominiums already showed signs of cracks in the construction. Moreover, the design of the group one condominiums is notably different from its surroundings; the condominiums have different and bright colours. However, one should keep in mind that only two group one developments are evaluated in this field research.

The compatibility of the MHML developments differs per development and per group. The MHML developments are developed in different places. Lee, Culhane and Wachter (1999) showed that the

compatibility of housing is of importance. It is difficult to interpret compatibility because it differs per development.

Group one

Address: R JUQUIA, 1200, Santo André

Group two

Address: R ZUMBI DOS PALMARES, 55, MAUA

Group three

Address: Rua Inocêncio Pedro, 63, Pq. São Vicente, Mauá/SP

Figure 17. Pictures of the MHML developments, conducted through a googlemaps search and field research.

Conclusion

The earlier hypothesis: *the MHML developments have a negative effect on property prices*, is further expanded and adjusted into two new hypotheses (due to the new information):

1. *Group one has a negative effect on surrounding regular market real estate prices*

The location analysis shows that there is a difference between groups of the MHML programme. The hypothesis will analyse if the earlier stated suggestions and conclusion are correct.

2. *Group two and three have a positive effect on surrounding regular market real estate prices*

The location analysis identifies that group two and three may have a positive effect on the nearby real estate prices. The correctness will be analysed in this hypothesis.

5.2 Regression analysis

The regression analysis is performed by a combined dataset, there are 362 real estate developments with 36 and 55 MHML developments to analyse, as discussed in chapter four.

The results from the regression analysis are shown in the regression results. Model (1) shows the results from the logarithm of the real estate launch price. The independent variables are the different municipalities and the housing characteristics; floors per unit, bathroom, garage, blocs, elevator, usable floor space, total units of the development and the total area of the development in m . The following variables have a positive effect on real estate launch prices; bathrooms (16,8%), garage (11,1%) and elevator (6,3%), this means that if one extra bathroom would be installed the launch price would increase with 16,8%. Furthermore, if the launch price increases with 1%, usable floor space increases with 65,2%. The amount of blocs per development has a small negative effect of 6,1% and the total area of the development has a small negative effect (0,008%). The municipalities all show a significant result, the reference category for this model is São Caetano do Sul. São Caetano do Sul is the municipality with the highest real estate launch prices therefore the other municipalities now show a significant negative result.

In model (2) the distances to the MHML developments are added, due to this addition the R-squared increased with 0,0036. There is no significant effect found in this model for the distances to MHML developments.

Model (3) has one addition that is the distance of real estate launches to slums, the R-squared increased with 0,0022 due to this inclusion. The distance to slums is significant on a 95% significance level and, has a small positive effect (0,0493%) on real estate launch prices. Due to the inclusion of slums, one distance to MHML developments that is significant is the distance between 501-1000m. The results indicate that when a MHML development is developed within 501-1000m from real estate launches the real estate launch price will increase with 12% compared to the reference category (further than 2001m).

Robust		Model 1			Model 2			Model 3			Model 4		
		Coef.	P>|t|	S.E.	Coef.	P>|t|	S.E.	Coef.	P>|t|	S.E.	Coef.	P>|t|	S.E.
Diadema		-0,297	***	0,041	-0,275	***	0,053	-0,224	***	0,058	-0,287	***	0,066
Maua		-0,442	***	0,050	-0,389	***	0,073	-0,341	***	0,079	-0,277	***	0,093
Santo Andre		-0,071	**	0,032	-0,070	**	0,035	-0,027		0,041	-0,053		0,040
Sao Bernardo		-0,143	***	0,033	-0,151	***	0,045	-0,114	**	0,049	-0,123	***	0,046
Floor unit (L)		0,292	***	0,054	0,289	***	0,055	0,287	***	0,054	0,274	***	0,055
Dorm unit		0,003		0,028	-5E-05		0,028	0,003		0,028	0,007		0,029
Bath unit		0,168	***	0,033	0,164	***	0,032	0,158	***	0,032	0,158	***	0,032
Gar unit		0,111	***	0,021	0,118	***	0,021	0,121	***	0,021	0,110	***	0,022
Blocs		-0,061	***	0,022	-0,062	***	0,022	-0,063	***	0,022	-0,079	***	0,025
Elevator		0,063	***	0,019	0,065	***	0,019	0,064	***	0,019	6,55E-02	**	2,04E-02
Usable floor space (L)		0,652	***	0,121	0,653	***	0,120	0,643	***	1,19E-01	6,45E-01	***	1,22E-01
Total unit (L)		0,002		1,71E-02	0,003		1,74E-02	0,001		1,74E-02	6,99E-03		1,77E-02
Total area		-7,54E-06	***	2,75E-06	-8E-06	***	2,84E-06	-7,61E-06	***	2,84E-06	-7,29E-06	**	2,88E-06
Average distance MHML													
	1				-0,058		0,048	0,060		0,072			
	2				-0,012		0,038	0,082		0,060			
	3				0,046		0,039	0,120	**	0,054			
	4				0,021		0,042	0,087		0,057			
Distance to slums								4,93E-05	**	2,46E-05	1,22E-05		2,23E-05
Group1													
	2										-0,198	***	0,068
	3										-0,083		0,075
	4										0,089	*	0,053
Group2													
	1										-0,213	**	0,085
	2										-0,039		0,093
	3										0,006		0,059
	4										-0,035		0,037
Group3													
	1										-0,024		0,087
	2										0,018		0,061
	3										-0,008		0,047
	4										0,048		0,043
Constant		8,774	***	0,465	9,066	***	0,466	8,941	***	0,477	9,091	***	0,484
R-squared		0,8068			0,8104			0,8126			0,8179		
N		362			362			362			362		

Regression results. ***=99%significance level, **=95% significance level, *=90% significance level. The reference category is Sao Caetano and distance to MHML developments 5 (>2001m).

In model (4) the distance to the MHML developments has been categorized per group. Using this method gives 55 MHML developments and 362 EMBRAESP observations. The methodology is explained in chapter 4. For every distance, the reference group is number five (further than 2001m). The results show that when one separates the groups there is a difference in the effect on the real estate launch prices. For group one there is no observation for the distance between 0-100m (number one). The distance between 101-500m has a negative effect on launch prices, compared to the distance further than 2001m, with 19,8%. For the distance between 501-1000m no statistic significant difference is found and last, the distance between 1001-2000m has a positive effect on launch prices compared to the launch prices which are located further than 2001m from MHML developments. For group one developments only four observations are analysed and therefore it is difficult to interpret these results statistically.

Model (4) shows one other significant distance; the developments between 0-100m for group two. This distance has a negative effect on launch prices of 21,3% compared to developments located further than 2001m from MHML developments. A statistical significant difference for the other distances is not found. The R-squared for this model is 81,79%, which is the highest R-squared found from this analysis. Although the R-squared implies to explain more, this model also has a lot of unknowns and uncertainties.

Ellen et al., (2007) witnessed a negative effect of the construction of social housing in New York City. Model (4) shows that group one developments (distance 101-500m and 501-1000m) and group two developments, between a 0-100m from a MHML development, have a negative effect on launch prices. Galster and Tatian (1998) argued that varying proximities influence the effect of social housing units on property prices, which is comparable with the results from model (4).

Dorms per unit are insignificant in this model. In the 20 characteristics of Sirmans et al., (2006) the variable bedrooms appeared 25% of the time insignificant; this research is comparable with those 25%.

Nguyen (2006) argues that few studies have examined the impact of social housing programmes differentiated by type of developments within a social housing programme. When differentiating the types of MHML developments in model (4) some distances are significant and show differing effects.

6 Conclusion and discussion

This chapter answers the research question: *What implications did the MHML programme have on the property prices of the surrounding regular housing market in the ABC region?*
First the discussion of the research is shown, after which a conclusion will be presented, then a reflection will be shown and at last some recommendations will be discussed.

Keeping in mind that there are a lot of restrictions on the data. The results indicate that, in general, there appears to be no statistical significant difference due to the implications of the MHML developments on nearby property prices.

The MHML programme was created to tackle the problems of urbanization in Brazil; the programme was confronted with some early criticism. Architect Luciana Correa de Lago, argued that MHML developments often led to social housing units of poor quality on cheap land, far from city centres and without proper transportation (Rio Times, 2011). This research evaluated if this was true for the distances to amenities: the first hypothesis: *the location of the MHML developments, in the ABC region, have poor access to amenities* is rejected and the alternative hypothesis is accepted. This result is comparable with the result from Klink and Lourdes Pereira Fonseca,(2016) they argued that the MHML developments, in the ABC region, did not show poor access to amenities suggested by Rolnik (2014).

The negative effect, of the construction of social housing like Ellen et al., (2007) witnessed in New York City, is difficult to answer in this research. Therefore, hypothesis three; *group one has a negative effect on surrounding regular market real estate prices'* cannot be rejected and the alternative hypothesis cannot be accepted.

On average, the MHML developments did not show a significant effect on property prices, which answers the second hypothesis drafted: '*there is a negative effect on property prices due to the MHML developments'*. Therefore, a rejection of the null hypothesis fails and the alternative hypothesis cannot be accepted. This is comparable with the literature, which says that there are many ways to reduce the negative effect of social housing construction; for instance by developing social housing units which are compatible within the neighbourhood, with good quality and design or through rehabilitation (Lee, Culhane, and Wachter, 1999; Cummings and Landis, 1993; Santiago, Galster, and Tatian, 2001; Galster, Tatian, and Smith; 1999;). The last hypothesis drafted: '*group two and three have a positive effect on surrounding regular market real estate prices'* is rejected and the alternative hypothesis is accepted. Group two has a negative effect on property prices within 0-100 meter. The other distances in group two and three did not show a statistical significant difference due to the implications of the

MHML programme. An interpretation of why these distances are not significant is difficult, which implies (again) that the data on real estate launch prices is not the right data for this topic.

One of the findings of this research is that there are a lot of slums, like the introduction said '*seven percent of the total urban population in Brazil (2010) lives in slums'*. During the research I could see that a new slum developed nearby MHML development group one. This was an interesting discovery because the slum was developed after the establishment of the MHML development.

Nguyen (2006) argues that few studies have examined the effect of social housing programmes differentiated by type of developments within a social housing programme. This research can contribute to this discussion, the models in this research show that when the groups are combined there is no effect but when they are separated there is a difference on the effect on the housing market. However one may argue that MHML developments are not social housing developments

Furthermore, it is unknown why the distance to slums has a small positive effect (0,0493% model 3) in the regression analysis. If the data regarding sale prices would have been available, it could have changed the research and contributed to the literature regarding the effect of social housing on property prices. Furthermore, looking at the data and the other literature (Lee, Culhane, and Wachter, 1999; Cummings and Landis, 1993; Santiago, Galster, and Tatian, 2001; Galster, Tatian, and Smith; 1999; Preez and Sale, 2013) a lot of restrictions are found that are not appear in the other literature. In this research numerous variables are not significant, the possibility exists that the data is just not good.

One of the results of the location analysis was that slums were, on average, located 815m from social housing developments. However, I could not find a research regarding social housing and slums; therefore an interpretation regarding this result is difficult. My own experience is that 815m to a slum are close.

Last, as previously suggested this research has a lot of 'flaws' due to the scarcity of the data. If, in 10 or 20 years, the data about real estate sale prices is more substantial, a similar research could be performed again and may then lead to conclusion that are more substantiated results and conclusions.

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Appendices

Appendix 1. Table of distance per group

	Group one					Group two				
Variable	Obs	Mean	Std.	Min	Max	Obs	Mean	Std.	Min	Max
dist_centr	4	1525	287.2281	1300	1900	27	1314.444	913.9531	150	2800
dist_hosp	4	1950	574.4563	1600	2800	27	1959.481	902.4158	500	5000
trainstati	4	4670.25	2437.483	2869	8269	27	3387.148	2715.275	951	8922
creche	4	1455	509.6437	877	1889	27	1088.111	405.4536	346	1980
elemschool	4	449.25	417.1557	103	986	27	440.5926	187.4731	77	733
museum	4	3550.75	2012.517	2395	6564	27	2848.556	1281.206	1187	6902
highschool	4	459.75	411.0048	103	986	27	1051.333	490.0523	136	1647
shopcentre	4	2190	291.0796	1886	2555	27	2258.444	906.4393	1271	3944
park	4	4206.5	2690.137	1077	6459	27	2902.111	2176.087	825	7655
theatre	4	2399	649.3284	2023	3367	27	1567.333	839.4818	619	3498
bustermina	4	3079	892.5204	1764	3706	27	3991.074	1392.912	2077	5686
favela	4	652.75	211.7851	376	883	27	791.8889	291.229	191	1531

	Group three					Total				
Variable	Obs	Mean	Std.	Min	Max	Obs	Mean	Std.	Min	Max
dist_centr	29	1001.379	896.0722	0	2800	60	1177.167	886.2121	0	2800
dist_hosp	29	1970.414	780.8104	500	3600	60	1964.133	815.4894	500	5000
trainstati	29	4530.172	2924.266	857	9635	60	4025.15	2819.433	857	9635
creche	29	881.4483	369.638	344	1672	60	1012.683	418.1227	344	1980
elemschool	29	331.6552	203.3356	15	746	60	388.5167	216.8834	15	986
museum	29	2966.172	1551.11	1042	7631	60	2952.217	1449.281	1042	7631
highschool	29	674.7241	525.7677	15	1572	60	829.8667	537.7453	15	1647
shopcentre	29	2068.759	1088.503	439	4558	60	2162.2	968.1233	439	4558
park	29	3798.31	2533.17	357	7794	60	3422.233	2394.805	357	7794
theatre	29	1842	1168.592	489	4579	60	1755.533	1013.922	489	4579
bustermina	29	3661.103	1954.883	750	7545	60	3770.783	1664.242	750	7545
favela	29	783.5862	285.4337	417	1449	60	778.6	281.9364	191	1531

Appendix 2. Group pictures

Group one
Address: R GEMA, 131, DIADEMA

The condominium:

Area around:

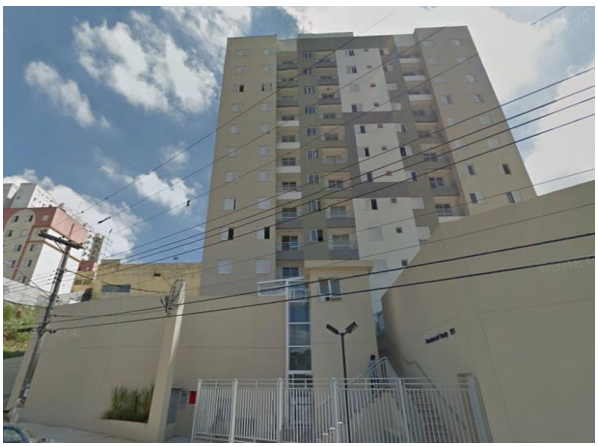
Group one
Address: R JUQUIA, 1200, Santo André

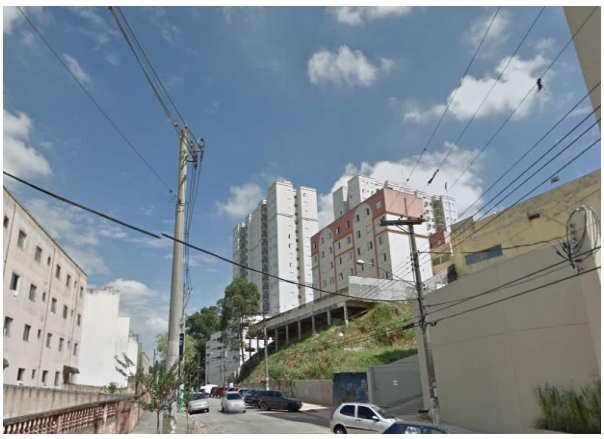
Group two
Address: R ZUMBI DOS PALMARES, 55, MAUA

Group two
Address: R JORGE BERETTA, 282, SANTO ANDRE

Group two
Address, AV WALLACE SIMONSEN, 1450, 763, SÃO BERNARDO DO CAMPO

Group three
Address: R MARTIM AFONSO, 191, Diadema





Group three
Address: R QUATA, 641, Santo André

Group three
Address: R BRASILIO MACHADO, 424, SÃO BERNARDO DO CAMPO

Group three
Address: Rua Inocêncio Pedro, 63, Pq. São Vicente, Mauá/SP

Appendix 3. Dataset EMBRAESP.

Variável	Leitura da Variável	Descrição
Type_development	Type of Development	Horizontal refers to the house type. Vertical refers to the building type.
Rel_date	Release Date	Date the business was launched
Rel_Year	Release Year	Year the project was launched
Del_Date	Delivery date	Date the business was delivered or delivery forecast
Municipality	Municipality	Municipality of the development
Address	Address	Full address of the development, containing the street and number
num	Number	Plot number on the street
Zipcode_compleet	Zipcode complete	Zipcode complete
Zipcode _4	Zipcode 4 number	Zipcode used for georeferences
Name_dev	Name of the development	Name of the development
Dorm_unit	Number of bedrooms per unit	Number of bedrooms per unit
Bath_unit	Bathrooms per unit	Number of bathrooms per unit
Gar_unit	Parking spaces per unit	Number of parking spaces per unit
Elev	Lifts per launch complex	Number of lifts per launch
Blocs	Blocs in the development	Number of blocks in the development
Floor_unit	Number of units per floor	Number of units per floor
Floors_building	Floors	Number of floors of the development
Us_floor_unit	Unit floor area	Usable floor area in m
Tot_unit	Total Unit Area	Total unit area in m
Tot_land	Total land area	Total plot area in
Total_unit	Total of the units of the development	Total of the units of the development
dorm_Complex	Total of dormitories of the development	Total of dormitories of the development
banh_Complex	Total bathrooms of the development	Total bathrooms of the development
Gar_Complex	Total vacancies of the enterprise	Total vacancies of the enterprise
Use_area	Total area of the development	Total useful area of the development in m
Tot_area	Total total area of the development	Total of total area of the development in m
Price_perunit_nominal	Unit selling price	Unit price (in R $) in par value at the time of launch
Price_persquaremeter_nominal	Price per m of unit floor area	Price per square meter of floor space (in R $) in nominal value at launch time
Price_unit_real	Unit selling price – updated	Price per unit (in R $) in December 2013 values by IGP-DI
Price_m2_real	Price per m2 floor area of the unit – updated	Price per square meter of the total area of the unit (in R $) in December 2013 values by IGP-DI
Tot_salepricedevelopment_real	Total sale price of the development	Total sale price of the project in amounts of December 2013 by the IGP-DI
Fin	Agent	Who financed the project

Developer	developer	Name of the developer (s) responsible
Hotel	Hotel	If the development is hotel - 1 / No hotel - 0
Flat	Flat and Aparthotel	Se Flat or Aparthotel - 1 / No Flat or Aparthotel - 0
exflat	Ex-flat	It was built to be flat, but now it is an ordinary residential - 1/0
renresp10	Average Income of the Responsible Person in 2010	Average Income in 2010 of the Heads of Household with and without income in the Area of Weighting where the enterprise is.
DIST_MHML	Distance from the MHML developments	1: 0-100m 2:101-500m 3:501-1000m 4:>1001m

Appendix 4. Robustness check regression

Checking collinearity:

Model1		
Variable	VIF	1/VIF
Log_us_flo~t	7.63	0.131031
elev	6.23	0.16061
tot_area	5.93	0.16867
Log_total_~t	3.73	0.268034
dorm_unit	3.41	0.293423
gar_unit	2.92	0.342574
bath_unit	2.78	0.35921
Sao_bernardo	2.59	0.386438
Santo_andre	2.58	0.388149
Logfloor_u~t	2.56	0.390533
Sao_Caetano	2.53	0.395091
blocs	2.43	0.411146
Maua	1.69	0.592021
Mean	|	3.62

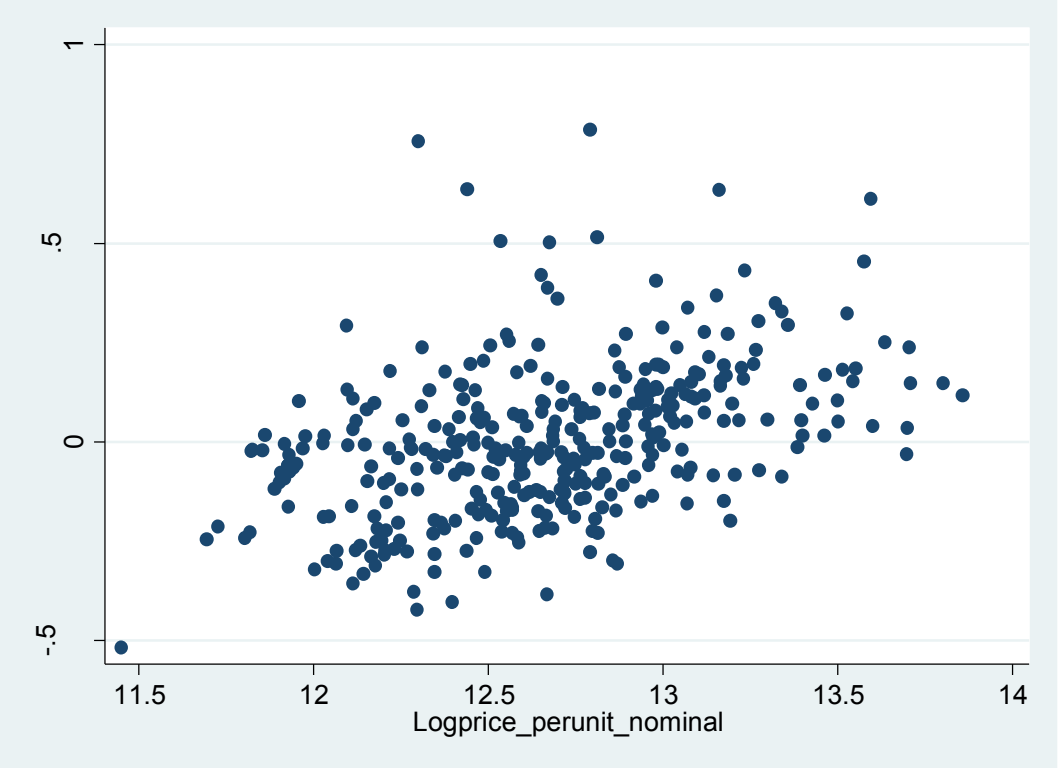
Model 2		
Variable	VIF	1/VIF
diadema	2.26	0.442531
Maua	2.75	0.364188
Santo_andre	2.25	0.443946
Sao_bernardo	3.33	0.300102
Logfloor_u~t	2.58	0.387417
dorm_unit	3.46	0.289429
bath_unit	2.82	0.355122
gar_unit	3	0.333157
blocs	2.44	0.410137
elev	6.34	0.157734
Log_us_flo~t	7.82	0.127942
Log_total_~t	3.9	0.256586
tot_area	6.11	0.163663
dist_mhml		
1	2.29	0.436221
2	2.1	0.475067
3	2.02	0.496249
4	1.31	0.762085
Mean	|	3.34

Variable	VIF	1/VIF
diadema	2.91	0.343941
Maua	3.16	0.316802
Santo_andre	3.16	0.316655
Sao_bernardo	3.98	0.251418
Logfloor_u~t	2.58	0.38708
dorm_unit	3.46	0.288813
bath_unit	2.84	0.352189
gar_unit	3.01	0.332172
blocs	2.44	0.409929
elev	6.35	0.157476
Log_us_flo~t	7.85	0.127449
Log_total_~t	3.9	0.256211
tot_area	6.15	0.162678
dist_mhml		
1	6.39	0.156445
2	5.12	0.195145
3	3.91	0.255937
4	2.35	0.4259
distance	8.35	0.1197
Mean	|	4.33

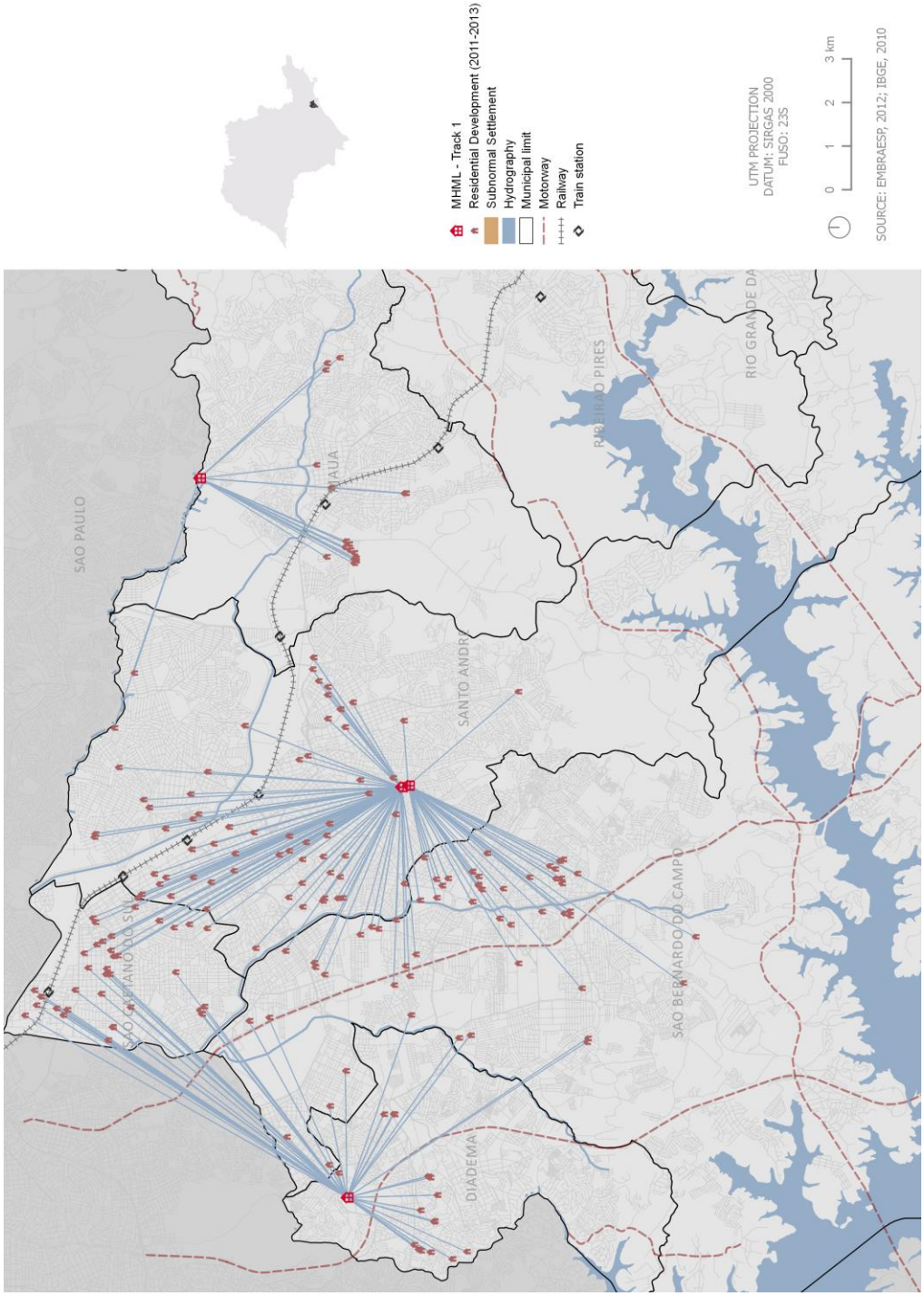
Variable	VIF	1/VIF
diadema	3.56	0.281199
Maua	3.99	0.250531
Santo_andre	3.07	0.325942
Sao_bernardo	3.83	0.260791
floor_unit	1.89	0.52794
dorm_unit	3.64	0.274458
bath_unit	2.96	0.338111
gar_unit	3.2	0.312447
blocs	2.54	0.394299
elev	6.43	0.155473
Log_us_flo~t	8.34	0.119937
Log_total_~t	3.72	0.268852
tot_area	5.98	0.167199
dist_mhml1		
2	1.12	0.889251
3	1.62	0.616122
4	1.29	0.775376
dist_mhml		
1	3.69	0.270705
2	2.1	0.475376
3	1.69	0.592173
4	3.13	0.319272
dist_mhml3		

1	4.07	0.245926
2	3.26	0.307024
3	3.17	0.315175
4	3.5	0.28593
Distance_Slums	7.31	0.136799
Mean		3.56

Appendix 5. linearity scatterplot



Appendix 6. GIS Map model (4) group (1).



Appendix 7. Stata output model (1), (2) and (3).

Output model (1), (2), and (3)

```
tabulate municipality, gen(dmun)
ren dmun1 diadema
ren dmun2 Maua
ren dmun3 Santo_andre
ren dmun4 Sao_bernardo
ren dmun5 Sao_Caetano
tabulate dist_mhml, gen(dmun)
ren dmun1 distance_till100
ren dmun2 distance_101till500m
ren dmun3 distance_501till1000m
ren dmun4 dinstance_1001till2000m
ren dmun5 distance_more2001m
tabulate mhml_track , gen(dmun)
ren dmun1 Track1
ren dmun2 Track2
ren dmun3 Track3
histogram price_perunit_nominal, normal
summarize price_perunit_nominal, detail
drop if price_perunit_nominal >= 1075626
swilk price_perunit_nominal
gen Logprice_perunit_nominal = ln(price_perunit_nominal)
histogram Logprice_perunit_nominal, normal
histogram floor_unit, normal
gen Logfloor_unit = ln(floor_unit)
histogram us_floor_unit, normal
gen Log_us_floor_unit = ln(us_floor_unit)
histogram Log_us_floor_unit, normal
gen Log_total_unit = ln(total_unit)
histogram Log_total_unit, normal
histogram bath_unit, normal
gen Log_bath_unit = ln( bath_unit )
histogram dorm_unit, normal
gen Log_dorm_unit = ln(dorm_unit)
histogram tot_land , normal
gen Log_tot_land = ln(tot_land)
reg Logprice_perunit_nominal diadema Maua Santo_andre Sao_bernardo Sao_Caetano Logfloor_unit
dorm_unit bath_unit gar_unit blocs elev Log_us_floor_unit Log_total_unit tot_area, robust
estat vif
reg Logprice_perunit_nominal diadema Maua Santo_andre Sao_bernardo Sao_Caetano Logfloor_unit
dorm_unit bath_unit gar_unit blocs elev Log_us_floor_unit Log_total_unit tot_area ib5.dist_mhml,
robust
estat vif
reg Logprice_perunit_nominal diadema Maua Santo_andre Sao_bernardo Sao_Caetano Logfloor_unit
dorm_unit bath_unit gar_unit blocs elev Log_us_floor_unit Log_total_unit tot_area ib5.dist_mhml
distance, robust
estat vif
```

Appendix 8. Stata output model (4).

```
Output model (4)
tabulate municipality, gen(dmun)
ren dmun1 diadema
ren dmun2 Maua
ren dmun3 Santo_andre
ren dmun4 Sao_bernardo
ren dmun5 Sao_Caetano
histogram price_perunit_nominal, normal
summarize price_perunit_nominal, detail
drop if price_perunit_nominal >= 1075626
swilk price_perunit_nominal
gen Logprice_perunit_nominal = ln(price_perunit_nominal)
histogram Logprice_perunit_nominal, normal
histogram floor_unit, normal
gen Logfloor_unit = ln(floor_unit)
histogram us_floor_unit, normal
gen Log_us_floor_unit = ln(us_floor_unit)
histogram Log_us_floor_unit, normal
gen Log_total_unit = ln(total_unit)
histogram Log_total_unit, normal
histogram bath_unit, normal
gen Log_bath_unit = ln( bath_unit )
histogram dorm_unit, normal
gen Log_dorm_unit = ln(dorm_unit)
histogram tot_land , normal
gen Log_tot_land = ln(tot_land)
reg Logprice_perunit_nominal diadema Maua Santo_andre Sao_bernardo Sao_Caetano floor_u
> nit dorm_unit bath_unit gar_unit blocs elev Log_us_floor_unit Log_total_unit tot_are
> a ib5.dist_mhml1 ib5.dist_mhml ib5.dist_mhml3 distance_slums, robust
estat vif
```