An essay on housing, from a financial perspective to tax reforms to converge towards a fairer market equilibrium

by

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Abstract

In the last decade, the housing market has been characterized by three main facts: an overall increase in housing prices, a stronger rate of growth in the most important cities and a reduction in the values of the rent to price ratio. This process has led to a huge heterogeneity in housing rents, prices and, as a consequence, yields. Moving from these market phenomena, this work will provide a new opinion on the possible causes that have triggered these events. The financial perspective is positioned at the centre of the debate, leading to justify market trends and paying attention to possible irrational elements in the construction of market growth expectations. Finally, the work will focus on the social implications deriving from the current condition of the real estate market and on possible political interventions.

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1 Introduction

In the last twenty years, a growing stream of literature has been focusing on house price dynamics. The 2007 crisis has highlighted how real estate prices are interconnected with the business cycle. As shown by Mian, Rao, and Sufi (2013) this is particularly relevant for poor and more indebted households.

Indeed, housing costs can alter households living conditions by reducing their ability for consumption of different goods. Aladangady (2017) shows that an appraisal of property value leads to higher consumption for house owner but it has negligible effect on renters. He also shows that this is particularly relevant for indebted households, suggesting looser borrowing constraints are a relevant driver of the propensity to consume out of housing wealth.

In this period, the home ownership rate in Italy has been constantly above 70% and the level of debt to income has been ranging, although with a decreasing trend, from 65% to 60%[1].

However, the financial crisis has led to a tightening in the credit conditions that have produced several effects on the market and the society. On this respect, Duca J. and ot. (2011) show that standard housing models are better are predicting when taking into account credit shock. On a similar issue, Gan and Hill (2008) find that in the period preceding the financial crisis the purchase affordability

[1] Data source: tradingeconomics.com — Eurostat

remained quite stable, while the repayment affordability strongly deteriorated. Indeed, we can expect that a tightening in the credit conditions for mortgage access could lead to an improvement of the repayment affordability measure and, as a consequence, a stabilization of the financial market but, at the same time, it will also affect households' purchase affordability and homeownership rates.

For these reasons it is particularly important to understand how house price dynamics evolve through time and across locations and which are the main drivers of these movements so to understand the social and economic implications for the society.

Many empirical analyses have shown that the rise in house prices has been much more pronounced in the most important cities, the so called "Superstar cities". The same stream of literature has highlighted that this trend has not been followed up at the same pace by rent prices. This phenomenon has generated an exponential decline in the values of the rent-to-price ratio and, as a consequence, this was particularly relevant in denser areas.

These movements have led to very heterogeneous level in the value of this indicator across and within different locations (Gyourko, J. E. and Mayer, C. J. and Sinai, T. M., 2006; Hilber, C. A. L., Mense, A., 2021; Colonnello, S., Marfè, R., Xiong, Q. 2021).

There have been several attempts in the literature to understand the causes of this phenomenon which, moving from the same research question, have reached different, sometimes complementary, theories.

The next section will provide an overview of the main explanations that have been provided by the different strands of literature and an idea of the role of the rent to price ratio in the housing literature. Chapter 2 will provide a replica and an evolution of the standard empirical model used in the real estate finance literature to show the role of the rent to price ratio in predicting the evolution of the housing market, following the Gordon model approach that will be presented in the next section. Chapter 3 will introduce a new user-cost perspective to emphasize the role of housing cost and deterioration; the section is divided into a theoretical part and an empirical analysis to support the theory. Finally, chapter 4 will present a micro-level overview of the labour and housing market with a focus on the concepts of inequality and affordability in order to understand the size and geographical dispersion of this crisis. All the analysis will be conducted at the neighbourhood level on the municipality of Milan by exploiting different sources of data that will be described in the following sections. The work will conclude with an overview of the Italian housing fiscal system and a possible reform proposal aimed at shifting the real estate market towards a more socially and economically sustainable environment.

1.1 Rent to price: Related literature

As already said, the last ten years have highlighted an overall reduction in the value of the rent to price ratio in most. However, the speed of reduction has been very heterogenous across locations leading to a divergence in the value of this indicator within and across locations. This topic has been object of study of numerous research; while the financial literature has spent more time in understanding the role of this indicator in the housing market, the housing literature has tried to understand the mechanisms that are driving this market phenomenon.

Most of the studies, from both sides of the literature, reach the common conclusion that these differences reflect a variability in the future trajectories of both the sales market and the rental market; the following subsections will go through the main theories that have been used to explain the causes of the heterogeneity in the value of this indicator and some empirical evidence provided in support of its ability to forecast future fluctuations in the real estate market.

1.1.1 Financial meaning

In the financial literature, housing rents are considered as financial dividends and the rent (or dividend) to price ratio is interpreted as a predictor for the evolution of the fluctuations in the housing market.

Indeed, according to the original static Gordon Growth Model (GGM), the value of a stock is equal to the sum of all future dividends discounted to the present at the rate at which investors are expected to be paid for the riskiness of their investment. In the original version of the model the rate of growth of the dividends and the discount rate are assumed to be constant over time.

Hence, given r the discount interest rate required to acquire capital (i.e. The cost of debt) and g the rate of growth of dividends, the value of the stock can be written as:

$$P_0 = \sum_{t=1}^{\infty} D_0 \frac{(1+g)^t}{(1+r)^t} \tag{1.1}$$

This can be rewritten as:

$$P_0 = D_0 \frac{(1+g)}{(1+r)} \left[1 + \frac{(1+g)}{(1+r)} + \frac{(1+g)^2}{(1+r)^2} + \frac{(1+g)^3}{(1+r)^3} + ... \right] \tag{1.2}$$

If $|\frac{(1+g)}{(1+r)}| < 1$ the sum in parenthesis is equal to $\frac{1}{1-\frac{(1+g)}{(1+r)}}$ and the stock price is:

$$P_0 = \frac{D_0 \frac{(1+g)}{(1+r)}}{1 - \frac{(1+g)}{(1+r)}} \tag{1.3}$$

which, by multiplying for $\frac{1+r}{1+r}$ leads to the final form dividend-price ratio can be approximated as:

$$\frac{D_1}{P_0} = r - g \tag{1.4}$$

Campbell and Shiller's (1988b) derive a Dynamic version of the original Gordon model that makes the log of the dividend price ratio linear with respect to future value of r and g that are allowed to vary in time. According to this, a high value of the rent to price ratio should imply that either housing returns are expected to rise, or future rent growth should reduce, or eventually both; Indeed, a high $\frac{D}{P}$ may be due to a relatively high value of the cost of debt (r) which is the consequence of a high risk adjusted return or a relatively low level of the rate of growth (g) of the business profits (i.e. dividends or rents).

Since then, there have been an increasing number of empirical papers trying to test the predictive ability of the dividend price ratio in the housing market.

The work of Plazzi et al. (2010) shows that the predictive power of the rent to price ratio only works for some asset classes; indeed, in their paper, the ability to predict future return and rent growth is negligible for the office sector. Campbell and ot. (2009) provide a version of the model where the discount rate is divided between real interest rates and housing premium and they show that housing premium are forecastable and account for a large fraction of the variability of the rent to price ratio in time and across location. On the other hand, Engsted et ot. (2015) show that predictive patterns are unstable in time and periods, especially for rent growth, and results are strongly dependent on whether returns are measured in real or nominal terms. Indeed, they also show that much of the predictability of nominal returns is due to the predictive power of the rent to price ratio on the future level of inflation. They justify this result as deriving from a money illusion mechanism where homeowners do not adjust for inflation.

Colonnello et al (2021) find similar results for the German market with statistically significant but of limited economic magnitude ability to forecast; they also show that neither the local factors nor the asset specific characteristics are able to explain the variability of the rent to price ratio across regions.

One of the main issues of the Gordon model applied to firms is due to the viscosity in the distribution of dividends which is often affected by management decisions and firm policies and, as a consequence, it does not necessarily reflect the true state of companies. Indeed, some firms could decide not to increase their dividends when profit increases in order to save for future investments; on the other side, firms could decide not to reduce their dividends following a loss of earning so as not to transmit fear to their stakeholders.

As highlighted by Plazzi et al. (2010), the real estate market overcomes this issue since sale and rental prices are observed market price where agents try to maximize their deals. However, although this may be true, the real estate market is characterised by long-term rental contracts, large shares of vacancy, search frictions and a dual function of this type of asset, consumption and investment good. Hence, some form of viscosity in the distribution of dividends may also apply in this market due to some of these characteristics.

Furthermore, differently from stock returns, it is important to distinguish between gross and net returns. The pure housing investment is characterized by the owning of an asset to receive an income stream from the rental activity and a potential capital gain deriving from the difference between the initial purchase and the final price at which the asset is sold. Regarding this, another stream of literature has tried to justify the changes in the rent to price ratio as arising from the user cost equation.

The user cost of a durable good is the present value of buying it, using it for one period and then selling it (Hicks, 1946). In equilibrium, this should equal the cost of renting the good for the same holding period. Hence, differences in the rent to price ratio across properties should be reflected in differences in the cost of owning them.

Indeed, in a typical user cost framework, the cost of owning of a property is represented as:

$$u_t = r_t + \omega_t + \delta_t + \gamma_t - g_t \tag{1.5}$$

where r is the interest rate, ω is transaction cost, δ is depreciation rate, γ is the risk premium of owning as opposed to renting and g_t is expected capital gain. Most of this literature have used this approach to extract expectations on future capital gain and justify the huge drop in the value of the rent to price. Poterba (1984) shows that rising inflation reduces the cost of owning and increases the tax subsidy to homeowners. Following this approach Himmelberg et ot. (2005) construct the imputed rent as the percentage of the property prices and, in doing so, they set an annual depreciation rate equal to 2.5 percent, following the estimates of Harding, Rosenthal and Sirmans (2004). Chen et Ot. (2022) analyse the market in Shanghai and they have come to the conclusion that extremely high expectations on future property appraisal have turned the user-cost of owning to be negative. In their works, as in most of the user-cost literature on housing, all these measures are constructed as a percentage of the property price. However, although this may be true for some type of costs, it does not hold for many others. This is confirmed by an increasing number of works related to housing price depreciation rate; Yoshida (2019) provides an empirical analysis where he shows that depreciation rates consistently vary across property types, locations and age. Halcket et al. (2020) shows that structural characteristics and unobserved quality are important for the allocation of properties between the owner-occupied or the rental sectors.

They also show that location is not significant for this choice, although the value of amenities for rents relatively increases with distance from the city centre with respect to prices.

These intuitions will be at the base of the theoretical model presented in section 3 that attempts to provide a theoretical solution to the rent to price ratio dilemma.

1.1.2 Determinants

All the works previously mentioned come to the common conclusion that differences in the value of the indicator should reflect different rate of growth in the value of the asset.

Another stream of literature has been trying to understand the main drivers of this heterogeneous growth. However, few theories have tried to provide reasonable theory for the explanations at the base of the divergence of the rent to price ratio. Among those, an interesting attempt is provided in Hilber and Mense (2021) where they model the mechanism at the base of the divergence in the rent to price ratio through the combined effect of differences in short- and long- term elasticity in the supply of rental and sales properties. According to their model, housing demand shocks are autocorrelated, short-run housing supply is less elastic than long-run and the two are positively correlated. Hence, a positive shock in the demand for housing will reflect in a higher rental price increase in the locations with a more rigid supply, given that rental market only depends on short term supply and demand responses. However, the effect on the rent to price ratio is due to the autocorrelation of the demands side that, wherever this effect is higher than the long-run supply response, will lead to further increase in rent prices. The effect on the rent to price ratio derives from the fact that while the second demand shock on rent will be visible in the future, the effect on the price will be capitalized straightforward, leading to a reduction in the level of the rent to price ratio where supply is sufficiently constrained.

Himmerlberg et al. (2005) explains how the sensitivity of the rent to price ratio to changes in interest rates depends, according to the user-cost, on the value of the expected growth rate. In the same way, areas with different income per capita, are differently affected by tax subsidy to owner-occupied housing. Greenwald et al. (2021) shows that the response of the price to rent ratio and homeownership rate to a credit shock strongly depends on the degree of segmentation in the housing market. Badarinza and Ramadorai (2018) assesses the role of foreign direct investments and they show that the areas of London with high concentration of residents originating from a specific country have an increase in prices and demands after an episode of elevated risk in the country. Bracke (2013) investigates the role of property characteristics through the use of hedonic models and he shows that for the city of London the rent to price is lower for bigger and central units.

Although all these mechanisms may provide a piece of the story, none of them is probably able to capture the whole movements in the levels of the indicator.

This thesis attempts to contribute to this literature in several respects; by contextualizing the analyses on the Italian market, and in particular in the city of Milan, this work will attempt to provide another piece of the story by testing the role of the rent to price ratio. exploiting the intertemporal role of housing deterioration in determining housing returns and equilibrium prices and rents. Indeed, the initial part of the project will be devoted to providing an overview of the socio-economic context in which the analyses will be carried out. The work will follow with an econometric exercise aimed at providing an alternative view of the financial models that were previously discussed. The core part of the thesis will focus on the intertemporal role of housing costs; indeed, housing costs represent a key aspect in the understanding of the housing market dynamics (Gleaser et. ot., 2005). Finally, I will focus on the possible detrimental effects of an underestimation of these causes and how policies could be a driver in the mitigation or, if poorly implemented, an amplification of these.

2 The predictive power of the rent to price ratio

This section is dedicated to test the predictive ability of the rent to price ratio as described in the previous section.

According to the Dynamic Gordon Model, a high rent to price ratio may imply that either housing returns are expected to rise, or future rent growth should reduce, or eventually both.

One of the main issues of the Gordon model applied to firms is due to the viscosity in the distribution of dividends which, as previously described, can be a peculiarity in the housing market too. This implies that the variance of the rent to price ratio across and within regions may not be the consequence of the discounting effect on the future level of prices and rents.

The analysis will aim to testing the role of the rent to price ratio in the housing financial literature and to understand whether households adjust their expectations on the base of this indicator.

2.1 A dynamic approach

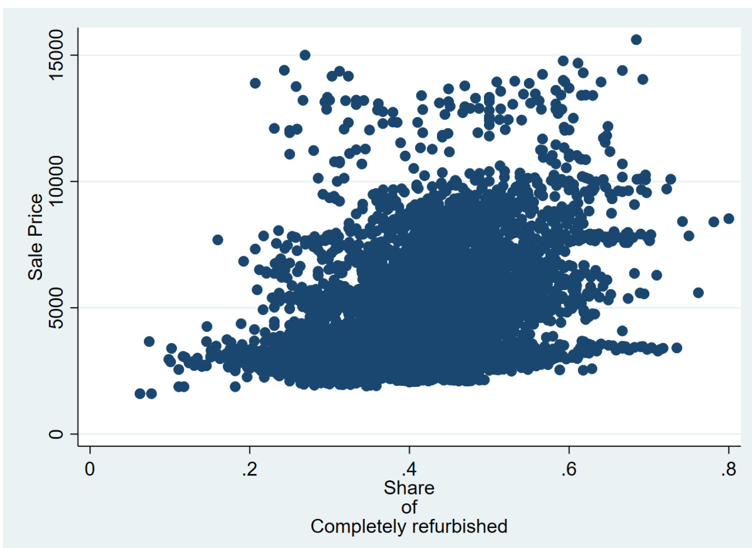
The predictability exercise applied to the residential market of the city of Milan confirms this theory; however, in order to account for other possible mechanism of pricing adjustment, the dynamic version of return and rent growth predictability equations are also exploited through Arellano and Bond (1991). The results show that the role of past performances is significant for the understanding of future trends; hence, the rent to price ratio is only one of the aspects to take into account when trying to predict future dynamics.

2.2 Data and Methodology

In order to test these hypotheses, we conduct an analysis on a dataset provided by the main property advertisement website in Italy ("Immobiliare.it").
The dataset is a panel dataset of the area of Milan with monthly observations that span from January 2016 to December 2019. The municipality of Milan is divided in 144 micro areas which have been defined by real estate practitioners taking into account the characteristics of the housing market. This should guarantee a sufficient degree of homogeneity in the properties that contribute to the creation of the neighborhood indexes. The dataset contains information on average price and standard deviation for ads entered and removed in the reporting period both for sale and rent advertisement, classified by housing type and maintenance status.
In order to construct all the indexes, I assume that each apartment that is removed from the website is either rented or sold out. Unfortunately, we are only able to observe the listing price, not the transacted one. In order to reduce possibility of bias deriving from undetectable characteristics in the samples, I aim to control for the frequency of each characteristic in the sample. As previously said, the available

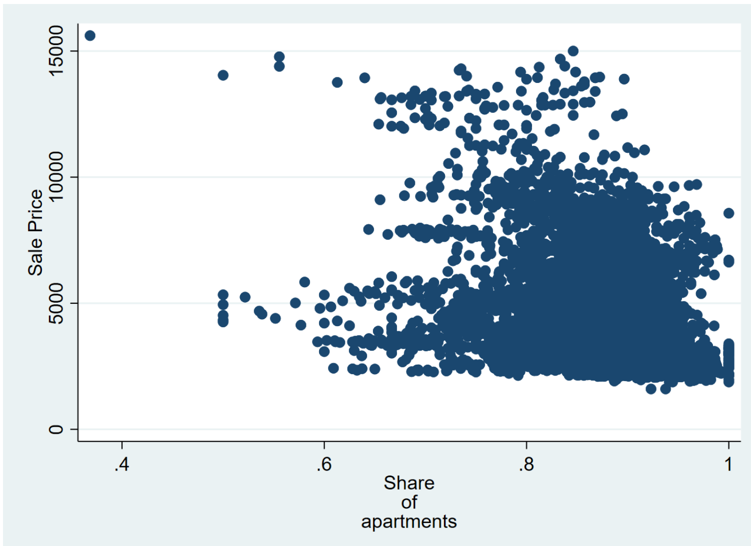
data provides local indexes for each refurbishment level or property typology. The most frequent refurbishment level in the sample is "completely refurbished", while the most common typology is apartment. In order to decide which of these two characteristics take into account to mitigate the potential bias I have decided to take into account the overall frequency of each category.

Figure 2.1: Status "refurbished" - Frequency



The Graph shows the correlation between prices and the share of all listings that are classified as "Completely refurbished".

Figure 2.2: Typology "apartment" - Frequency



The Graph shows the correlation between prices and the share of all listings that are classified as "apartment".

While the share of apartments that are listed as refurbished is about 50%, the average share of properties that are listed as "apartment" is close to 90%; moreover, while the frequency of the typology seems uncorrelated with the level of prices, the frequency of the refurbishment status is positively correlated to the average local values of properties.

Hence, according to this methodology, the characteristic that was more important to control is property status and the indexes that have been selected for the analysis refer to properties that are classified as "completely refurbished". Apparently, this does not imply that all possible sources of bias are taken into consideration but it provides the most reliable approximation.

	mean	sd	min	max
Average price	4644.442	2292.636	1600	15612
Average rent	16.8274	4.030445	7.05	30.8867
Average RtP	4.849285	1.251649	1.949785	11.75749

As shown in Table 4.2, the average sale price[1] in the period 2016-2019[2] in the Municipality of Milan is, approximately, 4600€ with a maximum of 15500€ and a minimum of 1600€; hence, the top area costs is approximately ten times more expensive than the cheapest location. Although some of this gap could be due to differences in property characteristics that we cannot take into account in the dataset, most of the variability is likely to be linked to neighbourhood characteristics. The aim of this paper is not to explain these differences in the price level but, on the other hand, is concerned with analyzing the relationship between rents and prices.

Moreover, the dataset provides information on the average time a rent advertisement stays on the website[3]. This measure will be used as a proxy for market liquidity to check whether it can provide an explanation to local differences in the level of the price to rent ratio.

Two different proxies are constructed and plotted against the level of prices and price to rent ratio (Figure 2.3 and 2.4). The two proxies for market liquidity are constructed as:

[1]Prices are defined as € per square meter

[2]The analysis is interrupted in 2019 so as not to include the arrival of Covid.

[3]measured in number of months

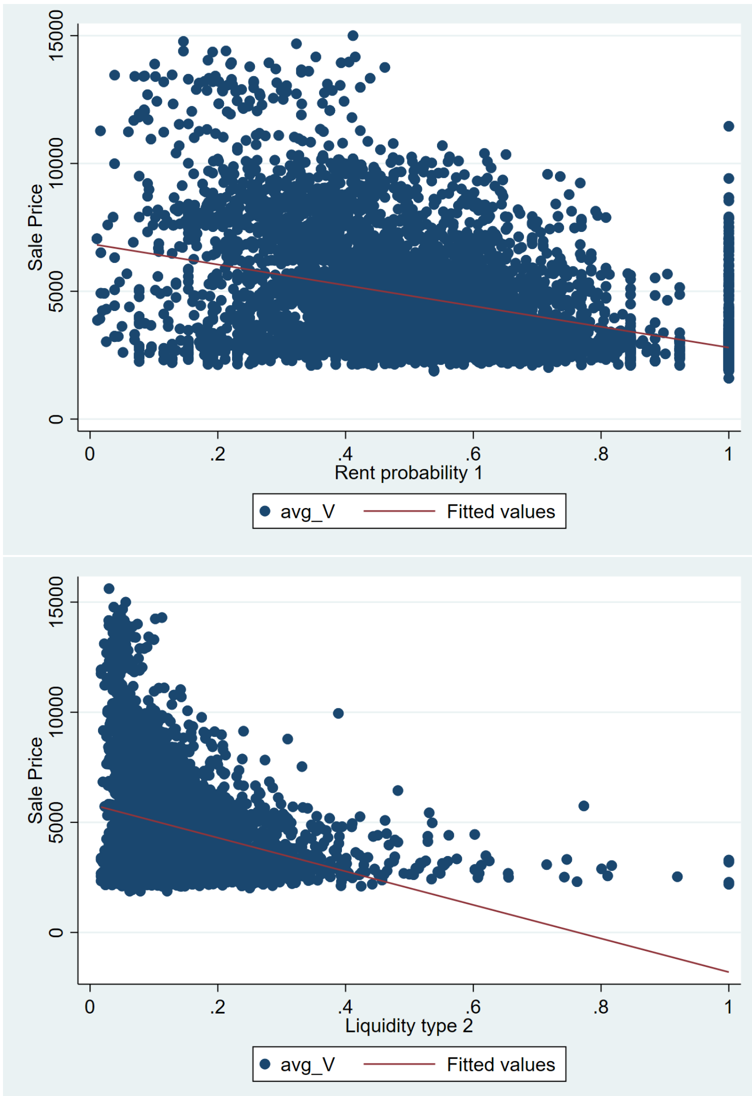
$$[\text{Monthly liquidity proxy 1}]_{i,t} = 1 - \frac{\text{Average time on the website}_{i,t}}{\text{Maximum all}} \tag{2.1}$$

$$[\text{Monthly liquidity proxy 2}]_{i,t} = 1 - \frac{\text{Average time on the website}_{i,t} - \text{Average all}}{12}{}^{4} \tag{2.2}$$

where "Maximum all" and "Average all" are, respectively, the maximum and average time that rent advertisements stay on the website across all areas in the year of the reference period i.

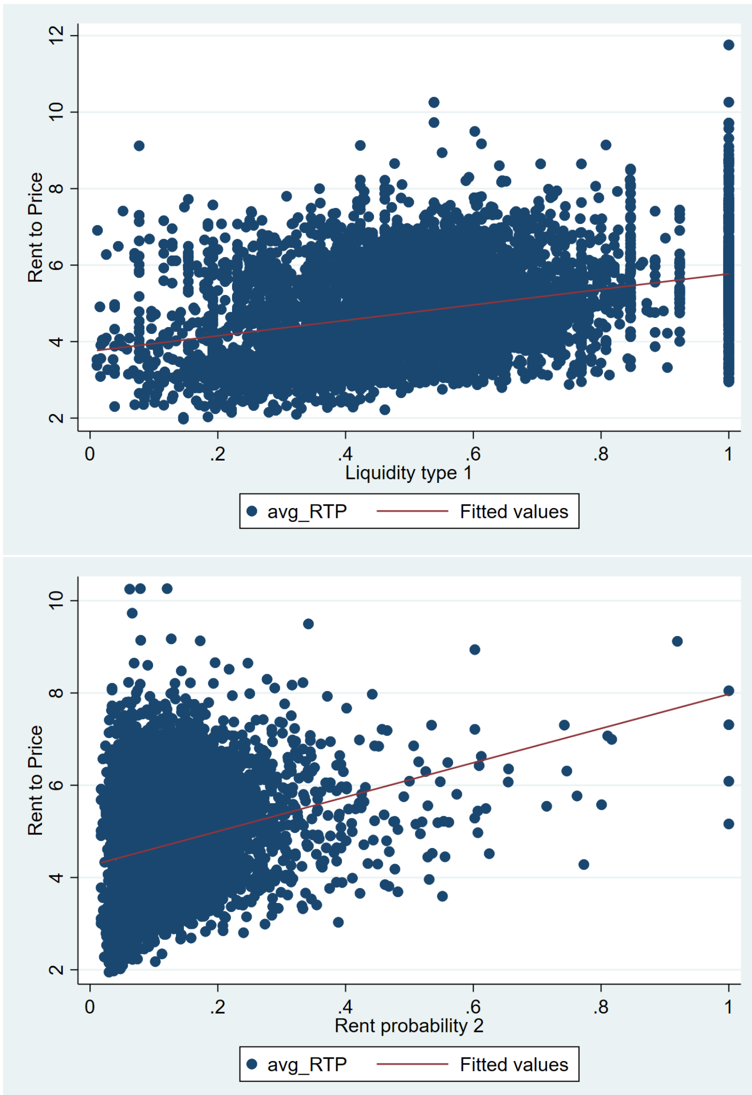
[4] This is divided by 12 to parametrize the coefficient in number of years

Figure 2.3: Type 1 and 2 market liquidity versus price



The graph shows the correlation between the price of properties and the liquidity of the market. Type 1 and type 2 description are provided in the section.

Figure 2.4: Type 1 and 2 market liquidity versus rent to price ratio



The graph shows the correlation between the rent to price ratio and the liquidity of the market. Type 1 and type 2 description are provided in the section.

Figure 2.3 and 2.4 show that, for both measures, there is a direct correlation with rent to price ratio and an inverse correlation with rent price. This result suggests that market liquidity can not be accounted as a plausible justification to yield heterogeneity.

The natural logarithm of the annual rent to price ratio is computed as:

$$ln\left(\frac{H}{P}\right)_{i,t} = ln\left(100 \times \frac{12 \times H_{i,t}}{P_{i,t}}\right) \tag{2.3}$$

where i and t denotes respectively the neighbourhood and the monthly observation. The rental price H is the monthly average rent price per square meter, exclusive of bill expenses, of all the ads removed from the rent section of the website in the reference period; the same holds for sale prices P. Unfortunately, the price is constructed as the average of a pool of listing which I do not have the possibility to control for; hence, potential bias could arise from differences in the characteristics between properties listed for rent and for sale and/or across locations.

Using the same dataset, I compute the logarithmic total monthly return for each neighbourhood as:

$$r_{i,t} = ln\left(\frac{P_{i,t} + H_{i,t}}{P_{i,t-1}}\right), \tag{2.4}$$

which, as in Plazzi et al. (2010), represents both the capital gain from appreciation and the rental income.

In the same way, the rent growth index is computed as:

$$h_{i,t} = ln\left(\frac{H_{i,t}}{H_{i,t-1}}\right). \tag{2.5}$$

Other sources of data are employed in order to control for local demographic and economic characteristics. In particular, I use a dataset that contains demographic, administrative and territorial characters, divided at the district level (88 NIL - Nucleo di Identità Locale) provided by "SIAD – Unità Statistica" in order to control for local differences. The 88 districts are matched manually with the constructed by Immobiliare.it.

The forecasting ability of the rent to price ratio on rent growth and returns is tested following a similar approach to Colonnello et al.(2021).

In particular, the predictive equations estimated at the neighborhood level are:

$$r_{i,t} = \alpha + \beta \left(ln(\frac{H}{P})_{i,t-1} \right) + \epsilon_t^r \tag{2.6}$$

$$h_{i,t} = \mu + \lambda \left(ln(\frac{H}{P})_{i,t-1} \right) + \epsilon_t^h \tag{2.7}$$

Neighborhood level and time fixed effects are also used in the analysis in order to capture any unobserved heterogeneity.

Furthermore, I assess whether the pricing decisions of households[5] are influenced by past realizations in the housing market. In order to build this extended dynamic

[5]This model assumes that all agents are price-taker.

version of the predictability equations I will add lagged values of the dependent variables. The Arellano and Bond (1991) procedure instruments the predetermined and endogenous variables in the model in first difference with suitable lags in their own level. This estimation procedure loses two time periods from the sample, one to implement the first difference and another for the instrument. Because return and rent growth are themselves a logarithmic difference, in order to save a time lag in the estimation, I decide to use a slightly modified version of the original equations. This will allow me to handle the endogeneity arising in the typical dynamic panel regression framework and will preserve the time dimension of the panel. Indeed, the original dynamic predictability equations are:

$$r_{i,t} = \alpha + \beta_1 \left(ln(\frac{H}{P})_{i,t-1} \right) + \beta_2 r_{i,t-1} + \epsilon_t^r \tag{2.8}$$

and

$$h_{i,t} = \mu + \lambda_1 \left(ln(\frac{H}{P})_{i,t-1} \right) + \lambda_2 \Delta h_{i,t-1} + \epsilon_t^h . \tag{2.9}$$

Assuming an AR(1) model

$$y_{i,t} = \alpha y_{i,t-1} + \epsilon_{i,t} \tag{2.10}$$

where

$$\epsilon_{i,t} = \nu_{i,t} + \mu_i \tag{2.11}$$

it is clear that $\epsilon_{i,t}$ is correlated with $y_{i,t-1}$.

The most used technique to solve this issue is the first difference transform ("difference GMM").

$$\Delta y_{i,t} = \alpha \Delta y_{i,t-1} + \Delta \nu_{i,t} \tag{2.12}$$

Implementing the first difference to the AR(1) equation allows to get rid of fixed effects in the error component but does not solve the endogeneity problem (i.e. $y_{i,t-1}$ in $\Delta y_{i,t-1} = y_{i,t-1} - y_{i,t-2}$ is still correlated with $\nu_{i,t-1}$ in $\Delta \nu_{i,t} = \nu_{i,t} - \nu_{i,t-1}$). However, differently from the mean-deviations transform, further lags of the dependent are orthogonal to the error term and can be used as instruments in the first difference equation (Roodman D., 2009).

This transformation works nicely for any equation whose original dependent variable is in levels. Since we are investigating the role of return and rent growth, the second lag of the variables are still correlated with the error term;

indeed, the rent growth equation:

$$h_{i,t} = \beta_1 \left[ln \left(\frac{H}{P} \right)_{i,t-1} \right] + \beta_2 \left[h_{i,t-1} \right] + \epsilon_t^h \tag{2.13}$$

can be rewritten as[6]

$$ln\left(\frac{H_{i,t}}{H_{i,t-1}}\right) = \beta_1\left[ln\left(\frac{H}{P}\right)_{i,t-1}\right] + \beta_2\left[ln\left(\frac{H_{i,t-1}}{H_{i,t-2}}\right)\right] + \frac{\epsilon_t^H}{\epsilon_{t-1}^H} \tag{2.14}$$

Hence, the second lag of the regressor is not a valid instrument to solve the endogeneity problem because, when we differentiate (14), $H_{i,t-2}$ in $\Delta H_{i,t-2}$ is still correlated with ϵ_{t-2}^h in $\Delta\epsilon_{t-1}^h$. This would waste a further time observation. The same applies for the return equation.

However, if we transform the return equation in a simple sale asset price equation and the rent growth equation in the rent asset price equation and we use the term in logarithm, eq. 13 can be rewritten as:

$$ln\left(H_{i,t}\right) = \beta_1\left[ln\left(\frac{H}{P}\right)_{i,t-1}\right] + \beta_2\left[ln\left(H_{i,t-1}\right)\right] + \epsilon_t^H \tag{2.15}$$

Eq. (13) differs from eq.(15) but the Arellano and Bond procedure expects that the original model is transformed in first difference; hence, eq. (15) becomes:

$$ln(H_{i,t}) - ln(H_{i,t-1}) = \beta_1\left[ln(\frac{H}{P})_{i,t-2}\right] + \beta_2\left[ln(H)_{i,t-1} - ln(H)_{i,t-2}\right] + \epsilon_t^H - \epsilon_{t-1}^H \tag{2.16}$$

[7]

[6]Remember that $h_{i,t} = ln\left(\frac{H_{i,t}}{H_{i,t-1}}\right)$.

[7]Tables 2.1 and 2.2 provides two version of this equation: the last column where the rent to price ratio is instrumented in its levels (as defined in the equation) and the second column where,

since $ln(H_{i,t}) - ln(H_{i,t-1}) \approx \frac{H_{i,t}-H_{i,t-1}}{H_{i,t-1}}$ the Arellano and Bond procedure, applied to an equation with variables for sale and rent prices in their levels as dependent, allows us to estimate exactly the desired original equation and to use any lagged value (except the first one) of the dependent as a valid instrument to solve the endogeneity issue. In the return equation, the return from the investment reduces to the capital gain from the buying and selling activity, while the gain from the renting activity disappears from the numerator.

The coefficient should provide an estimate for the effect of past realization of return and rent growth rate on their future realization.

Because we are interested also in the sign of the coefficient of the rent to price ratio after the use of this control, we run the estimates using the variable in its level, as in the previous exercise.

2.3 Results

The standard predictability exercise provided in the first column of tables 2.1 and 2.2 confirms the results previously found in the literature for, respectively, return and rent growth. Both exercises do not focus in explaining the overall variability between areas but are aimed at explaining the within variation of the model.

The Rent to Price ratio has a significant positive effect on returns, implying that high value of the indicator should correspond to future capital appreciations.

as for the dependent variable, it is instrumented in its difference.

On the other hand, the rent growth equation shows that high value of the ratio should imply a slowdown in the growth of rents[8].

Second and third column in tables 2.1 and 2.2 provide the dynamic panel

Table 2.1: Return predictability exercise

	(1)	(2)	(3)
	Std.	Abond	Abond(RtP level)
L2.RtP ratio	0.0613***		
	(0.000)		
L.RtP ratio		0.147***	0.0613***
		(0.000)	(0.000)
L.Abond return		0.969***	1.035***
		(0.000)	(0.000)
Constant	-0.0858***	0.0339	-0.385***
	(0.000)	(0.666)	(0.000)
Observations	5336	5452	5452

p-values in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The first column provides the standard predictability exercise with neighbourhood and time fixed effects. Columns 2 and 3 provide a dynamic version of the return equation.Arellano and bond is implemented on the logarithm of the house price, that is transformed in return after the differentiation. Column 2 provides a version where the level of the rent to price ratio is instrumented in its difference, while column 3 provides the level version.

version of the return and rent growth equation as explained in section 4. The difference between second and third column is due to the use of the Rent to Price regressor; while column 2 instruments the value of the rent to price ratio in its difference, column 3 does it in levels (as in the standard Gordon framework). The results show that, although the impact of the rent to price ratio coefficient remains significant and preserves the same sign of the original exercise, the impact of past

[8]Indeed, an implication of the Model is that if the rent to price ratio in Portello is higher than in Brera, either the growth of prices in Portello will be higher than those expected in Brera, or rents in Portello are expected to grow at a slower rate than in Brera, or both.

Table 2.2: Rent growth predictability exercise

	(1)	(2)	(3)
	Std.	Abond	Abond(RtP level)
L2.RtP ratio	-0.131***		
	(0.000)		
L.RtP ratio		-0.792***	-0.105***
		(0.000)	(0.000)
L.Abond rent growth		1.204***	0.859***
		(0.000)	(0.000)
Constant	0.207***	0.647***	0.563***
	(0.000)	(0.000)	(0.000)
Observations	5336	5452	5452

p-values in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The first column provides the standard predictability exercise with neighbourhood and time fixed effects. Columns 2 and 3 provide a dynamic version of the rent growth equation. Arellano and bond is implemented on the logarithm of the rent values, that is transformed in rent growth after the first differentiation. Column 2 provides a version where the level of the rent to price ratio is instrumented in its difference, while column 3 provides the level version.

realizations of both return and rent growth can not be ignored.

Table 6.2 in the Appendix provides additional results of the standard predictability exercise with controls for local demographic characteristics. The lagged value of the RtP ratio remains significant in both regressions. Some of the demographic characteristics seem to play a role in the evolution of housing rents, but do not have any impact on housing returns.[9]

These results may suggest that investors pricing decisions can be influenced by previous performance, beyond possible mechanisms equilibrium adjustment. This may be thought as an arbitrage opportunity that, however, investors seem unwilling to exploit. Indeed, in this economic setting, a maximization strategy could induce people to invest in the cheapest areas with higher potential yields, and exploit the services and features of the most expensive neighborhoods with a renting solution. Nevertheless, this section does not aim to provide a solution to what currently happens in the real estate market; indeed, this analysis is mainly devoted to show that the Gordon model applied to real estate, even if it is not able to capture all future movements in prices and rents by itself, it remains significant when different controls are added to the model.

[9] Tables 6.2, 6.2, 6.2, 6.2, 6.2 and 6.2 in the Appendix provide, respectively for return and rent growth, the results the following equations:
- Standard predictability exercise using 3,6,9,12 months lags of RtP ratio, with FE
- Standard predictability exercise using 3,6,9,12 months lags of RtP ratio, without FE
- Dynamic predictability exercise using 3,6,9,12 months lags of RtP ratio and the dependent variable, with FE

3 The role of housing costs on real estate dynamics

As shown by Gleaser et al. (2005), construction costs represent a key aspect in the understanding of the housing market dynamics; indeed, they show that housing prices below construction costs lead cities to decline and that the combination of cheap housing and weak labour demand attracts individuals with low levels of human capital to declining cities. This process leads to self-reinforcing mechanisms that generate a rise in spatial inequality and segregation.

As described in the introduction, according to the user-cost equation, in equilibrium, the cost of owning an asset should equal the cost of renting it for the same holding periods. The cost of owning should include expenses for property maintenance, taxes, capital gain or losses and the loss of interest rates that could derive from allocating the resources in a risk-free investment.

Moving from the idea that construction costs do not vary as much as land prices, especially at the city level, I provide a theoretical framework in which the relative deterioration of properties varies in time and across locations. As a consequence, the same level of growth across locations may result in different level of property appraisal. The model suggests how policy makers can intervene to reduce territorial imbalances during the different phases of the economic cycle. The work also shows how, during bust, fixed costs generate rigidity in the rental market and amplify housing affordability problems.

There is a huge debate in Italy on how the tax system on properties should be revised. Indeed, to date, property taxes are calculated on the base of the cadastral values which have undergone only marginal changes in the last 70 years. This has led, on average, to favour the owners of the most expensive properties. Without spreading too much on the Italian issue, this is to confirm that most of the costs related to the owning of a property are not constant (in percentage terms) as the typical user-cost framework assumes but there exist multiple mechanisms that can lead to economies of scale.

3.1 A new user cost perspective on rent to price divergence

This section will focus on deterioration cost as one of the possible mechanisms to justify the heterogeneity in the rent to price ratio.
The value of land, the share of the property that does not deteriorate with time, represents a relatively higher portion of the property prices in the most expensive areas. Combes et al. (2021) shows that differences in the value of land across locations are much greater than construction costs and the cost of labour. This is particularly true if we conceptualize this idea within a single city. Unfortunately, data on construction costs are not available at the neighbourhood level; however, looking at the municipality of Milan, the minimum price for square meter in the period 2016-2021 is around 1.765€ in Ponte Lambro and the maximum is almost 16.000€ in Brera. Hence, it is difficult to expect that the cost for labour and

materials can vary so much across neighbourhoods.

Then, most of the variability in the property prices across different locations must be due to differences in the value of the land on which the structure is built; as a consequence, the percentage impact of deterioration on property prices is different and it depends on the relative weight of land and refurbishment in the composition of the property price.

In the following theorems, I will assume that, at the city level, the cost of refurbishment is independent on location; hence, I will rewrite the impact of housing deterioration in the user-cost equation as a function of building cost, land value and depreciation rate.

The obvious implication of this assumption is that deterioration has a lower impact on the more expensive properties. The consequence is that, during periods of growth, if the land value grows at the same rate across different locations, the impact of this land appraisal will always lead to higher capital gain for the most expensive properties.

In this proposal, I provide a version of the user-cost model where depreciation is constant in nominal terms and, hence, its relative impact varies across observations. This, according to my knowledge, has never been done in any of the exercises that have tried to predict expected capital gains through the use of the user-cost equation's equilibrium condition.

In this model, the price of the house P is modelled as the sum of the value of land P_L and the value of the structure P_R. For the reasons mentioned above, I impose that the value of the structure is constant across locations. This assumption can

be relaxed if we impose building costs to increase less than proportionally with respect to property prices. The price of land is obviously different and, indeed, can also follow different trends that may depend on several economic, social and political factors.
The Italian law offers a property tax exemption for the holding of your first house. Moreover, many other costs such as tax on the purchase of the property, notary and agency fees are also generally equal to a percentage of the property price and hence they cannot be accounted for a possible cause of the rent to price divergence across locations. Furthermore, agency fees are paid also from the renters and since they are faced only at the time of the purchase, they would require further assumptions on the length of the asset's holding. Because of these reasons, I will focus exclusively on the effect of deterioration cost on rent and sale prices. A different thought should be done on the interest rate as, although it is relatively constant across property prices, it may provide useful insight on the propensity to invest in housing assets and locations. Unfortunately, the time span of the dataset does not contain significant variation in the interest rates to provide such empirical result.

In this section, I will show how deterioration costs can provide a further plausible mechanism to justify what has been observed in the housing market in the last decade[1]. The proof will be divided in three different steps. In the first step I

[1]From the Abstract remember that: "In the last decade, the housing market has been characterized by three main facts: an overall increase in housing prices, a stronger rate of growth in the most important cities and a reduction in the values of the rent to price ratio. This process has led to a huge heterogeneity in housing rents, prices and, as a consequence, yields."

will demonstrate how, during boom periods, the property appraisal is higher in the more expensive properties. In the second part, I will show why the rent to price ratio tend to decrease. Finally, the last part will focus on why the heterogeneity in the rent to price ratio across locations tends to increase.

Let's assume that the refurbishment completely deteriorates at a constant rate in "n" years. The time length and the linearity assumption are irrelevant if the homogeneity across locations holds. Then, the yearly "nominal" variation of the property price will be equal to:

$$\Delta P = \Delta P_L - \frac{P_R}{n} \tag{3.1}$$

However, the percentage variation will depend both on the rate of growth/degrowth of the price of land and on the impact of the price of land on the value of the property. Indeed, let's call the yearly nominal deterioration cost $P_R/n = K$ and write the shift in the property value as:

$$\frac{P_{t+1} - P_t}{P_t} = \frac{P_{L,t+1} - P_{L,t}}{P_{L,t}} \times \frac{P_{L,t}}{P_t} - \frac{K}{P_t} \tag{3.2}$$

The term $P_{L,t}/P_t$ is needed to measure the impact of a variation in land prices on the value of the property.

Moving back to the initial condition $P = P_L + P_R$ we can derive

$$\frac{P_R}{P} = 1 - \frac{P_L}{P} \tag{3.3}$$

and if we substitute $P_R = nK$ we get:

$$\frac{K}{P_t} = \frac{1}{n}\left[1 - \frac{P_{L,t}}{P_t}\right] \tag{3.4}$$

then the percentage variation of the property price can be rewritten as:

$$\frac{P_{t+1} - P_t}{P_t} = \frac{P_{L,t+1} - P_{L,t}}{P_{L,t}} \times \frac{P_{L,t}}{P_t} - \frac{1}{n}\left[1 - \frac{P_{L,t}}{P_t}\right] \tag{3.5}$$

Theorem 1:

Let's imagine that there are two locations, A and B and define the share of land value in A and B as

$$\frac{P_{LA,t}}{P_{A,t}} = x_{A,t} \tag{3.6}$$

and

$$\frac{P_{LB,t}}{P_{B,t}} = x_{B,t} \tag{3.7}$$

and assume that $x_{A,t} > x_{B,t}$.

Let's further define the percentage rate of variation in the value of land as

$$\frac{P_{L,t+1} - P_{L,t}}{P_{L,t}} = g_t \tag{3.8}$$

then, the rate of property appraisal in location A and location B is:

$$\frac{P_{A,t+1} - P_{A,t}}{P_{A,t}} = g_{A,t} \times x_{A,t} - \frac{1}{n}[1 - x_{A,t}] \tag{3.9}$$

and

$$\frac{P_{B,t+1} - P_{B,t}}{P_{B,t}} = g_{B,t} \times x_{B,t} - \frac{1}{n}[1 - x_{B,t}] \tag{3.10}$$

Now, if we assume that the level of land appraisal is the same in location A and location B (i.e. $g_{A,t} = g_{B,t} = g_t$), for any positive level of g_t, the rate of property appraisal in location A will always be greater than in location B, indeed:

$$\begin{aligned} &\frac{P_{A,t+1} - P_{A,t}}{P_{A,t}} - \frac{P_{B,t+1} - P_{B,t}}{P_{B,t}} = \\ &= g_t \times x_{A,t} - \frac{1}{n}[1 - x_{A,t}] - \left[g_t \times x_{B,t} - \frac{1}{n}[1 - x_{B,t}] \right] = \\ &= g_t[x_{A,t} - x_{B,t}] + \frac{1}{n}[x_{A,t} - x_{B,t}] \end{aligned} \tag{3.11}$$

Then, we can state the following:

Proposition 1: for any $g_t \geq 0$ and $x_{A,t} > x_{B,t}$, the rate of property appraisal in location A will always be greater than the rate of appraisal in location B. On the other hand, for any $g_t < 0$ and $x_{A,t} > x_{B,t}$, the rate of depreciation in location A will be lower than in location B if and only if the rate of deterioration dominates the land depreciation rate (i.e. $\frac{1}{n} > |g|$).

Example: Lets now assume that "n" is equal to 25 years and impose the share value of land in location A at time t to be equal to:

$$\frac{P_{L_A,t}}{P_{A,t}} = 60\% \tag{3.12}$$

while for location B it is equal to:

$$\frac{P_{L_B,t}}{P_{B,t}} = 40\% \tag{3.13}$$

Then, if we further assume that g (the percentage variation of land price) is the same for both location A and location B and it is equal to 10%, we can rewrite equation (3.5) for both locations:

$$\frac{P_{A,t+1}-P_{A,t}}{P_{A,t}} = \frac{P_{L_A,t+1}-P_{L_A,t}}{P_{L_A,t}} \times \frac{P_{L_A,t}}{P_{A,t}} - \frac{1}{25}\left[1-\frac{P_{L_A,t}}{P_{A,t}}\right] = 10\% \times 60\% - \frac{1}{25} \times 40\% = 4.4\% \tag{3.14}$$

in the same way we can estimate the appreciation rate for location B

$$\frac{P_{B,t+1}-P_{B,t}}{P_{B,t}} = \frac{P_{L_B,t+1}-P_{L_B,t}}{P_{L_B,t}} \times \frac{P_{L_B,t}}{P_{B,t}} - \frac{1}{25}\left[1-\frac{P_{L_B,t}}{P_{B,t}}\right] = 10\% \times 40\% - \frac{1}{25} \times 60\% = 1.6\% \tag{3.15}$$

As you can see from this simple example, the same rate of appreciation for the land value in location A and location B has generated a higher increment in the value of property A with respect to property B.

Obviously, although we are investigating the price appraisal of properties at the city level, we could expect that land prices grow at different rates across locations; however, this simple model provides a possible mechanism to justify why the last two decades have highlighted a much stronger rate of property appraisal in the most expensive cities (the so called "Superstar cities"). Other models have justified these patterns with the use of different rate of expected property appraisal (Chen & Ot., 2022; Hilber & Ot., 2021). This model does not exclude the possibility of different mechanisms, but it provides a further theory that could amplify the effect when combined with others. Moreover, this divergence has occurred even across historical centres of different cities where we can expect that the amount of developable land and new building constructions is negligible and, hence, the role of elasticity should not be significant.

This simple proof however does not tell us anything about the within and between movement of the rent to price ratio in the last few decades.

From the standard user cost equation

$$u_t = r_t + \omega_t + \delta_t + \gamma_t - g_t \tag{3.16}$$

we know that if $\omega_t + \delta_t$ are assumed to be constant, a reduction in the rent to price ratio can be due to a reduction in the interest rate, a reduction in the perception of the risk of owning the housing asset or an increment in the expected rate of property appraisal; however, interest rates have been constantly low during the last ten years and a reduction in the housing risk seems quite unfeasible after the financial crisis[2]. Hence, the decrease in the rent to price ratio, according to the original model, can be justified only by very high rates of land appraisal. Moreover, even if we allow ω_t, δ_t and γ_t to vary through time but not across locations, because their impact is on the whole property value and it is not restricted to the structure component, the model would still be unable to explain heterogeneous pattern in the rent to price ratio degrowth.

In this context, I try to solve this issue by substituting δ with eq.(3.4), so to rewrite the user-cost equation as:

[2] A risk premium for the ownership of a property should be higher after the financial crisis; as a consequence, a lower risk premium is probably not the cause of the reduction in the user-cost of the last 10/15 years.

$$u_{t+1} = r_{t+1} + \omega_{t+1} + \frac{1}{n}\big[1 - \frac{P_{L,t+1}}{P_{t+1}}\big] + \gamma_{t+1} - g_{t+1} \tag{3.17}$$

moreover from eq.(3.3) we know that

$$\frac{P_{L,t+1}}{P_{t+1}} = 1 - \frac{P_R}{P_{t+1}} \tag{3.18}$$

It is clear that, because P_R is constant, during a boom period (i.e. $P_{t+1} > P_t$)

$$\frac{P_R}{P_{t+1}} < \frac{P_R}{P_t} \tag{3.19}$$

which implies that

$$\frac{P_{L,t+1}}{P_{t+1}} > \frac{P_{L,t}}{P_t} \tag{3.20}$$

As a consequence, given all the other parameter constant, we have that:

$$u_{t+1} = \frac{R_{t+1}}{P_{t+1}} < \frac{R_t}{P_t} = u_t \tag{3.21}$$

Finally, we need to show why the rent to price ratio has increased in heterogeneity during this period. Indeed, the reduction in the value of this indicator has been much more pronounced in the more expensive locations.

We will proceed defining the variation in the rent to price ratio as:

$$\frac{u_{t+1} - u_t}{u_t} = \frac{(\Theta_{t+1} + \delta_{t+1}) - (\Theta_t + \delta_t)}{(\Theta_t + \delta_t)} \tag{3.22}$$

where $\Theta_t = r_t + \omega_t + \gamma_t - g_t$. In order to keep the computation simple and to provide a more straightforward idea on the effect of deterioration, I will assume that $\Theta_t = 0$.

Then,

$$\frac{u_{t+1} - u_t}{u_t} = \frac{\delta_{t+1} - \delta_t}{\delta_t} \tag{3.23}$$

as before, δ (the rate of deterioration) can be rewritten as in eq.(3.4) so that:

$$\frac{u_{t+1} - u_t}{u_t} = \frac{n^{-1}(1 - \frac{P_{L,t+1}}{P_{t+1}}) - n^{-1}(1 - \frac{P_{L,t}}{P_t})}{n^{-1}(1 - \frac{P_{L,t}}{P_t})} \tag{3.24}$$

From (3.4), we also know that

$$\frac{P_L}{P} = 1 - \frac{nk}{P} \tag{3.25}$$

Hence, rearranging equation (3.24) we can rewrite the formula for the variation in the rent to price ratio as:

$$\frac{u_{t+1} - u_t}{u_t} = \frac{P_t}{P_{t+1}} - 1 \tag{3.26}$$

From this equation we can extrapolate again that, if there is an appraisal of the property prices from period t to period $t+1$, the effect of deterioration on the rent to price ratio will be negative.

Moreover, and most importantly (since this implication was already proved), because we also proved that, given the same level of land appraisal, the property price of location A grows more than the property price of location B, then:

$$\frac{P_{A,t}}{P_{A,t+1}} < \frac{P_{B,t}}{P_{B,t+1}} \tag{3.27}$$

which implies that

$$\frac{P_{A,t}}{P_{A,t+1}} - 1 < \frac{P_{B,t}}{P_{B,t+1}} - 1 \tag{3.28}$$

This is the proof that the effect of deterioration cost on the rent to price ratio, during a boom period, will be more relevant (and negative) in the more expensive locations.

Obviously, this simple framework does not aim to provide a justification for the whole within and between variation of the rent to price ratio but, as previously said, it provides a further mechanism of price adjustment in the housing market which appears to be in line with what we have seen in the recent years.

Hence, in this paper I propose a modified version of the user cost equation which, however, may provide better insights on the rent to price divergence:

$$u_t = r_t + \omega_t + \delta_{i,t} + \gamma_t - \alpha_t g_t \tag{3.29}$$

where g_t is expected capital gain of land, $\delta_{i,t}$ is the rate of deterioration (i.e. $\frac{1}{n}\left[1 - \frac{P_{L,t}}{P_t}\right]$) which is assumed to vary across location and within time, given that it remains constant in nominal terms. As usual, r_t, ω_t and γ_t are respectively the mortgage interest rate, transaction costs and a risk premium for the owning of the property.

3.2 Data and Methodology

In order to test these hypotheses, we use a dataset provided by the main property advertisement website in Italy.

The dataset is a panel dataset of the area of Milan with monthly observations that span from January 2016 to December 2021. The data are further aggregated at the quarterly level in order to deal with missing data and potential outliers. The municipality of Milan is divided in 144 micro areas which have been defined by real estate practitioners taking into consideration the characteristics of the housing market. This should guarantee a sufficient degree of homogeneity in the properties that contribute to the creation of the neighbourhood indexes. The dataset contains information on the average sale and rent price for: all property available in dataset in the reference period, property classified by their structure (Apartment, detached, loft, ..) and property classified by their refurbishment level(new, completely refurbished, average conditions and in need of refurbishment). Unfortunately, the combination of types and refurbishment level is not available, and we will have to control for possible sources of bias deriving either from differences in the quality of the property or in their structure.

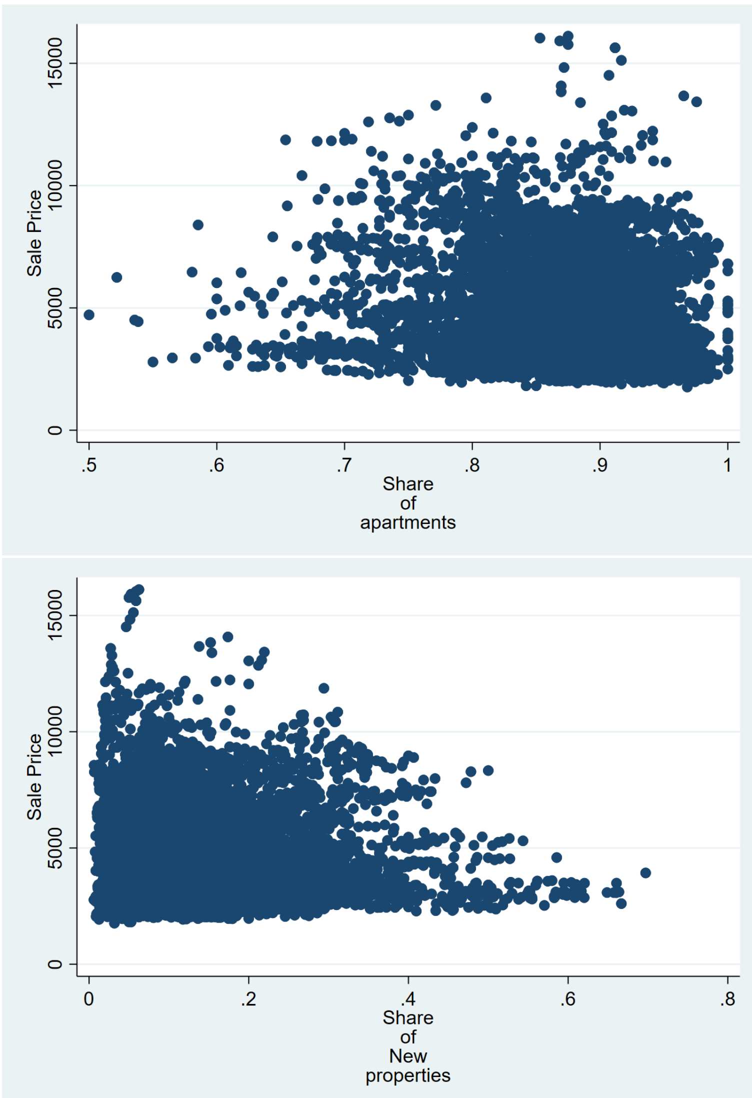
Table 3.1: Summary statistics

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**
Sale price	4805	2296	1765	16021
Rent price	17.29	4.05	8.2	30.99
Rent to Price	4.81%	1.24%	2.05%	9.90%
N		2871		

Table 4.1 provides an idea of average sales and rental prices in the period 2016-2021 in the Municipality of Milan taking into consideration all the available data. As you can see, the average asking price for property for sale is 4805€ but prices range from 1765€ to 16021€; hence, the average maximum price in the sample is about nine times larger than the average price in the cheapest areas. On the rent side, asking prices do not vary as much; indeed, the maximum price asked in the period is only 3.8 times larger than the least expensive observation. These values lead to heterogeneity in the rent to price ratio and, as already said, in this work I will try to assess the role of housing deterioration costs in shaping these differences.

The main idea is that, given the same quality, building costs can't vary as much as property prices; hence, any model that approximate deterioration cost as a common percentage of property price would provide an overestimation of this cost in the most expensive areas and an underestimation in the least expensive ones.
In order to minimize the potential bias and use the best available data, I show that the variance in the quality of refurbishment is much bigger than the variance in the property structure. In this regard, the analysis on the number of ads included in the sample shows that the average share of listings, in each area and period, that are classified as "apartment" is equal to $86,4\%$; moreover, another 6% of the sample is, on average, classified as penthouse which can however be considered a sub-category of apartment. On the other side, the maintenance status is much more heterogeneous; Hence, price estimates could be much more affected by the differences in the quality than in the property structure.

Figure 3.1: Correlation between Sale Price with the share of "apartments" and the share of properties in "Excellent condition"



The Graph shows the correlation between prices and the share of all listings that are classified as "apartment" and "New/Excellent condition".

Figure 3.1 provide a graphical idea of the correlation between the average property sale price with the share of apartments, in the same period and location, that are in "excellent condition" and with the share of properties that are classified as "apartment". As you can see, for any price level, the share of apartments represents a very large share of the whole sample and there seems to be no correlation with the price level. On the other hand, the share of properties in the sample that are in "excellent condition" represents a lower share of the sample. This implies that potential sources of bias could more likely derive from differences in the refurbishment level than from the type of structure.

Moreover, it has already been proved in the literature that properties for rent are, on average, of lower quality than those for sale. Hence, if we do not control for this type of distortions, our rent to price ratio estimates would probably be downward biased.

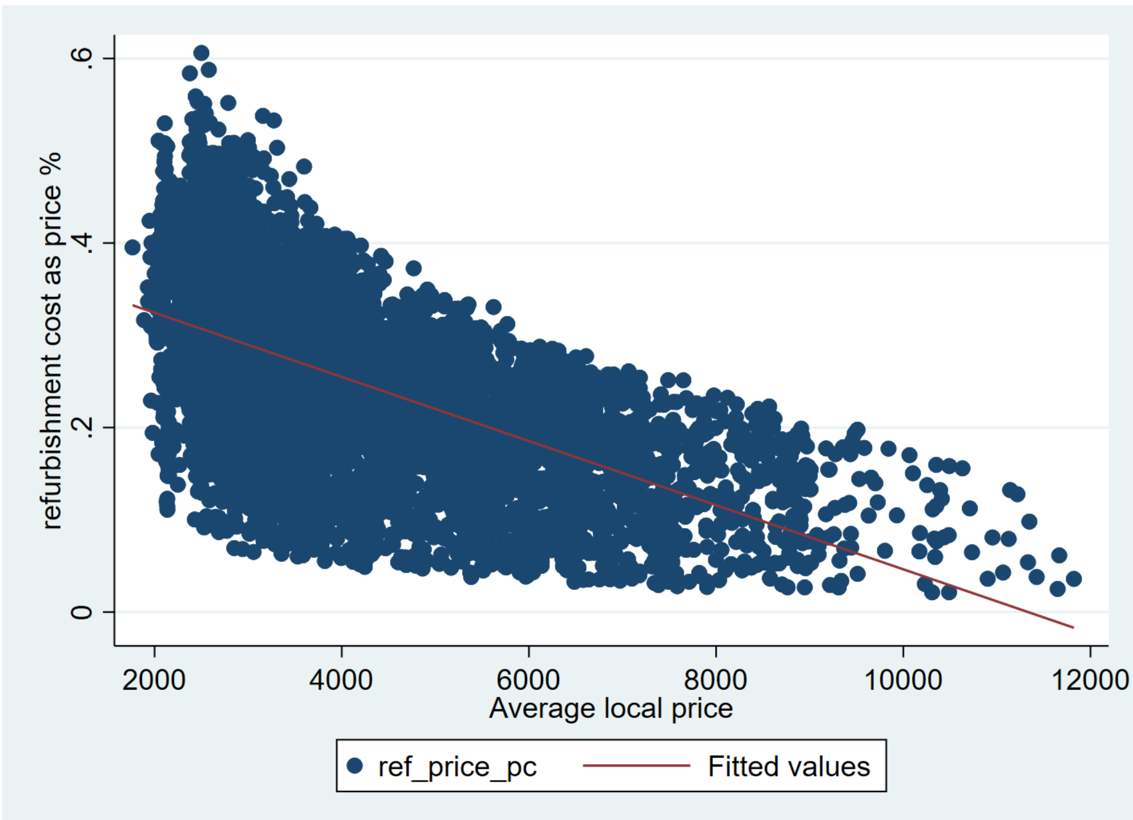
Due to all the above reasons, the RtP ratio index is constructed using the sample of properties in "excellent refurbishment condition" in order to provide the best achievable approximation.

In table 4.1, I provide a summary table of the statistics Sale price, rent price and rent to price ratio.

In order to test the cost homogeneity assumption, the nominal refurbishment cost at the neighbourhood level is computed as the difference between the average price for new properties and the average price for property that are in need of refurbishment.

Figure 3.2 shows the correlation the average impact of refurbishment on property

Figure 3.2: The impact of refurbishment price on the property value



The overall average price is plotted on the percentage cost of refurbishment that is computed as:

$$\frac{\text{(Average price for "New" properties - Average price for properties "in need of refurbishment")}}{\text{Average price for "New" properties"}} \tag{3.30}$$

values; although the cost of refurbishment seems to be positively correlated with property prices (Fig. 6.7 in the Appendix), when we plot the impact of refurbishment cost (constructed as "nominal refurbishment cost"/"sale property price") we see that price variability is much stronger and the impact of refurbishment on housing tends to decrease with prices. Moreover, I expect this estimate to represent a lower bound since I am unable to control for the quality of refurbishment which I expect to be positively correlated with the property value.

These two graphs seem to suggest deterioration costs cannot be considered as a fixed percentage of the property value and some form of adjustment is required.

Moreover, the dataset provides information on the average time a rent advertisement stays on the website[3] and on the average number of contacts (i.e. Request for information) the publisher of the ads receives. If we conceptualize the idea of rent into the financial market, we could think of the rent payment as the distribution of a monthly dividend; however, because the market is characterised by large share of vacancies, the owner may not be able to rent its property and receive the expected dividend. Then, this information is used to construct two different proxies for market liquidity in order to control if they can provide a possible explanation for the differences in housing yields.

The two proxies for market liquidity are constructed as:

$$[\text{local liquidity proxy 1}]_{i,t} = 1 - \frac{\text{Average time on the website}_{i,t}}{\text{Maximum all}} \tag{3.31}$$

[3] measured in number of months

$$[\text{local liquidity proxy 2}]_{i,t} = \frac{\text{Average number of contacts for advertisement}_{i,t}}{\text{Maximum all}} \tag{3.32}$$

where "Maximum all" is, respectively, the maximum average number of months in the market and ads contact requests across all periods and areas.

Figure 6.8 and 6.9 in the appendix show, for both measures, a positive correlation between liquidity and rent to price ratio. This is not the result someone would expect in the financial market because a stock with an high probability to be sold at the current price should, all else being equal, be considered less risky and, as a consequence, investors should be willing to accept a lower dividend. The positive correlation between housing yields (dividends) and market liquidity seems to suggest that the latter cannot be accounted as a plausible justification for the observed heterogeneity in housing yields.

The rent to price ratio is computed as:

$$\left(\frac{R}{P}\right)_{i,t} = \frac{12 \times R_{i,t}}{P_{i,t}} \tag{3.33}$$

where i and t denotes respectively the neighbourhood and the quarter. Rental prices R are expressed in monthly value, exclusive of bill expenses[4].

[4]Rents and prices are aggregated at the quarterly level by averaging the monthly observations

The empirical analysis is divided in two main steps. The first part will be devoted to providing empirical evidence in support of the main assumption of the model. The hypothesis of homogeneity in the housing costs is indeed crucial in shaping the impact of deterioration over time and between different economic conditions. The second part of the analysis will instead replicate the standard exercise on housing return predictability by imposing the market equilibrium condition in the modified version of the user cost equation[5].

The model starts from the assumption that building costs are, given the same quality, homogeneous across locations (in this work the spatial dimension is the neighbourhood level). Because of this, the relative impact of deterioration varies across the different quantiles of the housing price distribution; this implies that lower price properties will have a higher deterioration rate.

In order to test this hypothesis, I am going to exploit a very recent tax incentive that was introduced by the Italian Government in May 2020. This incentive, called Superbonus 110%, allows private household to receive a tax credit equal to 110% of the refurbishment expenses aimed at improving the seismic risk and energy dispersion of the properties. As a matter of facts, household can completely renew for free a large share of their refurbishment expenses.

The incentive has been designed in order to try not to discriminate across people

in the reference period t in order to deal with missing observations. All prices are expressed in value per square meter

[5]The modified version of the user cost equation imposes deterioration rate $\delta = \frac{1}{n}\left[1 - \frac{P_L}{P}\right]$

with different fiscal or liquidity capacity; indeed, the system provide the opportunity to avoid the liquidity disbursement by selling the tax credit to the construction company (invoice discount) or to a bank which will then provide the money to pay for the expenses to the landlord (credit transfer and loan).

Moreover, prices are capped from regional price lists; this implies that there isn't any variation across neighbourhoods in the amount of money each household receives. For the way the program is implemented, it seems that the regulator agrees with the assumption on the homogeneity in the cost of refurbishment.

The empirical analysis tries to exploit this incentive to show that, providing a fix amount of nominal money in order to refurbish old property will generate higher benefit in the least expensive areas.

The main issue with the empirical strategy is that the incentive was announced in late March 2020 and officially started in May 2020, right in the middle of the pandemic. In this particular period, the government responses to the pandemic had forced people to work and spend the free time inside their housing. This situation has brought households to change their housing preferences towards bigger and more comfortable properties and outdoor spaces.

The available dataset does not allow to control for such characteristics and, as a consequence, looking at the price level across neighbourhoods without taking into consideration this shift in consumer preferences would provide uninterpretable results.

Then, in order to provide reliable results in support of the model assumption, I will focus on the variation in the relative prices, demand and supply for newly constructed and old (in need of refurbishment) properties. The idea is that, while the pandemic may have shifted the preferences across locations and property characteristics, the only channel that may have changed the consumer preferences between new or old houses is the tax incentive provided by the Government.

A difference-in-difference regression with continuous treatment variable is implemented to take into consideration differences in housing costs; indeed, the variable used to analyse the effect of the tax incentive is the product of a dummy variable for the pre/post treatment effect (D_t) and a continuous variable ($Treat_i$) constructed by normalizing prices (hence, by construction, deterioration rate) between zero and one.

The dummy variable is equal to zero for all periods until the first quarter of 2020 and to one for all the following periods, since the "Superbonus 110" was announced in late March, although it came into effect only at the end of May.

The continuous variable is, more precisely, constructed as:

$$Treat_i = \frac{P_{i,16} - maxP_{16}}{minP_{16} - maxP_{16}} \tag{3.34}$$

where P_i is the average price for the properties in need of refurbishment in location "i", $maxP$ and $minP$ are respectively the maximum and minimum average price across all neighbourhoods and 16 represents the 16th quarter of the sample (October 2019 - December 2019)[6]. By doing so, the degree of treatment will be equal

[6] The index variable is constructed at period 16 in order to avoid possible distortion caused by the arrival of Covid19

to one in the least expensive locations (those with the higher level of deterioration rate) and to zero in the most expensive one, in accordance with the theoretical framework.

I also exploit a dynamic version of the treatment variable where the variable treat is computed at each period using prices at t-1. This allows to consider the mechanism of adjustment which may affect the degree of treatment across and within locations as time goes on.

Then, the static version of the model can be written as:

$$Y_{i,t} = \beta_0 + \beta_1 Superbonus_{i,t} + \beta_2 X_{i,t} + \alpha_i + \alpha_t + \epsilon_{i,t} \tag{3.35}$$

where

$$Superbonus_{i,t} = D_t \times Treat_i \tag{3.36}$$

while the dynamic equation will have:

$$Superbonus_{i,t} = D_t \times Treat_{i,t-1} \tag{3.37}$$

$Y_{i,t}$ is constructed as the ratio between "newly constructed properties" and those "in need of refurbishment" in the levels of prices, demand and supply (i.e. $Y_{i,t} =$

$\frac{New_{i,t}}{Old_{i,t}}$).

More precisely, for the effect on the level of prices the ratio is constructed using the average level of prices that are present on the website at the 15th of each month; the demand side is proxied using the average number of request for information each advertisement receives during the month in area i; finally, the supply side is represented by the number of listings entering in the reference period.

$X_{i,t}$ is a set of control which includes the share of new and old properties in the listings, the percentage of new listings[7] and the percentage of stock on sale[8] The dynamic version of the model is constructed updating the degree of treatment in order to account for the dynamism of the theoretical framework; however, a simultaneous change in the control and in the dependent variable, only for the price level regression, induced by a change in the level of the prices could induce a bias in the estimate. In order to solve this issue, the variable is constructed using the one period lagged price levels. Moreover, an increase in the average price for the properties in need of refurbishment[9] would produce, at the same time, a decrease in both variables and, as a consequence, a positive correlation between them. However, the result of the price level regression shows, as expected, a negative effect of the control on the dependent variable and this source of distortion only produces a downward bias of the estimate.

In order to control for possible sources of unobserved variation, neighbourhood level and time fixed effects are included in the regressions. Given the high granu-

[7]Constructed as $\frac{numberofnewlistingsforsale}{alllistingsforsale}$

[8]Constructed as $\frac{numberoflistingsforsale}{allhousingstockavailable}$

[9]The data used to construct the control and the dependent variable

larity of the dataset we should be able to prevent any potential distortion deriving from demographic and economic differences between neighbourhoods; moreover, the fixed effects allow to capture for the overall effect of the ”Superbonus 110” on the whole market and any potential constant difference in the trend of the two sample; by doing so, the control variable (Superbonus) should be able to capture the asymmetry across the neighbourhoods in the treatment received from the program in the relative prices, demand and supply between new and old properties. Finally, the percentage of advertisements of new and old homes on the total number of advertisements[10], the percentage of new listings and the percentage of listings on the total housing stock in the neighbourhood are added as controls.

3.3 Results

Table 6.2 provides the results of the equations for price, supply and demand.

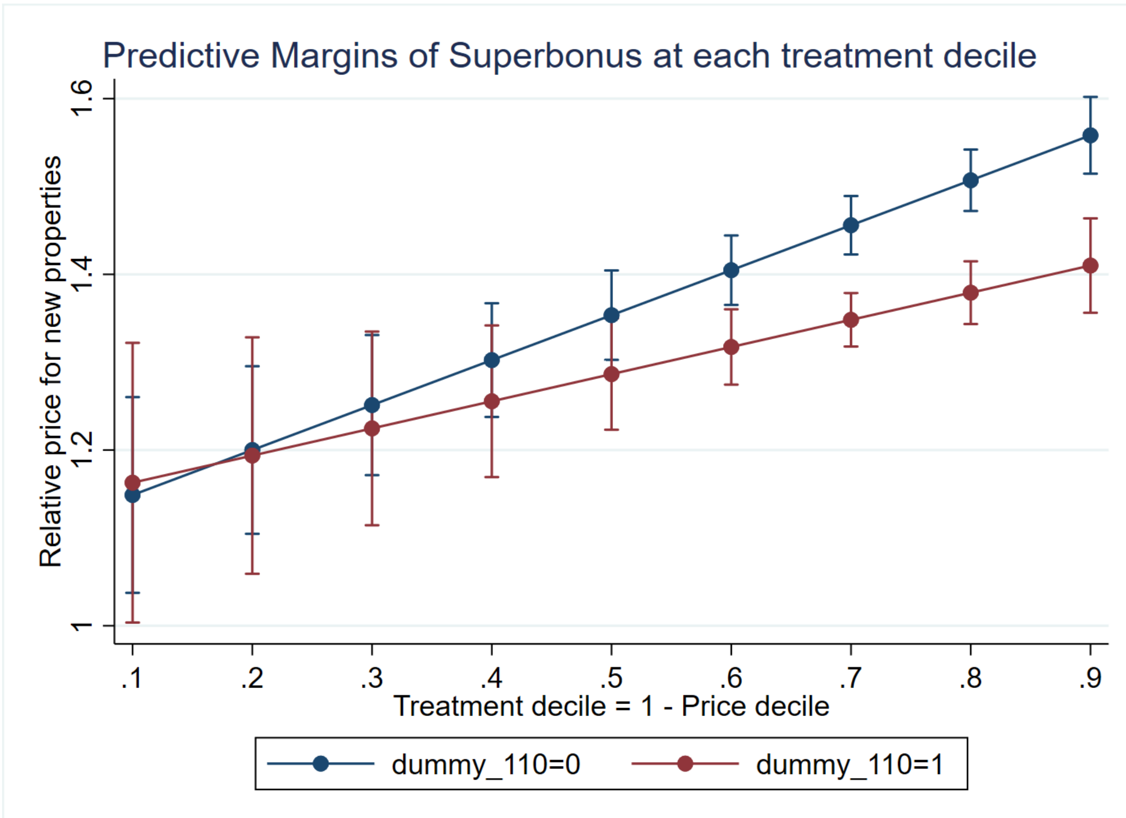
The price and supply regressions confirm our initial hypothesis about the heterogeneous impact of such a policy across the different quantiles of the price distribution.

Indeed, the negative sign of the variable ”Superbonus” indicates that as we approach the highest decile in the ”Superbonus” variable (i.e. The cheapest neighbourhoods, see (3.34) (3.36)) the impact of the policy on the price of new homes

[10]not included in the supply regression

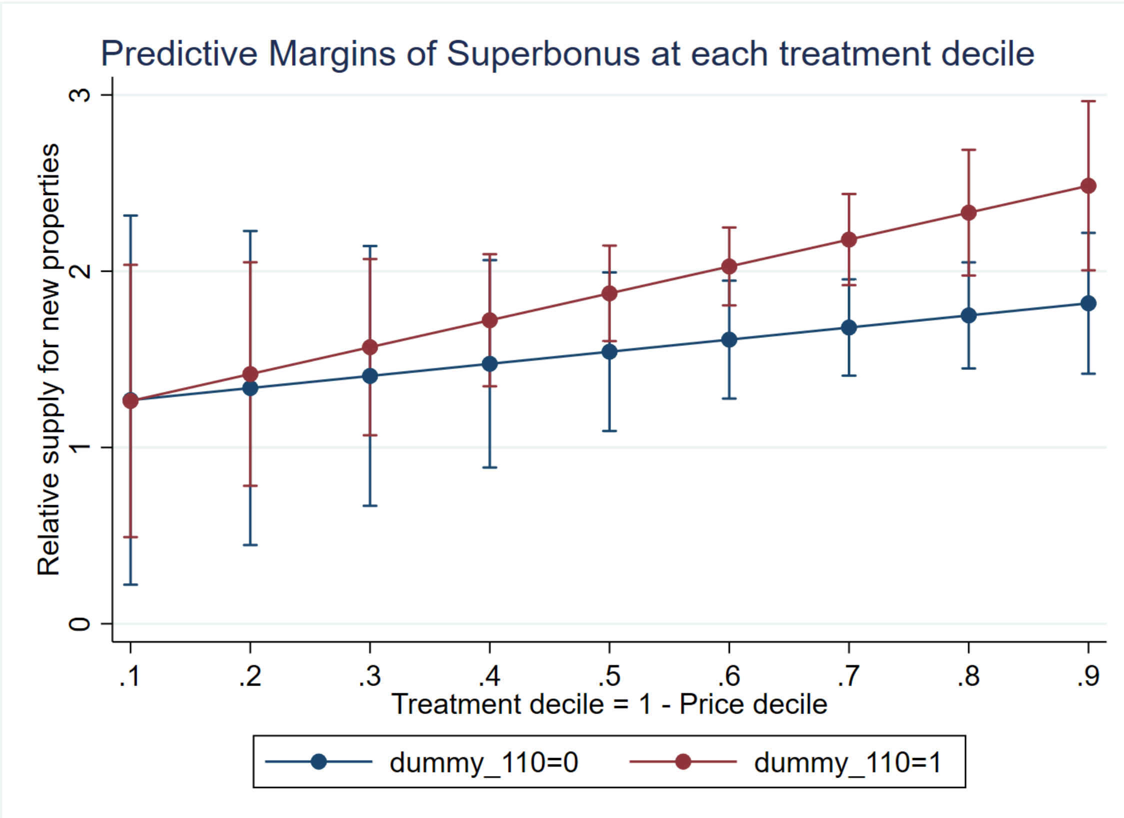
compared to the old ones was stronger. As we can notice from 3.3 the overall effect has generated, as expected, an overall appraisal of old properties but this appraisal was stronger in the least expensive neighbourhoods. In order to investigate to possible channel of transmission on the level of prices, we repeat the regressions on proxies for the supply and the demand of these types of properties.
In the supply equation, we still find significant evidence about the heterogeneous impact of the Superbonus on prices and we see that the relative supply of new properties has increased more at the least expensive neighbourhoods. The reason is that the opportunity to freely refurbish your property leads homeowners not to sell their property in order to exploit the benefit and this is perceived as a much bigger opportunity where the impact of refurbishment is higher.
On the other side, the demand regression does not provide significant results. The most reasonable underlying justification is that, given the relatively short time of the incentive, the possibility of looking for an old property in order to exploit the incentive has not been perceived as a profitable path to go through.
Furthermore, the shortage of building companies and the inability of the financial sector to provide a smooth system for the "credit transfer" and "invoice discount" solutions, have generated a customer selection mechanism which may have downward bias the estimates of all regressions.

Figure 3.3: Policy impact on the relative price for new properties



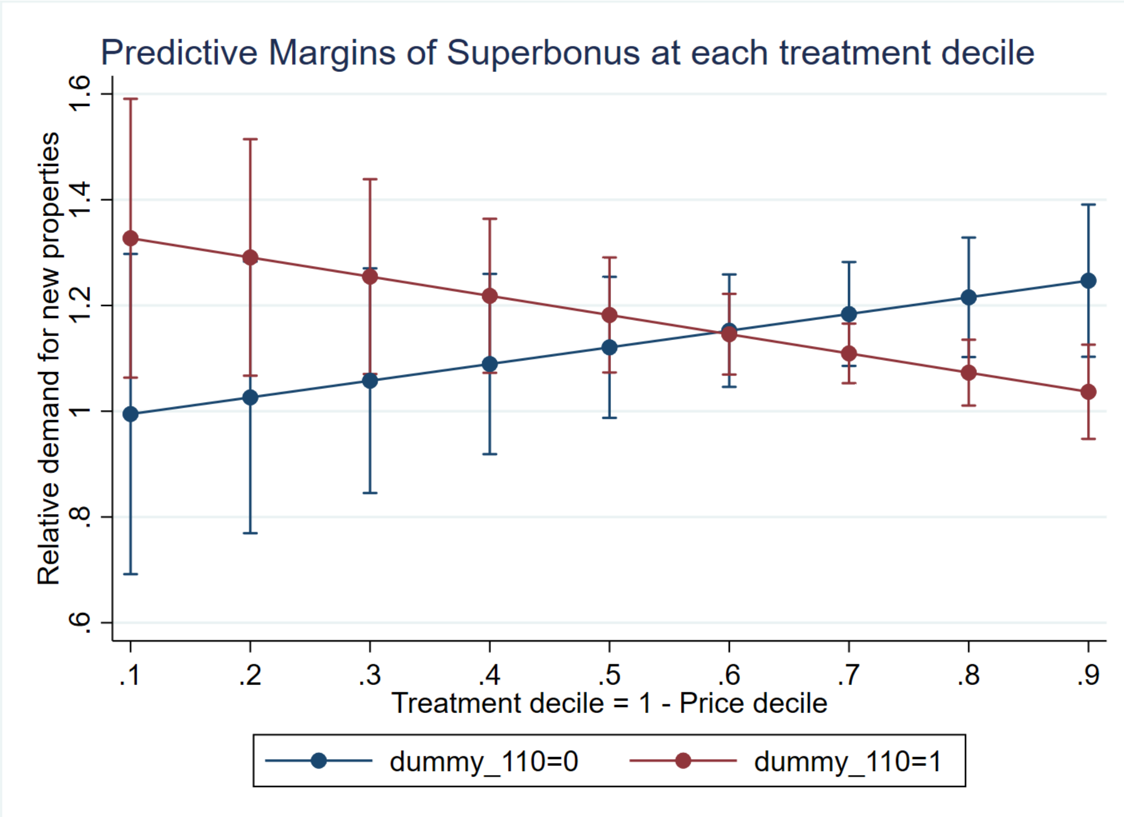
The graph shows the predicted relative price of new versus old properties, before(blu line) and after(red line) the implementation of the Superbonus, at each level of treatment decile. Following what is previously discussed, treatment decile is equal to $1 - "price"$. The graph shows that the relative price of new properties decrease after the implementation of the policy, especially in the least expensive neighbourhoods. Results seems to support the theoretical model.

Figure 3.4: Policy impact on the relative supply for new properties



The graph shows the predicted relative supply of new versus old properties, before (blu line) and after (red line) the implementation of the Superbonus, at each level of treatment decile. Following what is previously discussed, treatment percentile is equal to [1 − price percentile]. The graph shows that the relative supply of new properties increases after the implementation of the policy, especially in the least expensive neighbourhoods. Results seems to support the theoretical model. Housing supply is measured as the number of listings that are added in the reference period.

Figure 3.5: Policy impact on the demand for new properties



The graph shows the predicted relative demand of new versus old properties, before (blu line) and after (red line) the implementation of the Superbonus, at each level of treatment decile. Following what is previously discussed, treatment decile is equal to $1 - "price"$. The graph shows that the relative demand of new properties increases after the implementation of the policy in the more expensive areas, while it decreases in the least expensive neighbourhoods Housing demand is measured as the number of request for information that are sent in the reference period.

In order to quantify the magnitude of these effects, Figures 3.3, 3.4 and 3.5

show the average predicted values[11] of the relative price, supply and demand of new properties at the different deciles of the distribution[12], before and after the implementation of the policy. Just to provide an example, the relative price of new with respect to old properties at the ninth decile of the price distribution is 5.28% lower than before the Superbonus was introduced, while the relative price at the tenth decile is reduced by 8.68%.

To conclude, the empirical evidence seems to support the assumption of the theoretical model by showing that housing costs play a role in the equilibrium levels of prices, demand and supply; however, additional research and data could help to provide more interpretable results. According to my view, this research sets a lower bound for the possible effects in terms of redistribution since, as I said, a better planned incentive could have produced much stronger and robust results; indeed, for example, a longer time horizon could have led to the activation of the demand channel and reduced part of the problems with the supply chain, leading to an efficiency both from a social and environmental point of view.

[11] Table 6.2 in the appendix provide the numerical overview of the estimates.

[12] Remember that the ninth decile of the treatment coincide with the tenth decile of the price distribution, due to the way the "Treat" variable is constructed

4 Inequality and affordability: implications for housing

In a booming housing market, the consumption of basic needs is reduced by the increasing housing costs. The objective of policy makers should be to foster household's welfare and inclusion. Housing costs represents households' main item of expenditure; however, in addition to a consumption good, the house also represents a form of investment in which to allocate the accumulated wealth. The city of Milan has experienced, in the last 10 years, an incredible rise in the value of property; however, the level of income has not followed the same growth and the city has experienced an unprecedented affordability crisis. In such a context, we would expect a slow down in the value of properties, given the increasing rate of unaffordability; however, as of now, the housing market seems not to converge towards a more sustainable equilibrium. This work exploits information on the residential composition in terms of income and wealth at the CAP level in combination with a rich real estate dataset in order to monitor the extent of this crisis and to understand whether households' welfare and the Italian tax system on properties can provide a ratio for this trend.

The city of Milan is located in the Italian region of Lombardy. The city is populated by 1373517 residents (Bilancio demografico anno 2022, ISTAT) in an area of 181,67 km2. After the second world war the city has experienced a huge migratory flow from other regions leading to a strong process of suburbanization. The city is divided in 9 municipalities within which 38 areas are further identified by a different postal code (CAP).

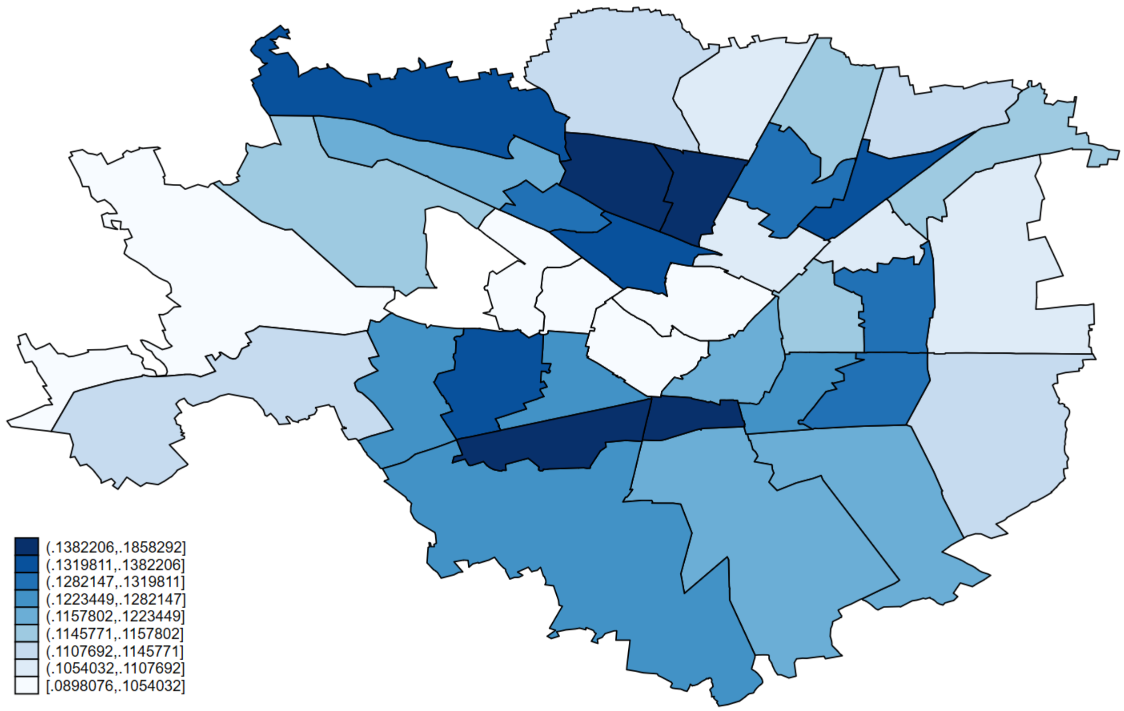
These areas are characterized by a multiplicity of differences, part of which I intend to analyse in this paper in order to provide a general overview and to understand some of the possible mechanisms that could affect household's residential choices. Table 4.1 provides some statistics for sale and rental price of the 38 areas in which the municipality is divided. As you can see, the sale and rental prices per sqm varies greatly within the city.

Table 4.1: Summary statistics

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**
Sale price	4180	1836	2043	10095
Income	37020	18115	18708	101430

By looking at the average income and price of properties in each area of the city (Figures 6.10 and 6.11), it seems reasonable to justify the price of housing and its affordability; indeed, although income and house value tend to be greater in the most central locations, the spatial distribution of the price to income ratio (Figure 4.1) does not seem to follow the same pattern.

Figure 4.1: Price to Income ratio



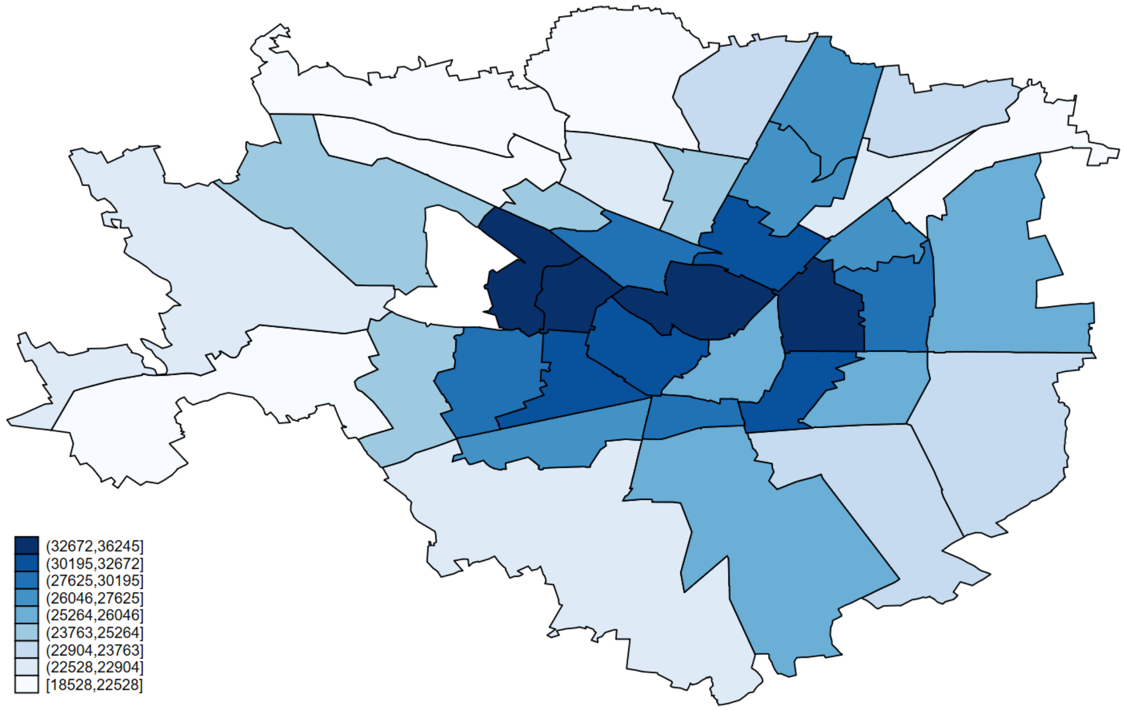
The Graph shows the local distribution (CAP level) of the price to income ratio. Average price of properties and income are used to construct the ratio. The mean of income is constructed as the ratio between all income generated in the area and workers.

In such a context, we would expect that the availability of resources for other consumption is not altered by housing costs and, on average, households invest the same portion of their income on housing. However, the consumption of necessary goods cannot be assumed to be homothetic and a deeper analysis on the absolute levels of income and prices has to be done to take into account all these factors. In order to disentangle the main issues previously described, I would like to start from the concept of inequality. Indeed, taking into consideration the average level of salaries would make sense if those were uniformly distributed. This paper will show that the distributions of income and wealth at the neighbourhood level tend to be right-skewed and, above all, the magnitude of skewness is positively correlated with the mean values; as a result, I will show that the wealthiest locations are also the most unequal.

The last few decades have been characterized by a huge rise in inequality, within and across country. Looking at the top income workers (those earnings more than 120.000€ gross per year) we can see that, although they are far more concentrated in the most central areas, the average share of workers belonging to this group is only 3,87%, the maximum value is 16.5% in Brera and only four areas out of 38 have a share of this group of taxpayers exceeding 10%.

The affordability of housing hardly affects top income earners but, on the other hand, is a huge problem for most of the population. If we concentrate on the income composition of the neighbourhoods without taking into consideration the share of top income earners, we can see that the heterogeneity in income across location is not as higher as highlighted before; indeed, the average income in the top locations only doubles the bottom groups, with a maximum value of 25408€ and a minimum of 14105€ (fig. 4.2). As a consequence, housing costs relative impact on households' balance sheets varies greatly across the different areas.

Figure 4.2: Average income per capita taking into account only those earning less than 120.000€



The Graph shows the local distribution (CAP level) of the mean level of income without taking into account workers that earns less than 120.000 euros per year.

An increasing relative cost of housing should dampen the demand for rents and sales, especially in those areas where housing is strongly unaffordable for the population. However, while the income levels have not been growing at the same speed of housing, the last ten years have been characterised by a boost in inequality, where a consistent and increasing share of income and wealth is detained by a relative small share of the population.

In such a context, according to my view, the Italian tax system is encouraging the owning of real estate asset in the form of investment; as a consequence, while this does not allow the market to converge towards more sustainable levels, a reduction in the accessibility to mortgages is shifting a substantial portion of the demand towards rentals. This work will be devoted to providing a general overview of the labour and real estate market and, through the use of key indicators, it will attempt to provide a representation of the income and welfare composition of residents, in order to understand the extent and the dispersion of the affordability crises that has invested the city of Milan. As it was previously mentioned, looking at mean levels of income and wealth can be misleading in the understanding of the households living conditions in an area; indeed, the city of Milan presents a very heterogeneous composition in terms of income, wealth and inequality; as a matter of fact, I will show that relatively small shares of residents entail huge amount of income and wealth while the majority of the others lies below the mean values.
The last section will provide a discussion about the Italian fiscal system in the housing market, its possible implications and, to conclude, a tax reform idea aimed at dampening the real estate boom and affordability problem.

4.1 Data

In order to proceed with the analysis, the work combines different sources of data. As for the previous analysis, the level of rent and prices are taken from the main online property advertisement in Italy. The listings of properties for rent and sale are extracted each month on the same day and aggregated at the micro-level[1] in order to construct local averages. The dataset allows to distinguish information on the average sale and rental asking price for: all property available in dataset in the reference period, property classified by their structure (Apartment, detached, loft, ..) and property classified by their refurbishment level (new, completely refurbished, average conditions and in need of refurbishment). Unfortunately, the combination of types and refurbishment level is not available, and we will have to control for possible sources of bias deriving either from differences in the quality of the property or in their structure. In order to minimize the potential bias and use the best available data, I show that the variance in the quality of refurbishment is much bigger than the variance in the property structure. In this regard, the analysis on the number of ads included in the sample shows that the average share of listings, in each area and period, that are classified as "apartment" is equal to 86,4%; moreover, another 6% of the sample is, on average, classified as penthouse which can be considered as a sub-category. On the other side, the maintenance status is much more heterogeneous; indeed, in each period and area, there is an average of 41,8% of the listings which are in "excellent condition", 22,4% that are in "good condition" and 11,2% that are "in need of refurbishment". Finally, there is a remaining share of the listings that are classified as "new/in construction"

[1] The city of Milan is divided in 144 micro areas which have been defined by real estate practitioners taking into consideration the characteristics of the housing market. This should guarantee a sufficient degree of homogeneity in the properties that contribute to the creation of the neighbourhood indexes

or are not classified. Hence, price estimates could be much more affected by the differences in the degree of refurbishment than in the property structure.

Figure (3.1) provide a graphical idea of the correlation between the average property sale price with the share of listings classified in "excellent condition" and with the share of listings classified as "apartment". As you can see, for any price level, the share of apartments represents a very large share of the whole sample and there seems to be no correlation with the price level. On the other hand, the share of properties in the sample that are in "excellent condition" not only represents a much lower share of the sample but the refurbishment level seems to be positively correlated with the sale prices. This implies that potential sources of bias could much more likely derive from differences in the refurbishment level than from the type of structure.

Moreover, it has already been proved in the literature that properties for rent are, on average, of lower quality than those for sale. Hence, if we do not control for this type of distortions, our rent to price ratio estimates would be downward biased.

Due to all the above reasons, the local indexes are constructed using the sample of properties in "excellent refurbishment condition" in order to provide the best achievable approximation.

The rent to price ratio is computed as:

$$\left(\frac{R}{P}\right)_{i,t} = \frac{12 \times R_{i,t}}{P_{i,t}} \tag{4.1}$$

where i and t denotes respectively the neighbourhood and the quarter. Rental prices R are expressed in monthly value, exclusive of bill expenses[2].

In table 4.1, I provide a summary table of the statistics Sale price, rent price and rent to price ratio.

Table 4.2: Summary statistics

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**
Sale price	4180	1836	2043	10095
Rent price	17.53	3.38	11.2	26.88
Rent to Price	5.52	1.31	3.19	8.22

In order to investigate income and wealth conditions across neighbourhoods, "Agenzia delle Entrate" has been providing since 2019 a set of information at the CAP level (the city of Milan is divided in 38 CAP areas). The dataset contains the number of taxpayers and the total nominal amount of taxable income for each different source of income (work, pension, housing) and across 8 different class of taxpayers (below zero, 0to10.000; 10.000to15.000; 15.000to26.000; 26.000to55.000; 55.000to75.000; 75.000to120.000; above 120.000); unfortunately, the combination of the two is not available. Income is considered as before tax.

Housing indexes for CAP areas are constructed as an average of the micro areas included in each CAP.

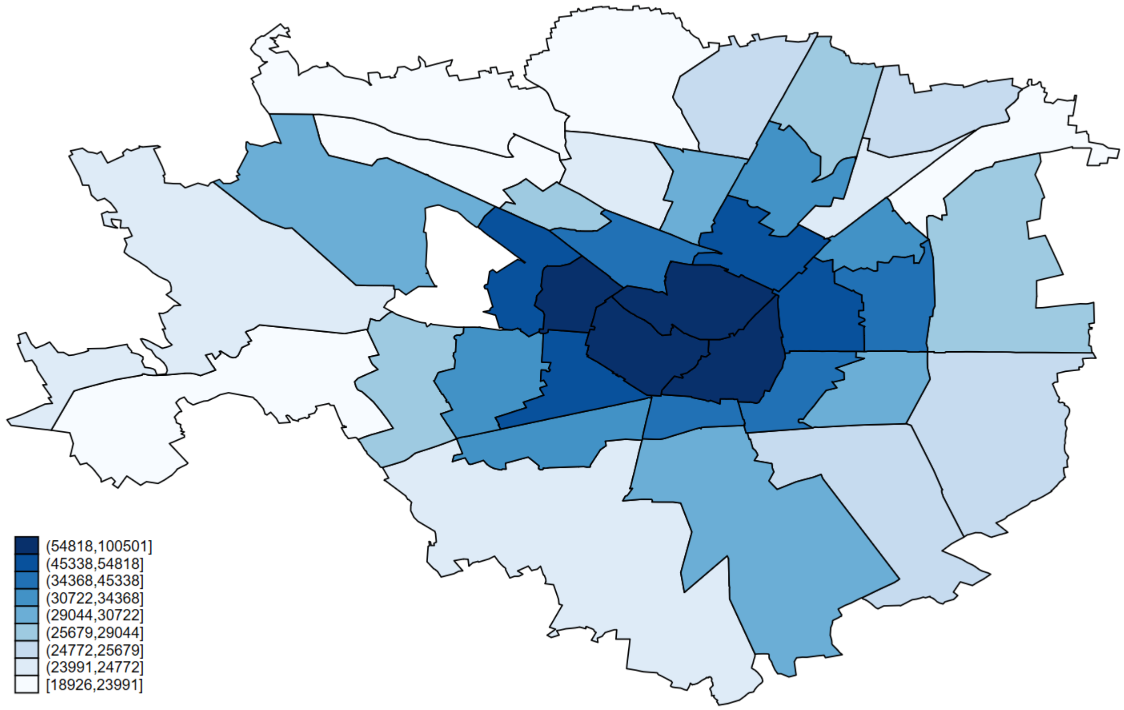
[2]Rents and prices are aggregated at the quarterly level by averaging the monthly observations in the reference period t in order to deal with missing observations. All prices are expressed in value per square meter

The analysis will be conducted on the data available for year 2019. Finally, the difference between the cadastral value and the market value is analysed for all italian regional capitals using the values provided by "UIL Servizio Lavoro, Coesione e Territorio".

4.2 Households Income and housing

As shown in figure 6.10, the most central areas tend to have an higher average amount of income per capita; in particular, the average income per capita in the top location is five times greater than the one of the bottom area.

Figure 4.3: Average amount of income per capita

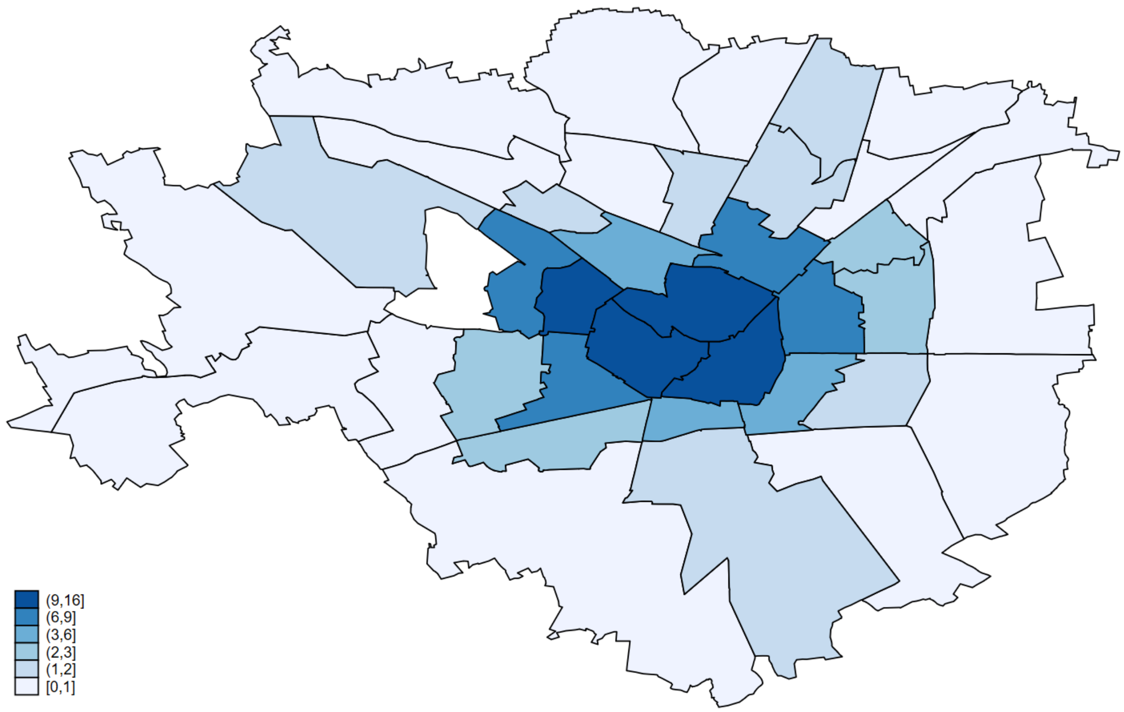


The Graph shows the local mean income per capita taking into account all workers. average income is constructed assuming uniform distribution within each class of income group. This is due to the fact that the dataset only provides information on the total amount of income generated in each class and the number of workers. No information are provided about the distribution of workers within each category.
The index at the CAP level is constructed as a weighted sum of the prices of the micro-areas (from Immobiliare.it) that are included in CAP zone. Micro-areas are assigned to CAP by looking at the position of their centroids.

This difference between neighbourhoods seems in line with the average sale price of housing which, however, tend to be much more homogeneous within the neighbourhood. In order to understand the impact of housing cost on residents, it is interesting to highlight that most of the difference in income is driven by the group of people earning more than 120.000 per year; nevertheless, this group of top income workers represents a relatively small percentage of the total composition of the neighbourhoods; indeed, as shown in figure 4.4, only 4 CAP areas (20121; 20122; 20123; 20145) out of 38 have a share of top income earners that exceed 10% [3], with a maximum value of $16,36\%$.

[3] To notice that the analysis is conducted on taxpayers only (not the whole amount of residents); hence this is an upper bounded estimate of this information

Figure 4.4: Share of taxpayers earning more than 120.000€



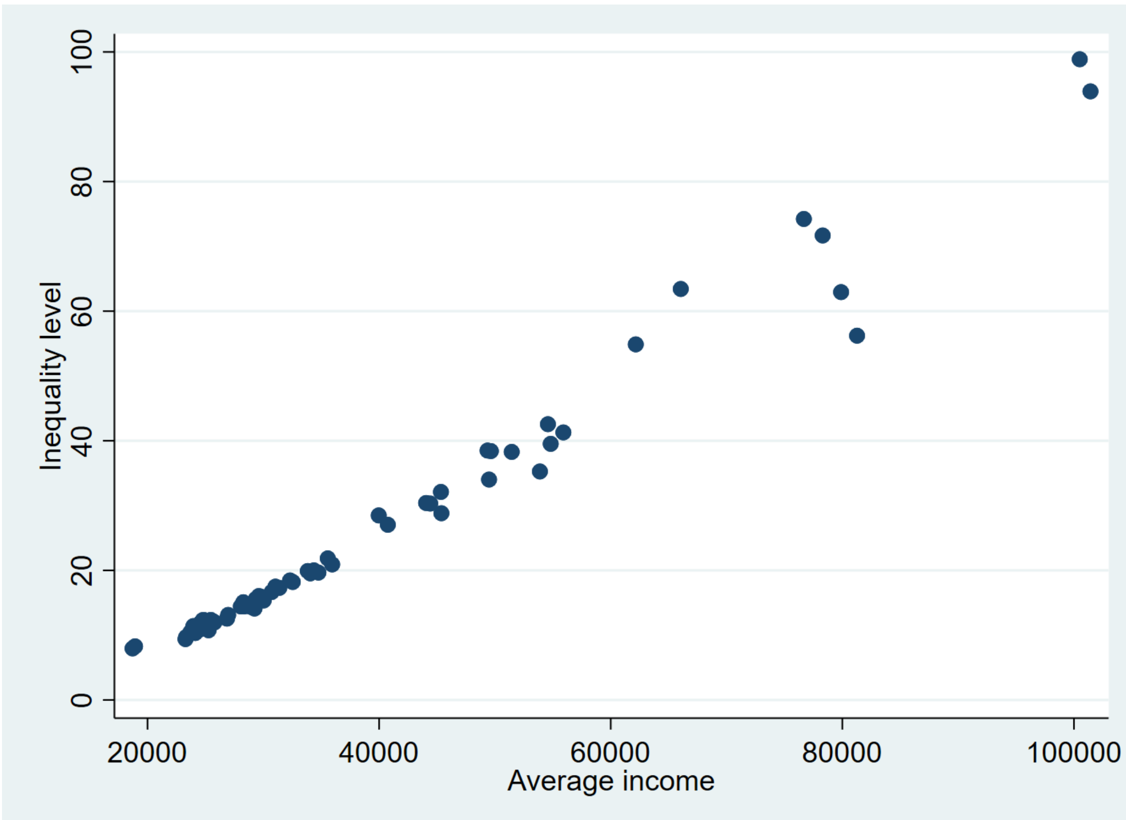
The Graph shows the share of taxpayers that earns more than 120.000 euros per year.

In order to understand how much this group of workers impacts the local economy and to provide an idea of the shape of the distribution of the income in each area, I have decided to look at the correlation between income and inequality. The measure of inequality used for the analysis is the official Eurostat inequality index[4] S80/S20, which is constructed as the sum of the incomes of the richest 20th divided by the sum of the incomes of the poorest 20th.

[4]Differently from the original Eurostat index, this version does not take into account any form of government redistribution such as social benefits or taxes

$$\textbf{Inequality}_i = \frac{\textbf{sum of income generated by the richest 20th percentile}_i}{\textbf{sum of income generated by the poorest 20th percentile}_i}$$

Figure 4.5: Correlation between inequality and income



The Graph shows the correlation at the local level between average income and neighbourhood inequality. The inequality measure is constructed as described in the section.

Figure 4.5 clearly shows that, the degree of inequality is strictly correlated with the average income in the location.

This result may imply that the skewness of the income distribution is positively correlated with its mean value and, although it may seem trivial, has important implications that must necessarily be taken into account in this analysis. First of all, since I will assume a uniform distribution within each single group of taxpayers, the measures of affordability that I will propose can be considered as a very conservative estimate. Moreover, the distortion generated by this correlation is larger in the areas where housing is more expensive, given that income and house prices are positively correlated.

Finally, It is important to consider that income levels refer to pre-tax amounts reported by taxpayers and, given that housing costs cannot be deducted, we need to account for taxes in order to correctly assess the impact of housing costs on households spending capacity.

Since top income earners[5] are less likely to be affected by the rise in housing prices and given that this group of taxpayers only represent 3,5% of the whole taxpayers in Milan, we would like to compare the local affordability and the spending possibility of those workers who do not belong to this group.

Figure 4.2 provide an idea of the after-tax average income per capita without taking into considerations those earning more than 120.000 euro per year. As we can see from the map, although the values are still higher in the most central areas, the level of the richest location is only 80% higher than the amount of the location at the bottom of the group[6]. Hence, while the difference in income when taking into consideration the whole sample seems closer to the gap in the sale prices across

[5]Those earning a gross income higher than 120.000€

[6]Remember that, when taking into consideration all the groups of taxpayers and without taxes, the difference was 500%

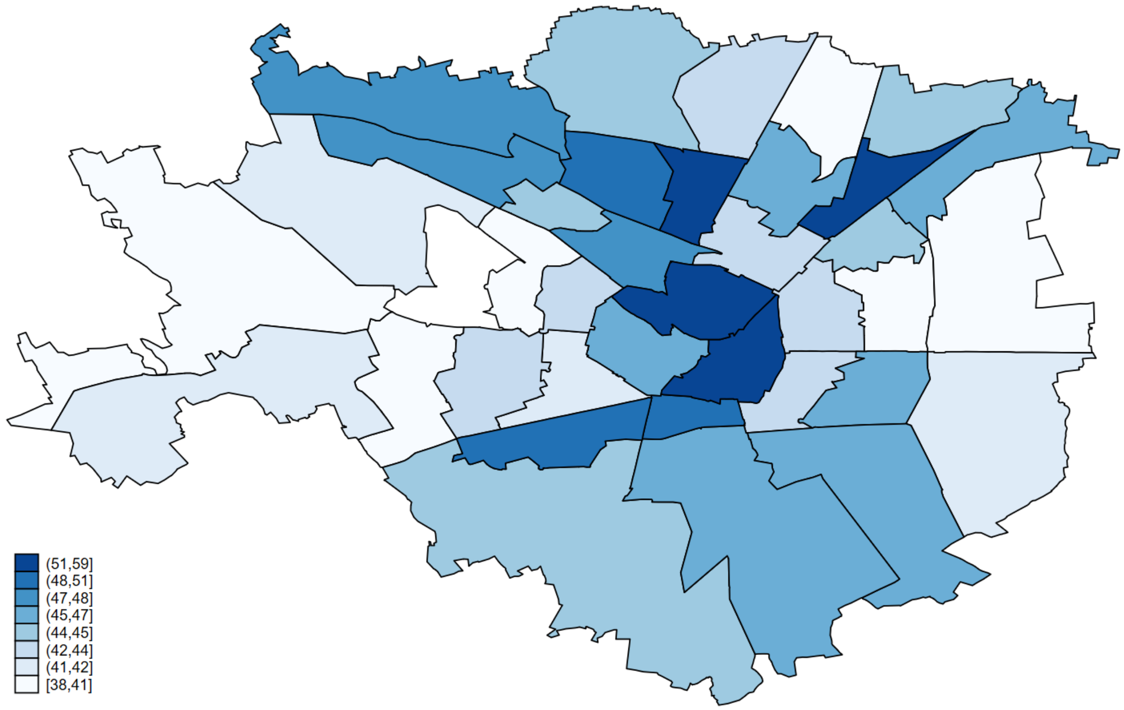
locations, the heterogeneity in income of this sub-group of workers is closer to the gap of the rental market.

In order to proceed with a measure of housing affordability, I will start with a brief description of the main assumptions of the model. The idea relies on the notion of cost taken from the user-cost literature so that the cost of renting can be considered as the way to measure housing expenditure.

As it was previously shown, the average cost for a square meter in the city of Milan is 17.53€, with a minimum of 11.2 and a maximum of 26.88. Assuming that those agents could live by their own, I hypothesize a minimum size for a property of 35sqm. In such a way, I can create a map of the local annualized cost for housing[7]. Then, we are now able to provide an estimate for the local average share of income devoted to housing (Figure 4.6) and the amount of money left for the consumption of other goods (Figure 4.7).

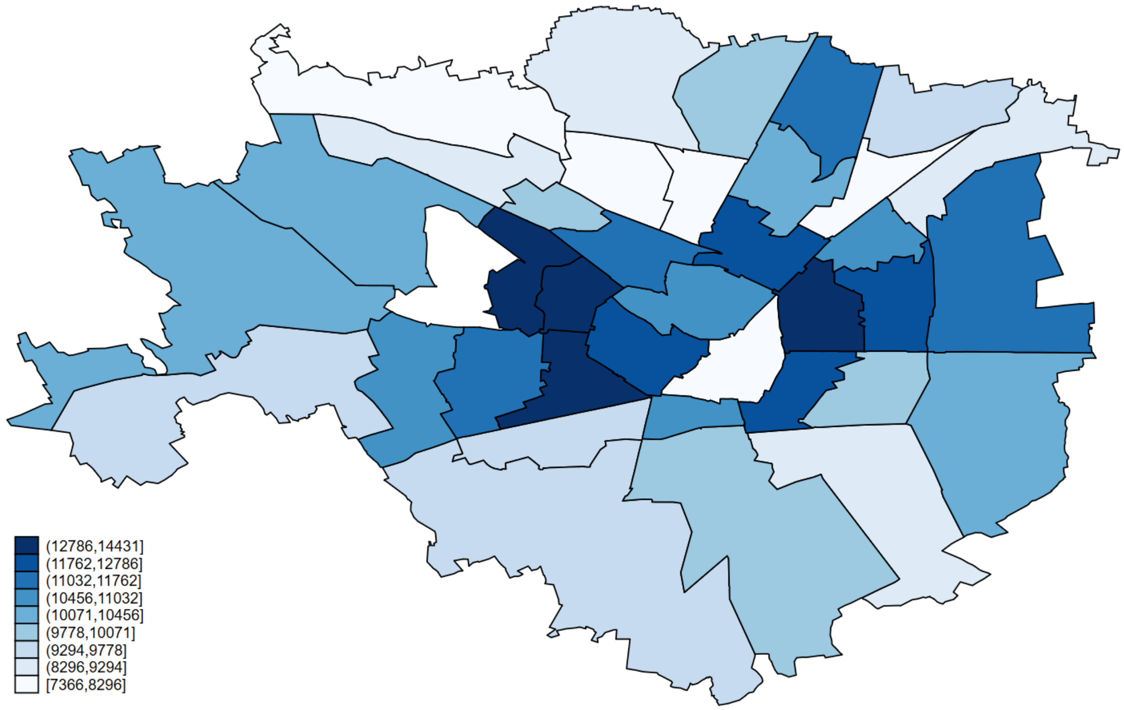
[7]Another 100€ per month are added to take into account the additional cost of housing such as electricity, water, gas and condominium expenses.

Figure 4.6: Average share of income on housing



The Graph shows the local distribution (CAP level) of the average share of income that is spent on housing taking into account those earning less than 120.000 per year.

Figure 4.7: Average income left after housing



The Graph shows the local distribution (CAP level) of the average income left after housing taking into account those earning less than 120.000 per year.
The rental price at the CAP level is constructed as a weighted sum of the prices of the micro-areas (from Immobiliare.it) that are included in CAP. Micro-areas are assigned to CAP by looking at the position of their centroids.

The analysis shows that the average spending for housing lies between 30% and 50%; from the map we can notice that the share of income devoted to housing is larger in the most central areas; however, the income left for other consumption seems to be bell-shaped with respect to the distance from the city centre.
This may be the consequence of the affordability mechanism that drives segrega-

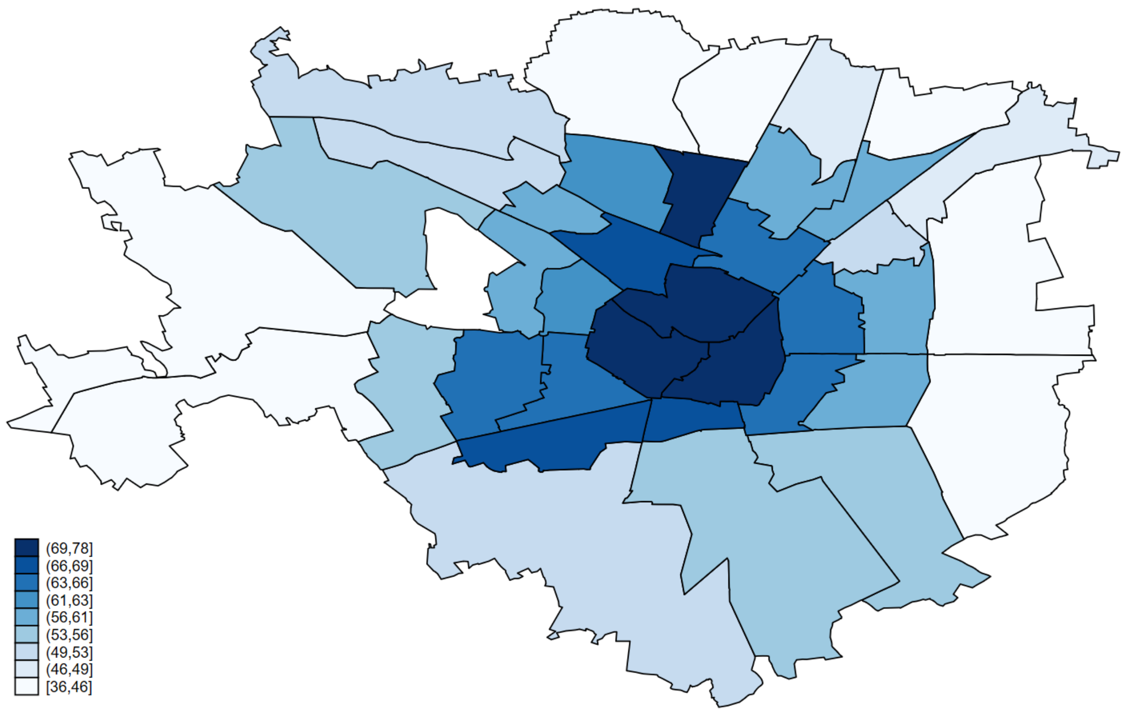
tion; indeed, from one side, the people with the lowest level of income cannot afford to leave in the most central areas since they need a minimum amount of income to consume other necessary goods. On the other side, moving towards the areas with the highest levels of income, people tend to choose their location depending on their willingness to spend for proximity to services or location amenities.
Hence, according to this analysis, 96,5% of the working population living in Milan would spend, living on their own in a 35sqm house, at least 30% of their income on rents. Moreover, as already said, there are different sources of bias in the analysis that, if corrected, could even worsen the situation.

4.3 Mortgage affordability to predict future trends

The house represents the largest share of spending of an household; however, being also an investment asset, it very often represents the largest part of an individual's personal balance sheet, both in terms of assets and liabilities. The idea of housing as an investment good may discourage people to spend a large fraction of their salary by renting something that they, alternatively, could capitalize on the future. However, the transition from renting to owning is conditioned by the availability of resources to purchase a property. Banks allow, through mortgages, households to transform a rent payment into a mortgage instalment for the purchase of the asset in which they live at the cost of an interest rate. However, the payment of interest rates does not guarantee households to have access to credit. Indeed, a crucial aspect, among many others, is the mortgage affordability limits set by banks. A standard rule used in the Italian banking system consists in the 30% threshold, meaning that the monthly payments should not exceed 30% of the available income (net of taxes and other financial commitments).

Differently from previous analysis, this one is conducted considering the whole group of taxpayers, including those earning more than 120.000€ per year.

Figure 4.8: Average share of Taxpayer exceeding the 30% rule for the access to mortgages



The Graph shows the local distribution (CAP level) of the average share of taxpayers that can not afford a mortgage according to the 30% rule. All income classes are taken into consideration. Uniform distribution is assumed within each class.

Figure 4.8 shows the share of taxpayers that, according to the 30% rule, would not have access to a mortgage set to 30 years at an annual interest rate of 2%, for the purchase of a property of 35sqm in the area where they live.

The correlation with the proximity to the city centre, and hence house prices is easy to identify; indeed, in the 3 most central areas, despite the city's highest per capita income, more than 70% of the taxpayers could not afford the mortgage under analysis.

Moving towards a more general perspective, the situation does not seem to improve much with an average share of workers able to access the mortgage close to 40% . The estimates are very conservative for different reasons. The main reason is that we assume that every taxpayer is young enough to access a 30 year mortgage. This is very conservative in two ways:

- not all households are young enough to access this type of mortgage;
- we can expect a positive correlation between income and age.

This imply that the agents that could not afford the 30 years length are likely to be those that could overcome the 30% rule.

Moreover, given that local price indexes are constructed using all available flats for rent and sale and because prices per square metre are inversely related to the size of properties, we expect that average cost of a 35 sqm apartment will be greater than the amount utilized in this analysis.[8].

Finally, there is a share of residents who do not declare any income (inactive and unemployed) and, for this reason, could hardly have access to credit. This analysis does not take into account this share of resident that, alternatively, were likely to worsen the estimates.

Hence, it would be interesting to consider the implications of what has been observed in this analysis and, jointly, in the real estate market in the last 10 years.

[8]The reason is that we expect the average size of the flat in the website to be bigger than 35sqm. Unfortuntaly, the available information does not allow to check for this type of bias.

The rent to price ratio is, in the financial literature, considered as a measure for predicting future trends. As described in the previous Chapters, according to the Gordon model, a high level of the rent to price ratio should imply a future better performance of sale prices with respect to rents, no matter the general trend, in order to converge towards a common equilibrium. The Superstar cities, such as Milan, have shown, in the last 10 years, a steady decline in the level of this indicator, mainly generated by the performance of the sales market; indeed, although both rents and sale prices have been constantly growing, the rate of growth of the latter has always been bigger. This is particularly true for the most expensive areas.

Hence, on the base of what has been observed, low level of affordability and decreasing level of the rent to price ratio should predict a decline in the value of the properties in order to converge towards more sustainable levels.

Nevertheless, from December 2019 (i.e. before the beginning of the pandemic, the war in Ucrania and the rise in interest rate) to Decembre 2022, the value of house prices grew by 17%, against 7% of the rental market[9]. This implies that neither prices are falling nor the price-rent ratio is converging towards more common levels.

4.4 Inequality and taxation

As previously described, rental affordability and access to ownership are becoming an increasingly serious problem. The role of policy maker should be to guarantee

[9] Data extracted from Immobiliare.it (https://www.immobiliare.it/mercato-immobiliare/lombardia/milano/)

wellbeing and inclusion of all residents.

In a standard microeconomic framework, the unaffordability of a good should slow-down its demand and prices should converge towards more desirable levels for the consumer. However, neither the demand for renting nor for owning seems to slow down. In such a context, it is important to remember that housing is a necessary good, as well as being a form of investment. A further obstacle to the adjustment of prices is given by the rigidity of the real estate supply. This has been widely discussed in the literature. However, Italian cities are characterized by historicity and policies for the protection of cultural heritage that do not allow to provide sufficient supply responses as demand increases. Hence, it is crucial for policy makers to define new solutions in order to guarantee basic housing requirements and to push the real estate market towards a more sustainable direction.

Financial returns from housing investments are made of 2 components: an annual dividend yield generated by the rental activity of the property and a potential capital gain generated by the appraisal of the asset.

The Italian law system allows private property investors to manage their assets in a professional or unprofessional way. The professional way involves the transfer of the assets towards a new legal entity whose taxation depends on the legal form acquired by the new entity. Although the role of asset management company has been growing over time, the focus of their investments is still mainly concentrated in the retail sector[10]; indeed, the Italian residential market is still mainly domi-

[10] info source: Rapporto fondi di Scenari Immobiliari (https://www.scenari-immobiliari.it/2022/11/23/in-italia-patrimonio-dei-fondi-immobiliari-a-oltre-120-miliardi-di-euro-nel-2022-previsioni-positive-sul-2023/)

nated by households that manage their portfolios in an unprofessional way.

The Italian tax system for private investors (i.e. unprofessional system) allows homeowners to avoid taxes on the appraisals of properties[11] and to decide[12] whether to tax the profits deriving from the rental activity at a flat tax rate equal to 21% [13]. Given that the flat tax applied to real estate dividends (i.e. rents) is lower than the tax rate applied to the minimum tax bracket, real estate investments reverse the progressive nature of income taxation envisaged by the Italian system. Besides this, the benefits of this tax system are evidently greater for those with the highest level of income, given that they are taxed at an higher marginal tax rate.

This is not a peculiarity of the housing market as, for example, financial incomes are again taxed at a constant rate. However, financial incomes derive from a pure allocation of wealth towards investments and they don't directly interfere[14] with the demand and supply of necessary goods, such as housing.

In such a context, while increasing prices shift a share of potential buyers towards the rental market, contributing to the increase in rentals, the fiscal opportunities provide a fertile ground for that small slice of very wealthy investors, especially those with high levels of income.

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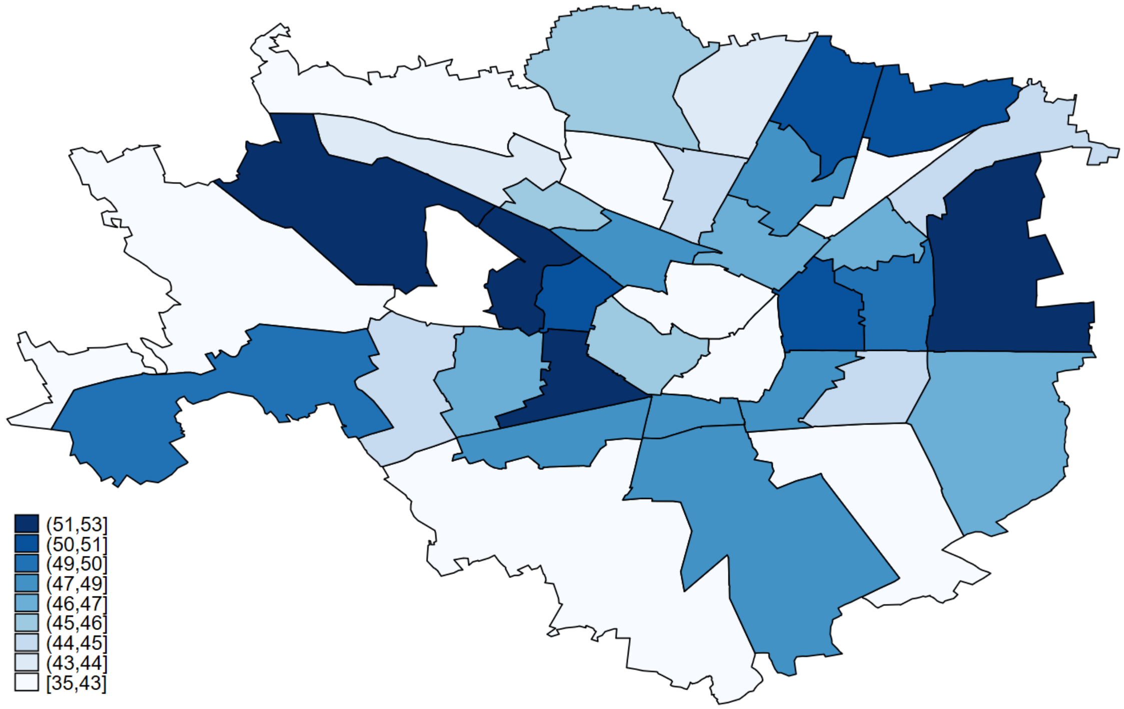
[11] This is true if the holding of the asset is longer than 5 years, otherwise owners have to pay a flat tax equal to 26% on the capital gain (20% up to 2019)

[12] landlords can decide whether to add their rental income to their other source of income (i.e. subject to tax at the marginal rate of their income) or apply flat tax

[13] There is no limit to the number of units to which owners are allowed to apply the flat tax. Flat tax can be applied up to a limit of 4 units since 2021 for the short stay rental business (i.e. Airbnb)

[14] There may be form of distortion produced by the allocation of money towards key relevant sector but they are legislated according to the corporate rules and there is no possibility of unprofessional interference. Moreover, the aim of this research is to focus on the housing market and any other possible type of distortion in the system is not in the scope of this analysis.

Figure 4.9: Share of Taxpayer declaring an income from real estate

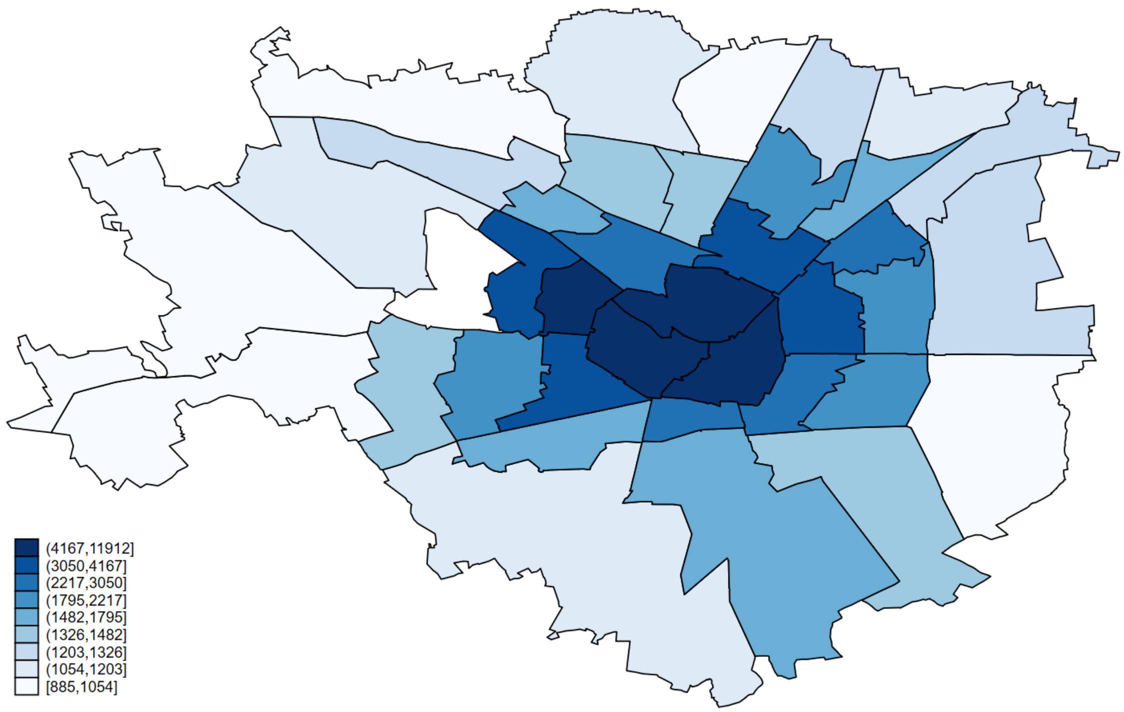


The Graph shows the local distribution (CAP level) of the share of households that uses housing as investment asset. The measure is constructed as the number of taxpayers declaring an income from real estate divided the number of all taxpayers.

Figure 4.9 provides an idea of the share of taxpayers declaring income from real estate. As you can see, the share seems not to be correlated with the level of income. However, the situation is completely reversed when we look at the per capita amounts. (Figure 4.10). Unfortunately, given the available data, we are not able to match real estate income to income from work, but by comparing figures

6.10 and 4.4 with figure 4.10 we can easily see the similarities in the geographical distribution of the maps.

Figure 4.10: Average per capita income from real estate



The measure is constructed dividing the whole amount of income deriving from real estate for the total number of taxpayers declaring such type of income.

In such a context, it seems reasonable to state that the growth of the rental market is mainly driven by the growing demand generated by those consumers which are excluded from the possibility of buying, while the rise of the sales market is supported by the fiscal advantages for top income earners.

Moreover, the maintenance of houses requires ordinary and extraordinary expenses.

A large part of this costs are fixed in size and are not correlated to the value of the properties[15]. This implies that the cost on income ratio is lower in the most expensive locations and, as a consequence, a flat tax on gross income tend to favour those areas. Although some form of economies of scale are presents in most markets, as already said, a fair tax system should prevent speculative actions that contribute to generating several social issues, as well as to amplifying economic differences.

An increase in the supply of housing would help to reduce prices when the supply of rental houses will exceed its demand, leading to a reduction in real estate investments and a convergence towards more sustainable levels. However, space and time limitations are an obstacle to a timely and effective response to this crisis and, in the meantime, could contribute to worsen the situation.

A review of the real estate tax system, both on property and on income, could instead lead more quickly and effectively to a fair and inclusive system.

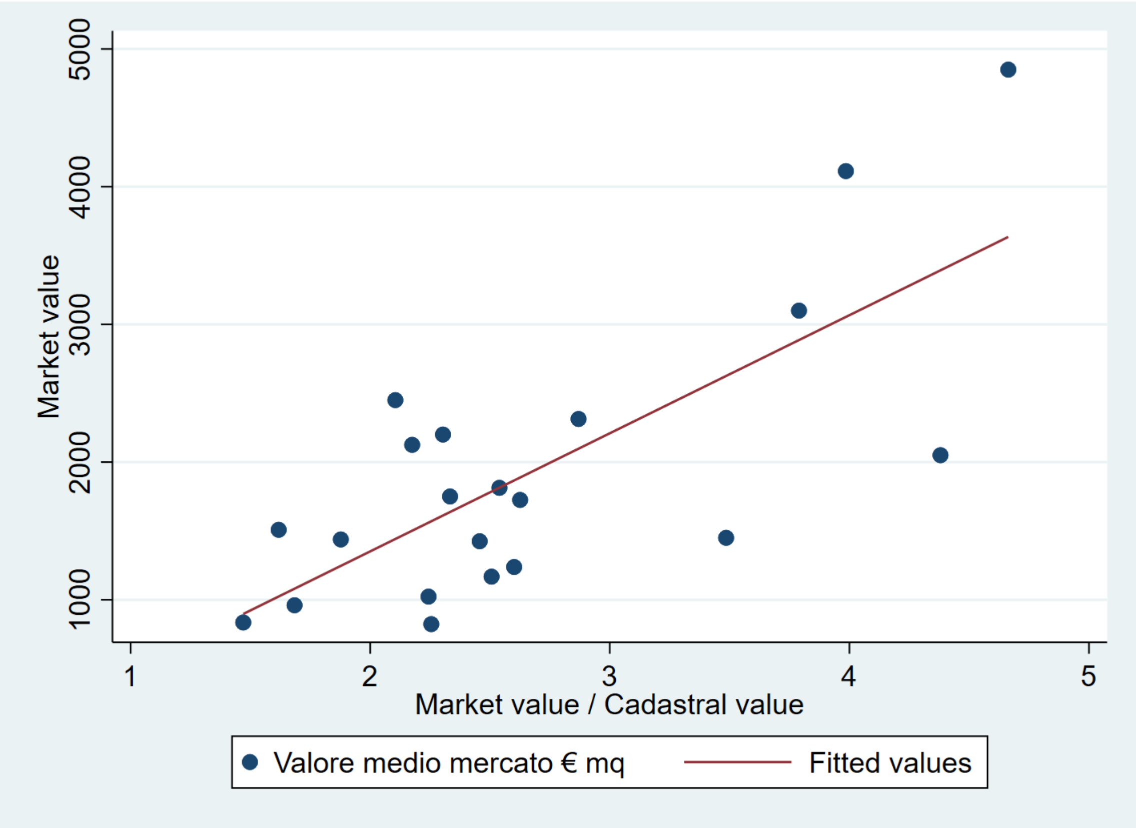
Indeed, the italian tax system on housing consists in a tax on the ownership of the asset, except for the first ownership, and a tax, as already described, on the income generated by the asset.

The tax on ownership should be proportional to property values; however, the last updates of the cadastral values, on which property taxes are calculated, dates back to 1989. This imply that the areas that have been growing the most are subject to relatively lower taxation. Figure 4.11 provides an idea of the misalignment between real and cadastral value. As you can see, in the most expensive cities (such

[15]Emprical and theoretical proof of this mechanism is provided in the second chapter. The chapter also shows that, for the same reason, during boom periods most expensive properties tend to appreciate faster

as Rome and Milan), the ratio between real and cadastral is between 4 and 5. A reform and an update of the cadastral value is expected for the year 2026 so to rebalance taxation on property towards a fairer level.

Figure 4.11: Correlation between Market value and underestimation of the cadastral value



The graph is plotted using the data provided by "UIL Servizio Lavoro, Coesione e Territorio". The underestimation of the cadastral value is constructed as the ratio between the Market value and the cadastral value. Given that ownership taxes are based on the cadastral value, an high level of underestimation means a relative low level of taxation with respect to the value of the asset.

However, on my personal view, a review of the taxation on the ownership of assets, although necessary, will not be sufficient to bridge the differences between the areas. Instead, the abolition of the flat tax and the abolition of the unprofessional management method for housing could more quickly and effectively lead to the desired welfare effects. Indeed, such a system, at least from a fiscal perspective, would make real estate ownership as attractive as any other form of entrepreneurship. Top income earners would cease to benefit from regressive property taxation. The reduction in the demand for ownership as an investment would help to slow down the growth in prices and increase the rate of mortgage affordability. Furthermore, higher lower prices and higher affordability rates would shift part of the consumption of housing from renting to owning and, as a consequence, could help to reduce rental prices too.

In such a way, the consumption of housing would be enlarged towards a larger share of the population in a more affordable way, both through purchase and rent, and taxation on investments would benefit lower income owners.

Moreover, a system of tax on net profits, would help to converge areas towards similar level of attractiveness since, as previously described, flat tax on gross rents reduce taxation in the most expensive areas where the impact of housing costs is lower.

However, the effects of such a reform should also be analyzed in a macro perspective (which is outside the scope of this research) since a drop in the real estate market could damage the financial system as a whole and strongly impact the financial stability of the highly mortgage leveraged households.

5 Conclusion

This thesis contributes to the housing literature in several respects. From a financial perspective, it shows theoretically and empirically the role of the rent to price ratio by providing new interpretations of the Gordon and user-cost models. Furthermore, it investigates the role of housing cost in the fluctuations of prices and rents. On this respect, it also provides an empirical assessment of an Italian incentive policy on the green redevelopment of buildings. In the second part of the thesis, the analysis combines the role of the labour market and the fiscal system to understand the divergence of the trends observed from those expected from the financial literature. The section shows that the city is characterized by low levels of housing affordability and high levels of inequality; however, the results are very heterogeneous across neighbourhoods. The shortage in the supply of housing and the fiscal system are pushing the residential market outside a socially sustainable environment and, in the meantime, contribute to amplify economic differences. Two ways could slow down these imbalances, but only one of them seems practicable. A revision of the taxation on housing towards a more progressive system is required to dampen this crisis. The unprofessional system of housing management should be forbidden so as to equate houses to any other form of investment and to reduce the demand for housing and its prices. At the same time, a macro perspective is crucial to analyse the possible effects on the financial stability of households.

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6 Appendix

6.1 Figures

Figure 6.1: Rtp ratio and sale price

Figure 6.2: Rtp ratio and rent price

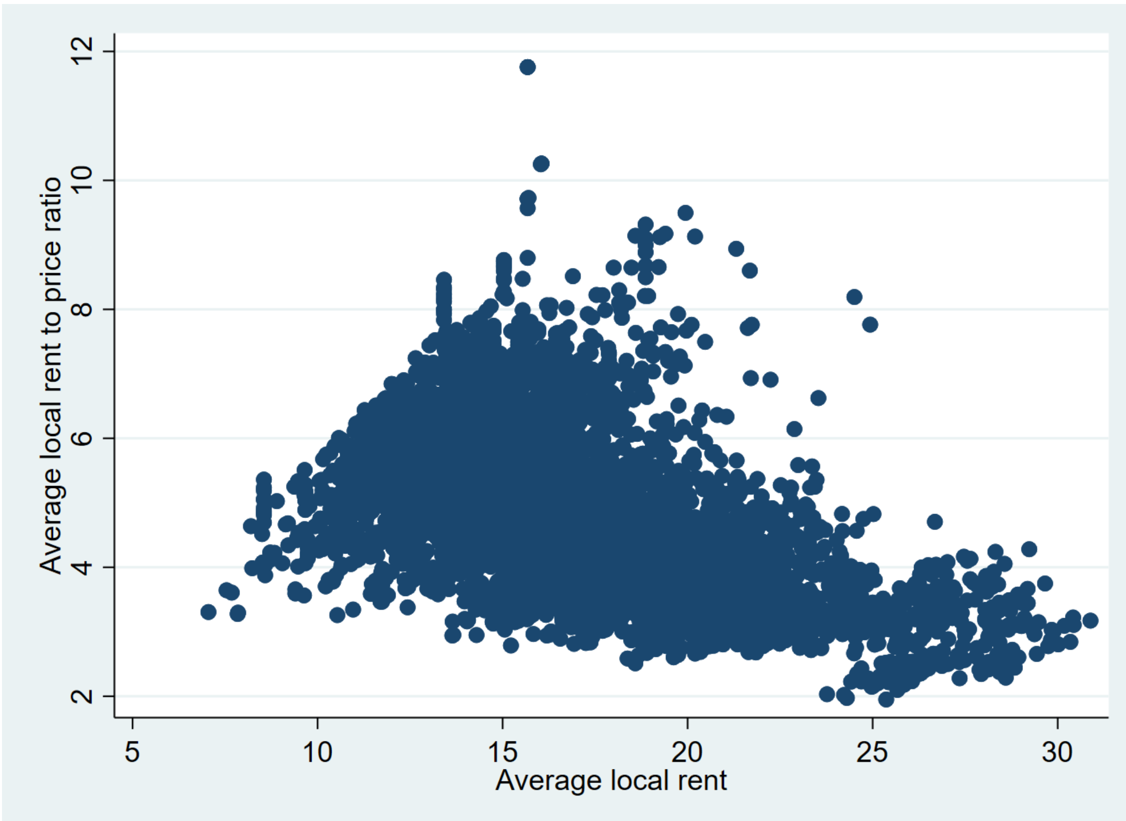


Figure 6.3: Manual match between NIL (Municipality of Milan and Microzone (Immobiliare.it)

microzona realytics	Id	nil
Brera	10240	2
Cadorna - Castello	10241	1
Duomo	10242	1
Missori	10243	1
Quadrilatero della Moda	10244	1
Cantalupa - San Paolo	10245	46
San Babila	10246	1
Arco della Pace	10248	8
Arena	10249	8
San Vittore	10253	7
Navigli - Darsena	10255	44
Corso Genova	10256	7
Moscova	10263	2
Palestro	10264	3
Turati	10265	2
Paolo Sarpi	10268	69
Amendola - Buonarroti	10270	58
Pagano	10271	68
Portello - Parco Vittoria	10272	67
Vercelli - Wagner	10273	51
Washington	10276	51
Solari	10279	50
Bocconi	10281	5
Cadore	10285	26
Montenero	10287	26
Indipendenza	10289	26
Morgagni	10291	20
Centrale	10292	10
Porta Nuova	10293	9
Repubblica	10294	10
Isola	10295	11
Garibaldi - Corso Como	10296	9
Certosa	10302	71
Quarto Oggiaro	10303	76
Gallaratese	10307	65
Monte Stella	10310	66
Cascina Merlata – Musocco	10311	72
San Siro	10312	57
Trenno	10313	64
Bande Nere	10314	52
Baggio	10315	55
Bisceglie	10316	53
Gambara	10319	52
Inganni	10320	53
Quartiere Olmi	10321	55
Quinto Romano	10322	62
Barona	10323	45
Giambellino	10325	49

microzona realytics	id	nil
Lorenteggio	10326	53
Pezzotti - Meda	10330	43
Quintosole - Chiaravalle	10331	85
Chiesa Rossa	10332	42
Gratosoglio	10333	41
Ripamonti	10337	37
Vigentino - Fatima	10339	38
Corvetto	10340	36
Lodi - Brenta	10341	28
Viale Ungheria - Mecenate	10342	30
Ponte Lambro	10344	31
Rogoredo	10345	32
Santa Giulia	10346	33
Casoretto	10348	20
CittÃ Studi	10349	22
Quartiere Feltre	10350	18
Lambrate	10351	23
Ortica	10353	24
Parco Lambro	10354	18
Rubattino	10356	23
Plebisciti - Susa	10357	26
Bicocca	10358	15
Gorla	10359	16
Greco - Segnano	10360	13
Figino	12638	63
Ghisolfa - Mac Mahon	12641	70
Guastalla	12643	4
Istria	12644	12
Lanza	12646	2
MonluÃ¨	12649	31
Parco Trotter	12651	20
Ponte Nuovo	12654	17
Porta Romana - Medaglie d'Oro	12656	27
Porta Vittoria	12657	25
Prato Centenaro	12658	14
Primaticcio	12659	53
Quartiere Forlanini	12660	24
Quarto Cagnino	12663	61
Roserio	12666	74
Scala – Manzoni	12672	2
Zara	12682	11
Argonne – Corsica	12796	25
Bignami – Ponale	12797	15
Farini	12798	78
Monte Rosa – Lotto	12799	58
Dezza	12800	51
Vincenzo Monti	12801	7
QT8	12802	66

microzona realytics	id	nil
Tre Castelli – Faenza	12803	48
San Carlo	12804	56
Cenisio	12805	70
Bologna – Sulmona	12806	35
Melchiorre Gioia	12807	9
Frua	12808	51
Buenos Aires	12809	21
Cascina Gobba	12810	18
Piazza Napoli	12811	49
Tripoli – Soderini	12812	52
Piazzale Siena	12813	52
Greco - Segnano	10360	13
Maggiolina	10361	12
Pasteur	10363	20
Turro	10365	19
Villa San Giovanni	10366	16
Affori	10367	80
Bovisa	10368	77
Bovisasca	10369	81
Comasina	10370	82
Dergano	10371	79
Niguarda	10372	14
Bruzzano	11387	83
Cimiano	11403	19
Crescenzago	11405	19
Molise - Cuoco	11459	29
Martini - Insubria	11534	28
Precotto	11538	16
Muggiano	11540	87
Ticinese	11544	6
Corso San Gottardo	11546	6
Famagosta	11714	45
Sempione	11805	67
Quartiere Adriano	11810	17
Porta Venezia	12157	21
Piave - Tricolore	12158	26
City Life	12276	59
Vialba	12278	76
Cermenate - Abbiategrasso	12281	42
Udine	12284	18
Rovereto	12286	20
Ascanio Sforza	12620	6
Sant'Ambrogio	12621	1
Borgogna - Largo Augusto	12624	1
Carrobbio	12630	1
Cascina dei Pomi	12631	13
Quadronno - Crocetta	12633	4
Ca' Granda	12634	14

Figure 6.4: Rent to price ratio in Milan, 2021- 4_{th} quarter

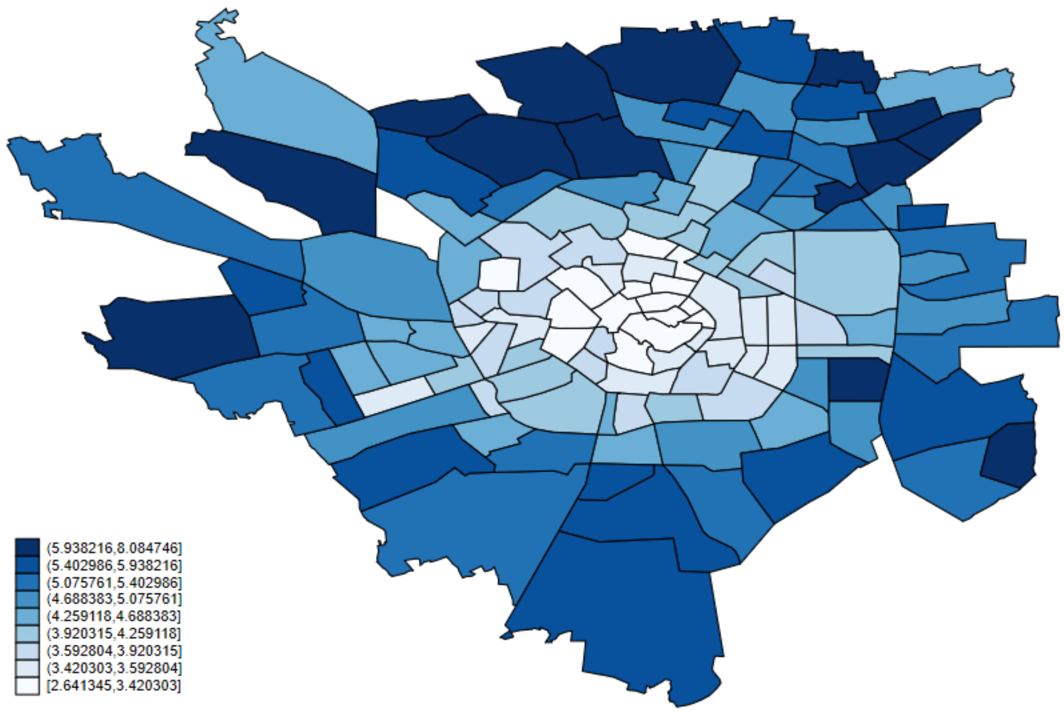
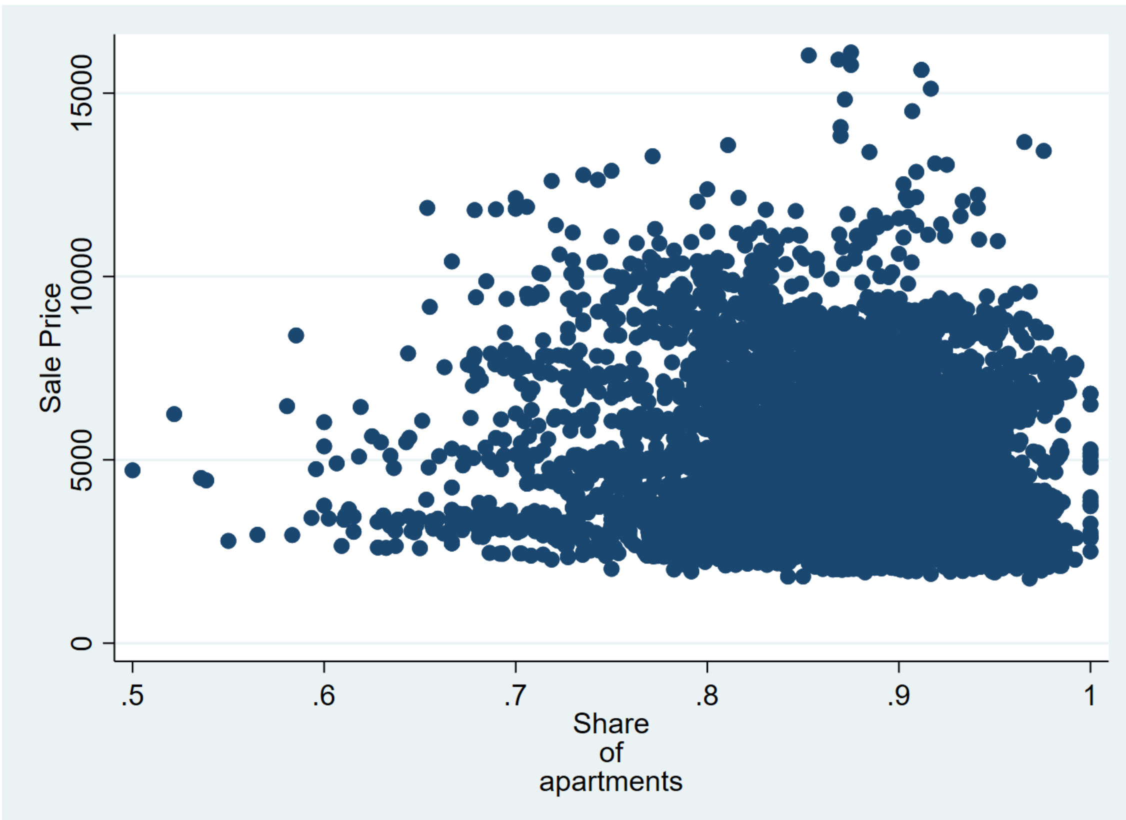


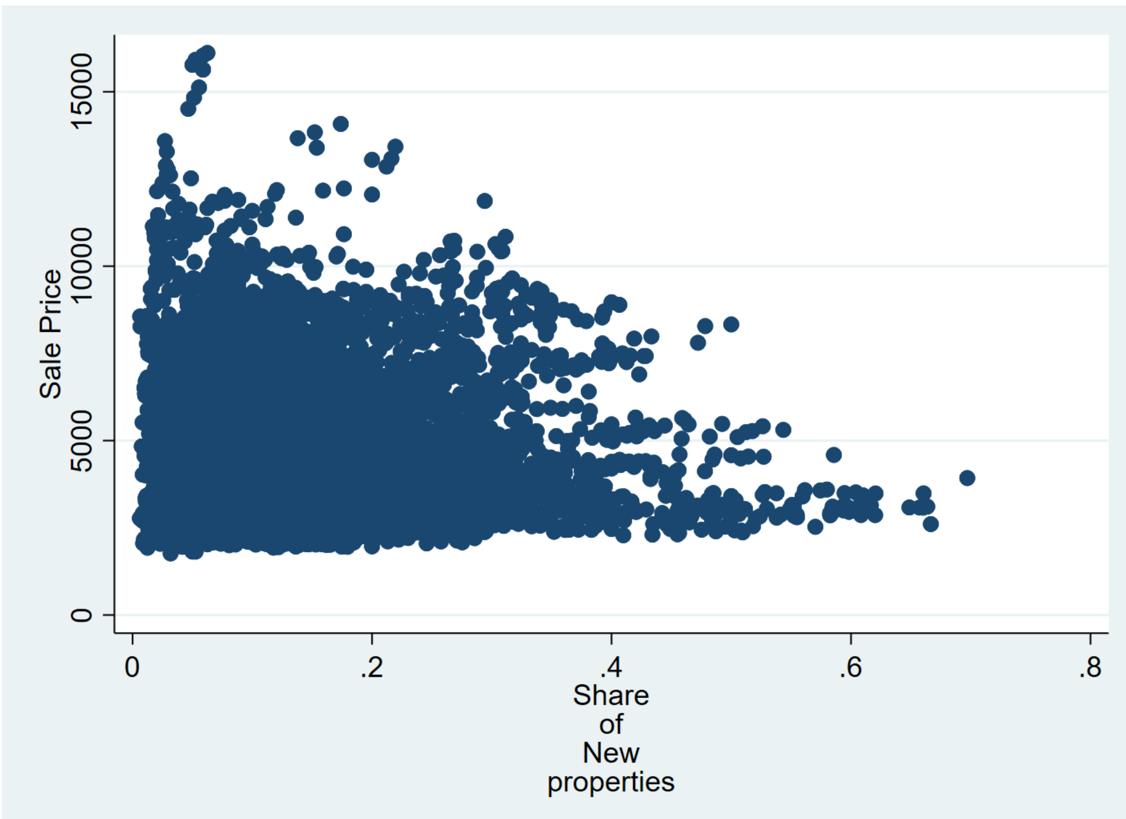
Figure 6.5: Sale Price and the share of listings classified as "apartment"



The share of "apartments" is constructed as:

$\frac{\text{number of listings classified as apartments}}{\text{Total number of listings}}$

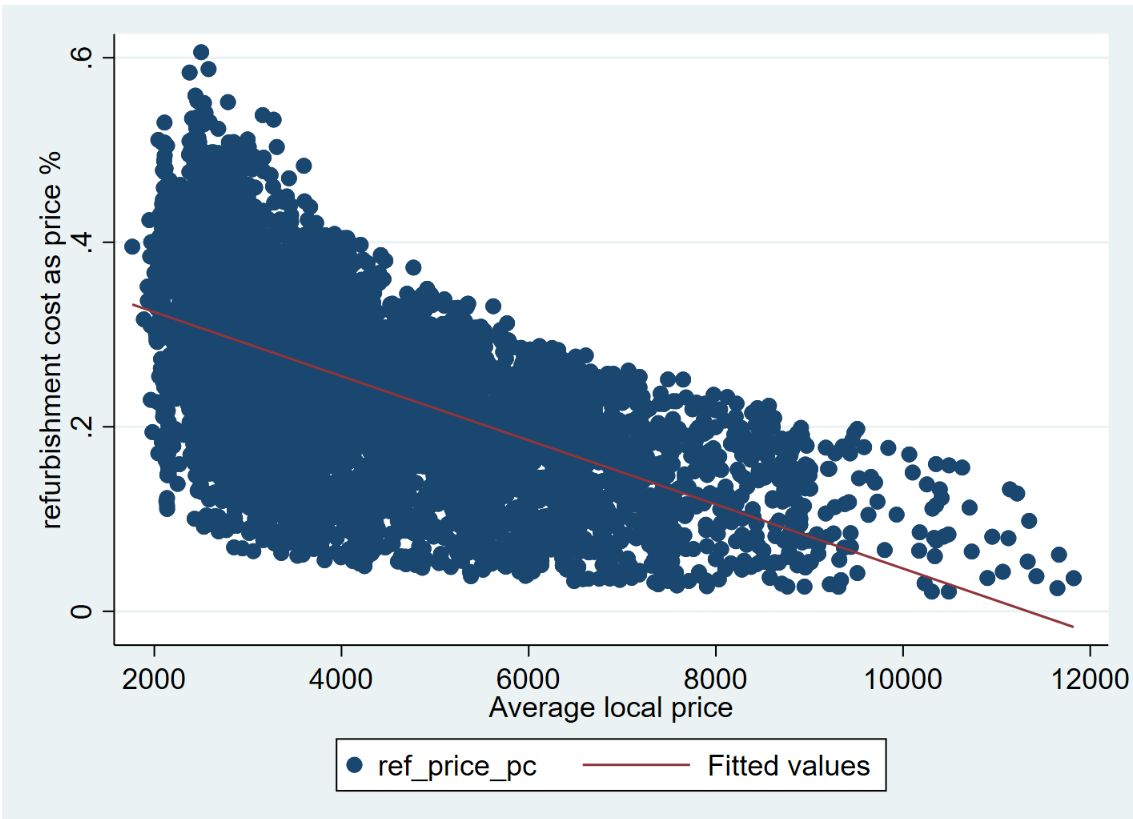
Figure 6.6: Sale Price and the share of listings classified as ”New”



The share of ”Completely refurbished” is constructed as:

$$\frac{\text{number of listings classified as ”Completely refurbished”}}{\text{Total number of listings}}$$

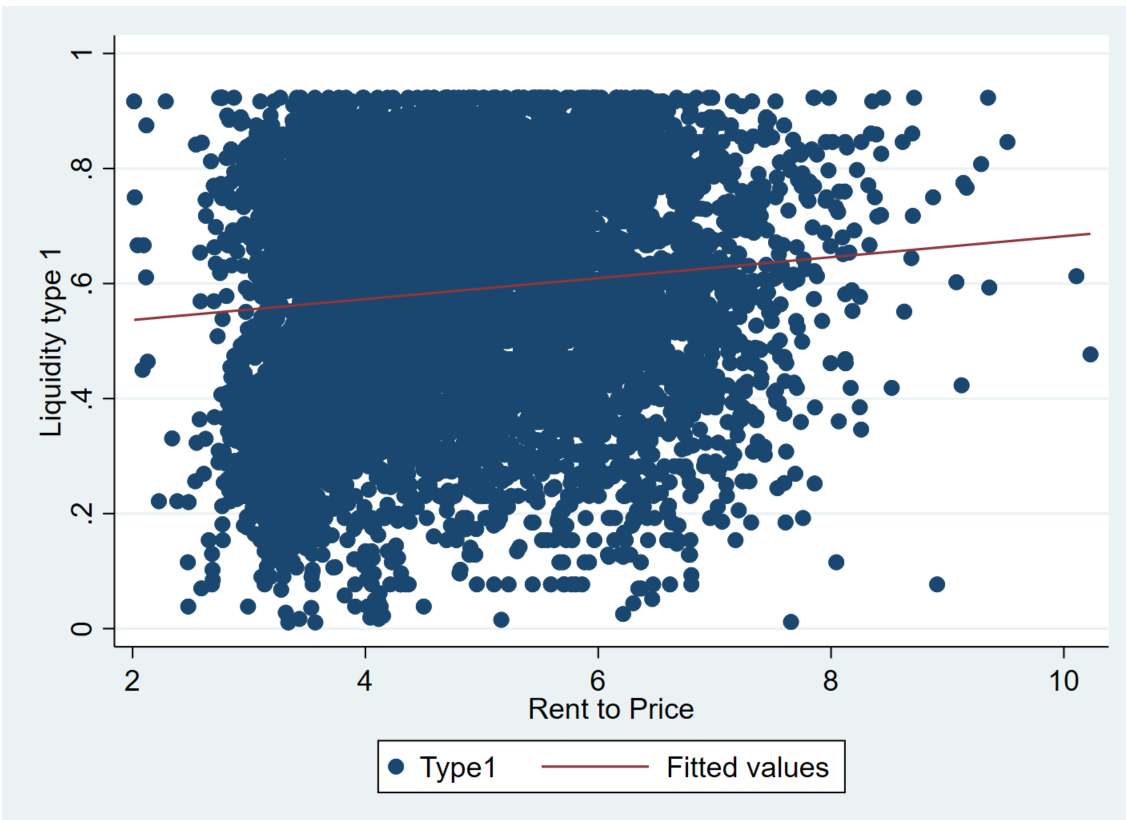
Figure 6.7: The impact of refurbishment price on the property value



The average price for each location is plotted on the nominal cost of refurbishment that is computed as:

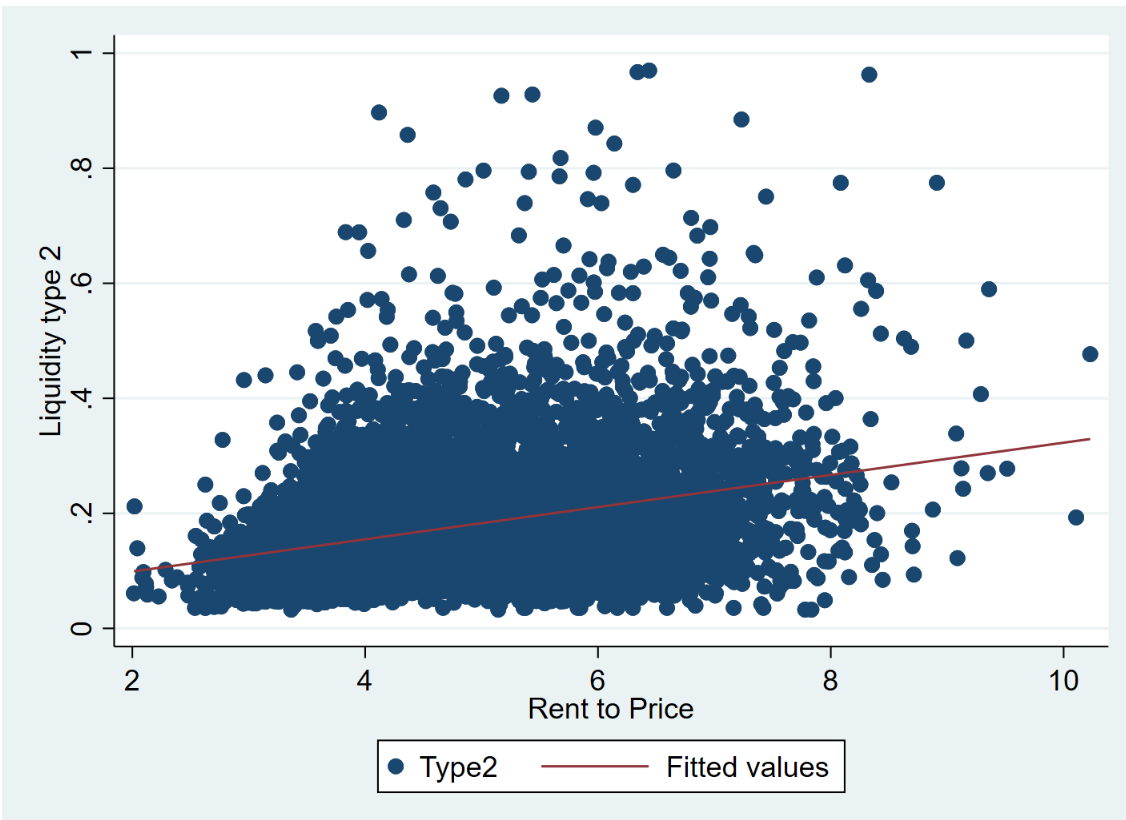
Average price for ”completely refurbished” properties - Average price for properties ”in need of refurbishment”

Figure 6.8: Correlation between liquidity (type 1) and rent to price ratio



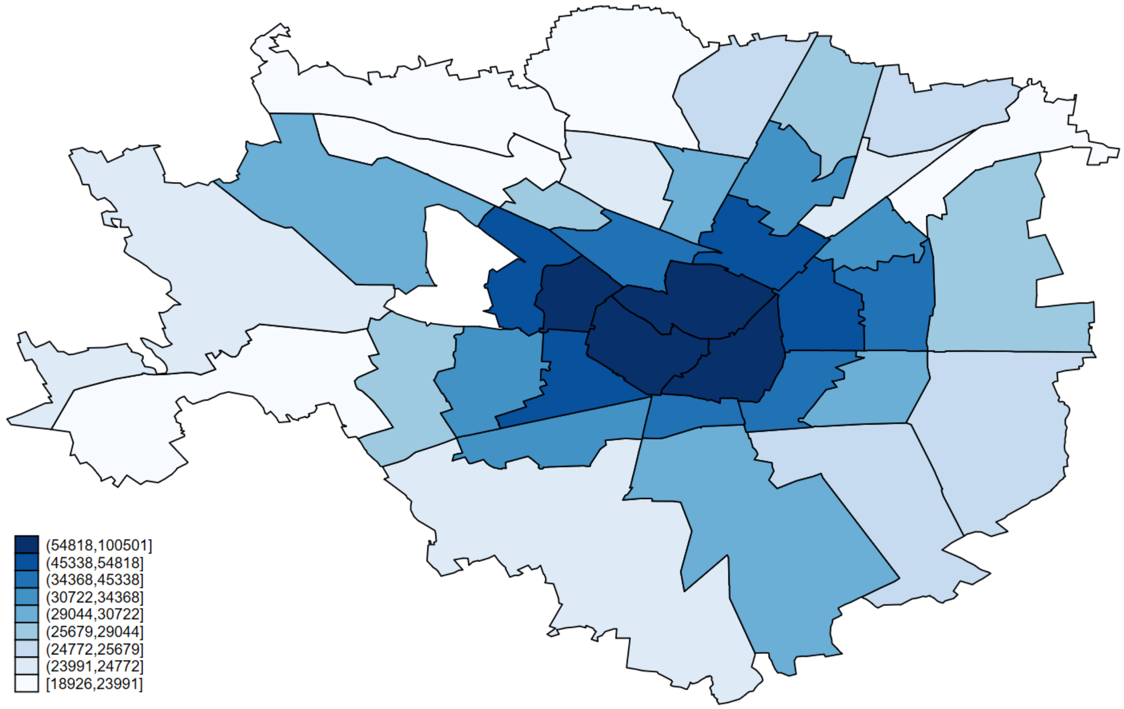
Liquidity is constructed as described in the section.

Figure 6.9: Correlation between liquidity (type 2) and rent to price ratio



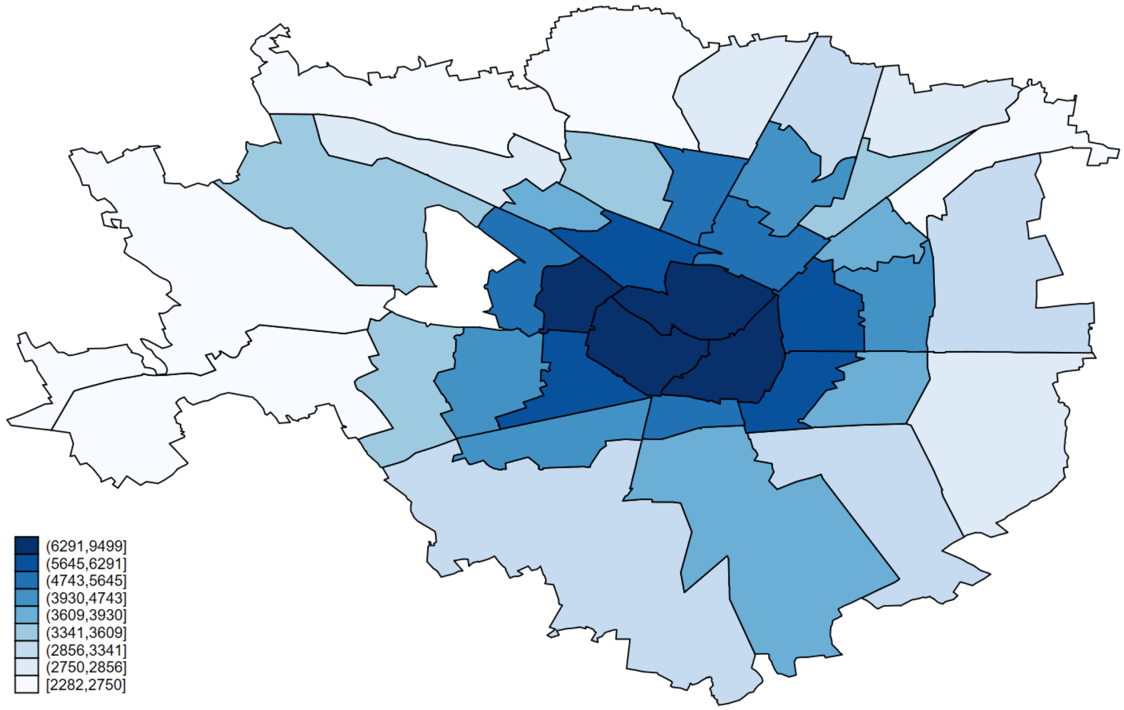
Liquidity is constructed as described in the section.

Figure 6.10: Average Income



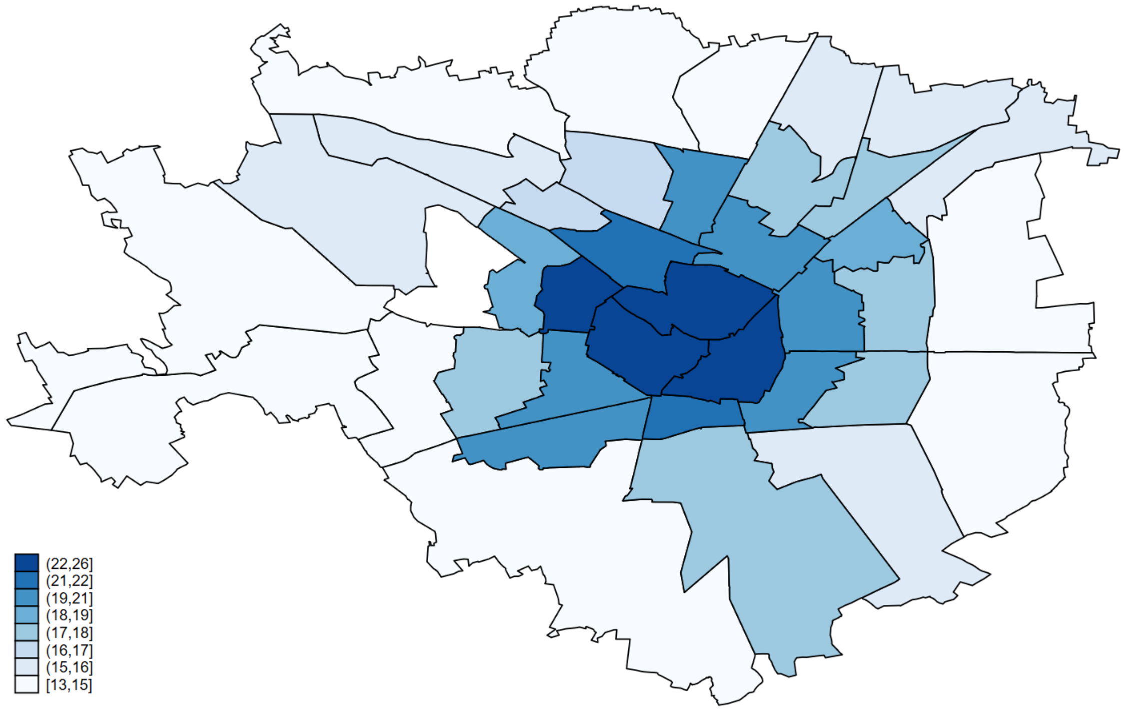
Average level of income taking into account all taxpayers declaring an income from work.

Figure 6.11: Average sale prices



Average level of sale price per square meter. The index at the CAP level is constructed as a weighted sum of the prices of the micro-areas (from Immobiliare.it) that are included in CAP zone. Micro-areas are assigned to CAP by looking at the position of their centroids.

Figure 6.12: Average rental prices



Average level of rental price per square meter. The index at the CAP level is constructed as a weighted sum of the prices of the micro-areas (from Immobiliare.it) that are included in CAP. Micro-areas are assigned to CAP by looking at the position of their centroids.

6.2 Tables

Table 6.1: Return predictability exercise, Standard Model (FE)

	(1)	(2)	(3)	(4)
	3 months	6 months	9 months	12 months
L3.RtP ratio	0.0441***			
	(0.000)			
L6.RtP ratio		0.0147*		
		(0.024)		
L9.RtP ratio			0.0186*	
			(0.013)	
L12.RtP ratio				-0.00170
				(0.764)
Constant	-0.0606***	-0.0156	-0.0211	0.00958
	(0.000)	(0.114)	(0.064)	(0.266)
Observations	3828	3480	3132	2784

p-values in parentheses: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The first column provides the dynamic exercise using 3, 6, 9 and 12 months lags of the Rent to Price ratio and the dependent. neighbourhood and time fixed effects are included in the model. The high number of T=48 should guarantee a sufficient size to reduce the Nickell bias deriving from the use of lagged values of the dependent.

Table 6.2: Rent growth predictability exercise, Standard Model (FE)

	(1)	(2)	(3)	(4)
	3 months	6 months	9 months	12 months
L3.RtP ratio	-0.0823***			
	(0.000)			
L6.RtP ratio		-0.0196		
		(0.163)		
L9.RtP ratio			-0.0210	
			(0.091)	
L12.RtP ratio				0.00826
				(0.618)
Constant	0.130***	0.0346	0.0373*	-0.00656
	(0.000)	(0.106)	(0.049)	(0.794)
Observations	3828	3480	3132	2784

p-values in parentheses: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The first column provides the dynamic exercise with neighbourhood and time fixed effects using 3, 6, 9 and 12 months lags of the Rent to Price ratio and the dependent. Fixed effects are included in the model. The high number of T=48 should guarantee a sufficient size to reduce the Nickell bias deriving from the use of lagged values of the dependent.

Table 6.3: Return predictability exercise, Standard model

	(1) 3 months	(2) 6 months	(3) 9 months	(4) 12 months
L3.RtP ratio	0.00637***			
	(0.000)			
L6.RtP ratio		0.00410***		
		(0.000)		
L9.RtP ratio			0.00477***	
			(0.000)	
L12.RtP ratio				0.00518***
				(0.000)
Constant	-0.00296	0.000585	-0.0000271	-0.000839
	(0.055)	(0.747)	(0.989)	(0.690)
Observations	3828	3480	3132	2784

p-values in parentheses: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The columns provide the standard Gordon predictability exercise for housing returns using 3, 6, 9 and 12 months lags of the Rent to Price ratio. No fixed effects. The exercise is implemented to capture the overall correlation between rent to price ratio and rent growth. Indeed, nor fixed effects nor differentiation allow to capture the tendency to converge towards a common yield.

Table 6.4: Rent growth predictability exercise, Standard Model

	(1)	(2)	(3)	(4)
	3 months	6 months	9 months	12 months
L3.RtP ratio	-0.00635**			
	(0.003)			
L6.RtP ratio		-0.000829		
		(0.644)		
L9.RtP ratio			-0.000218	
			(0.893)	
L12.RtP ratio				0.00164
				(0.434)
Constant	0.0143***	0.00604*	0.00563*	0.00347
	(0.000)	(0.024)	(0.019)	(0.251)
Observations	3828	3480	3132	2784

p-values in parentheses: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The columns provide the standard Gordon predictability exercise for rent growth using 3, 6, 9 and 12 months lags of the Rent to Price ratio. No fixed effects. The exercise is implemented to capture the overall correlation between rent to price ratio and rent growth. Indeed, nor fixed effects nor differentiation allow to capture the tendency to converge towards a common yield.

Table 6.5: Return predictability exercise, Dynamic

	(1) 3 months	(2) 6 months	(3) 9 months	(4) 12 months
L3.RtP ratio	0.0428***			
	(0.000)			
L6.RtP ratio		0.0103		
		(0.134)		
L9.RtP ratio			0.0173*	
			(0.039)	
L12.RtP ratio				-0.00330
				(0.613)
L3.return	-0.00603			
	(0.787)			
L6.return		-0.0594*		
		(0.011)		
L9.return			-0.0203	
			(0.419)	
L12.return				-0.0310
				(0.355)
Constant	-0.0586***	-0.00830	-0.0190	0.0121
	(0.000)	(0.426)	(0.135)	(0.225)
Observations	3712	3364	3016	2668

p-values in parentheses: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The first column provides the dynamic exercise using 3, 6, 9 and 12 months lags of the Rent to Price ratio and the dependent. Neighbourhood and time fixed effects are included in the model. The high number of T=48 should guarantee a sufficient size to reduce the Nickell bias deriving from the use of lagged values of the dependent.

Table 6.6: Rent growth predictability exercise, Dynamic

	(1) 3 months	(2) 6 months	(3) 9 months	(4) 12 months
L3.RtP ratio	-0.0626***			
	(0.000)			
L6.RtP ratio		-0.0339**		
		(0.009)		
L9.RtP ratio			-0.0153	
			(0.289)	
L12.RtP ratio				0.00997
				(0.578)
L3.rent growth	-0.0636**			
	(0.007)			
L6.rent growth		0.0299		
		(0.227)		
L9.rent growth			-0.0186	
			(0.491)	
L12.rent growth				0.0231
				(0.428)
Constant	0.101***	0.0565**	0.0286	-0.00981
	(0.000)	(0.004)	(0.194)	(0.718)
Observations	3712	3364	3016	2668

p-values in parentheses: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The first column provides the dynamic exercise with neighbourhood and time fixed effects using 3, 6, 9 and 12 months lags of the Rent to Price ratio and the dependent. Fixed effects are included in the model. The high number of T=48 should guarantee a sufficient size to reduce the Nickell bias deriving from the use of lagged values of the dependent.

Table 6.7: Standard returns and rent growth predictability exercise, additional controls

	(1) Return	(2) Rent growth
L2.RtP ratio	0.0535***	-0.134***
	(0.000)	(0.000)
immigrants	0.00000204	-0.00000708
	(0.559)	(0.323)
emigrated	-0.00000195	0.00000223
	(0.504)	(0.658)
foreigners	0.00000142	0.0000111*
	(0.478)	(0.043)
older 80	0.00000725	-0.0000373*
	(0.263)	(0.024)
n. of death	0.00000562	-0.0000852*
	(0.822)	(0.030)
n. of births	-0.0000166	-0.0000105
	(0.585)	(0.858)
single-component fam.	-0.00000573	0.0000424***
	(0.250)	(0.001)
Constant	-0.0628**	0.0338
	(0.010)	(0.451)
Observations	3944	3944

p-values in parentheses: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

	Return
Lag 3 months	-0.0008
Lag 6 months	-0.0612
Lag 9 months	-0.0245
Lag 12 months	-0.0227
correlation	

The graph shows returns auto-correlation

	Rent growth
Lag 3 months	-0.0946
Lag 6 months	0.0004
Lag 9 months	-0.0315
Lag 12 months	-0.0250
correlation	

The graph shows rent growth rates auto-correlation

Table 6.8: Marginal impact of housing costs on prices, demand and supply, static

	(1) Price	(2) Supply	(3) Demand
1._at × dummy_110=0	1.149***	1.269*	0.995***
	(0.000)	(0.018)	(0.000)
1._at × dummy_110=1	1.163***	1.264**	1.327***
	(0.000)	(0.001)	(0.000)
2._at × dummy_110=0	1.200***	1.337**	1.026***
	(0.000)	(0.003)	(0.000)
2._at × dummy_110=1	1.194***	1.416***	1.291***
	(0.000)	(0.000)	(0.000)
3._at × dummy_110=0	1.251***	1.406***	1.058***
	(0.000)	(0.000)	(0.000)
3._at × dummy_110=1	1.225***	1.569***	1.255***
	(0.000)	(0.000)	(0.000)
4._at × dummy_110=0	1.302***	1.475***	1.089***
	(0.000)	(0.000)	(0.000)
4._at × dummy_110=1	1.256***	1.722***	1.218***
	(0.000)	(0.000)	(0.000)
5._at × dummy_110=0	1.354***	1.543***	1.121***
	(0.000)	(0.000)	(0.000)
5._at × dummy_110=1	1.286***	1.874***	1.182***
	(0.000)	(0.000)	(0.000)
6._at × dummy_110=0	1.405***	1.612***	1.152***
	(0.000)	(0.000)	(0.000)
6._at × dummy_110=1	1.317***	2.027***	1.146***
	(0.000)	(0.000)	(0.000)
7._at × dummy_110=0	1.456***	1.681***	1.184***
	(0.000)	(0.000)	(0.000)
7._at × dummy_110=1	1.348***	2.180***	1.109***
	(0.000)	(0.000)	(0.000)
8._at × dummy_110=0	1.507***	1.749***	1.215***
	(0.000)	(0.000)	(0.000)
8._at × dummy_110=1	1.379***	2.332***	1.073***
	(0.000)	(0.000)	(0.000)
9._at × dummy_110=0	1.558***	1.818***	1.247***
	(0.000)	(0.000)	(0.000)
9._at × dummy_110=1	1.410***	2.485***	1.037***
	(0.000)	(0.000)	(0.000)
Observations	5859	5460	6080

p-values in parentheses: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6.9: The impact of housing costs on relative price, demand and supply of new versus old properties, static

	(1) Price	(2) Supply	(3) Demand
superbonusFIX_s4	-0.208	0.820	-0.644**
	(0.135)	(0.179)	(0.008)
Share old properties for sale	-0.403	-13.18***	-0.0840
	(0.098)	(0.000)	(0.873)
Share new properties for sale	0.149	20.17***	-0.824*
	(0.206)	(0.000)	(0.048)
Number of properties for sale	-0.0220	0.445*	-0.0111
	(0.073)	(0.022)	(0.720)
Observations	5859	5460	6080
F	3.248	25.18	3.684

p-values in parentheses: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The table shows the impact on relative price, supply and demand of new ("Completely refurbished") versus old ("In need of refurbishment") properties using DiD model with continuous variable treatment. The main regressors are a time dummy for before and after the implementation of the policy, the degree of treatment for each level of price (FIX4price) and their interaction.

Table 6.10: The impact of housing costs on prices, demand and supply, static

	(1) Price	(2) Supply	(3) Demand
FIX4price	0.512***	0.687	0.315
	(0.000)	(0.409)	(0.207)
dummy_110=0	0	0	0
	(.)	(.)	(.)
dummy_110=1	0.0342	-0.0887	0.400*
	(0.735)	(0.823)	(0.012)
dummy_110=0 × FIX4price	0	0	0
	(.)	(.)	(.)
dummy_110=1 × FIX4price	-0.203	0.839	-0.678**
	(0.136)	(0.158)	(0.005)
Share old properties for sale	-0.370	-13.14***	-0.160
	(0.125)	(0.000)	(0.756)
Share new properties for sale	0.289*	19.40***	-0.535
	(0.027)	(0.000)	(0.078)
Number of properties for sale	-0.000500	0.381**	-0.0466*
	(0.945)	(0.003)	(0.042)
Constant	1.091***	-1.599	1.202***
	(0.000)	(0.211)	(0.000)
Observations	5859	5460	6080

p-values in parentheses: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The table shows the impact on relative price, supply and demand of new ("Completely refurbished") versus old ("In need of refurbishment") properties using DiD model with continuous variable treatment. The main regressors are a time dummy for before and after the implementation of the policy, the degree of treatment for each level of price (FIX4price) and their interaction.