Ca' Foscari University of Venice

Master's Degree

In

Economia e Finanza

Curriculum Finance

Final Thesis

EXAMINING THE EFFECT OF GOVERNMENT INCENTIVES ON ENERGY EFFICIENCY RETROFITTING IN THE ITALIAN REAL ESTATE MARKET

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Academic Year
2021/2022

Summary

Introduction

The Italian real estate market has historically been a crucial component of the country's economy, with the sector accounting for a significant portion of Italian's GDP. Between the half of 2014 and the end of 2022, the market has experienced notable changes due to a variety of factors such as the economic downturn, increased housing supply, changing demographics, and policy interventions.

This dissertation aims to providing an analysis of the Italian real estate market over the last eight years. The main object of this is to see the effect of one of the last tax benefits concerned the Italian real estate market, the so called Superbonus 110%. The latter is part of the "*Decreto Rilancio*", a decree law aiming to revive the Italian economy after the slowdown due to the pandemic caused by Covid 19. This initiative aimed to encourage homeowners and landlords to make energy-efficient renovations to their properties by offering a 110% tax credit on qualifying expenses. The Superbonus 110% is a substantial incentive, as it covers not only the cost of the renovations but also additional expenses such as design, planning, and works management. This is interest because it is one of the first tax benefits where the benefit is higher than the actual expense that the citizen must pay, so we can notice a moral hazard problem. In this way, the citizens will not be incentivized to search for the best opportunity in the market, so one of the competitive market conditions will not be met.

As the result of the Superbonus 110%, the real estate market has experienced some notable changes, including an increase in renovation activities, a rise in the prices of energy-efficient properties, and a boost in the construction industry's activities. The impact of the Superbonus 110% on the Italian real estate market has been substantial, and a thorough analysis of the effects of this policy intervention is essential in understanding the market dynamics. This dissertation seeks to provide a detailed analysis of the effects of the Superbonus 110% on the Italian real estate market from July 2014 to December 2022. We will examine the relationship between the Superbonus 110% and macroeconomic variables such as interest rates, inflation, and GDP growth, and investigate the impact of the Superbonus on the house and rent prices. By doing so, we aim to provide valuable insights into the role of policy intervention in shaping the dynamics of the Italian real estate market.

In the first chapter of the dissertation, we are going to describe the characteristics of the Italian real estate market, and which are the main microeconomic and macroeconomic factors that influenced the real estate market. Always in this chapter there is the presentation and description of all the data that we are going to use in the empirical analysis. Still in this chapter we will go on to explain why these data were chosen and how they were processed.

The main topic of the second chapter is the Superbonus 110%. In the initial part there is a short description of the Italian tax system, the definition of IRPEF and the various kind of tax benefits. At the end of the chapter, we are going to explain the Ecobonus and the Superbonus policy and how people are using them.

In the third chapter we are going to describe what panel data are and we are also defining the panel data model that we are going to use in the final chapter. We also explain which are the main problems with this kind of model and the relative tests to verify the presence and how to resolve them.

The last chapter concerns the implementation of various panel models that will help us understand what the effect of the 110% Superbonus policy has been on house prices and rents in Italy. In addition, we are going to use the different tests describe in the previous chapter to check for problems. Thanks to them we can use models that have a better fit with more precise estimations and results.

1. The Italian real estate market

In this chapter we are going to explain which are the main characteristics of the Italian real estate market. We begin with a general description of the history and the main changes occurred in the last years. After that, we are going to describe the main microeconomics and macroeconomics factors that influenced the Italian real estate market and this sector in general. In the final part we are going to comment the data that we are going to utilize in the empirical analysis of the last chapter of this dissertation.

1.1 Features of Italian real estate market

Italy is a very diversified nation in terms of real estate. In fact, there are clear distinctions between services depending on the area of reference. The historic district of Italian cities has an extension that is unmatched in all of Europe, while the suburbs of each industrial downtown have unique aspects. Small provincial towns have always been attractive areas for the real estate market, as have newly redeveloped spaces within urban centers ('40 (+1) Statistiche Del Mercato Immobiliare Italiano' 2022).

The socio-economic environment has changed. Important demographic aspects to consider include immigration from nations outside of Europe and the population's increasing age. They are also closely related to the wealth disparity in housing, as the older are often native owners, while newcomers to the property market are immigrants. Increased insecurity in the labour market affects young people's ability to borrow and save money as well as have respectable and consistent wages. Access to home ownership without family help appears to be more challenging than in the past, especially considering the dynamics of hose pricing. Land and urban planning, as well as building norms, have now been fully implemented, and housing-related markets are becoming more professionalized than in the past. These are housing-specific structural changes. This implies that low-cost and informal paths to home ownership are diminishing, and that the re-stratification associated with these paths is no longer present (Poggio, n.d., 4).

The Italian real estate market is also significantly influenced by tourism, particularly in popular destinations. Due to the strong demand for vacation rentals, homes in tourist destinations like Tuscany, Sardinia, and the Amalfi Coast may cost more.

Finally, it is crucial to consider the evolution of recent years. COVID-19 pandemic, which began in the first half of 2019, has spread quickly throughout the world. To reduce contagions, governments have implemented numerous measures, the majority of which have required individuals to stay at home. Because of this, people have been forced to do a lot of their usual activities at home, especially work. This has altered the nature of daily life. Home spaces now need to adapt to the new necessities appeared, as work has become more flexible, and many large companies are now using remote solutions. The residential market must also adjust to the adoption of digital technologies since modern home seekers use the Internet. Thus, spaces like the living room, bedrooms and kitchen have often converted into workspaces, exercise equipment and meeting spaces to suit uses for which they may not have been designed. At the same time, because it is impossible to perform outdoor activities balconies, terraces, or condominium green outdoor spaces have become the only escape from the house and have been transformed into gyms, places of leisure, relaxation, or work, and meeting place (Tajani et al. 2021, p.1). On the other hand, it must be considered that in terms of commercial real estate, large spaces are no longer needed to house the workforce. Many business firms prefer to work exclusively online and avoid having a physical operational headquarter, preferring to have only the legal one.

Given all these changes, it is crucial to understand the functioning of the Italian real estate market, especially relying on accurate statistics. Italy has peculiar and unique characteristics, but a slow and steady transformation has been taking place for a while and the process was speeded up due to recent occurrences.

As we can see from the following statistics about house prices and the value, there are changes that have been ongoing for years, while other changes are the result of recent times:

- As a result of the US sub-prime crisis in 2007, housing values decreased. The downturn has continued through 2019. However, there has been a minor improvement in recent years.

- Between 2011 and 2019, the value of existing homes decreased by 23,3%, reaching a maximum of 30,3% in Central Italy.
- Meanwhile, if we look at the 1998 to present period, we can see that national real estate valued have increased by 38,2%.

In contrast to other European markets, most houses in Italy are owned by private individuals. Small towns and villages have greater rates of home ownership than large cities, while young and low-income households are less likely to own homes than wealthy and senior households, respectively (Poggio 2012). Home ownership increased in Italy throughout the second half of the 20th century for all classes of society. Home ownership demand and supply have typically been supported by non-policy determined factors. From one hand, a lack of respectable, safe, and reasonable renting alternatives has contributed to households' desire for this arrangement. On the other hand, weak regulations and tolerance for illegal construction have sustained cheap routes – usually family-based – to home ownership through self-building and informal self-development and the acquisition of low-quality, low-cost homes developed by speculators in a grey legal context. Additionally, owning a home has traditionally represented a normal asset-building approach for the Italian culture and has been one of the foundations of the family-based welfare system (Baldini and Poggio 2014). In a global comparison, the percentage of Italian families living in their homes is only higher than Spain, but lower than the EU average (Manganelli, Morano, and Tajani 2014, 221).

Another important aspect of Italian real estate market is the number of second houses; in fact, an estimated 18% of Italians own a second house. Meanwhile, 15,2% of people has a second house that they use only for vacation. These statistics make it clear that some second residences are intended to increase revenue, while others are merely for enjoyment. Italy is also a popular destination for foreign buyers looking for a second home, particularly in some regions like Tuscany, Umbria, Sardinia, and the Amalfi Coast. The attractive landscapes, historic towns and villages, and extensive cultural history of these regions are well known. The possibility of owning real estate in Italy for vacation use, rental income, or as a long-term investment appeal to many foreign buyers. Due to their high demand and scarcity, properties in these localities are typically more expensive than those in other regions of Italy. Furthermore, homes that have been renovated or are in good shape typically demand a greater price.

Understanding who are the owners and how people buy real estate is a valuable element to understand the dynamics of Italian real estate market.

- In Italy, about 3.6 million households, equivalent to 19.2% of Italian households, pay mortgage, especially first home loans.
- There is evidence that people between the ages of 18 and 35 make the most house purchases[1].

At last, understanding how many people live in rentals and how much they spend can be helpful in estimating the rental housing market. 18% of Italian households pay rent for the home in which they live. Due to an onerous tax treatment that negatively affects both real estate investments with the potential for future profitability and those intended for quick resale after limited use, there are fewer rental homes available than the total amount of available assets. This contradicts with the tax breaks given to first houses, which have instead increased demand for this segment (Manganelli, Morano, and Tajani 2014, p. 221).

The social protection offered to households in the rental sector by the Italian housing system is inadequate. Municipalities, either directly or through special companies, manage the majority of social housing. By European standards, the sector is incredibly small. Since the 1980s, it has been further diminished as a result of declining governmental investment and sales to renters who are already occupied. Throughout the 1990s, the private rental sector saw significant liberalization. This helped the rental market recover after the “fair rent” regime of the 1980s brought it to a stop, despite the expense of increasing affordability issues. A national housing allowance program was established in 1998, however it only covers roughly 5% of resident ad has a small offsetting impact (Baldini and Poggio 2014, 320).

The complicated and diversified Italian real estate market offers a range of homes to suit various tastes and price ranges. There are several key features of the Italian real estate market that are relevant:

- *Regional diversity*: geographically speaking, Italy has a wide variety of areas and temperatures. As a result, the real estate market is also diverse, with various

[1] All these data are available on ISTAT and Idealista websites. Consulted the 12th of December.

geographic areas providing a range of different types of property and pricing points. Rome's market, for instance, is more expensive than those in other regions of the nation because of the city's fame as a tourist destination and the high demand for real estate there.

- *Historical properties*: ancient ruins and medieval castles both may be found throughout Italy, which is a country rich in historical landmarks. For individuals interested in conserving and renovating old architecture, these homes frequently require extensive restoration work, but they may be a special and gratifying investment.
- *Luxury properties*: Italy is renowned for its luxurious real estate, which includes villas, castles, and flats in luxury locales like Tuscany, Umbria, and Lake Como. These properties can be extremely expensive but can provide an elevated level of prestige and exclusivity.
- *Rural properties*: farmhouses and vineyards are among the rural properties found in Italy. For individuals seeking a second home in the country or with an interest in farming and winemaking, these properties might be a great investment.
- *Leasehold properties*: Properties are frequently sold as leaseholds rather than freeholds in Italy. This indicates that although the property is built on land, the owner only has the right to utilize the land temporarily. Although freehold homes are frequently more expensive than leasehold ones, it is crucial to carefully evaluate the lease's terms before making a purchase.

Overall, the Italian real estate market is a diverse and complex market that offers a variety of properties to suit different tastes and budgets. There are a wide range of houses available to fit various tastes and price ranges on the diversified and complex Italian real estate market.

To conclude the general view, despite growth rates in Italian real estate market have been lower than those in many other European nations, it is important to note that the sector has remained relatively steady in recent years. Additionally, government regulations, high property taxes, limited availability of mortgages, and the slow market growth can make purchasing property in Italy a significant financial investment.

1.2 Macroeconomic determinants of housing markets

Apart from microeconomic factors, which are described as a collection of components of the local environment in which housing is found and the characteristics of housing itself, macroeconomic factors also have a huge effect on the level of housing prices. In fact, they determine the state of the overall economy in a nation, they affect the prices of goods and services produced across all industries, and they specify the composition of the overall demand (Gasparėnienė, Remeikienė, and Skuka 2016, 123). People who own more expensive houses feel wealthier since their homes are worth more, increasing the amount of collateral they have available to borrow with. An increase in house values might be the only chance for people with limited liquidity to borrow money at all. As consequences, this wealth effect leads to increasing consumption. When home price drop, more mortgages default, which reduces the amount of bank credit available as banks lose some of their bank capital, which has a negative impact on consumer spending (Adams and Füss 2010, 39).

The scientific literature has made it possible to define the macroeconomic variables that have been considered as having an impact on the level of property prices. In this analysis we are going to use the following macroeconomic variables to explain the changes in price of house and rent prices: the interest rate, the Consumer price index (CPI), the industrial production, the unemployment rate, and the government policies. We are going to explain the concept of every variable in the following sections.

1.2.1 Interest rate

In general, interest rate represents the cost of money and define the amount someone has to pay extra for borrowing money, or that has earned when lending them. The real estate markets are significantly affected by interest rate. This happens especially because a significant part of all the houses is bought using a mortgage. The latter's main variable is the interest rate, and they are positive correlated. The ability of a person to buy a residential property can be significantly affected by changes in interest rates. This is because as interest rates decline, mortgage application fees decrease, increasing demand for real estate and resulting in higher prices. In addition, to discourage potential purchasers from getting a home, rising founding costs caused by increasing interest rates also limit real estate market liquidity and extend the sales cycle. As a result, rising interest rates eventually reduce the price of home, since renting becomes a more appealing option and vice versa (Gasparėnienė, Remeikienė, and Skuka 2016). Interest rates can also affect the supply of homes for sale. For instance, homeowners may be more inclined to refinance their mortgages if interest rates are low to benefit from the lower rates. The fact that homeowners are looking to relocate to a new house after refinancing, may increase the availability of properties for sale. Additionally, changes in interest rates can also affect the value of the Euro, which can also impact the Italian real estate market if the Euro appreciates or depreciates against other currencies. In the case when the Euro appreciates, it can make Italian property more expensive for foreign buyers, which can decrease demand for real estate. At the opposite, if the Euro depreciates against other currencies, it can make Italian property cheaper for foreign buyers, which can increase demand for real estate.

Overall, the interest rate should be considered while analysing the real estate market and making decisions one the purchase or sale of a home, in fact, it can impact both the demand and supply for sale, as well as the profitability of real estate investments.

The interest rate used is the "*long-term government bond yields: 10-year*[2]". These data are monthly observation between June 2014 to November 2022, as showed in Figure 1.1. In the empirical analysis the interest rate will be the same for every Italian region. This is because we are using the Italian risk-free interest rate, so it is the same in the whole Italy.

[2] Organization for Economic Co-operation and Development, Long-Term Government Bond Yields: 10-year: Main (Including Benchmark) for Italy [IRLTLT01ITM156N], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/IRLTLT01ITM156N.

Figure 1.1 – Time series of Italian long-term government bond yields: 10 years. The time interval is from June 2014 to November 2022.

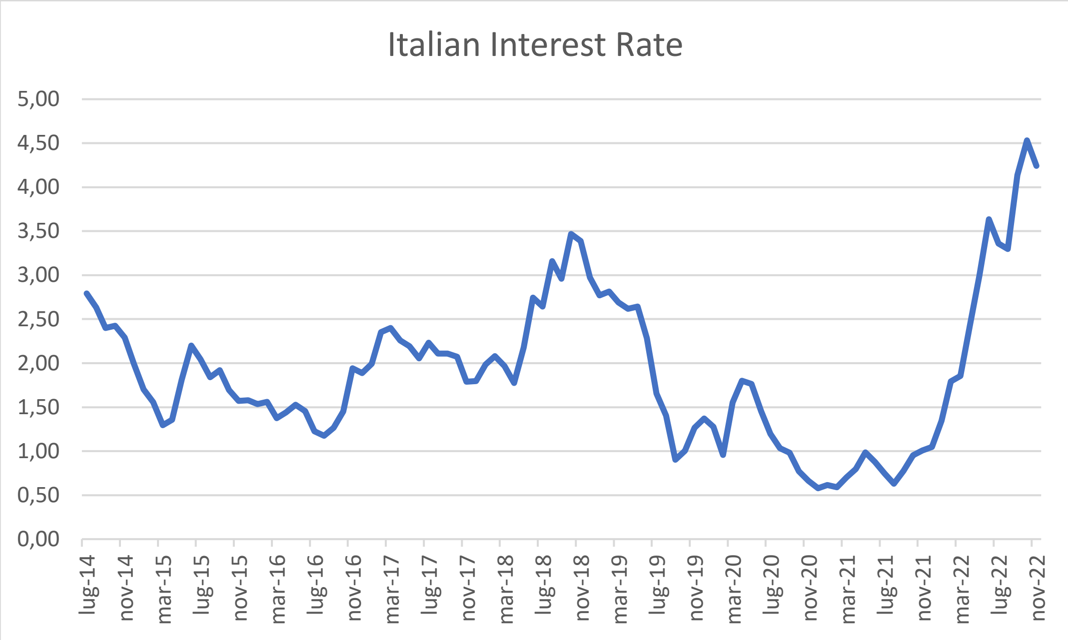

Figure 1.1 - Italian interest rate development from June 2014 to November 2022. Data taken from the FRED website.

As Figure 1.1 shows, the mean and the variance in this timeframe are respectively equal to 1,88521 and 0,848982. From the graph, we can notice that from July 2014 to July 2021 the interest rate goes up and down regularly, while in the last periods it goes only up, reaching over 4,50%. The Italian interest rate depends by the monetary policy that the European Central Bank (ECB) decides to apply, and it influenced every country that used Euro as domestic currency. For example, the growth of Italian interest rate in the last year is due to the decision of the ECB to raise the interest rate to contrast the inflation.

1.2.2 Consumer Price Index (CPI)

Another important macroeconomic factor that can explain the movements of house and rent price is inflation. Inflation is the sustained increase in the general price level of goods and services over a period. Higher inflation is thought to raise house prices along with a persistent increase in the general level of prices for goods and service, while deflation, on the other hand, contributes to a drop in housing prices. Inflation measured by consumer price index (CPI) is defined as the change in the prices of a basket goods and services that are typically purchased by specific groups of households ('Prices - Inflation (CPI) - OECD Data'). It is used to calculate the typical difference in pricing of household goods between two specified periods. It is an overall assessment of product pricing trends while keep quality. The CPI can influence the real estate market in several ways:

- Consumers' purchasing power may be impacted by inflation, which may have an impact on their capacity to purchase a home. For instance, if the CPI rises over a brief period of time, customers may find it harder to afford a property due to the higher cost of living. This may result in a decrease in housing demand and a drop in home prices.
- Real estate assets' value can be impacted by inflation. The value of a home might rise because of the higher cost of living, for instance if the CPI rises dramatically over an extended period of time. For investors, this may increase the profitability of real estate investments.

The data used is a transformation of the *Consumer Price Index of All Items in Italy*[3], with monthly observation and index 2015 = 100, as showed in figure 2.2. The CPI is a useful indicator to see how the price change during the time, but to use it as an indicator of inflation we must take the growth rate of this index. We can define the growth rates as the change of a specific variable within a specific time period. In our case, the time period is always equal to one month. The formula that we use is the following:

$$Inflation = \frac{CPI_2 - CPI_1}{CPI_1}$$

We are going to use this formula to find the growth rate of the industrial production index. Also, in this case the growth of CPI is the same for all regions.

[3] Organization for Economic Co-operation and Development, Consumer Price Index of All Items in Italy [ITACPIALLMINMEI], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/ITACPIALLMINMEI

Figure 1.2 – Time series of the growth of CPI from June 2014 to October 2022

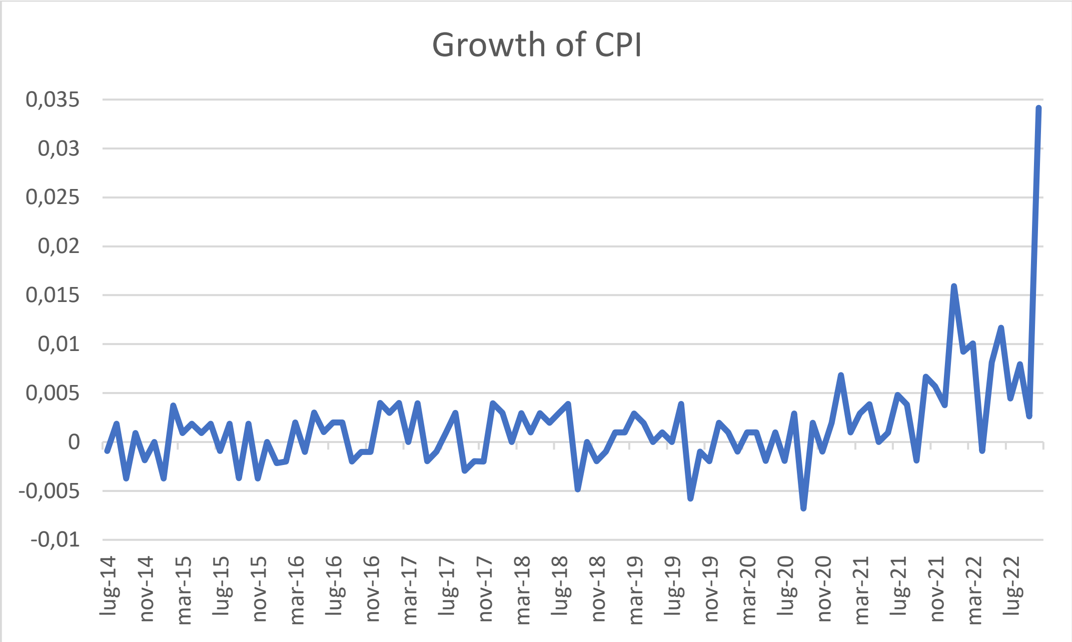

Figure 1.2 Growth of Italian Consumer Index Price (CPI) development from June 2014 to October 2022. Data taken from FRED website.

The mean and the variance in Figure 1.2 are respectively equal to 0.001667 and 0,004814. As we can notice from the mean, the monthly inflation is positive during this period. In the initial period until November 2020 the inflation has a low variance, and it is stable, while in the last year the growth rate is particularly high. This is due especially to the macroeconomic condition of the world economic. As we commented before, the interest in the last year is particularly high to contrast the inflation.

1.2.3 Industrial production index

OECD define industrial production as "the output of industrial establishments and covers sectors such as mining, manufacturing, electricity, gas, steam, and air-conditioning. This indicator is measured in an index based on a reference period that expresses change in the volume of production output." Typically, it is presented as an index, with 100 denoting the average level of industrial production during a reference year. The industrial production is a better indicator for the empirical analysis rather than Gross Domestic Product (GDP) because the first one is available also with monthly observation, while the latter only quarterly or annually. Industrial production can influence the real estate market in several ways:

- The demand for housing may rise because of an expanding economy driven through a strong industrial sector. People may be more likely to buy a property when they become more employed and have extra money. This may cause housing prices to rise.
- Industrial production can also affect the demand for commercial real estate. For instance, if a business needs more space because its activities are growing, it may lease or buy more commercial real estate. As a result, prices for commercial real estate may rise due to an increase in demand.
- The availability of houses for sale can also be impacted by industrial production. For instance, if there are job losses because of a recession in the manufacturing industry, homeowners may decide to sell their homes and move to a different area. Due to an increase in the number of available residences, housing prices may be under pressure.

Overall, industrial production is a significant economic indicator that can affect the real estate market by affecting the availability of homes for sale, the demand for housing, and the demand for commercial real estate.

In this case, the data used is a transformation of the *Production of total industry in Italy*[4], with monthly observation and index 2015 = 100. We are going to use the growth rate of

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[4] Organization for Economic Co-operation and Development, Production of Total Industry in Italy [ITAPROINDMISMEI], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/ITAPROINDMISME

the industrial production index. As for the interest rate and the growth rate of CPI, this indicator is the same for every Italian region.

Figure 1.3 – Time series of the growth of Industrial Production from June 2014 to September 2022

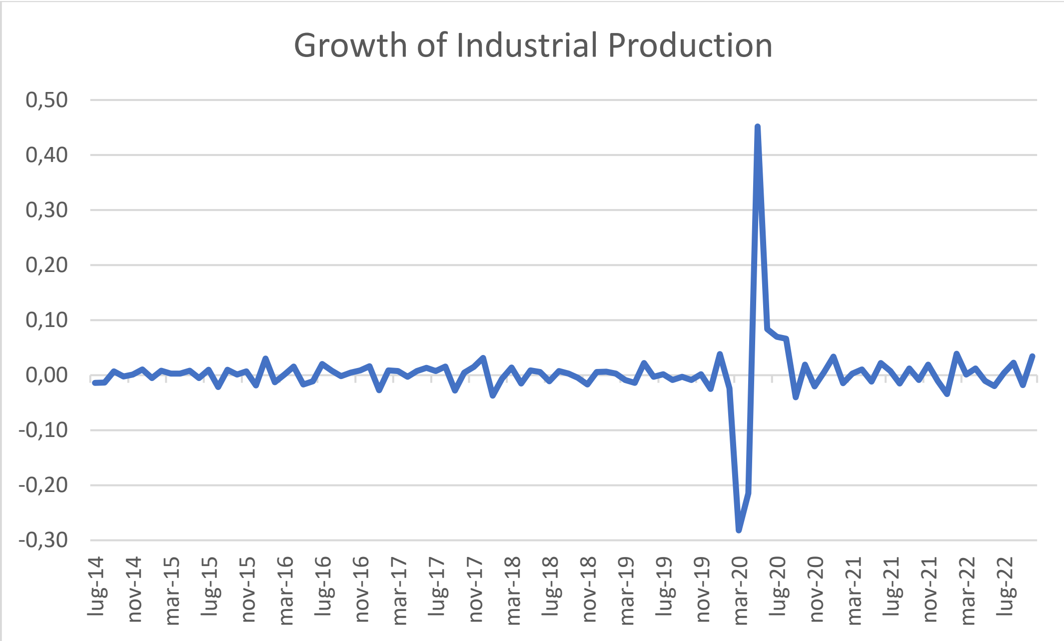

Figure 1.3 Growth of Italian Industrial Production development from June 2014 to September 2022. Data taken from FRED website.

The mean and the variance in Figure 1.3 are respectively equal to 0,0025979 and 0,061159. From this interval we can notice that the growth of Industrial Production is steady during the whole observation period, expected from the first half of 2020. This is not surprising because it was caused by the policies adopted by Italy government during the first months of Covid 19 pandemic.

1.2.4 Unemployment rate

The unemployment rate is the proportion of unemployed people to a country's total labour force. When we talk about the total labour force, we mean the sum of employees on the payroll or contract, the self-employed such as those with VAT numbers, and those who are unemployed but otherwise qualified for employment. In fact, those who are ineligible for employment – such as children or elderly retirees, for example – are eliminated from this type of examination. In this situation, these are people who, despite being a member of nation's population, are unable to work and, as a result, are not included in the unemployment rate because they are not considered to be unemployed.

The real estate market may be negatively impacted by a high unemployment rate. For example, people may be less likely to make major purchases, like buying a home, if they are unemployed or worried about their job security. This can lead to a slowdown in the real estate market, since fewer homes are being bought and sold. On the other side, a low unemployment rate may signify a strong labour market and a solid economy, both of which could boost demand for housing and the real estate market.

In Italy, the monthly unemployment rate for every region is not accessible, because ISTAT (*Istituto Nazionale di Statistica*) does not collect this information. From January 2018, ISTAT website has included the data of quarterly unemployment rate for every region, while before the data was available only at macro region level, such as North-West, North-East, Center, and South and Islands. Due to this situation, to include the employment rate to the model the data available was merged: that is why in the statistics from June 2014 to December 2017 the regions who belonged to the same macro area present the same numbers. Since all other observations are monthly, while the unemployment rate was only available quarterly, it was decided to consider the same value of every trimester for every month included in that period. For example, the unemployment rate for region Veneto of the first quarter of 2022 is 5,1%, so in the dataset the unemployment rate of January, February and March is equally 5.1%. Due to this, we are going to also use another unemployment rate. In this case the unemployment rate is collected every month, but it is not different from every region, because this is the Italian unemployment rate. This database is taken from ISTAT website.

Figure 1.4 – Time series of Italian unemployment rate from July 2014 to November 2022.

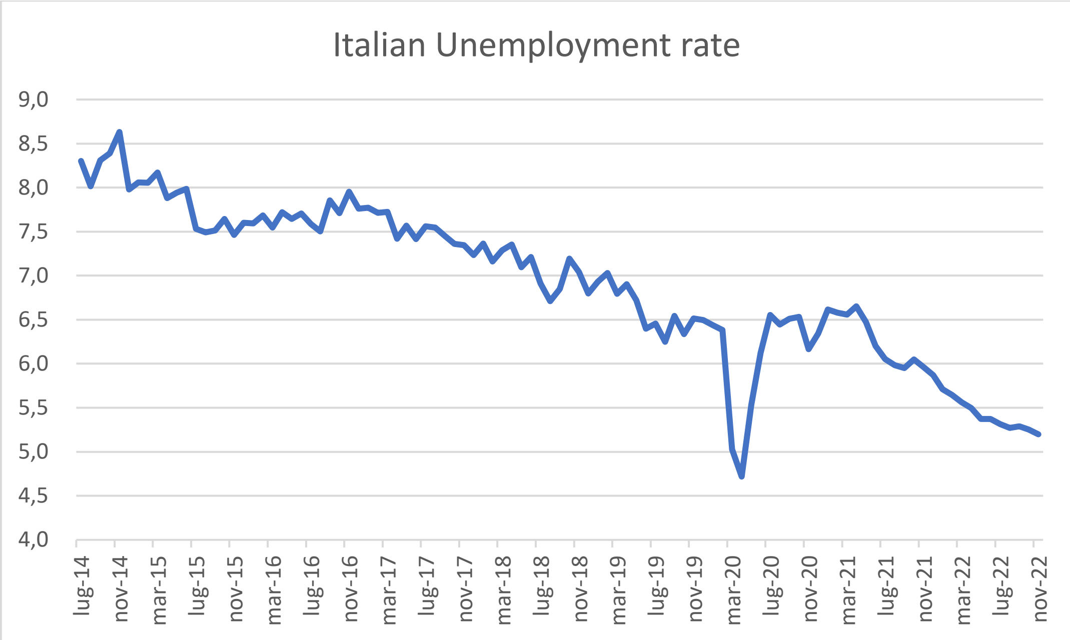

Figure 1.4 Italian Unemployment rate development from July 2014 to November 2022. Data taken from ISTAT website.

The mean and the variance in this case are respectively equal to 6,90007 and 0,895625. From Figure 1.4 we can notice that the Italian unemployment rate has a decreasing trend during the whole observation period. As was said before for the industrial production, also in this case we have an exception during the first months of Covid 19 pandemic, always due to the policies adopted by the Italian government.

1.2.5 Government Policies supporting energy efficiency

Another element that can have a significant impact on property demand and price of real estate is legislation. For as long as they are in place tax deductions, tax credits, and subsidies are a few ways the government might temporarily increase real estate demand. In the period between 2014 to 2022 the main policy in Italy was the Superbonus 110%. It is a tax deduction that began in the second half of 2020, and it is the main topic of second chapter of the dissertation. All facilities affecting real estate were adopted with the aim or reducing sectorial difficulties resulting from periods of crisis and with the aim of improving the environmental and energy. However, these concessions detect effects on the market: prices became less important in determining demand and supply. Demand experiences an exponential increase leading supply to have to adjust. Another key aspect of building renovation deductions is to produce a regressive distributional effect, with the wealthier part of population in the income distribution benefiting at least ten times more than the poorer subjects. This effect is due to the problem of incapacity of subjects with low incomes, but also because wealthy individuals are owners of more housing units and have more resources to cope with the expenses of the subsidized interventions.

The biggest problem for the analysis of this policy is the absence of data about the credits granted by the Italian state. To resolve this problem in the empirical analysis the variable Superbonus 110% is presented in three diverse ways that now we are going to explain.

The first one is using the data taken from Google trends. The latter is a free analysis and research tool from Google that is useful to know the Web search frequency of keywords used by people in their searches on the Google search motor. Thanks to this website it is possible to proxy the interest of Italian people for every region about this policy. Google Trends offers indexes that reflect the popularity of a particular subject on the internet by tracking its web search volume over time. The indexes can be obtained for specific regions or globally. The higher the value of a Google Trends index, the more interest there is in that topic. Recent studies have demonstrated that Google Trends data has the ability to provide explanations and make prediction in various areas of economics and finance (Costola M., Iacopini M., Santagiustina C. 2021). The word of interest, researched filtering for Italy and not worldwide, is “Superbonus”. Google trends give to us values from 0 to 100, where 0 means that the research on Google of this word where at the minimum, while 100 means that the research were at the maximum. As we wrote before it is only a proxy variable, and we can define it as easily measurable variables that analysts include in a model in place of unmeasurable or hard-to-measure factors. Proxy variables can be not of great interest but has a close correlation with the variable of interest.

The second way is using a dummy variable. In this case, our dummy is *Superbonus Time Effect*, that captures the different effects made by the presence of Superbonus on the growth of house and rent price. A dummy variable can be defined as a variable that takes values of 0 and 1, where the values show the presence or absence of something. Dummy variables can be used to describe qualitative effects (e.g., gender, ethnicity, geography), or to control with respect to time (seasonal dummies, annual dummies, regime effects), or public policy effects (e.g., individuals subjected to initiatives to help reintegration into employment). In this specific case, Superbonus time effect takes values equal to zero from June 2014 to July 2020, when Superbonus 110% was still not implemented, while it is equal to 1 when applied.

The last method that we utilized to capture the impact of Superbonus 110% is with the data taken from ENEA website. ENEA (Energia Nucleare Energie Alternativa) is an Italian public research organization working in the fields of energy, environment and new technologies to support competitiveness and sustainable development policies. ENEA is useful for the analysis because it collects the absolute value of investments eligible for deduction. This dataset is useful to implement our model because they are monthly data and there is information for every region, however it lacks all the data needed for the analysis. In fact, the ENEA observation began from August 2021, so the data are missing for the first year of the policy. Moreover, ENEA does not provide a dataset with all these data but only a PDF file for every month. In every file is reported for every region the number of asseverations uploaded to the dedicated site, the absolute number of investments eligible for deduction and the absolute and percentage rates of works already conducted. However, for the sake of the study, we only take into consideration the absolute number of investments eligible for deduction.

The Superbonus 110% is the main interest of the empirical analysis because it is a distinctive policy where the state gives more tax savings respect to the expense that the citizen had pay. The main problem with the Superbonus is that it incentivize moral hazard. The latter can be defined as the condition in which a person, exempt from any negative economic consequences of a risk, behaves differently than he or she would if he or she were to suffer them instead. Knowing that the costs will be entirely borne by the state, homeowners and construction companies have no incentive to keep costs down. In fact, there may even be an incentive to inflate expenses and distribute the money thus taken from the taxpayers. The mechanism of caps type of intervention does not appear to be robust enough and can be circumvented with the help compliant technicians. The problem is becoming topical because of the sharp increase in demand for restructuring and the soaring prices of raw materials internationally that are causing increasing the price of interventions massively. One wonders whether there is too much tolerance on the part of homeowners towards these increases since they are supported by the state. As stated by

Minister Franco, the Supebonus turns out to be an expensive measure that is not sustainable in the long run (Brugnara and Ricciardi, 2021, 8).

1.3 House and Rent price

Real estate sale and rent prices in Italy are difficult to track and are not public. As a result, listing prices are used by institutional entities to conduct market assessment as well as by real estate companies and evaluators to determine how much a home is worth. In this context, listing prices serve as a significant indicator of the value of a home.

Osservatorio del Mercato Immobiliare (OMI), the real estate market observatory of the Italian Tax Office, is the primary source of spatially disaggregated data on housing markets in Italy. OMI aims to ensure maximum transparency and prevent any attempt at tax evasion. The organization aims is to ensure maximum transparency and prevent any attempt at tax evasion. OMI specifically processes and analyses all data and information regarding the value of a property and the rental market. Among the numerous administrative datasets that OMI maintains, two are especially important for the study of the housing market. First, OMI publishes twice-yearly estimates of the lowest and maximum house price inside what are known as OMI micro-zones, which are homogenous socioeconomic area equivalent to neighbourhoods. The OMI projections are based on a small sample of actual sales and purchase offer collected by real estate firms. Second, OMI publishes data on the quantity of real estate transactions at the city level. OMI also keeps a database of microdata on every transaction as reported in the notary registers, but unfortunately, this database is not accessible to the public. Additionally, the OMI estimates of home values are not always indicative of transactions because they are only made accessible after a delay of many months ,due to the small sample size (Loberto, Luciani, and Pangallo 2018, 5–6). Due to this features the OMI's dataset is not useful for the empirical analysis, in fact we need monthly data for every region. To resolve this problem, we took data from Immobiliare.it through web scraping.

Web scraping extracts text from web pages to obtain and store information. It is comparable to an automatic copy-and-paste process. This method focuses more on transforming unstructured data on the Web, usually in HTML format, into metadata that can be store and analysed locally in a database, where they can be adjusted and examined, as necessary. There are several scraping techniques, but a distinction is made between manual and automatic scraping.

- Manual scraping refers to the manual process of copying and pasting information and data. This can be compared to the activity of clipping and collecting newspaper article. Manual scraping is done only if individual information is to be found and stored. It is a very labour-intensive process that is rarely used for substantial amounts of data.
- Automatic scraping, on the other hand, uses software or an algorithm that searches multiple web pages to extract information. Specific software exists for this, depending on the type of website and content being searched for.

To extract data from Immobiliare.it website, we wrote a code in Python and utilize the tool *Selenium* to implement an automatic web scraping, in order to copy all the data of house and rent price of every region in different excel file, that could not be found already elaborated by some other studies. We had to use the tool *Selenium* because the HTML page could not be read automatically only by using the function *Beautiful Soup*. This was due to the structure of the page that kept adjourning the data of our interest. The Python code can be found in the first part of the appendix.

Immobiliare.it is a famous online portal for real-estate services in Italy. The main goal of this website is to make easier for buyers and sellers to connect in the housing market. The scale of measurement of both, rent and house price, is euros for every cubic meter (€/m^2). Now, we are going to present the data of every Italian region divided in several macro-area to make easier the graphical analysis.

Figure 1.5 Time Series of house price of North-East region in Italy from June 2014 to December 2022.

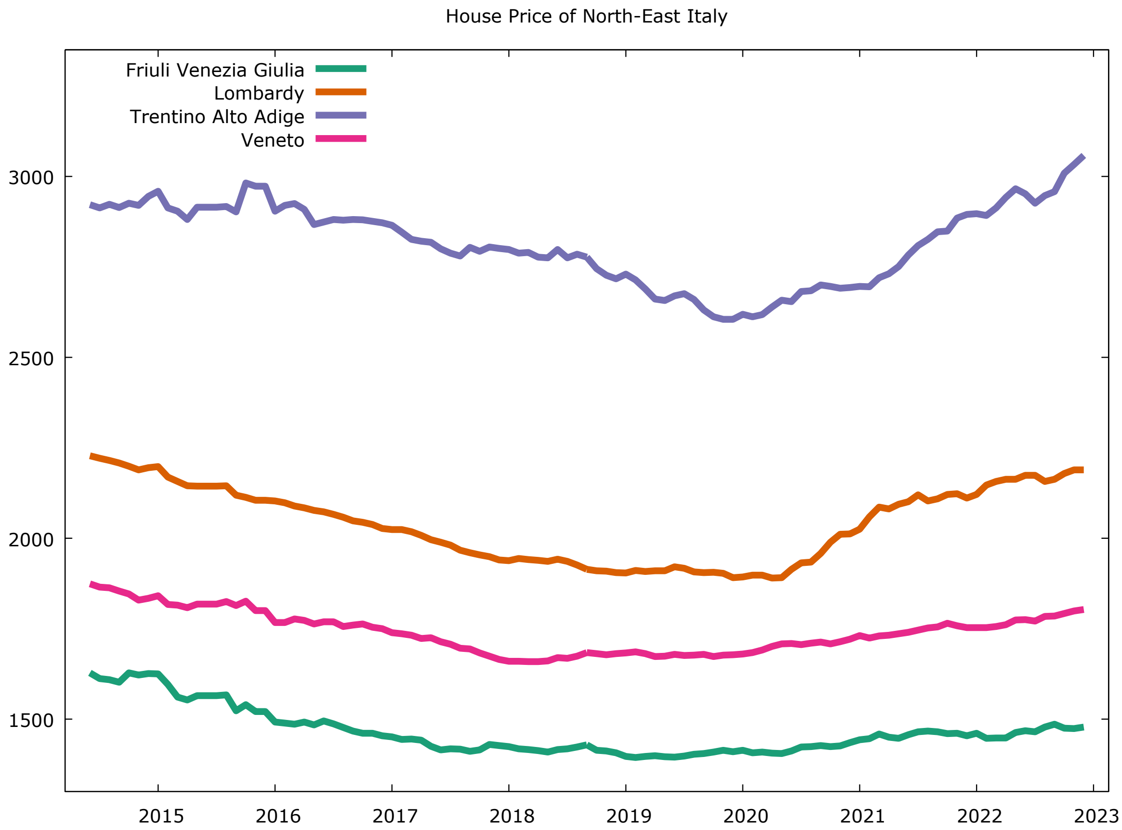

Figure 1.5 House price of North-East regions in Italy from June 2014 to December 2022. Created by the Author with Gretel.

As we can see from Figure 1.5, the house price in Veneto looks stable while in the other regions there is a decreasing trend until the end of 2020 where the prices began to increasing. In this macro-region Trentino Alto Adige is the region where to buy a home while Friuli Venezia Giulia is the cheaper.

Figure 1.6 Time series of rent price of North-East region in Italy

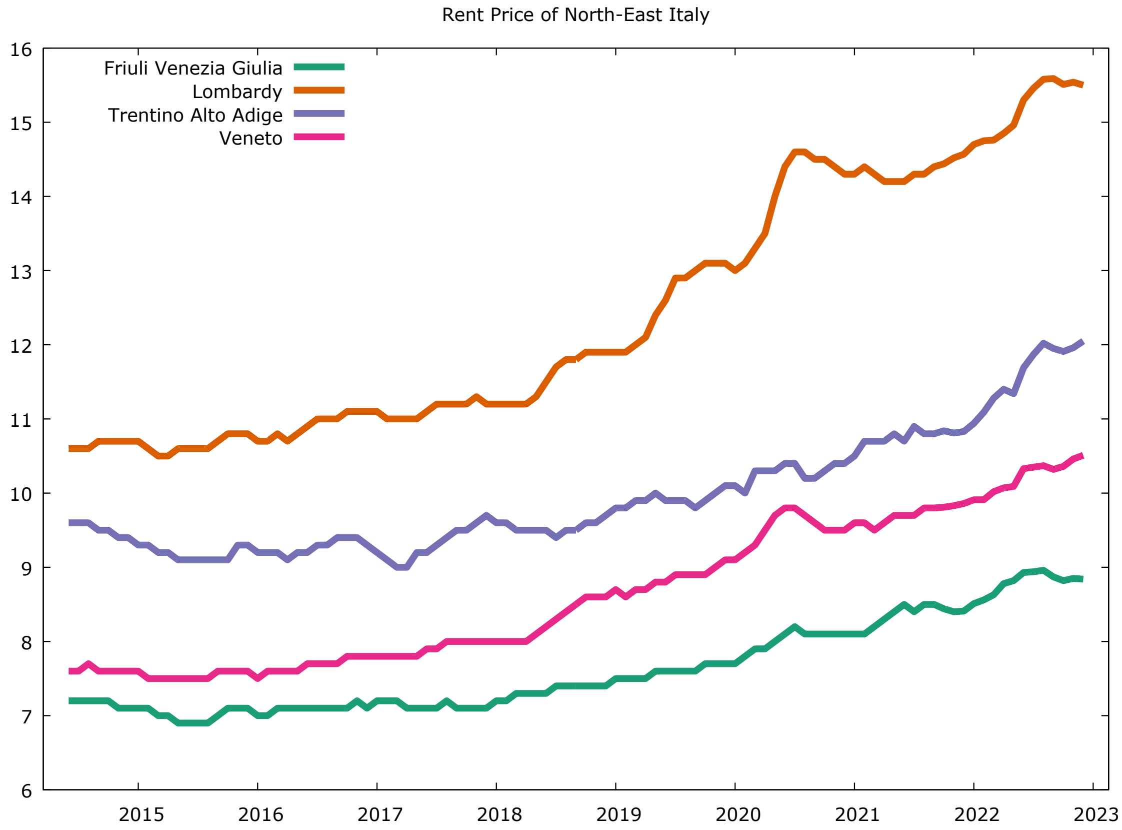

Figure 1.6 Rent price of North-East regions in Italy from June 2014 to December 2022. Created by the Author with Gretel.

Contrary to the house price, in this case, as seen in Figure 1.6, in all the regions we can notice an increasing trend during the whole observation period. From this graph, we can notice that Friuli Venezia Giulia is always the cheaper while now Lombardy is the more expensive region to rent a house.

Figure 1.7 Time series of house price of North-West of Italy

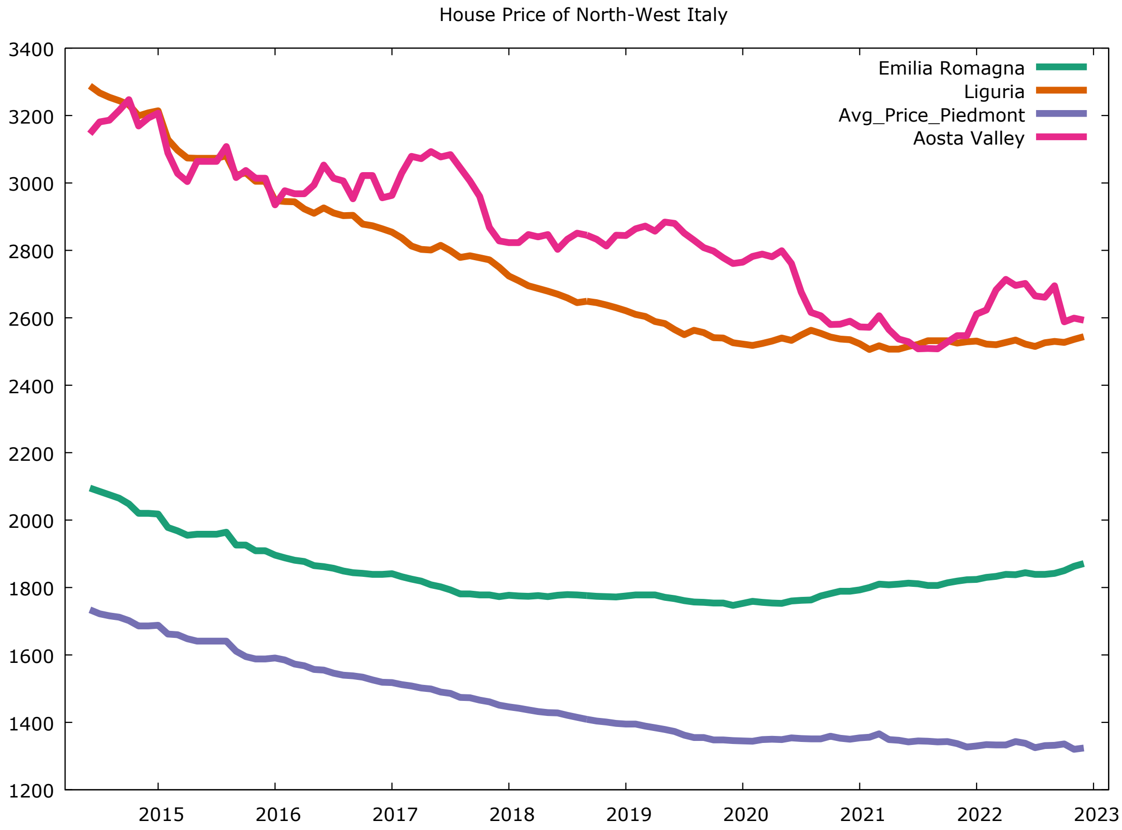

Figure 1.7 House price of North-West regions in Italy from June 2014 to December 2022. Created by the Author with Gretel.

As Figure 1.7 shows, in this macro-region the house price follows the same diminishing trend. Only Valle d'Aosta has an upwards at the end of 2020. Aosta Valley and Liguria are the more expensive while Piedmont is the cheaper of this macro-region.

Figure 1.8 Time series of rent price of North-West of Italy

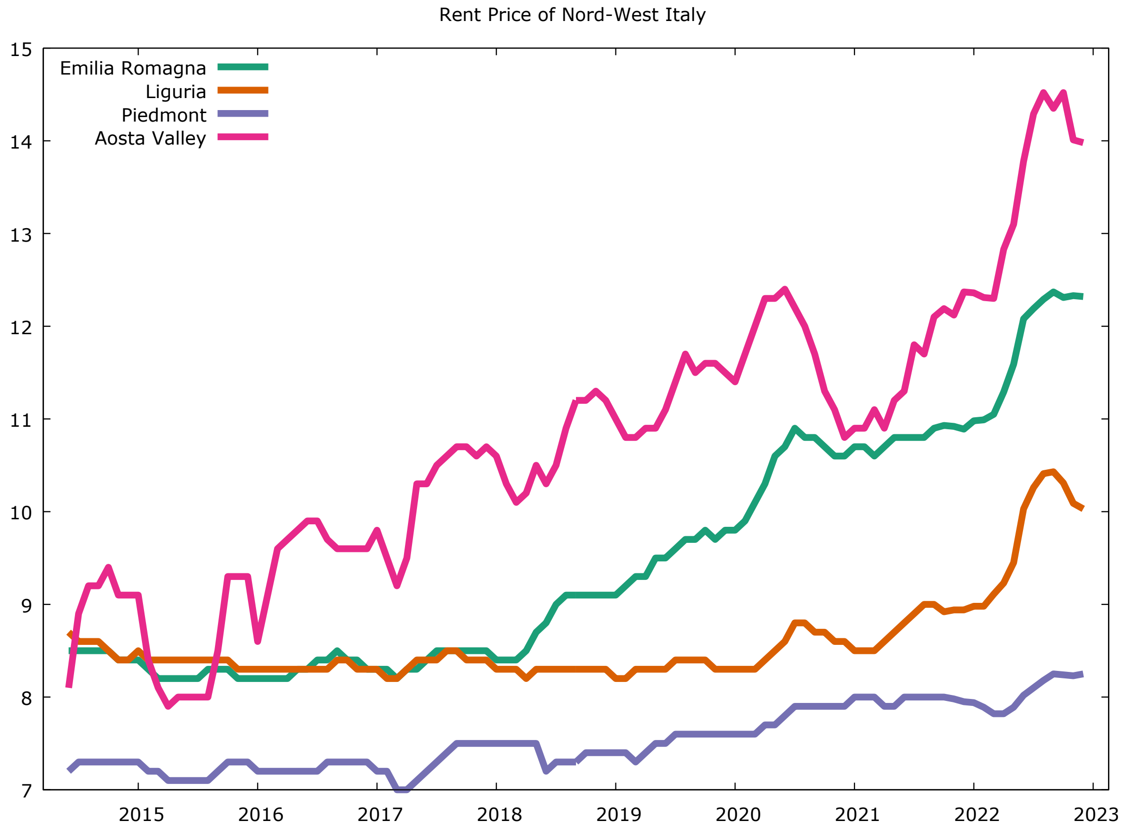

Figure 1.8 Rent price of North-West regions in Italy from June 2014 to December 2022. Created by the Author with Gretel.

Regarding the rent price, as presented in Figure 1.8, in Nord-West Italy there is an increasing trend, especially in Aosta Valley where in the last eight years the rent price has almost double. So, Aosta Valley is pricier than the other regions for both house and rent cost.

Figure 1.9 Time series of house price of Center of Italy

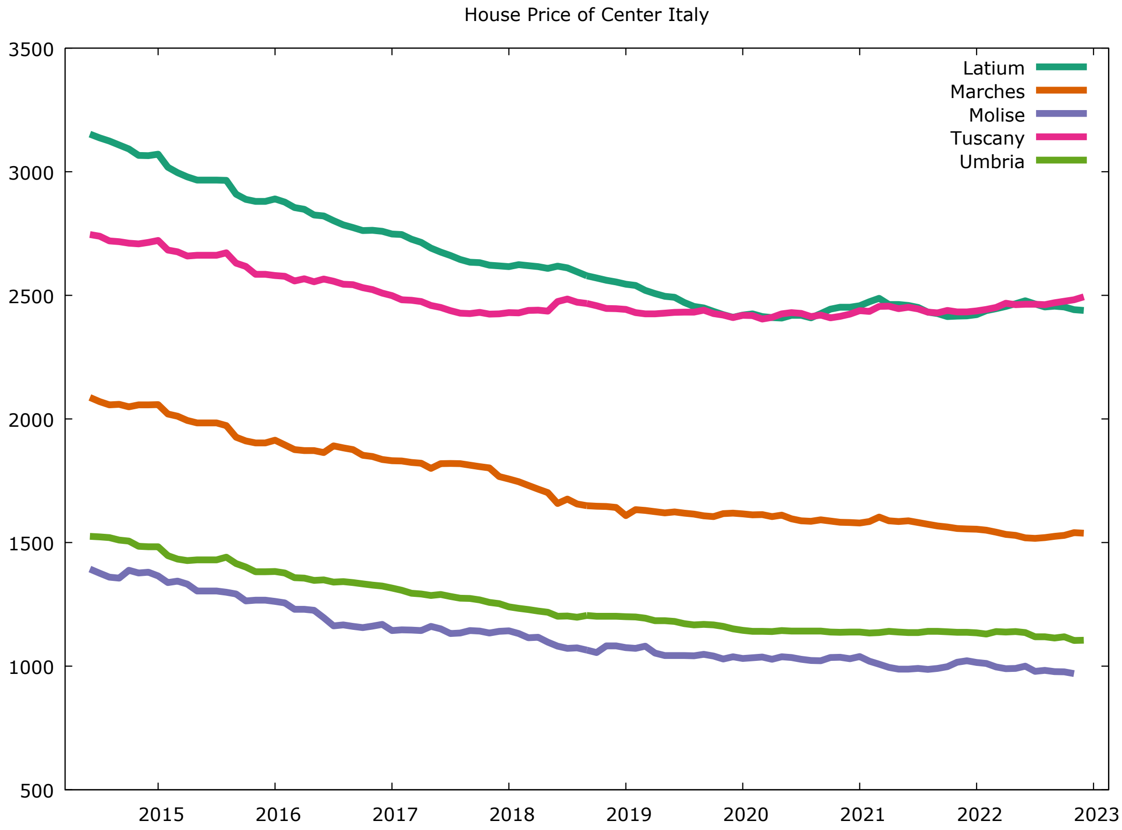

Figure 1.9 House price of Center regions in Italy from June 2014 to December 2022. Created by the Author with Gretel.

As already discussed, the houses value in the Center of Italy are diminishing from the house price bubble of 2008. In this case, represented in Figure 1.9, there is no region that has an increasing trend during the observation period. Latium and Tuscany are the most expensive price in the Center of Italy, while Molise and Umbria are the cheaper and they also follow the same trend.

Figure 1.10 Time series of rent price of Center of Italy

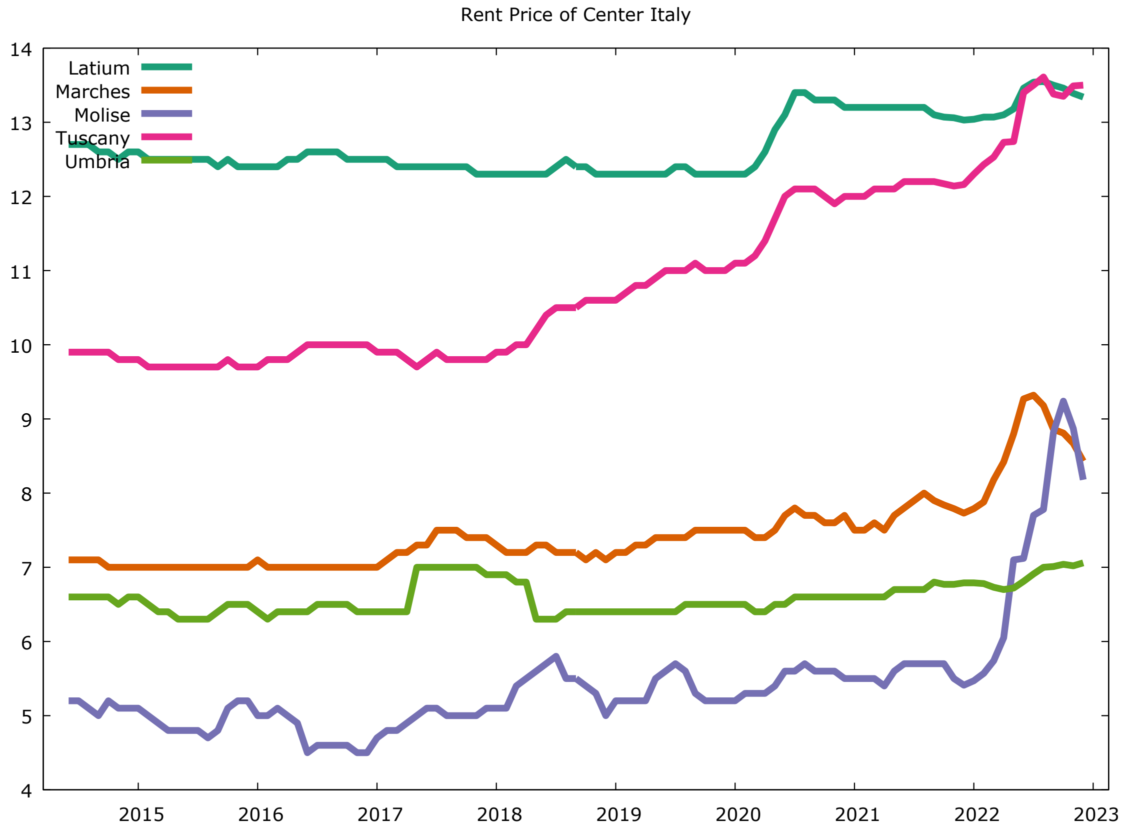

Figure 1.10 Rent price of Center regions in Italy from June 2014 to December 2022. Created by the Author with Gretel.

About rent price of Center Italy, we can see in Figure 1.10 that Umbria has the same prices over the observation period, while the others have an increasing trend, especially in the last periods. We can notice as in these days, Latium and Tuscany house and rent price are almost equal.

Figure 1.11 Time series of house price of South Italy

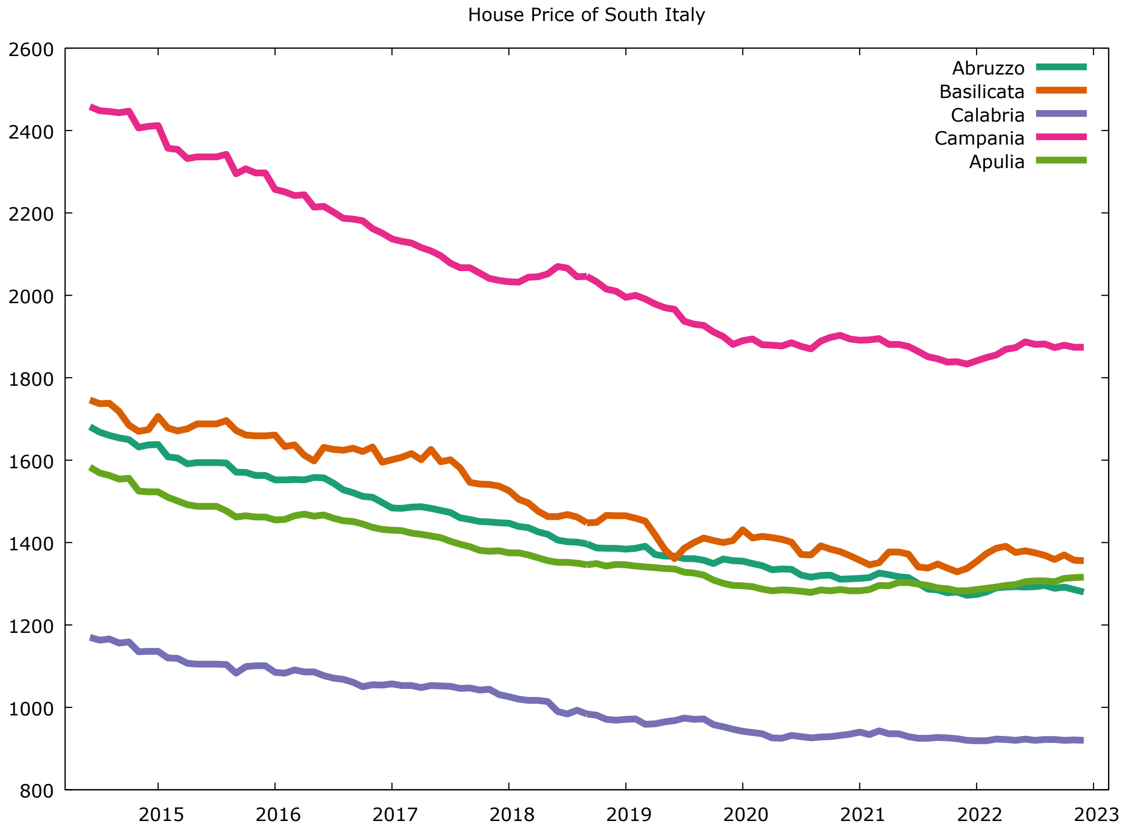

Figure 1.11 House price of South regions in Italy from June 2014 to December 2022. Created by the Author with Gretel.

In Figure 1.11 all the regions follow the same diminishing pattern, especially noticeable in Campania. Calabria is the cheaper region while Campania is the more expensive in the South of Italy. The house price of Basilicata, Apulia and Abruzzo have almost the same price in the whole observation period.

Figure 1.12 Time series of rent price of South Italy

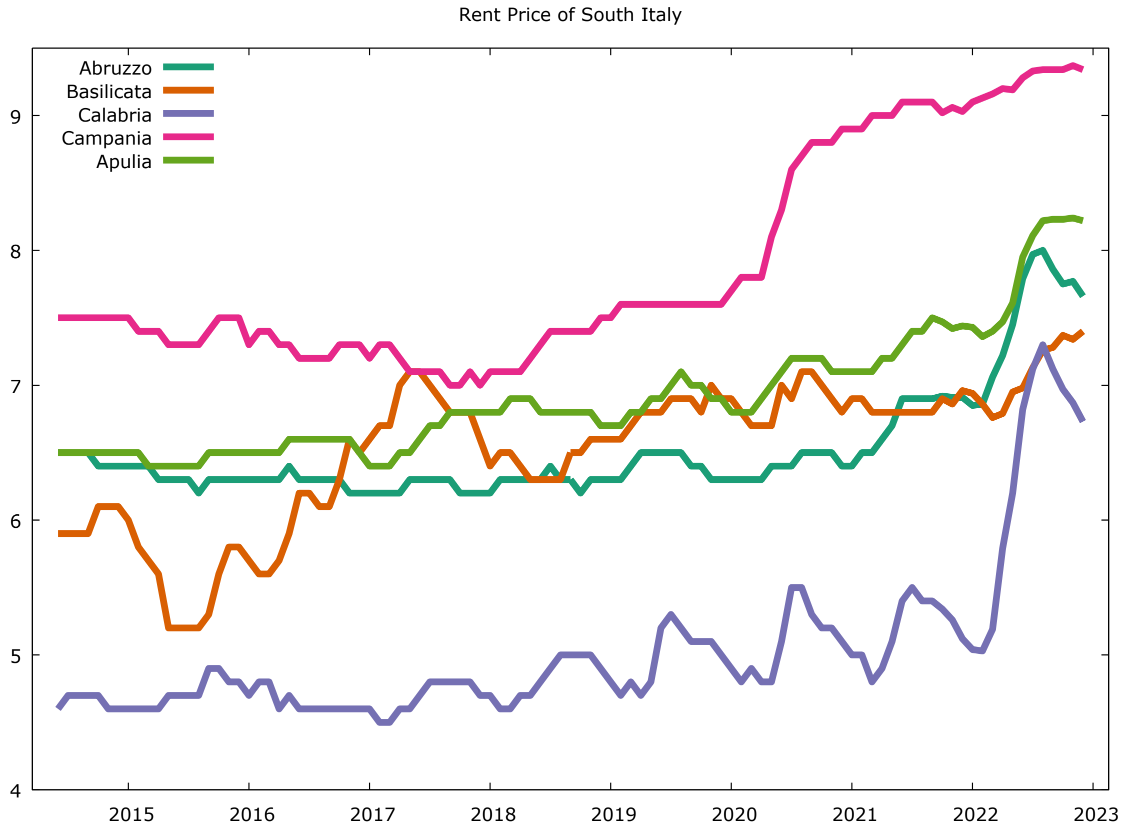

Figure 1.12 Rent price of South regions in Italy from June 2014 to December 2022. Created by the Author with Gretel.

As the other regions of the peninsula, in the period shown in Figure 1.12 the rent price is growth, especially in the last months. Also, in this case the pricier region is Campania while Calabria is always the cheaper of this macro region. We can also notice that in the last years the rent prices of Abruzzo, Basilicata, Calabria, and Apulia are similar.

Figure 1.13 Time series of house price of Islands

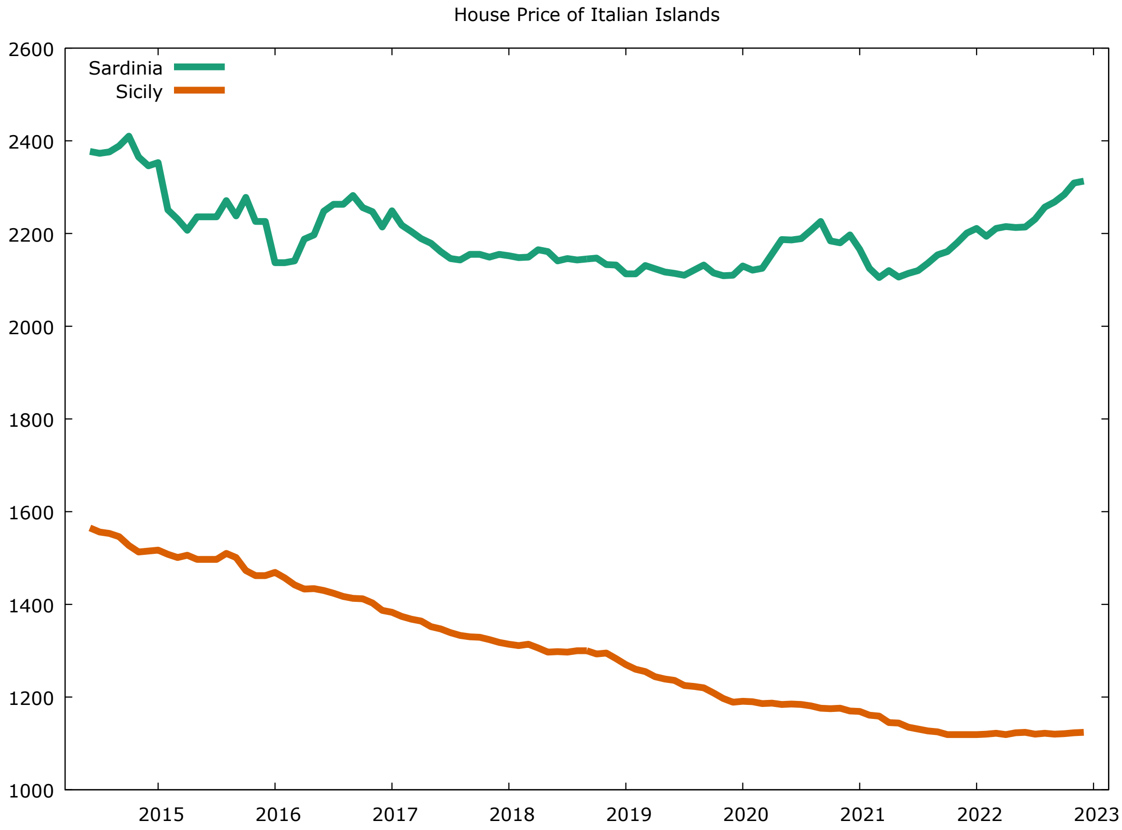

Figure 1.11 House price of Islands in Italy from June 2014 to December 2022. Created by the Author with Gretel.

In the Islands presented in Figure 1.13 we can notice that the Sicilia's real estate decrease the value so far, as the rest of Italy, while Sardegna's house price is constant over the observed period. The Sardinia's prices are always significantly higher than the Sicily one.

Figure 1.14 Time series of rent price of Islands

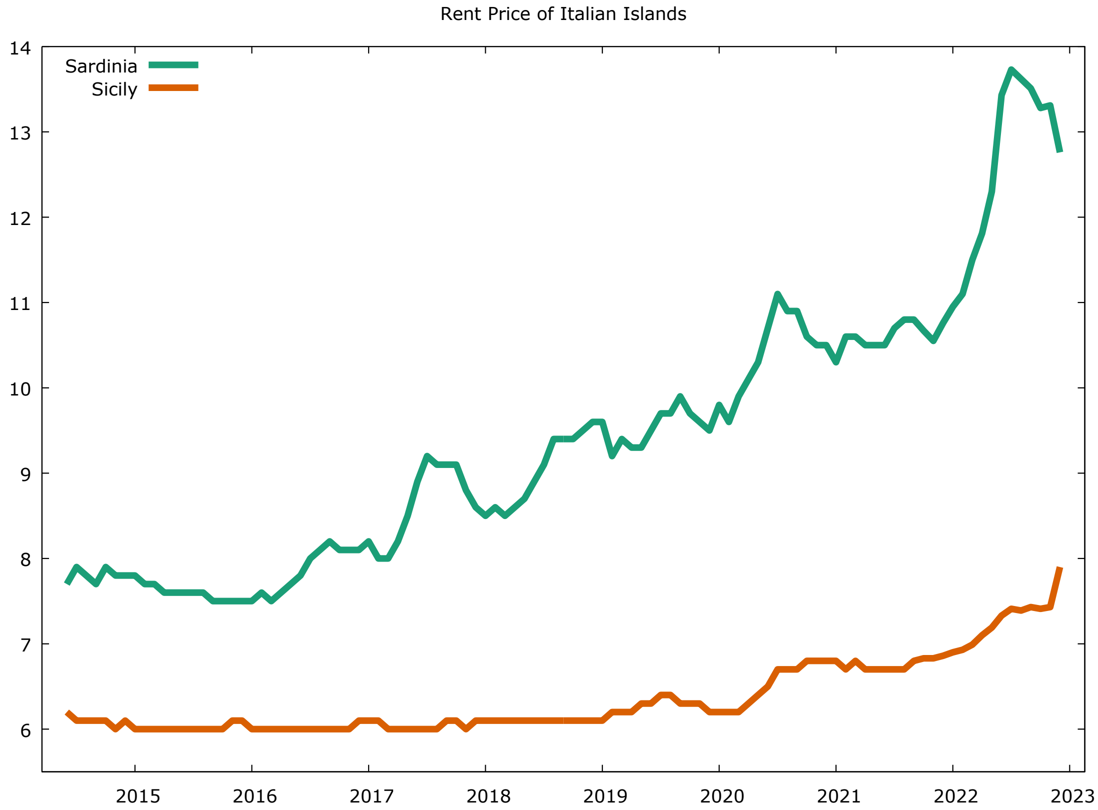

Figure 1.14 Rent price of Islands in Italy from June 2014 to December 2022. Created by the Author with Gretel.

In this last graph, Figure 1.14, we can notice that Sardinia's rent price follows an increasing trend while the Sicilian one is more constant. Also speaking about the rental price, we can say that the Sardinia's prices are higher than the Sicily one.

2. Tax concessions

Tax concessions or tax relief can be defined as the whole instruments that the government can use to decrease the tax burden of economic entities. These are exemptions used to calculate taxes; they reduce the tax base or taxes paid by economic entities and, in most situations, they are named deductions and allowances. Deductions help to lower the total tax, while also lowering the income used to compute taxes. Tax incentives enable the payers to reduce their burden. From a policy perspective, they can be used to favour certain categories of subjects or certain sectors; from the budgetary point of view, they create a revenue shortfall and therefore they become a cost and part of the expenses that the community incurs for certain economic and social programs.

To simplify the concept of tax relief, we should also define what taxes are. A tax is a percentage that the state imposes on every individual, business or corporation that earns an income, to finance government spending. As a result, the tax is a requirement for funds that the government collects entirely through its coercive powers. Taxes will then be used to provide citizens with public services.

We can divide taxes in two major distinctions: direct tax, and indirect tax. Wealth in general (goods and services) is usually financed by direct taxation. For example, IRPEF (Italian personal income tax) is the principal direct tax and is deducted annually from tax returns and from each paycheck. On the other hand, indirect tax has an impact on how wealth manifests itself throughout the transfer or consumption of a good. The VAT (Value Added Tax) is the primary indirect tax. Another difference between direct and indirect tax is that the first one is more related to an individual's ability to pay from an economic perspective, but it also causes the taxpayer a lot of psychological annoyance and may encourage tax evasion. On the other hand, indirect taxes are simpler to collect.

Taxes can be distinguished into four main categories:

- Fixed, where the tax does not alter in response to changes in income or other features and it is unaffected by the economic subject's action.
- Proportional, where the rate is fixed and it is directly proportional to the tax base.
- Progressive, where the rate rises as the taxable base does; IRPEF is an example of this type of rate structure.

- Regressive, when as the tax base increases, the rate decreases.

The idea of progression has always been a feature of the Italian system; in fact, the Italian Constitution's Article 53 has established that every taxpayer must contribute to public expenses in proportion to their ability to contribute. Applying this concept shows how the taxes paid by each individual increase more than proportionally with respect to total income; taxes change as the tax base change as well. Therefore, it may be inferred that progressive taxes are an efficient way to lessen economic disparities between people, because they proportionally affect the wealthiest to a greater expense than the poor. In practice, to best express the concept of progressive tax, we need to refer to how the tax varies as the tax base changes.

2.1 IRPEF

IRPEF is a direct, personal, and progressive tax that affects the total income of individuals. Its main responsibility is to implement the progressivity that the Italian Constitution (Article 53, Paragraphs 1 and 2) mandates for the whole tax system. The prerequisite for the tax is the possession of income, in cash or in kind, within the range of those explicitly provided for in the regulations. Taxpayers are individuals, residents (for income held both domestically and abroad), and non-residents (limited to income earned in the territory of the state). The following are the scenarios" No Tax Area": in which IRPEF is not applied, and the individual is exempt from taxation.

- Retires over the age of seventy-five who have a total income of less than 8.000 euros.
- Employees with a total income of less than 8,174 euros per year.

We also must consider the IRS, which allows taxpayers to get "discounts" on taxes. These discounts can be divided in two categories:

- "Deductible" charges, which can be subtracted from income before calculating the tax to be paid, thus decreasing the tax base on which the tax is calculated.
- "Redactable" charges, which can be subtracted directly from the tax payable, thus decreasing the amount of tax.

Before 2022, there was five IRPEF brackets and rates to be applied to taxable income, but the Italian 2022 Budget Law has proven the presence of only four brackets:

- The first bracket covers all taxpayers with income between 0 and 15.000 euros: in this case the expected IRPEF rate is 23%.
- The second bracket includes all citizens with income between 15.001 and 28.000 euros: in this case the expected IRPEF rate is 25%.
- The third bracket involves incomes between 28.001 and 50.000 euros: in this case the expect IRPEF rate is 35%.
- The fourth bracket affects individual with income over 50.001, for whom the IRPEF rate applied is 43%.

The differences between these rates and the older ones are that the second rate was lowered from 27 percent to 25 percent, the third rate was lowered from 38 percent to 35 percent for incomes up to 50.000 euros, and the fourth rate was raised to 43 percent for incomes from 50.000 euros, and no longer above 75.000 euros. It is important to keep in mind that starting with the secondo IRPEF bracket, the successive IRPEF rate only apply to the part of excess income that is over the base IRPEF rate. For instance, the structure of the tax calculation for a taxpayer with € 40.000 in income is as follows:

- Up to € 15.000 he will have taxation of 23%, so 15.000 x 23%, equal to € 3.450.
- From 15.000 to 28.000 will have taxation of 25%, so 13.000 x 25%, equal to €3.250.
- From 28.000 to 40.000 will have a taxation of 35%, so 12.000 x 35%, equal to € 4200.

  He will pay a total tax of € 10.900.

2.2 Types of tax concessions

Tax relief and benefits are among the most popular political instruments. This should come as no surprise, given the fact that they are thought of as a non-bureaucratic help and are simple to apply to specific actions and situations. Since it results in less revenue being generated, the government should not have to support new expenditure. Tax breaks are often referred to as "liberal government initiatives." This is due to the fact that the government's take appears to be declining rather than increasing. Even today, there is still a lot of discussion about taxation. Taxes still have an impact on how economic actors behave, having an income effect ad a substitution effect. From the welfare's perspective, taxes reduce the size of the market, which lowers the quantity exchanged of the consumer. The tax revenue that the public authority receives from taxation is redistributed to taxpayers, since the consumer earns the advantages of the services that were made possible by paid taxes. Progressive taxers have significant drawback of disincentivizing labour effort by encouraging tax evasion or even causing taxpayers to earn less income to avoid paying taxes.

To effectively define the idea of tax relief, one must understand the underlying concept of tax. The latter applies when taxes are collected and is specifically concerned with the source and rate components. Government officials use tax exemptions to support those who are struggling financially, or to encourage the growth of new economic sectors. However, they have one major flaw, which is the reducing government revenue.

We can, therefore, divide tax breaks into six macro areas:

1. Tax exemptions
2. Tax deductions
3. Tax reductions
4. Tax credits
5. Reduction of tax rates
6. Advantage tax schemes

To understand Ecobonus and Superbonus we are going to explore only the first four tax breaks.

2.2.1 Tax exemptions

Tax exemption is the removal of a taxpayer from taxation that would have otherwise affected his taxable sphere. A type of tax relief known as tax exemption is figured out by the legislature through unique exemptions under tax law. Tax exemption is adopted by the lawmaker for several reasons, such as the promotion of the economic development of a depressed area or as a social policy tool to lessen the tax burden on low-income people. Tax exemption can be:

- Subjective: based on the context of the topic.
- Objective: applies to all subjects in a particular area.
- Temporal: depends on the period of validity and requirements.
- Permanent: never expiring.

The government uses exemptions as a flexible instrument to influence the domestic market and, often, to prevent growth from stagnating. Tax exemptions supply the following advantages when used:

- Reduced tax burden: decreasing taxes whenever possible.
- Benefits on purchases: a low tax burden encourages purchases, which revitalizes the market.
- Transparency: less tax relief results in more transparency and less waste.

But applying tax exemption can also generate some disadvantages:

- Increased costs: at the infrastructural level, costs could rise for management and compliance.
- Increased time: the time needed to follow the exemption is likely to be longer the more steps there are in a tax process.
- Embezzlement: occurs when the return approaches the exemption thresholds for income and expenses.
- Tax collection: application of the exemption results in a decrease for tax due.

Additionally, if the government decides that it is necessary to raise citizens' expenditures in certain areas, such as medical insurance, it may supply exemptions on such expenditures. The types of tax exemption can vary and change depending on how a company is structured. For example, the non-profit social work organization, where such entity is not needed to pay taxes on any of its income.

2.2.2 Tax deductions

Tax deduction are tax benefits, expenses that are deducted from the tax basis of a particular tax or fee. As a result, the base under which the tax rate is applied is reduced, which decreases the amount of taxes that must be paid. The most common costs that qualify for a tax deduction are social security contributions and charitable contributions. The taxpayer who incurred the expenses is the only one who may deduct it from their taxes. This type of relief is very convenient for the taxpayer in terms of tax calculation, as the deduction has an important impact on the total amount to be paid to the state coffers. In Italy, where we have a progressive tax system, the deduction will help taxpayers with higher incomes the most.

2.2.3 Tax reductions

Tax reductions have an immediate impact on the gross tax, defined “net tax.” They are considered after deductions when the tax has been figured out. The reductions are then subtracted from the gross tax, generating the net tax that must be paid. The formula used is:

$$T = t(Y) - d$$

Where:

- T is the net tax
- t is the gross tax
- Y is the tax base
- d is the amount of the reduction

The reduction is the amount, equal to a certain percentage of an expense incurred, that is subtracted from the gross tax, which is then reduced. The expenses that can be reduced from the gross tax vary each year, but there are certain categories of expenses that still are consistently reducible. Reductions are a part of the IRPEF tax that taxpayers paid that is covered by specific types of expenses that the taxpayer incurs. The person or company pays for the services and related taxes in full, but then gets cash payments in the amount that is considered “reducible taxation” (and which is usually around 16%). Ecobonus and Supebonus, which will be discussed in the next chapters, are included in the tax reductions.

2.2.4 Tax credits

Tax credits include all those credits that the taxpayer has against the state, which are used to offset the payment of other taxes and, in some circumstances, can be claimed for compensation. To put it simply, an amount that a taxpayer claims against the Treasury is known as a tax credit. A situation like this might happen when:

- there are withdrawals or payments that exceed the real tax obligation. For example, with the payment of grater advances IRPEF than the tax debt resulting from 730, the declaration will close with a refundable tax credit.
- is present based on the operation of certain tax mechanisms that are essential for the functionality of specific taxes. Consider, for instance the VAT recoupment and deduction procedure.
- there are specific facilities, recognized under the tac credit formula.

An important new feature concerns the possibility to transfer the tax credit to a third party. This method enables the transferring of the ability to claim a tax deduction to banks, enterprises, or insurances providers, typically in exchange for a quick discount in bills. It is one of the most widely used solutions now, because it gives the possibility to put resources into circulation without having to pay for them. The credit assignment can also be useful where the person obtaining the deduction possibility does not have sufficient IRPEF ability and their part of the credit would be lost. The primary driving reason behind the state’s provision of these numerous concessions that allow the taxpayer (individual or business) to decrease the amounts to be paid, is to stimulate the economic growth of individuals which are found in disadvantaged situations and support competitiveness among businesses. It is a government aid provided to support various markets, such as the real estate market that is the object of our analysis.

2.3 Beneficiaries of tax benefits

The beneficiaries of tax benefits are obviously those who paid taxes. With the term "taxpayers" we refer to all individuals who are required by law to pay certain taxes and fees, including businesses and households, to fund the government's economy. Specifically, they can consider themselves as the taxable entity to which the administration refers tax in connection with a tax obligation. Included in the taxpayers there are all natural persons and VAT holders. We can recognize various taxpayers depending on the type of income received:

- Employees: all individuals who are working, whether on a temporary or permanent basis. However, it is not necessary that the income from employment is the prevailing income, the worker can therefore also receive other types of income.
- Retired persons: people who are retired are those who either claim to be socially productive workers or get retirement income. Even thus, the pension would not serve as the only source of income.
- Self-employed: all people who obtain revenue through self-employment activities without reporting to anyone are considered self-employed. They can be categorized as freelancers and entrepreneurs.
- Participation: taxpayers who earn income from stock-based investments in businesses are assumed to be taking part.
- Other income: all financial revenue is considered, such as income from different taxes and other income.

Each of these types offers the chance to receive tax advantages, being all income taxed IRPEF. In terms of VAT holders, we can refer to anyone who performed an action during the year that resulted in effects for the purposes of calculating VAT and company revenue. The income "from VAT registration" can be accompanied by other types of income. Differentiation exists among VAT registration holders:

- Entrepreneurs: they are people who run a business and generate income from it.
- Professionals and artists: taxpayers for whom self-employment income is prevalent over all other types of income received.
- Farmers: people whose primary source of income is from agriculture.

The following individuals are eligible for tax benefits based on their geographic profile, including both residents and non-residents of the state's territory who hold any form of income. Many reliefs, such as deductions for building renovations or reliefs for first home, affect taxpayers' real estate: therefore, the legislature has added specific requirements to qualify for the requested relief. In the special case of the condominium, benefits gain to all individual condominium owners for work conducted on the common parts of the building, in proportion to the thousandths of ownership. Typically, the certification is produced by the same administrator who produces the certification of the shares due to the condominium owners.

2.4 Ecobonus

The Decree-Law No 63 of 04/06/2013 introduced incentives to encourage energy efficiency construction works. Ecobonus is the tax deduction supported energy upgrading work on existing buildings. As far as the regulation of spending limits, allowed works and needed fulfilments are concerned, we refer to Article 14 of Dl No. 63/2013, which was amended several times until the last Budget Law of 2021. Ecobonus falls under the Irpef and Ires deductions.

Article 16 bis of the TUIR regulates the deductibility regime for expenses related to the rehabilitation of the building environment and provides for a 36 percent deduction of expenses in the 48.000 € for each property unit. However, the legislature made changes by including the 50 percent deduction with 96.000 € limit from 2013. If the construction work continues for several years, the upper limit of 96.000 € must be considered in total. On the other hand, if more than one intervention is conducted on the same property unit, it is possible to consider a new limit of 96.000 €, without subject to the annual limit. This can happen only if for each type of intervention, there is a new building practice at the relevant municipality.

2.5 Superbonus 110%

Superbonus is the tax relief that we are analysing in this dissertation. It can be defined as the whole tax relief and deduction governed by Article 199 of Decree Law No.34/2020 (*Decreto Rilancio*), which consist in a deduction of 110% of the expenses incurred from the 1st of July 2020 for the implementation of specific interventions aimed at energy efficiency and static consolidation or reduction of the seismic risk of buildings. This is a deduction, equal to 110% of the expenses incurred, which goes to hit the gross tax; it will then be divided into five equal annual tranches. As an alternative to the deduction, one can benefit from the Superbonus through one of the methods provided by Article 121 of Decree Law No. 34/2020. In practice, it is possible to opt for an advance contribution in the form of a discount made by the suppliers of the goods or services or for the assignment of the credit corresponding to the deduction due.

This regulation is a modification of a pre-existing facility for the energy upgrading of buildings, which provided a 65% tax credit to be spread over 10 annual payments. The amendment of the "*Decreto Rilancio*" increased the deduction to 110 % and decreased by half the number of annual instalments. To take advantage of the Superbonus, the following requirement was established as necessary to carry out at least one "driving" intervention (thermal insulation or replacement of winter air conditioning systems); to be qualify as "driving" the object of intervention must be an improvement of at least two energy classes. Once this requirement was met, the deduction was also extendable to other interventions of energy efficiency. Among the "driving" interventions, for example, we can include replacement of windows and doors, sunscreens, installation of photovoltaic systems, storage systems, electric vehicle charging stations, home automation systems, elimination of architectural barriers for severely disabled persons and for people over the age of 65.

This new benefit has led the construction sector to rise after a period of deep crisis that had persisted for years and was put even more to challenge by the current period affected by a global pandemic. In fact, the decree-law that introduced the Superbonus was named "*Decreto Rilancio*," precisely because it gave a new opportunity for growth to the construction sector.

The introduction of the 110% deduction allowed companies to determine their prices independently by seeing price competition eliminated, thus incentivizing the construction industry. If with ordinary deductions the taxpayer had to bear at least one-third of the total invoice amount, now with deduction greater than or equal to 100%, the taxpayer has no expense to sustain. This situation produces an effect on prices; the taxpayer is no longer being influenced by the amount of the price of the work, so he will not be incentivized to evaluate different estimates. The amount reimbursed will no longer be the result of the matching of supply and demand but will be determined by the taxpayer who performs the work. Therefore, the legislature introduced the caps on expenses and the numerous certifications required to access the deduction; however, all of this fails to address the issue explained beforehand, as the taxpayer is no longer interested in evaluating the different proposals from suppliers, seeking for the offer with the best quality/price ratio.

2.5.1 Necessary requirements and APE certification

The theme regarding the requirements that the subject must meet was revised by the I.D. August 6, 2020. Here we begin to differentiate between work started before and after the date Oct. 6,2020. For those started after that date, the obligations to be fulfilled by the taxpayer are multiple, including:

- Endorsement by a licensed technician and energy certification (APE).
- Payment of expenses by “special” payment transfer.
- Depositing the technical report in the municipality.
- Retention of documents evidencing the expenses incurred, such as invoices and receipts.
- Certification of transmission to ENEA, within 90 days after completion of the work, of all the documentation.
- For the interventions carried out on common parts of residential buildings, copy of the certification issued directly by the condominium administrator.

The purpose of the energy performance certificate (APE) is to demonstrate, after the execution of works, the level of energy efficiency achieved; therefore, it is prepared by a neutral third party, not involved in the works. There are two APE certifications, one prepared before the beginning of works, and one at the end. This is a certificate that can be issued by technicians with degrees in engineering, architecture, agriculture, and forestry sciences, or with a diploma as an industrial expert. Technicians must be enrolled in a professional association or college and licensed to design buildings. Alternatively, one can become a certifier after passing special courses with a final examination. In case of requirement of multidisciplinary for the building assessment, several assessors may work in collaboration.

The APE certification cannot be drawn up by the company that will carry out the work. The APE certificate must be accompanied by a document that the standards identify with the high-sounding name of "Declaration of Independence"; this must certify the absence of conflict of interest, by means of a declaration by the certifier that he or she has no direct or indirect involvement in the process of design and construction of the evaluated building, nor with the producers of the materials and components, and that there are no family relationships up to the fourth degree with the client (Pagliuca 2022).

2.5.2 General concept of the bonus

Over the years, several types of benefits have been created, including Sismabonus, Bonus Facciata, and finally the Superbonus 110%. All these concessions have requirements that must be met to benefit from them:

- The type of subjects.
- The role of condominiums.
- The interventions must be conducted on existing properties.
- They cannot involve work conducted on new construction.
- The criteria for determining the maximum amounts of expenses recognized.
- The multi-year use of deductions in constant instalments.

Deductions for renovation of building property are entitled only if they relate to work conducted on residential building and their appliances, or if done on common parts of residential building (condominiums). Therefore, all the following are excluded from the deduction expenses incurred for renovations of buildings for commercial or industrial use such as stores, office, and laboratories.

It can be useful to define the main characteristics needed to take advantage of the benefits for building restoration work. There are some conditions that has to be met. The first one is "cash basis." The taxpayer can benefit from the deduction only at the time of the actual payment. Under this criterion, only expenses actually incurred and paid can be taken into deduction in the reporting year of the tax return and evidenced in the date of purchase reported in the payment document. In cases where the work continues over several years, the expenses can be deducted in different periods; the only limitation is that the amount is considered in total for all the reference years. When the expense is incurred by a single person, the deduction accrues entirely to it; when, on the other hand, it is incurred by more than one person, the deduction accrues according to the percentage of the expense sustained and not according to the share of ownership of the property. For expenses incurred on common condominium parts, the expense is apportioned according to the millesimal shares to which each individual condominium owner is entitled.

To take advantage of the benefit is necessary to submit the tax return for the year in which the expenses were incurred. You can take advantage of the deduction up to the amount of your gross tax liability and any excess cannot be carried forward to subsequent years or claimed for refunded or used in compensation. For these cases, at the time when you do not have too much capacity and therefore you would lose part of the deduction amount, Art. 121 of D.L May 19, 2020, No.3427 inserted the possibility of transforming the deduction into:

- Invoice discount applied directly by the supplier at the time of purchase.
- Tax credit, with which the taxpayer can offset other taxes or assign to third parties.

3. Panel regression

In the empirical analysis of this dissertation, we are going to use a panel model. This choice is due to the presence of various groups represented by the 20 regions, and because the data are collected over time. The convenience of using a panel model lies mainly in the gain in estimation efficiency, because larger number of observations compared with the cross sectional or time series dimension alone generates an estimator with smaller variance.

A panel model, also known as a panel data model or a longitudinal data model, is a statistical model that is used to analyse data collected over time from a sample of individuals or units. Panel model data consists of repeated measurements or observations on multiple subjects over a period. It is collected from the same subjects or entities at multiple points in time and allow researchers to analyse how variables change over time for the specific observation groups. Panel models are often used in economics to study changes in individual or aggregate level variables over time. They are particularly useful in cases where subjects or entities are not representative of the population as a whole and allow researchers to control for individual-level characteristics in their analysis. For example, a panel model might be used to study the relationship between education and income over time, or to examine how changes in government policies affect the unemployment rate. With panel data we can control for factors that:

- vary between units but not over time.
- could cause bias from omitted variables if they were excluded.
- are unobserved or unmeasured, and therefore cannot be included in a multiple regression.

There are several types of panel models, including fixed effects, random effects, and pooled models. Each type has its own strengths and limitations, and the appropriate model to use depends on the research question being addressed and the characteristics of the data. These models differ in how they account for the individual-level characteristics of the subject or entities in the panel data, and in the assumptions, they make about the relationships between variables.

Panel data and panel models can be useful in a variety of applications, including studying the effects of economic policies on individual firms or households, analysing the impact of social policies on individual behaviour, and examining the relationships between political institutions and outcomes. They offer a rich source of information for research and can provide valuable insights into the dynamics of social and economic phenomena. Overall, panel models are a powerful tool for studying changes in variables over time and for making predictions about future trends.

Panel data can be divided in balanced panel data and unbalanced panel data. The first one means that the datasets have the same number of observations for all groups. The latter denotes that the whole data have missing values at some time observations for some of the groups.

Large number of observations (N) and small number of time periods (T) are typical for panels. There are panels with large T and low N, and the procedures for these panels are slightly different and more in line with time series approaches.

The principal benefits of panel data according to («Econometric Analysis of Panel Data: Class Notes» s.d.) are the following:

- Time and individual variation in behaviour unobservable in cross sections or aggregate time series.
- Features that cannot be modelled with only cross section or aggregate time series data alone.
- Observable and unobservable individual heterogeneity.
- Rich hierarchical structures.
- More complicated models.
- Dynamics in economic behaviour.

3.1 Data Structures

When we use panel data, our base data have two different dimensions, while time series and cross-sectional data are in only one dimension.

A time series is a collection of data points that are typically measured periodically and uniformly spaced in time. Time series data can be used to investigate trends, patterns, and correlations over time since it is frequently collected and recorded at regular intervals, such as every year, quarter, or month. The prices of stocks, meteorological data, are a few examples of time series data. Time series analysis involves using statistical techniques to model and forecast future values in the series based on past values.

Cross-sectional data refers to data that is collected from a sample of individuals or organizations at a single point in time. Instead of describing changes across time, it is used to explain the features or qualities of a population in time. Cross-sectional data offers a snapshot of the variables of interest a particular point in time, as opposed to time series data, which monitors the same variables throughout time. This kind of information is frequently utilized in research to examine correlations between factors or to compare characteristics or results between various group. Surveys, pools, and census data are a few examples of cross-sectional data. Numerous techniques, including online surveys, in-person interviews, and database analysis, can be used to obtain cross-sectional data.

The pool sections repeatedly choose individuals at random, whereas the panel models evaluate the same subject throughout time. When people are chosen randomly for each period, the pooling approach is applicable.

3.2 Linear Panel Model

One of the crucial foundational pieces of empirical finance is the linear regression model. A linear regression model, in general, connects a single variable, the dependent variable, usually denoted by y, to a group of explanatory variable or independent variable, such as x_2, …, x_k. Then, a population model can be expressed as:

$$y = \beta_1 + \beta_2 x_2 + \cdots + \beta_k x_k + \varepsilon,$$

where the coefficients β_1, …, β_k are unknown population parameters, and typically our interest is focused on them, where ε denotes and unobserved disturbance term (or error term) (Verbeek 2022, 9).

When there is a suspicion that the outcome variable depends on explanatory variables, panel data are most helpful. Panel data estimators make it possible to consistently estimate the impact of the observable explanatory factors if the omitted variables are stable throughout time. The standard static model, including individual characteristics z_i, which do not vary over time, with $i = 1, \dots, N$, $t = 1, \dots, T$ is:

$$Y_{it} = \beta_1 + x'_{it}\beta_2 + z'_i\beta_2 + \varepsilon_{it}$$

There are some main problems in this kind of model:

- *Consistency*. A consistent estimator is an estimator that converge in probability to the true value of the parameter being estimated as the sample size increases. This suggests that the estimates would improve with increasing sample size if you regularly obtained samples from the population and used the estimator to estimate the parameter. Consistency is a crucial characteristic of an estimator since it indicates that the estimator is dependable and will eventually converge on the parameter's true value as sample sizes increase. A panel data model can be consistent in diverse ways. The generalized least squares (GLS) estimator, which is consistent under a wide range of circumstances, is one strategy. Another option is to use the fixed effects estimator, which is also shown to be consistent in some circumstances. A more formal definition is that assuming I.I.D. (Independent and Identically Distributed) errors and applying OLS the estimator is consistent if $E(\varepsilon_{it}) = 0$ and $E(x_{it}\varepsilon_{it}) = 0$, if the x_{it} are weakly exogenous.

- *Endogeneity*. It means that the explanatory variables may be correlated with the error term. This can lead to biased and inconsistent estimates of the coefficients. In a panel model, endogeneity can occur when the variables measured at different time periods are correlated with each other. Endogeneity can be managed in many ways in this kind of model. Utilizing instrumental factors, which are variables that have a correlation with the predictor variable but are unrelated to the response variable. Another option is using the fixed or random effects model, which permit the estimation of individual specific effects or the inclusion of time-invariant variables.
- *Autocorrelation*. It occurs when the residuals from the model are correlated with the lagged residuals. This means that the error terms for one time period are influenced by the error terms in previous time periods. This can lead to incorrect standard errors and hypothesis testing if it is not considered. There are several ways to test for autocorrelation in panel data models. One common approach is to use the Durbin-Watson test, which compares the sum of squared residuals of the model with and without lagged dependent variables. The Breusch-Godfrey test is an alternative method that checks for the presence of autocorrelation by including lagged residuals as additional explanatory variables in the model.
- *Heteroscedasticity*. It refers to the presence of non-constant variance in the errors of the model. This can be a problem because it can lead to incorrect inference, as the standard errors of the model will be biased if the variance of the errors is not constant. In panel data models, there are two main tests for heteroscedasticity. The Breusch-Pagan test, which checks for the existence of heteroscedasticity by including the squared model residuals as an explanatory variable. An alternative strategy is using the White test, which checks for this problem using an auxiliary regression. If in our model we detected heteroskedasticity, we are going to use robust standard errors.

3.2.1 Fixed effects model

A fixed effects model is a statistical model that estimates the effects of one or more explanatory variables on a dependent variable while controlling for the effects of individual-specific characteristics that may vary over time. The fixed effects regression model is used to calculate the impact of intrinsic characteristics of individuals in a panel data set. For example, consider a study that aims to estimate the effect of education on income for a sample of individuals. The panel data for this study might include observations on the education level and income of everyone for multiple periods. A fixed effects model can be used to control for the effects of individual-specific characteristics such as age, gender, and occupation, and estimate the pure effect of education on income.

Formally, it can be written as

$$y_{it} = \alpha_i + x'_{it}\beta + u_{it}$$

where y_{it} is the dependent variable for individual *i* at time *t*, x'_{it} is the explanatory variable of interest for individual *i* at time *t*, while β is the coefficient for that independent variable. Furthermore, the overall intercept term is removed from the vector x_{it} and the α_i are firm-specific intercept terms that are treated as fixed factors. We can write this in the usual regression framework as

$$y_{it} = \sum_{j=1}^{N} \alpha_j d_{ij} + x'_{it}\beta + u_{it}$$

where d_{ij} = 1 if i =j and 0 otherwise. Thus, the equation contains a set of N dummy variables as regressors in addition to x_{it}. So, the number of regressor in this model is equal to $N - 1$, to prevent collinearity problems. To account for the effects of individual variations, the model includes dummy variables that represents the various levels of the fixed effect. The OLS estimator β is referred to as the Least Squares Dummy Variable estimator (LSDV estimator) (Verbeek 2022, 43).

In addition to controlling for individual-specific characteristics, a fixed effects model can be used to account for time-varying features that can affect the dependent variable. In this scenario, in addition to the dummy variables for the individual-specific features, the model also includes dummy variables for each time period.

Issues concerning the unobservable variables that might be correlated with the variables in the regression must be addressed while estimating a linear OLS. Omitted variables are a prevalent phenomenon that can lead to endogeneity issue. Regressions with fixed effects may be able to address this issue since omitted variable bias can be removed if the unobservable qualities are fixed effects that do not change over time.

3.2.2 Random effects model

The random effects model is a particular case of fixed effects model. The random effect model is a model that allows for the effect of certain variables to vary randomly across observations. This can be useful in cases where there are unobserved factors that may be affecting the outcome of interest, and we want to account for the fact that the effects of some variables may vary randomly across these units. When unobserved heterogeneity is consistent across time and correlated with independent variables, such models help with controlling for it.

In a formal way, if we began from this model:

$$y_{it} = \beta_0 + \beta_1 x_{it1} + \cdots + \beta_k x_{itk} + \alpha_i + u_{it}$$

we can transform this in a random effects model only if we assume that the unobserved effect α_i is uncorrelated with each explanatory variable:

$$Cov(x_{itj}, \alpha_i) = 0, \quad t = 1, 2, \dots, T; \quad j = 1, 2, \dots, k.$$

Since α_i must be independent of all explanatory variables across all time periods, the optimal random effects assumptions contain all the fixed effects assumptions. Use first differencing or fixed effects in the case where you believe that α_i is associated with any explanatory variables (Wooldridge, J.M. 2013, 492).

Regarding the individual specific effect, there are two common assumptions of random effects and fixed effects. The assumption regarding the random effects is that the individual specific effects are uncorrelated with the independent variables, while, in contrast fixed effect assumption is that the individual specific effect is correlated with the independent variables. The random effects model is more effective than the fixed effects model if the random effects assumption is true. If this hypothesis is incorrect, the random effects model is incoherent.

3.3 Hausman test

The Hausman test is a statistical test used to determine whether to choose a fixed effects model or a random effects model when analysing panel data. The Hausman test is used to investigate the endogeneity problem, that is, if the unobserved heterogeneity in the panel data is correlated with the independent variables. The fixed effects model should be employed if the unobserved heterogeneity is correlated with the independent variables. On the other hand, the random effects model should be utilized if the unobserved heterogeneity is not connected with the independent variables.

The fixed effects model includes dummy variables for each individual in the panel data to account for the unobserved heterogeneity. In this way, the intercepts in the regression equation incorporate the unobserved heterogeneity. The fixed effects estimator, however, is consistent but inefficient because it does not take advantage of the data from the other participants in the panel study.

The error term in the random effects model is used to account for the unobserved heterogeneity, which is assumed to be independently and uniformly distributed among individuals. Even though random effects estimator is consistent and efficient, if the unobserved heterogeneity is correlated with the independent variables, it may produce biased results.

A Hausman test, in general, compares two possible estimators for the relevant parameters: one that is consistent under the null and alternative hypotheses, and another that is consistent (and often efficient) exclusively under the null hypothesis. If there is a considerable discrepancy between the two estimators, the null hypothesis is not likely to be true. However, the Hausman test only contrasts the estimators for random effects and fixed effects (excluding the coefficients of any time invariant regressors). The fixed effects estimator is consistent but inefficient under the assumptions of the random effects model, however random effect is consistent and asymptotically efficient.

The null hypothesis is that the better model is random effect, versus the alternative that is the fixed effects. Under the null hypothesis the difference $\hat{\beta}_{FE} - \hat{\beta}_{RE}$ is asymptotically normally distributed with covariance matrix

$$V\{\hat{\beta}_{FE} - \hat{\beta}_{RE}\} = \mathrm{V}\{\hat{\beta}_{FE}\} - \mathrm{V}\{\hat{\beta}_{RE}\}.$$

This straightforward outcome is the result of the random effects estimator's effectiveness. The Hausman test statistic can therefore be calculates as

$$\xi_{Hausman} = (\hat{\beta}_{FE} - \hat{\beta}_{RE})'[\hat{V}\{\hat{\beta}_{FE}\} - \hat{V}\{\hat{\beta}_{RE}\}]^{-1}(\hat{\beta}_{FE} - \hat{\beta}_{RE}),$$

where the $\hat{V}s$ denote estimates of the covariance matrices of the respective estimators, assuming homoskedasticity and absence of serial correlation in u_{it}. The test statistic has an asymptotic Chi-square distribution under the null hypothesis, with degrees of freedom equal to the number of significant variables that are used in the test (Verbeek 2022, 47–48).

3.4 Breusch-Pagan test

The Breusch-Pagan test is a statistical test used to assess the presence of heteroscedasticity in a model. In the case of heteroscedasticity, the variance of the residuals (the model's unexplained variance) does not remain constant across all observations. If heteroscedasticity is present, it may have an impact on the model's accuracy and how the results should be interpreted. The presence of heteroscedasticity in a panel data model may be particularly disturbing since it may suggest that the variance of the residuals is varying over time or changing among different individuals in the panel.

To perform the Breusch-Pagan test in a panel data model you would first need to estimate the panel model and determine the residuals, then the residuals would then be used to check for heteroscedasticity. There are several ways to perform this, but a Chi-squared test is one that is frequently used. If the test produces a statistically significant result, it means that the model contains heteroscedasticity and may require adjustment. As we can read in (Verbeek 2022, 55) we can explain it in a more formal way:

"To test the null hypothesis $V(u_{it}) = \sigma_u^2$ against the alternative:

$$V(u_{it}) = \sigma_u^2 h(z'_{it}\gamma),$$

where h is a continuously differentiable function with $h(0) = 1$, and z_{it} is a *J*-dimensional vector of conditioning variables (often a subset of x_{it}), one can use the fixed effects residuals $\widehat{u_{it}^2}$ upon a constant and upon the variables z_{it} that are suspected to affect the error variance. A test for the hull hypothesis of homoscedasticity correspond to a test for $\gamma = 0$ and a test statistic can be computed as $N(T-1)$ times the R^2 of the auxiliary regression. Under the null hypothesis, the test statistic has an asymptotic Chi-square distribution with *J* degrees of freedom."

If the Breusch-Pagan test yields a sufficiently low p-value, a corrective action should be taken. Simply using the heteroskedasticity-robust standard error is one option.

3.5 Durbin-Watson test

The Durbin-Watson test can be used to find autocorrelation in the residuals of a statistical model. The residuals are correlated with one another over time because of autocorrelation. The model's accuracy and the interpretation of the results may be impacted if autocorrelation is present in the residuals. Autocorrelation in a panel data model may be particularly important because it can show that the residuals are associated with one another through time or across various individual in the panel model.

To conduct the Durbin-Watson test in a panel data model, the model needs to be estimated, and the residuals would need to be calculated. These latter would then be used to check for autocorrelation. The Durbin-Watson test statistic is a number between 0 and 4, where a value of 2 denotes the absence of autocorrelation. If the test statistic differs from 2, autocorrelation may be present in the model and needs to be taken into consideration. In a formal way we can write the Durbin-Watson test in the following way:

$$DW = \frac{\sum_{t=2}^{n}(\hat{u}_t - \hat{u}_{t-1})^2}{\sum_{t=1}^{n}\hat{u}_t^2}$$

The fixed effects model can also be tested for serial correlation using a form of the Durbin-Watson test that was presented forward by Bhargava, Franzini, and Narendranathan (1982). The alternative hypothesis is that:

$$u_{it} = \rho u_{i,t-1} + \mathrm{v}_{it}$$

where v_{it} is not serially correlated. With the restriction that each firm has the same autocorrelation coefficient, this allows for autocorrelation over time. It is frequent practice to compare the one-side alternative of positive serial correlation, $\rho > 0$, is generally used to test the null hypothesis, $\rho = 0$. The test statistic is also based on the within-regression residuals (or LSDV regression), and it is provided by:

$$d\mathrm{w}_p = \frac{\sum_{i=1}^{N}\sum_{t=2}^{T}(\hat{u}_{it} - \hat{u}_{i,t-1})^2}{\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{u}_{it}^2}$$

Bhargava, Franzini, and Narendranathan (1982) construct lower and upper bounds on the critical values that only depend on N, T, and K using methods similar to those used by Durbin and Watson. Unlike the true time-series example, the panel data Durbin-Watson test has a small inclusive zone, especially when the panel's number of companies is high. For unbalanced panels, there are unfortunately no critical values available.

3.6 Clustered standard errors

Clustered standard errors are a type of standard error used in panel data analysis that takes clustering into consideration. Clustering occurs when the observations within a group are more like each other than they are to observations in other groups. This can result in estimations that are excessively precise and erroneous hypothesis testing due too small standard errors.

The standard errors can be "clustered" at the group level to resolve this problem. As a result, rather than treating all the observations as a single sample, the standard errors are determined by treating each group as a separate sample. Larger standard errors and more precise hypothesis tests may result from his.

In panel data analysis, when the data consists of multiple observations over time for each person or unit, clustered standard errors are frequently utilized. For example, in a study of wage growth over time for a sample of workers, the data would consist of multiple wage observations for each worker. Clustering the standard errors at the worker level would consider the fact that the observations within each worker are more like each other than they are to observations for other workers.

Clustered robust standard errors (CRSE) in panel data are a type of standard error that considers both the presence of clustering and the issues of heteroscedasticity and within-group correlation. Heteroscedasticity refers to the presence of unequal variance across groups or units in the data, while within-group correlation was explained before.

To correct for these issues, clustered robust standard errors are calculated by taking the average of the squared residuals within each group and then adjusting the variance-covariance matrix of the estimates to account for the clustering, heteroskedasticity, and within-group correlation. This can lead to larger standard errors and more accurate hypothesis tests. In the general case of one-dimensional clustering, we can write the covariance matrix estimate as:

$$\hat{V}\{\hat{\beta}\} = (\sum_{i=1}^{N}\sum_{t=1}^{T} x_{it}x'_{it})^{-1} \sum_{i=1}^{N}\sum_{j=1}^{N}\sum_{t=1}^{T}\sum_{s=1}^{T} I_{it,js}\hat{\varepsilon}_{it}\hat{\varepsilon}_{js}x_{it}x'_{js} \; (\sum_{i=1}^{N}\sum_{t=1}^{T} x_{it}x'_{it})^{-1} .$$

where $I_{it,js}$ denotes an indicator variable, equal to one if two observations (firm i in period t and firm j in period s) belong to the same cluster and zero otherwise (with $I_{it,js} = 1$). The bias in habitually provided standard errors typically rises as the number of observations in each cluster, the within-cluster variation of the error terms, and the correlation of the regressors with each other. Even a small correlation in the unobservable inside a cluster can result in cluster-robust standard errors that are considerable different from the default ones if the explanatory variables do not vary within a cluster (so they are within correlation equals to one). Clustering may occasionally result in lower standard errors, but this seems unusual in the majority of finance cases where either within-firm correlation can be expected (for example, firms' capital structures or investment behaviour) or within-period correlation can be expected (for example, aggregate shocks to asset returns), or both (Verbeek 2022, 30).

4. Empirical analysis

The object of this empirical analysis is showing what is the effect of the Superbonus 110% to the house and rent price of Italian real estate. Our variable of interest will be express in three different ways. The first models for every different dependent variable will be implemented using the interest of Superbonus 110% tracked by Google Trends in Italy. The second ones are built using a dummy variable, call Superbonus Time effect. The last models are constructed using the data taken from the ENEA website regarding the absolute number of investments eligible for deduction.

In order to conduct our analysis, we are going to utilize the unemployment rate of Italy, as well as fort every region, the Italian interest rate, the Consumer Index Price (CPI) and the Industrial Production as control variables, so we won't be interested to the final coefficients of them. In statistical analysis, a control variable is maintained constant to reduce its impact on the relationship being studied. It is used to isolate the effects of the independent variable on the dependent variable and to avoid spurious effects. This provides a more precise evaluation of the correlation between the variables under investigation. Research can be more certain that any observed association between variables is causal by controlling for these variables as opposed to the effect of a third variable. It is crucial to remember that only control variables that have a good chance of influencing the result should be used. Overcontrolling could lead to a loss of influence and reduce the accuracy of the results.

The data that we are going to utilize are both cross sectional and temporary, so the best choice to implement this analysis is a panel model. At the beginning of the empirical analysis, we choose the best model between the fixed effects and the random effect through the Hausman test. After that, we are going to analyse the results of the regressions, first with the house price as dependent variable and after with the rent price. We are going to implement the whole empirical analysis using the statistical software STATA.

4.1 Data transformation

At the beginning we started with the transformation of our variable. The two main operations that we are going to implement are the natural logarithms and the growth rate. The latter can be defined as the amount by which the value of an investment, asset, portfolio, or business increases over a predetermined period. In our case this period is equal to a month.

In statistical analysis, there are various advantages to converting variables to logarithms before converting to growth rates:

- Normalization: for the purpose of parametric statistical tests, normalization is important since it brings variables' distributions closer to a normal distribution.
- Stability: the variance is stabilized by the logarithmic transformation of the variables, which keeps it constant over the range of the variables. Regression analysis and modelling benefit from this.
- Interpretation: determining the growth rate following the logarithmic transformation yields a percentage change in the initial variables, making it simpler to understand the findings.
- Outliers: log transformations can improve the outcomes of statistical tests by reducing the impact of outliers on the data.

In general, converting variables to logarithms and growth rates enhances the quality of statistical analysis and clarifies the meaning of the findings.

We used the logarithms for the house and rent price and then we calculated the growth rate for both the variables. Transforming these data in logarithms, the growth rate is not computed with the usual formula, but it is calculated using the first difference of the logarithms data. Speaking about the control variables, we computed the growth rate for Industrial Production, Consumer Index Price (CPI), and for the interest rate. We transformed the variables of interest, the three proxy of the Superbonus 110%, in different ways. For the data taken from Google Trends, we simply divided every observation for 100. The dummy variable is equal to one during the period when the Superbonus is active remain unchanged, while we took the logarithm for the observation deriving from the

ENEA institute. In the latter we took the logarithm because these data have values that are too high to be inserted in the empirical analysis.

4.2 Results

Once constructed our variables in order to capture exactly the effects that we aimed for, we proceed with the implementation of different panel models to analyse the connection between those variables. Here we are going to present the results of the implementation, which are suggesting a positive correlation between the growth of house prices and the enactment of the Superbonus 110% policy after 2020.

At the beginning we are going to implement an Hausman test to decide which model is better for the observation between the fixed and the random effects model. We decided to implement this test first with all the independent variables and with the growth of house price as dependent variable, while after we are going to do the same but with the growth of rent price as the independent variable.

After the test, we added to the regression also the cluster standard errors. Thanks to this, we prevented the problems of heteroskedasticity and of autocorrelated errors. First, we are going to comment the models with the growth of house price as dependent variable and after we are going to do the same with the growth of rent price.

4.2.1 House price

As said before, we begin with the Hausman test. We are going to implement two different tests, where in the first one the variable Superbonus is express by the data taken from Google Trends divide by 100, while after we are going to use the Dummy variable.

This is the output of the first test obtained in STATA:

Hausman test	(b) fixed	(B) random	$(b - B)$ Difference	Sqrt(diag(V _b – V_B)) Std. err.
Superbonus/100	.0016677	.0018145	-.0001467	.0000891
Unemployment Rate Region	-.0001065	-.0000682	-.0000383	.0000225
Growth of Interest Rate	.0005822	.0005679	.0000143	.
Growth of CPI	.0006015	.0020813	-.0014798	.0006992
Growth of Industrial Production	-.0001853	-.0002156	.0000303	.0000125

b = Consistent under H0 and Ha; obtained from xtreg

B = Inconsistent under Ha, efficient under H0; obtained from xtreg

Test of H0: Difference in coefficients not systematic

chi2(5) = $(b - B)'$ [$V\_b - V\_B)$ ^(-1)] $(b - B)$

= **3.18**

Prob > chi2 = **0.6716**

($V\_b - V\_B$ is not positive definite)

As we can notice, the P-value of this test is higher than 0.05, so we can't reject the null hypothesis. This means that is preferred to use the random effects model rather than the fixed effect. In this case we are adding to the regression utilized for the test the cluster standard errors that, as explain before, are useful to avoid problems of heteroscedasticity and autocorrelation of the errors.

Now that we have decide which model to use, we can implement it. The following is the output of the regressions:

Table 4.1 Changing in house price express by the Superbonus variable. Random effect model using cluster standard errors.

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Growth of House Price	Growth of House Price	Growth of House Price	Growth of House Price	Growth of House Price
Superbonus/100	0.0022***	0.0019***	0.0018***	0.0018***	0.0018***
	(0.0002)	(0.0002)	(0.0003)	(0.0004)	(0.0004)
Unemployment Rate Region		-0.0001***	-0.0001***	-0.0001***	-0.0001***
		(0.0000)	(0.0000)	(0.0000)	(0.0000)
Growth of Interest Rate			0.0006	0.0006	0.0006
			(0.0006)	(0.0005)	(0.0006)
Growth of CPI				0.0026	0.0021
				(0.0247)	(0.0257)
Growth of Industrial Production					-0.0002
					(0.0006)
Constant	-0.0012***	-0.0004*	-0.0004*	-0.0004*	-0.0004*
	(0.0001)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Observations	2,040	1,980	1,980	1,980	1,980
Number of Region	20	20	20	20	20
Adjusted R-squared	0.00291	0.00289	0.00289	0.00289	0.00289

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
The first regression is composed by only the dependent variable and the variable of our interest. In every regression there is one more control variable.

Table 4.1 shows all the regressions estimated according to different specifications, where the first model includes only the variable of interest, whereas the last one contains all the variables. We can notice that the variable of interest, the Superbonus/100, is always significant and positive. This indicates that as the interest measured by Google trends (Superbonus/100) increases, the growth rate of the rent price has an augmentation as well. The beta of the variable Superbonus/100 in the last model is equal to 0.0018, this means that a unitary increase of the variable, is associated with a raise of 0.0018% of the growth rate of the house price. The number of observations is higher only in the first model, while in the other models the observations are 1980. The adjusted R-squared is constant over the regressions. For these reasons the model that has a better fit is the last one, as it includes a higher number of regressors and observations. While in this table we used the regional unemployment rate, in the appendix we have included the models estimated with the national unemployment rate (Table A.1).

The second models that we are going to implement was constructed with the Superbous Time Effect variable, in order to capture the effect of the introduction of the Superbonus in an additional way. This was done to provide different perspectives to the analysis, in order to make it more comprehensive and precise.

We decided to implement the Hausman test utilizing the dummy variable as a proxy of the Superbonus 110%. This is the result:

Hausman test	(b) fixed	(B) random	$(b - B)$ Difference	Sqrt(diag(V_b – V_B)) Std. err.
Superbonus Time Effect	.0010974	.0011704	-.000073	.0000558
Unemployment Rate Region	-.0000942	-.0000642	-.0000301	.000023
Growth of Interest Rate	.0008257	.000312	-5.52e-06	.
Growth of CPI	-.0019238	-.0009261	-.0009977	.0006456
Growth of Industrial Production	6.70e-06	-3.55e-6	.0000103	.

b = Consistent under H0 and Ha; obtained from xtreg

B = Inconsistent under Ha, efficient under H0; obtained from xtreg

Test of H0: Difference in coefficients not systematic

chi2(5) = $(b - B)'$ [$V\_b - V\_B$) ^(-1)] $(b - B)$

= **1.71**

Prob > chi2 = **0.8877**

($V\_b - V\_B$ is not positive definite)

In this case the p-value is higher than 0.05, so we can’t reject the null hypothesis. For this reason, we decided to utilize the random effect model as in the previous one. As we did before, we clustered the errors to avoid heteroskedasticity and autocorrelation of the errors. The following are the models with these variables:

Table 4.2 Changing in house price express by the Superbonus variable. Random effect model using cluster standard errors.

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Growth of House Price	Growth of House Price	Growth of House Price	Growth of House Price	Growth of House Price
Superbonus Time Effect	0.0014***	0.0012***	0.0012***	0.0012***	0.0012***
	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0002)
Unemployment Rate Region		-0.0001***	-0.0001***	-0.0001***	-0.0001***
		(0.0000)	(0.0000)	(0.0000)	(0.0000)
Growth of Interest Rate			0.0008	0.0008*	0.0008
			(0.0005)	(0.0005)	(0.0005)
Growth of CPI				-0.0009	-0.0009
				(0.0184)	(0.0189)
Growth of Industrial Production					-0.0000
					(0.0006)
Constant	-0.0012***	-0.0004**	-0.0004**	-0.0004**	-0.0004**
	(0.0001)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Observations	2,040	1,980	1,980	1,980	1,980
Number of Region	20	20	20	20	20
Adjusted R-squared	0.00290	0.00289	0.00288	0.00289	0.00289

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
The first regression is composed by only the dependent variable and the variable of our interest. In every regression there is one more control variable.

Table 4.2 shows all the regressions estimated in progression, where the first model includes only the variable of interest, whereas the last one contains all the variables. It differs from the previous one because the variable of interest changed from Superbonus/100 to Superbonus Time Effect. The latter has value equal to one when the Superbonus subsidy is active while otherwise it is equal to zero.

As the first table, observations do not change between models, differing only in the first one. The adjust R-squared remains steady over the regressions and our variable of interest is always positive and significant at 1%. Due to all these reasons, the better fit is found in the last model. The coefficient of the dummy variable in the last model is equal to 0.0012. Due to this beta, we can say that during the time when the Superbonus 110% were active, the growth rate of house price was 0.0012% higher respect the period when there was not this subsidy.

In appendix, the other models constructed with the national unemployment rate can be found (Table A.2).

The last models are built with the logarithm of Asseverazione Enea as the proxy of the Superbonus 110% and they utilize the growth of house price as dependent variable. We proceeded with the Hausman test, and this is the result:

Hausman test	(b) fixed	(B) random	$(b - B)$ Difference	Sqrt(diag(V_b – V_B)) Std. err.
Log Asseverazione Enea	-.0007766	-.0003127	-.0004639	.000399
Unemployment Rate Region	-.0004565	-.0000838	-.0003728	.0001352
Growth of Interest Rate	.0029419	.0026941	.0002478	.0000475
Growth of CPI	.08596687	.0748587	.01111	.0054728
Growth of Industrial Production	.007575	.0068818	.0006932	.

b = Consistent under H0 and Ha; obtained from xtreg

B = Inconsistent under Ha, efficient under H0; obtained from xtreg

Test of H0: Difference in coefficients not systematic

chi2(5) = $(b - B)'$ [$V\_b - V\_B)$ ^(-1)] $(b - B)$

= **7.62**

Prob > chi2 = **0.1786**

($V\_b - V\_B$ is not positive definite)

As before, the p-value is higher than 0.05%. This means that the random effect model is a better fit rather the fixed effect model for this panel data. The followings are the models with the growth rate of house price as dependent variable and all the macroeconomic variables as independent.

Table 4.3 Changing in house price express by the Superbonus variable. Random effect model using cluster standard errors.

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Growth of House Price	Growth of House Price	Growth of House Price	Growth of House Price	Growth of House Price
Log Asseverazione Enea	0.0001	-0.0001	-0.0002	-0.0003	-0.0003
	(0.0003)	(0.0004)	(0.0004)	(0.0004)	(0.0004)
Unemployment Rate Region		0.0001***	0.0001***	0.0001***	0.0001***
		(0.0000)	(0.0000)	(0.0000)	(0.0000)
Growth of Interest Rate			0.0029**	0.0027**	0.0027**
			(0.0011)	(0.0011)	(0.0011)
Growth of CPI				0.0658**	0.0749***
				(0.0265)	(0.0279)
Growth of Industrial Production					0.0069
					(0.0058)
Constant	-0.0008	0.0016	0.0023	0.0029	0.0030
	(0.0029)	(0.0033)	(0.0032)	(0.0032)	(0.0031)
Observations	340	280	280	280	280
Number of Region	20	20	20	20	20
Adjusted R-squared	0.00251	0.00232	0.00228	0.00227	0.00227

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
The first regression is composed by only the dependent variable and the variable of our interest. In every regression there is one more control variable.

As we can notice in Table 4.3, the log Asseverazione Enea variable is significant only in the first model, while in the others it is always not significant. This means that the effect of the Asseverazione Enea to the growth of the rent price is not different from zero. Another important data in the table is the number of observations. As before, the number of observations is higher in the first model while it is constant in the others. The number of observations is significantly less than in the case the other proxies. Due to this, we can affirm that the models are not very precise. In appendix, the other models constructed with the national unemployment rate are reported (Table A.3).

As a final thought, we can concern that in all the models where the number of observations is sufficiently high, there is a positive and significant coefficient for the two proxies of Superbonus. That means that there is a positive correlation between the growth of house price and Superbonus 110%. When the observations are not enough, the coefficient is not significant, so we do not have any kind of correlation.

4.2.2 Rent Price

Now we are going to do the same analysis changing the dependent variable, so we substitute the growth of house price with the growth of rent price. As we did before, we began with the Hausman test utilizing the proxy of Superbonus taken from Google Trends and this is the result:

Hausman test	(b) fixed	(B) random	$(b - B)$ Difference	Sqrt(diag(V_b – V_B)) Std. err.
Superbonus/100	.0011424	.0023428	-.0012004	.0002107
Unemployment Rate Region	-.0003624	-.0000581	-.0003042	.0000564
Growth of Interest Rate	.0014145	.001293	.0001215	.
Growth of CPI	.1093906	.1199077	-.0105171	.
Growth of Industrial Production	.0036575	.0034127	.0002448	.

b = Consistent under H0 and Ha; obtained from xtreg

B = Inconsistent under Ha, efficient under H0; obtained from xtreg

Test of H0: Difference in coefficients not systematic

chi2(5) = $(b - B)'\ [V\_b - V\_B)\ \hat{}(-1)]\ (b - B)$

= **29.11**

Prob > chi2 = **0.0000**

($V\_b - V\_B$ is not positive definite)

The test gives to us a p-value lower than 0.05%, so we can reject the null hypothesis. This means that, contrary to the models before where we used the random effect model, we implement fixed effect model.

A we did before, cluster standard errors were added to escape from heteroskedasticity and autocorrelation problems. These are the output of the models:

Table 4.4 Changing in rent price express by the Superbonus variable. Fixed effect model using cluster standard errors.

VARIABLES	(1) Growth of Rent Price	(2) Growth of Rent Price	(3) Growth of Rent Price	(4) Growth of Rent Price	(5) Growth of Rent Price
Superbonus/100	0.0025***	0.0021**	0.0019**	0.0013	0.0011
	(0.0006)	(0.0008)	(0.0008)	(0.0008)	(0.0008)
Unemployment Rate Region		0.0004***	0.0004***	0.0004***	0.0004***
		(0.0001)	(0.0001)	(0.0001)	(0.0001)
Growth of Interest Rate			0.0013	0.0010	0.0014
			(0.0009)	(0.0009)	(0.0010)
Growth of CPI				0.1007***	0.1094***
				(0.0316)	(0.0312)
Growth of Industrial Production					0.0037**
					(0.0014)
Constant	0.0007***	0.0050***	0.0051***	0.0050***	0.0050***
	(0.0001)	(0.0015)	(0.0015)	(0.0015)	(0.0015)
Observations	2,040	1,980	1,980	1,980	1,980
R-squared	0.0100	0.0358	0.0368	0.0388	0.0427
Number of Region	20	20	20	20	20
Adjusted R-squared	0.00666	0.00652	0.00652	0.00652	0.00651

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
The first regression is composed by only the dependent variable and the variable of our interest. In every regression there is one more control variable.

Table 4.4 shows all the regressions estimated in progression. The first model is composed by only the variable of interest, whereas the last one contains all the variables. The variable Superbonus/100 is significant at 1% only in the first regression, while every time we added another independent variable the significance level diminishing and it becomes not significant in the last two models. In these models we can also notice that in the last model, the control variables are almost all significant at least at 5% level except for the growth of interest rate. A reason can be that the growth of interest rate does not explain the growth of rent price.

The number of observations is higher in the first model, while it is constant in all the others and equal to 1980. The Adjusted R-squared tend to become higher every time we added a new regressor, so we can concern that the last model has a better fit, as it includes a higher number of independent variables and observations. In this last model, the coefficient of the Superbonus/100 variable is not significant. This means that if there is an increase of one unit of the Superbonus/100 variable, the changing in the growth rate of rent price is not different from zero. In this table we used the regional unemployment rate while in the appendix (Table A.4) there is the output utilizing the same unemployment rate for every region.

The following model that we are going to comment includes rent price as dependent variable and add the Superbonus Time Effect within the independent variables. As always, we started with the Hausman test to choose which panel model is better to conduct the analysis:

Hausman test	(b) fixed	(B) random	$(b - B)$ Difference	Sqrt(diag(V_b – V_B)) Std. err.
Superbonus Time Effect	-.000467	.0004042	-.0008712	.000129
Unemployment Rate Region	-.0004262	-.0000674	-.0003587	.0000574
Growth of Interest Rate	.0016976	.0017635	-.0000659	.
Growth of CPI	.1645828	.1764831	-.0119003	.
Growth of Industrial Production	.0038123	.0036901	.0001223	.

b = Consistent under H0 and Ha; obtained from xtreg

B = Inconsistent under Ha, efficient under H0; obtained from xtreg

Test of H0: Difference in coefficients not systematic

chi2(5) = $(b - B)'$ [$V\_b - V\_B$) ^(-1)] $(b - B)$

= **39.12**

Prob > chi2 = **0.0000**

($V\_b - V\_B$ is not positive definite)

As before, the p-value of the Hausman test is lower than 0.05%, so we can reject the null hypothesis. From the test we can say that the fixed model is a better fit for these panel data. At this point we added the cluster standard errors and these are the results:

Table 4.5 Changing in house price express by the Superbonus variable. Fixed effect model using cluster standard errors.

VARIABLES	(1) Growth of Rent Price	(2) Growth of Rent Price	(3) Growth of Rent Price	(4) Growth of Rent Price	(5) Growth of Rent Price
Superbonus Time Effect	0.0009**	0.0002	0.0001	-0.0005	-0.0005
	(0.0003)	(0.0004)	(0.0004)	(0.0004)	(0.0004)
Unemployment Rate Region		0.0004***	0.0004***	0.0004***	0.0004***
		(0.0001)	(0.0001)	(0.0001)	(0.0001)
Growth of Interest Rate			0.0020*	0.0012	0.0017*
			(0.0010)	(0.0009)	(0.0010)
Growth of CPI				0.1595***	0.1646***
				(0.0365)	(0.0366)
Growth of Industrial Production					0.0038**
					(0.0014)
Constant	0.0009***	0.0062***	0.0061***	0.0060***	0.0059***
	(0.0001)	(0.0016)	(0.0016)	(0.0016)	(0.0016)
Observations	2,040	1,980	1,980	1,980	1,980
R-squared	0.0033	0.0304	0.0326	0.0378	0.0421
Number of Region	20	20	20	20	20
Adjusted R-squared	0.00668	0.00654	0.00654	0.00652	0.00651

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
The first regression is composed by only the dependent variable and the variable of our interest. In every regression there is one more control variable.

In Table 4.5, all the models are show in progression, with the first one composed by only the Superbonus Time Effect while the last is built with all the independent variables. The dummy variable is significant and positive only in the first model.

As always, the number of observations is higher in the first model, and it is lower and constant in the other regressions. The adjusted R-squared increase every time we are adding a regressor. Considering this information, we can affirm that the best model between these is the last one. There, the coefficient of Superbonus Time Effect is not significant. This means that there is no difference between the period with the Superbonus and the period without it. So, we can say that the growth of the rent price is not influenced by the Superbonus subsidy. The same models built utilizing the same unemployment rate for all the regions are reported in the appendix (Table A.5).

The last models that we are going to comment are the ones with rent price as dependent variable and the logarithm of Asseverazione Enea as our variable of interest. As always, we started with the Hausman test to choose which panel model is better to conduct the analysis:

Hausman test	(b) fixed	(B) random	$(b - B)$ Difference	Sqrt(diag(V_b – V_B)) Std. err.
Log Asseverazione Enea	.0095431	.000619	.0089241	.0016278
Unemployment Rate Region	.0006343	.000132	.0005023	.0005287
Growth of Interest Rate	.0015166	.0041264	-.0026098	.
Growth of CPI	-.0255169	.1193887	-.1449057	.
Growth of Industrial Production	-.0463443	-.0340531	.0122812	.

b = Consistent under H0 and Ha; obtained from xtreg

B = Inconsistent under Ha, efficient under H0; obtained from xtreg

Test of H0: Difference in coefficients not systematic

chi2(5) = $(b - B)'$ [$V\_b - V\_B)$ ^(-1)] $(b - B)$

= **32.64**

Prob > chi2 = **0.0000**

($V\_b - V\_B$ is not positive definite)

Table 4.6 Changing in house price express by the Superbonus variable. Random effect model using cluster standard errors.

VARIABLES	(1) Growth of Rent Price	(2) Growth of Rent Price	(3) Growth of Rent Price	(4) Growth of Rent Price	(5) Growth of Rent Price
Log Asseverazione Enea	0.0001	-0.0001	-0.0002	-0.0003	-0.0003
	(0.0003)	(0.0004)	(0.0004)	(0.0004)	(0.0004)
Unemployment Rate Region		-0.0001***	-0.0001***	-0.0001***	-0.0001***
		(0.0000)	(0.0000)	(0.0000)	(0.0000)
Growth of Interest Rate			0.0029**	0.0027**	0.0027**
			(0.0011)	(0.0011)	(0.0011)
Growth of CPI				0.0658**	0.0749***
				(0.0265)	(0.0279)
Growth of Industrial Production					0.0069
					(0.0058)
Constant	-0.0008	0.0016	0.0023	0.0029	0.0030
	(0.0029)	(0.0033)	(0.0032)	(0.0032)	(0.0031)
Observations	340	280	280	280	280
Number of Region	20	20	20	20	20
Adjusted R-squared	0.00251	0.00232	0.00228	0.00227	0.00227

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
The first regression is composed by only the dependent variable and the variable of our interest. In every regression there is one more control variable.

The log Asseverazione Enea is significant at 5% only in the model where it is the only independent variable, while in the other models it is never significant at every level. This probably due to the lack of observations that composed every models. The observations are always less than 340, so they are not enough to produce precise results. In the appendix, there are reported the same models built utilizing the same unemployment rate for all the regions (Table A.6).

In conclusion we can affirm that, based on our models, the effect of Superbonus 110% to the growth rate of the rent price is not significant for every proxy of the subsidy.

Conclusions

Through this study we sought to provide in-depth context on the Italian housing market, and especially to capture the impact of macroeconomic variables on house prices, particularly regarding the effects of the 110% Superbonus policy. The main results that we obtained from the empirical analysis shows how Superbonus 110% has a significant impact on house price, but not to the rent price. The growth of house price increase when the interest regarding the Superbonus 110% is high. This growth rate is higher during the time when Superbonus 110% is active, rather than when it is not. Contrary to the growth of house price, the return of rent price is not significantly impacted by the interest or the presence of the Superbonus 110%.

In this analysis we faced some difficulties, especially since housing market data are difficult to obtain, particularly in Italy. In fact, they normally cover only short periods of time: this does not allow the conduct of medium- to long-term analyses, which are necessary to be able to fully grasp the effects of policies that, especially in the real estate sector, take years to fully manifest themselves. For this reason, the main problem of this empirical analysis is the absence of precise long-term data for the Superbonus 110%. In fact, the models that we implemented are built using two different proxy that are related with our variable of interest, but they cannot be, by definition, precise as the data of the Superbonus 110% itself.

However, this analysis has managed to provide some initial results on an innovative and unique policy, that precisely because of its novelty character needs numerous studies to understand its effects and effectiveness, as opposed to other policies that are traditionally used in the real estate sector and whose effects are more predictable. These outcomes show how the 110% Superbonus has led to an increase in the rate of growth of house prices, indicating how this policy cannot be sustainable to the long run. Thus, this empirical study, combined also with the aforementioned moral hazard issues that this policy inherently entails, underscore clear limitations that the 110% Superbonus has in sustaining the Italian housing market in the long run. These initial insights can therefore be further analysed more accurately when additional Superbonus data and more observations become available.

It is also necessary to emphasize that to ensure a growth that is sustainable both over time and for the citizens of the economic sector, there is a need for organic and structural policies and not short-term interventions aimed at only temporarily solving the difficulties faced by this sector. With this dissertation, we hope to have contributed in part to point out this need.

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Appendix

Web Scraping Python

```
"""
Library definition:
:bs4 as BeatifulSoup - Web scraping library for creating strings from
raw html
:webdriver - Requesting and creating html session library (compatible
with dynamic websites)
:pd as pandas - Dataframe library
:time
:plt as matplotlib - Visualization library
:np as numpy - Scientific calculus library, generates easy to handle
arrays for matrix multiplication, if needed
:re - ReGex library, containing regular expression methods, it handles
strings
"""
from bs4 import BeautifulSoup
from selenium import webdriver
import re
import pandas as pd
import numpy as np
import time
from matplotlib import pyplot as plt
import math


"""
## HYPERPARAMETER DEFINITION ##
"""
verbose = False
# Boolean variable to choose between running the extraction or the
visualization
# - True: Creating html sessions and downloading data from websites
# - False: Extracting from \Dati\ directory all present data of
"xxxRealEstate.csv" format
# - None: Skipping data handling for other analysis
html = None     # Initialization of html session variable
delay = 5       # Lasting time of html session
Nsamples = 99   # Number of samples that are wanted to be visualized
for each plot

"""
## CASE STUDY PARAMETER DEFINITIONS ##
"""
# Initialization of lists of possible regioni from where to extract
data, the format requires the r"", r"" ...
regioni = [r"Veneto",
            r"Abruzzo",
            r"Basilicata",
            r"Calabria",
            r"Campania",
            r"Emilia-Romagna",
            r"Friuli-Venezia-Giulia",
            r"Lazio",
            r"Liguria",
```

```
            r"Lombardia",
            r"Marche",
            r"Molise",
            r"Piemonte",
            r"Puglia",
            r"Sardegna",
            r"Sicilia",
            r"Toscana",
            r"Trentino-Alto-Adige",
            r"Umbria",
            r"Valle-d-aosta"]

# Definition of number of regioni to be anayzed for future reference
nreg = len(regioni)

"""
## BODY OF SCRIPT ##
"""
# INITIALIZATION of visualization, to have all possible RealEstate
data in figure 1
if not(verbose):
    plt.figure(1, figsize=(12, 8))

# INITIALIZATION of lists of urls, from lists of regioni
urls = [f"https://www.immobiliare.it/mercato-immobiliare/"+reg + "/"
for reg in regioni] #nreg x 1

# STARTING LOOP of number of urls, therefore of number of regioni
for i,url in enumerate(urls): # Enumerate works with iterable objects,
first output is index, second output is item
    reg = regioni[i] # extraction of regioni name at index i

   # print(url)

    #INITIALIZATION of x and y axis of single regioni data
    xdatapoints = []
    ydatapoints = []

    # STARTING HTML SESSION
    if verbose == True:
        # Opening HTML driver to open session once the url is given
        browser =
webdriver.Chrome(executable_path=r'C:\Users\tomma\OneDrive\Documenti\W
S_SeleniumTools\chromedriver_win32_v106\\chromedriver.exe')
        # Url is given, and html session is launched, web browser will
open
        browser.get(url)

        # Wait for delay seconds to have the session open, this is
required to let the website load all
        # dynamic data that are generated from .js scripts
        time.sleep(delay)

        # Extracting the raw html code and creating a string variable,
more like a organized string variable
        soup = BeautifulSoup(browser.page_source)

        # Find in organized string variable all lines of .txt that
contains tag:line with class:ct-point
        yticksm  = soup.find_all("div", class_="in-chart__gridItem in-
```

```
chart__gridItem--horizontal", style = "top: 100%;")
        yticksM  = soup.find_all("div", class_="in-chart__gridItem in-
chart__gridItem--horizontal", style = "top: 0%;")
        xticksm  = soup.find_all("div", class_="in-chart__gridItem in-
chart__gridItem--vertical", style = "left: 7.09882%;")
        xticksM  = soup.find_all("div", class_="in-chart__gridItem in-
chart__gridItem--vertical", style = "left: 91.9362%;")

        content = soup.find_all("path",class_="in-chart__svgLine")
#nTags = nSamples x ?

        yticksM =
(float(yticksM[0].contents[0].replace(".","").strip("
€")),float(yticksM[1].contents[0].replace(".","").strip(" €")))
        yticksm =
(float(yticksm[0].contents[0].replace(".","").strip("
€")),float(yticksm[1].contents[0].replace(".","").strip(" €")))
        xticksM =
(int(xticksM[0].contents[0]),int(xticksM[1].contents[0]))
        xticksm =
(int(xticksm[0].contents[0]),int(xticksm[1].contents[0]))
        #k = 0
        #while k< 2:

        # CLOSING of html session and web browser
        browser.quit()
        # INITIALIZING  loop for each tag or basically each sample
data taken from raw html. Could consist of many
        #               figures at the same time. For future analysis,
it could require handling on indexes
        for i,tag in enumerate(content):
            # Append at the END of the list object the single data
point (tag), the x axis is taken from the middle point
            #
between two consecutive (this is dependent
            #
on how the data was stored in raw html)
            #
, the y axis the value of the data point

            ylimM = yticksM[i]
            ylimm = yticksm[i]
            xlimM = xticksM[i]
            xlimm = xticksm[i]

            data = tag.get("d")
            datastring = data.split()
            for j,pointstring in enumerate(datastring):
                if j == 0:
                    continue
                point = pointstring.split("L")
                if len(point) == 1:
                    continue
                xdatapoints.append( xlimm +
(float(point[1])/100*(xlimM-xlimm)) )
                ydatapoints.append( ylimm + ((100-
float(point[0]))/100*(ylimM-ylimm)) )


#xdatapoints.append(round((float(tag["x1"])+float(tag["x2"]))/2))
```

```
            #ydatapoints.append(tag["ct:value"])

        #DEBUG LINES
        #print(np.shape(xdatapoints))
        #print(np.shape(ydatapoints))

        # CREATION of Dataframe using pandas library, the columns are
given from following line
        results = pd.concat([pd.DataFrame(xdatapoints),
pd.DataFrame(ydatapoints)], axis = 1, ignore_index=True)
        print(results)
        results.columns = ["xdatapoints","ydatapoints"]

        # SAVING of Dataframe in CSV file, specific to regioni
        results.to_csv(f"Dati\\"+reg+"RealEstate.csv", index=False)

    # CASE of not HTML requests session, but just visualization
    elif verbose == False:

        # LOADING of dataframe from CSV file containing the data
related to specific regioni
        results = pd.read_csv(f"Dati\\"+reg+"RealEstate.csv")

        # DEBUG to visualize data
        #pd.set_option('display.max_rows', None)
        #print(results)

        # PLOTTING of specific regioni data points, label = name of
the regioni
        plt.plot(results["xdatapoints"][:Nsamples],
results["ydatapoints"][:Nsamples],label=reg)

    # NO HTML SESSION OR VISUALIZATION CASE, if Verbose == None or
else, the code could continue doing something else
    #                                        without bothering of
previous things
    else:
        # SKIP LINES
        pass

if verbose == False:
    # After loop, and all plots are created, add legend and generate
figure with plt.show(), as long the figure is open
    # the code will not continue from said line
    plt.legend()
    plt.show()


# results = pd.read_csv(f"Dati\\PadovaRealEstate.csv")
# t = np.array(results["xdatapoints"][:Nsamples])*0.01
# y = np.array(results["ydatapoints"][:Nsamples])
# l = 7.5
# y_slow = np.zeros(len(y))
# for i,j in enumerate(t):
  #   ct = t-j
  #   print(ct)
  #   kernel = np.piecewise(ct, [ct>0, ct<=0], [lambda ct: l*np.exp(-
l*ct), lambda ct: l*np.exp(l*ct)])
  #   y_slow[i] =
np.divide(np.sum(np.multiply(kernel,y)),np.sum(kernel))
```

```
# y_fast = np.subtract(y,y_slow)
# plt.figure(1,figsize=(8,6))
# plt.subplot(211)
# plt.plot(y)
# plt.plot(y_slow)
# plt.subplot(212)
# plt.plot(y_fast)
# plt.show()
```

Other regressions using STATA

This is the Hausman test with Google Trends as proxy of Superbonus 110% and using the same unemployment rate for all the regions. The growth of house price is the dependent variable.

Hausman test	(b) fixed	(B) random	$(b - B)$ Difference	Sqrt(diag(V_b – V_B)) Std. err.
Superbonus/100	.0009349	.0009418	-6.90e-06	.0000156
Unemployment Rate Region	-.0005945	-.0005934	-1.06e-06	2.89e-06
Growth of Interest Rate	.0004575	.0004566	9.38e-07	8.73e-06
Growth of CPI	-.0003896	.0074873	.0001468	.0005202
Growth of Industrial Production	.003896	.0003878	1.75e-06	.0000119

b = Consistent under H0 and Ha; obtained from xtreg

B = Inconsistent under Ha, efficient under H0; obtained from xtreg

Test of H0: Difference in coefficients not systematic

chi2(5) = $(b - B)'$ [$V_b - V_B) $^$(-1)]$ $(b - B)$

= **0.20**

Prob > chi2 = **0.9992**

($V\_b - V\_B$ is not positive definite)

This is the Hausman test for the following models explain in Table A.1. As we can notice the p-value is higher than 0.05%. This means that the random effect model fits better than the fixed effect.

Table A.1 Changing in house price express by the Superbonus variable. Random effect model using cluster standard errors.

VARIABLES	(1) Growth of House Price	(2) Growth of House Price	(3) Growth of House Price	(4) Growth of House Price	(5) Growth of House Price
Superbonus_100	0.0022***	0.0010***	0.0009***	0.0011***	0.0009**
	(0.0002)	(0.0003)	(0.0003)	(0.0003)	(0.0005)
Unemployment Rate Italy		-0.0006***	-0.0006***	-0.0006***	-0.0006***
		(0.0001)	(0.0001)	(0.0001)	(0.0001)
Growth of Interest Rate			0.0004	0.0004	0.0005
			(0.0005)	(0.0006)	(0.0006)
Growth of CPI				-0.0053	-0.0075
				(0.0108)	(0.0239)
Growth of Industrial Production					0.0004
					(0.0006)
Constant	-0.0012***	0.0029***	0.0029***	0.0029***	0.0031***
	(0.0001)	(0.0007)	(0.0007)	(0.0007)	(0.0007)
Observations	2,040	2,020	2,020	2,000	1,980
Number of Region	20	20	20	20	20
Adjusted R-squared	0.00291	0.00289	0.00289	0.00290	0.00288

*** p<0.01, ** p<0.05, * p<0.1

The first regression is composed by only the dependent variable and the variable of our interest. In every regression there is one more control variable.

This is the Hausman test with a dummy variable as proxy of Superbonus 110% and using the same unemployment rate for all the regions. The growth of house price is the dependent variable.

Hausman test	(b) fixed	(B) random	$(b - B)$ Difference	Sqrt(diag(V_b – V_B)) Std. err.
Superbonus Time Effect	.000707	.000707	3.52e-17	.
Unemployment Rate Region	-.0005395	-.0005395	2.50e-17	.
Growth of Interest Rate	.0006108	.0006108	8.57e-18	.
Growth of CPI	-.0103881	-0.0103881	1.80e-16	.
Growth of Industrial Production	.000451	.000451	-2.20e-17	.

b = Consistent under H0 and Ha; obtained from xtreg

B = Inconsistent under Ha, efficient under H0; obtained from xtreg

Test of H0: Difference in coefficients not systematic

chi2(5) = $(b - B)' [V\_b - V\_B)$ ^$(-1)] (b - B)$

= **0.00**

Prob > chi2 = **1.0000**

($V\_b - V\_B$ is not positive definite)

This is the Hausman test for the following models explain in Table A.2. As we can notice the p-value is higher than 0.05%. This means that the random effect model fits better than the fixed effect.

Table A.2 Changing in house price express by the Superbonus variable. Random effect model using cluster standard errors.

VARIABLES	(1) Growth of House Price	(2) Growth of House Price	(3) Growth of House Price	(4) Growth of House Price	(5) Growth of House Price
Superbonus Time Effect	0.0014***	0.0007***	0.0007***	0.0007***	0.0007***
	(0.0001)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Unemployment Rate Italy		-0.0005***	-0.0005***	-0.0005***	-0.0005***
		(0.0001)	(0.0001)	(0.0001)	(0.0001)
Growth of Interest Rate			0.0005	0.0006	0.0006
			(0.0005)	(0.0006)	(0.0005)
Growth of CPI				-0.0081	-0.0104
				(0.0113)	(0.0192)
Growth of Industrial Production					0.0005
					(0.0005)
Constant	-0.0012***	0.0026***	0.0025***	0.0026***	0.0027***
	(0.0001)	(0.0007)	(0.0007)	(0.0007)	(0.0007)
Observations	2,040	2,020	2,020	2,000	1,980
Number of Region	20	20	20	20	20
Adjusted R-squared	0.00290	0.00289	0.00289	0.00289	0.00287

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
The first regression is composed by only the dependent variable and the variable of our interest. In every regression there is one more control variable.

This is the Hausman test with the variable Asseverazione Enea as proxy of Superbonus 110% and using the same unemployment rate for all the regions. The growth of house price is the dependent variable.

Hausman test	(b) fixed	(B) random	$(b - B)$ Difference	Sqrt(diag(V_b – V_B)) Std. err.
Log Asseverazione Enea	-.0008367	-.0004502	-.0003865	.0014976
Unemployment Rate Region	-.0006586	-.0002886	-.00037	.0014341
Growth of Interest Rate	.002737	.0026724	.0000646	.0002558
Growth of CPI	.0744218	.0727394	.0016824	.0067774
Growth of Industrial Production	.0069268	.0067681	.0001587	.0007558

b = Consistent under H0 and Ha; obtained from xtreg

B = Inconsistent under Ha, efficient under H0; obtained from xtreg

Test of H0: Difference in coefficients not systematic

chi2(5) = $(b - B)' [V\_b - V\_B)$ ^$(-1)] (b - B)$

= **0.07**

Prob > chi2 = **0.9999**

($V\_b - V\_B$ is not positive definite)

This is the Hausman test for the following models explain in Table A.4. As we can notice the p-value is higher than 0.05%. This means that the random effect model fits better than the fixed effect.

Table A.3 Changing in house price express by the Superbonus variable. Random effect model using cluster standard errors.

VARIABLES	(1) Growth of House Price	(2) Growth of House Price	(3) Growth of House Price	(4) Growth of House Price	(5) Growth of House Price
Log Asseveratione Enea	0.0001	0.0001	0.0000	-0.0001	-0.0005
	(0.0003)	(0.0004)	(0.0004)	(0.0003)	(0.0005)
Unemployment Rate Italy		0.0000	-0.0002	0.0001	-0.0003
		(0.0007)	(0.0007)	(0.0007)	(0.0008)
Growth of Interest Rate			0.0026**	0.0028**	0.0027**
			(0.0011)	(0.0012)	(0.0011)
Growth of CPI				0.0256	0.0727***
				(0.0235)	(0.0278)
Growth of Industrial Production					0.0068
					(0.0059)
Constant	-0.0008	-0.0006	0.0006	-0.0004	0.0051
	(0.0029)	(0.0060)	(0.0061)	(0.0058)	(0.0077)
Observations	340	320	320	300	280
Number of Region	20	20	20	20	20
Adjusted R-squared	0.00251	0.00258	0.00255	0.00255	0.00228

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
The first regression is composed by only the dependent variable and the variable of our interest. In every regression there is one more control variable.

This is the Hausman test with Google Trends as proxy of Superbonus 110% and using the same unemployment rate for all the regions. The growth of rent price is the dependent variable.

Hausman test	(b) fixed	(B) random	$(b - B)$ Difference	Sqrt(diag(V_b – V_B)) Std. err.
Superbonus/100	-.0007465	-.0007399	-6.56e-06	.000055
Unemployment Rate Region	-.0017136	-.0017126	-1.01e-06	9.44e-06
Growth of Interest Rate	.001032	.0010311	8.92e-07	.0000231
Growth of CPI	.0882359	.0880962	.0001397	.001561
Growth of Industrial Production	.0052693	.0052676	1.66e-06	.000032

b = Consistent under H0 and Ha; obtained from xtreg

B = Inconsistent under Ha, efficient under H0; obtained from xtreg

Test of H0: Difference in coefficients not systematic

chi2(5) = $(b - B)'$ [$V\_b - V\_B$) ^(-1)] $(b - B)$

= **0.01**

Prob > chi2 = **1.0000**

($V\_b - V\_B$ is not positive definite)

This is the Hausman test for the following models explain in Table A.5. As we can notice the p-value is higher than 0.05%. This means that the random effect model fits better than the fixed effect.

Table A.4 Changing in rent price express by the Superbonus variable. Random effect model using cluster standard errors.

VARIABLES	(1) Growth of Rent Price	(2) Growth of Rent Price	(3) Growth of Rent Price	(4) Growth of Rent Price	(5) Growth of Rent Price
Superbonus 100	0.0024***	-0.0003	-0.0004	0.0003	-0.0007
	(0.0006)	(0.0007)	(0.0007)	(0.0008)	(0.0008)
Unemployment Rate Italy		-0.0015***	-0.0015***	-0.0015***	-0.0017***
		(0.0002)	(0.0002)	(0.0001)	(0.0002)
Growth of Interest Rate			0.0012	0.0008	0.0010
			(0.0009)	(0.0009)	(0.0009)
Growth of CPI				-0.0323	0.0881***
				(0.0249)	(0.0309)
Growth of Industrial Production					0.0053***
					(0.0014)
Constant	0.0007***	0.0114***	0.0113***	0.0118***	0.0130***
	(0.0001)	(0.0012)	(0.0011)	(0.0011)	(0.0012)
Observations	2,040	2,020	2,020	2,000	1,980
Number of Region	20	20	20	20	20
Adjusted R-squared	0.00668	0.00655	0.00655	0.00653	0.00649

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
The first regression is composed by only the dependent variable and the variable of our interest. In every regression there is one more control variable.

This is the Hausman test with a dummy variable as proxy of Superbonus 110% and using the same unemployment rate for all the regions. The growth of rent price is the dependent variable.

Hausman test	(b) fixed	(B) random	$(b - B)$ Difference	Sqrt(diag(V_b – V_B)) Std. err.
Superbonus Time Effect	-.0018712	-.0018712	-7.76e-15	4.70e-10
Unemployment Rate Region	-.0021252	-.0021252	-6.03e-15	3.69e-10
Growth of Interest Rate	.0008612	.0008612	-2.53e-15	1.51e-10
Growth of CPI	.1330646	.1330646	-1.10e-13	5.74e-09
Growth of Industrial Production	.0055438	.0055438	4.99e-15	3.04e-10

b = Consistent under H0 and Ha; obtained from xtreg

B = Inconsistent under Ha, efficient under H0; obtained from xtreg

Test of H0: Difference in coefficients not systematic

chi2(5) = $(b - B)' \, [V\_b - V\_B) \text{^}(-1)] \, (b - B)$

= **0.00**

Prob > chi2 = **1.0000**

($V\_b - V\_B$ is not positive definite)

This is the Hausman test for the following models explain in Table A.6. As we can notice the p-value is higher than 0.05%. This means that the random effect model fits better than the fixed effect.

Table A.5 Changing in house price express by the Superbonus variable. Fixed effect model using cluster standard errors.

VARIABLES	(1) Growth of Rent Price	(2) Growth of Rent Price	(3) Growth of Rent Price	(4) Growth of Rent Price	(5) Growth of Rent Price
Superbonus Time Effect	0.0009**	-0.0015***	-0.0015***	-0.0014***	-0.0019***
	(0.0003)	(0.0004)	(0.0004)	(0.0004)	(0.0004)
Unemployment Rate Italy		-0.0019***	-0.0019***	-0.0020***	-0.0021***
		(0.0002)	(0.0002)	(0.0002)	(0.0002)
Growth of Interest Rate			0.0012	0.0009	0.0009
			(0.0010)	(0.0009)	(0.0009)
Growth of CPI				-0.0009	0.1331***
				(0.0240)	(0.0347)
Growth of Industrial Production					0.0055***
					(0.0015)
Constant	0.0009***	0.0147***	0.0144***	0.0152***	0.0162***
	(0.0001)	(0.0015)	(0.0014)	(0.0014)	(0.0015)
Observations	2,040	2,020	2,020	2,000	1,980
R-squared	0.0033	0.0416	0.0424	0.0472	0.0630
Number of Region	20	20	20	20	20
Adjusted R-squared	0.00668	0.00650	0.00650	0.00648	0.00644

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
The first regression is composed by only the dependent variable and the variable of our interest. In every regression there is one more control variable.

This is the Hausman test with the variable Asseverazione Enea as proxy of Superbonus 110% and using the same unemployment rate for all the regions. The growth of rent price is the dependent variable.

Hausman test	(b) fixed	(B) random	$(b - B)$ Difference	Sqrt(diag(V_b – V_B)) Std. err.
Asseverazione Enea	-.0152769	-.0041591	-.0111179	.0055091
Unemployment Rate Region	-.0256442	-.015	-.0106442	.0052708
Growth of Interest Rate	.0056587	.0038009	.0018578	.0008515
Growth of CPI	.0668598	.0184623	.0483975	.0206134
Growth of Industrial Production	-.0379363	-.0425013	.004565	.

b = Consistent under H0 and Ha; obtained from xtreg

B = Inconsistent under Ha, efficient under H0; obtained from xtreg

Test of H0: Difference in coefficients not systematic

chi2(5) = $(b - B)' [V\_b - V\_B) ^\wedge(-1)] (b - B)$

= **4.07**

Prob > chi2 = **0.5390**

($V\_b - V\_B$ is not positive definite)

This is the Hausman test for the following models explain in Table A.8. As we can notice the p-value is higher than 0.05%. This means that the random effect model fits better than the fixed effect.

Table A.6 Changing in house price express by the Superbonus variable. Random effect model using cluster standard errors.

VARIABLES	(1) Growth of Rent Price	(2) Growth of Rent Price	(3) Growth of Rent Price	(4) Growth of Rent Price	(5) Growth of Rent Price
Log Asseverazione Enea	0.0001	0.0001	0.0000	-0.0001	-0.0005
	(0.0003)	(0.0004)	(0.0004)	(0.0003)	(0.0005)
Unemployment Rate Italy		0.0000	-0.0002	0.0001	-0.0003
		(0.0007)	(0.0007)	(0.0007)	(0.0008)
Growth of Interest Rate			0.0026**	0.0028**	0.0027**
			(0.0011)	(0.0012)	(0.0011)
Growth of CPI				0.0256	0.0727***
				(0.0235)	(0.0278)
Growth of Industrial Production					0.0068
					(0.0059)
Constant	-0.0008	-0.0006	0.0006	-0.0004	0.0051
	(0.0029)	(0.0060)	(0.0061)	(0.0058)	(0.0077)
Observations	340	320	320	300	280
Number of Region	20	20	20	20	20
Adjusted R-squared	0.00251	0.00258	0.00255	0.00255	0.00228

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
The first regression is composed by only the dependent variable and the variable of our interest. In every regression there is one more control variable.