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"UNIVERSITY AND THE URBAN REAL ESTATE MARKET: THE CASE OF PADOVA "

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Firma dello studente

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INTRODUCTION

This thesis can be included in the bigger project Unicity-Lab of the University of Padua and coordinated by Prof. Patrizia Messina on behalf of the "Giorgio Lago" inter-department center on regional development (CISR): http://www.unicitylab.eu

The Unicity-Lab was created in 2018/2019 to respond to the emerging need to understand the linkages that arises from the interaction of "university and city" within the economic and social system. The Laboratory combines university functions and dynamics with the need to "know to decide and govern" the complex processes and trends of the urban organization of the city of Padua. The Unicity Lab, dedicated to the study of the relationship between the University and the City of Padua, is part of the University's Third Mission.

In particular, the work can be placed in the first research line – "Housing, University Locations and Services: Urban Impact and the Real Estate Market".

This section of the Unicity project aims to analyze the impact of the presence of the university on the local real estate market, with reference to the price and rent dynamics of the properties and the volume of commercial transactions. The analysis of price dynamics will be particularly useful in understanding whether the presence of the university stimulates the demand for urban land.

Specifically, the current thesis moves from this research question: is there a significant relationship between the presence of students in the city and the corresponding average value of real estate?

This work aims to answer this question through an empirical analysis conducted on the flows of students enrolled at the University of Padua and on the average values per square meter (m^2) of properties, and rents, for residential, commercial, and tertiary activities located within the city of Padua. The analysis is conducted using data on student flows, which was broken down by course of study, and which was provided by the Statistics Office of the University of Padua and data from the *Osservatorio del Mercato Immobilare* (OMI) of the Italian Tax Agency, *Agenzia delle Entrate*.

The econometric estimates show that, net of the presence of amenities and urban transport infrastructures, the areas of the city with a higher presence of students are characterized by higher average residential property values, while there is no significant relationship with the values of stores and offices. The presence of students in the city, on the other hand, is significantly correlated with higher rents for both residential and commercial activities, reflecting the effect that the presence of the university has on the demand of land.

The chapters are structured as follows: Chapter 1 will review the main classical and neoclassical theories on the determinants of the urban rent, such as the model provided by Johann Von Thünen, William Alonso, and Richard Muth, and it will move to the most recent contributions of Edward Gleaser on the consumer city. The focus will then move on to the real-estate market in Italy starting from a national perspective and then with a focus on the market of the Veneto region and concluding with a description of the housing market in the province of Padua.

Chapter 2 will describe the historical milestones of the University of Padua, from its beginning in 1222 until now. Through a historical analysis, it is in fact possible to outline the growth methods of the university city: the university of Padua can be described as campus city as its budlings are placed both in the city center and in modern area within the city itself. At the end of the chapter there is a focus on student flows, and the chapter analyzes how the residences of the students of Padua changed over the years, and thus how the University of Padua has been transformed during the years from a national hub to a regional hub, and finally to a metropolitan university hub.

Chapter 3 will describe the empirical strategy. After describing the data sources, and the variables, we will present the econometric strategy and the regression results. The main goal is to understand whether higher student flows in a year do have an influence on the urban rents, namely on market prices and rents for housing, commercial activities and offices.

A Section with some final remarks and conclusions follows.

CHAPTER 1 – THE URBAN REAL-ESTATE MARKET

The chapter is structured as follows: the first part briefly recalls the specific characteristics of the housing market and the implications for the method of analysis at the theoretical level. The second part briefly discusses some of the main approaches on the determinants of the urban rent.

Finally, the last part of the chapter will provide an overview of the real estate market in Italy, with a focus on Veneto region and on the province of Padua.

1.1 THE DETERMINANTS OF URBAN RENT: THEORETICAL ASPECTS

The literature on housing covers an immense range of topics and approaches. This is due to the complex nature of housing properties and the wide-ranging interaction between housing with other elements of the urban economy. As a result, the literature tends to look eclectic, with each study adding to the understanding of the topic, but also broadening the field rather than generating coherent set of knowledge (Whitehead, 1999).

In recent decades, economic research, both theoretical and empirical, has paid increasing attention to real estate markets, and in particular to the housing market. This literature can be divided into two major strands. The first concerns macroeconomic-financial studies, which focus on the aggregate dynamics of house prices over time. The second strand refers to microeconomic studies, which focus on the characteristics of heterogeneity and spatial fixity of real estate units, analyzing on the one hand the characteristics of housing as determinants of prices (hedonic models), and on the other hand the role of location in determining the spatial distribution of real estate prices between different geographical areas in a given period of time (Stanca, 2008).

It is important to emphasize, in fact, that the identification of structural, territorial, and spatial factors that contribute to the determination of housing price distribution provides important indications for economic policy. Firstly, it makes it possible to obtain price indexes that consider the differences in the characteristics of individual dwellings. Secondly, by estimating the implicit price which is attributed by the market to each housing characteristic make, it is possible to assess the impact of changes on individual well-being.

Since housing represents a high percentage of household wealth, variations in housing prices have important consequences on consumption choices and savings and, consequently, on individuals' well-being and economic activity at the aggregate level.

This part of the chapter will outline the specific features of the housing market.

Firstly, housing plays a dual role: it is a durable consumption good, as owners and tenants enjoy housing services over time; and it is an investment good, which accounts for a large share of household wealth. This dual nature implies that housing demand is the result of two types of decisions made by households: intertemporal consumption choices for housing services, and portfolio choices for housing as a form of financial investment.

Secondly, another important characteristic is the high cost of housing in respect to the average income of a family. This implies that the demand for housing is closely linked to savings decisions in previous periods and, above all, to the availability and cost of credit.

Thirdly, with regard to the supply of housing, the most relevant characteristics are, on the one hand, the long duration of the production process, and on the other hand, the length of the life cycle of housing. The supply of housing is inelastic in the short-run because of the flow of newly constructed houses is relatively small compared to the existing stock; the supply is also inelastic in the long-run because the availability of building land is limited. At any given time, the overall supply of housing is modified not just by new building but also by improvement of the existing stock on the one hand and depreciation of that stock on the other

A fourth essential characteristic is the high heterogeneity of the exchanged goods. Each house is different from the others with regards to not only the type (new, recent, old), but also and above all the intrinsic characteristics (surface, structure, number and arrangement of rooms, materials, ancillary services, etc.).

Finally, one of the most important characteristics of the housing market is the spatial fixity of the goods exchanged: geographic location is a characteristic of fundamental importance for housing. The distance of a house from the center, the presence in the area of location of amenities (green areas, churches, theaters, museums) as well as infrastructures, economic, social, environmental or landscape, are essential factors in determining the price of housing.

To sum up, housing is a complex product whose characteristics need to be incorporated into formal models, but all of the relationships and attributes cannot be grouped into a single framework. This results in a growing range of models which address specific elements of the housing market.

It is possible to talk about bid rent theory, when the price and the demand for real estate change as the distance from the central business district increases. The idea underlying this model is that retail establishments want to maximize their profitability, thus they are willing to pay more for land close to the city center than for land further away: in other words, he most profitable land is the most accessible one.

All the land users compete for the most profitable land near the city center, and what they are willing to pay is called "bid rent".

This can generally be represented in a "bid rent curve", which is based on the logic that the most accessible land, generally in the center, is the costliest. This results in a concentric zone model.

Figure 1: The bid rent curve

Source: author's elaboration
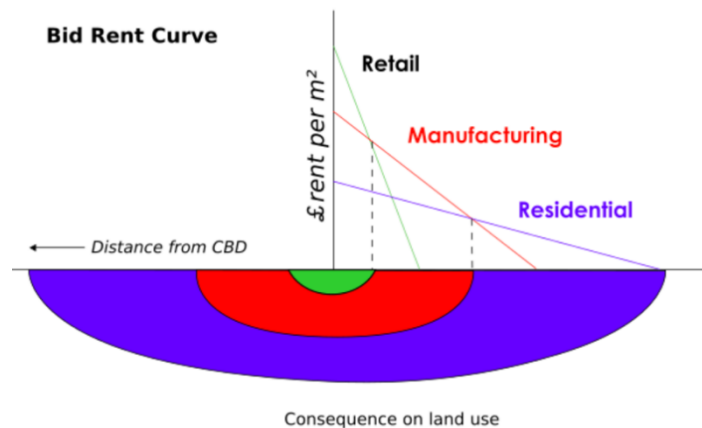
Drawing from Figure 1, the following conclusions can be made:

- Department stores and chains store are located in the inner center: they are willing to pay more for this location because they need a face-to-face interaction and thus it is the most accessible for a large population. They are seeking for large population because of stores require considerable turnover;
- Industry is generally reluctant to be inner center. In fact, there is more space available on the outskirts of a city but there are still good transportation links which are advantageous;
- Residential housing is located the furthest from the city center. People living in this area, how are also the richest and the least sensitive to transport costs, can benefit of lower land costs and thus purchase bigger housing.

1.1.1   Von Thünen's model on the location of agricultural activities

Even if the bid rent is mainly applied in the housing market, it was firstly developed in the agricultural context.

The most influential early writings on the economics of land use and land rent are, of course, David Ricardo (1817) and Johann von Thünen (1826).

Ricardo's theory of agricultural land rent is based on differential fertility and fixed supply of land at each level of fertility. The land actually in use with the lowest level of fertility earns no rent. The land with greater fertility earns rent per acre which is equal to the value of its output minus the value of the output of the least fertile land which is actually in use (McDonald, 2007).

The spatial fixity of housing implies that geographical location is a fundamental determinant of housing prices. The effects of geographic location can be traced back primarily to the concept of accessibility, which is a cardinal principle of urban economics.

In the traditional model of Von Thünen, which was developed in the early nineteenth century to analyze the territorial distribution of different agricultural products, the center is the seat of the market for agricultural products of the surrounding countryside.

The main aspect that Von Thünen introduces in his model concerns the link between the concept of rent and the demand for location of agricultural activities. The rent allows to optimize the distribution between agricultural land of different crops.

In order to limit the cost of transportation, farmers would like to choose land which is as close as possible to the urban center, where the product market is located. However, through the mechanism of competition for the most accessible land which is closer to the market - the different agricultural activities must necessarily be ordered according to their distance from the center and the ability to pay an income to the landowner.

This income, which is identified in a residual way, is determined by the difference between the price of the products and the total costs of production and transport. Only the production that will be able to pay more for the land closest land to the urban center will obtain this land.

The annuity, therefore, is characterized by the transfer of value from the producer to the landowner, and it represents the part of the value generated by the agricultural activity, whuch is equivalent to the level of savings obtained thanks to lower transportation costs due to the land's proximity to the urban center.

The assumptions underlying the model can be summarized as follows.

In the first place, the urban space is homogeneous and isotropic for which the infrastructures of transport are distributed towards all the directions and moreover the agricultural lands are homogenous thus they have equal fertility.

In second place, the market is in the center of a hypothetical medieval village; the demand of goods is unlimited, and the equilibrium depends exclusively on the curve of offer.

Another aspect concerns the distribution of productive factors, such as capital and labor. These are distributed equally in the different activities and do not represent an element of land allocation from the center.

The fourth hypothesis considers that the production function is specific for each good produced, but all the goods produced have the same characteristics: fixed coefficients and constant returns to scale.

The last two conditions of the model concern on the one hand the presence of perfect competition in the market of goods for which farmers are price-takers and on the other hand the existence of units of transportation costs.

It follows that the total cost of transportations depends exclusively on the distance of the center from the suburb and on the quantity of the production.

In analytical terms, we defined as "x" the quantity of the good produced by a grower, "c" the unit costs of production, "p" the price of the agricultural good, "t" the unit transportation costs, and "d" the distance to be traveled. The rent that the producer will be able to afford to pay to compete to acquire the right to use the most central lands will be given by:

(1) $$r(d) = (p - c - td)x$$

To simplify the analysis Von Thünen considered three farmers (A, B, and C) who produce three different agricultural goods with a different degree of perishability. For each of them, it is possible to construct an annuity supply curve.

In Figure 2 the three supply curves are represented in different positions and inclinations.

Figure 2: Model of Von Thünen
Source: author's elaboration
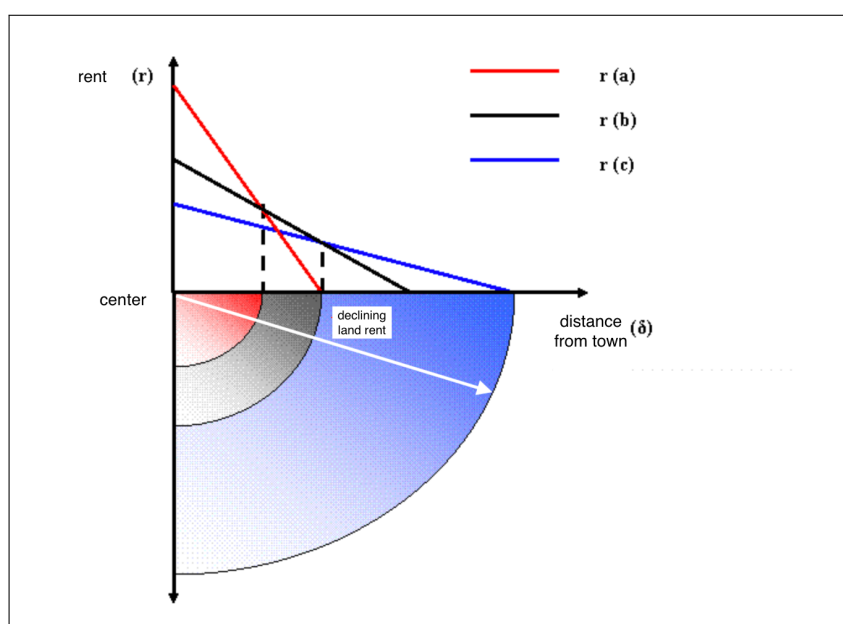
Usually, it is assumed that farmer A produces a more perishable good and therefore uses the land more intensively and efficiently. The slope of the curve of offer is more and more inclined to a greater willingness to pay for the land which is nearer to the village. On the contrary, the cultivator C produces the less perishable goods for which the earth is used in way less efficient way and is less productive, consequently the cultivator is not willing to pay a high value for the land. Therefore, it will place itself in the more distant lands from the center.

One of the main strengths of this model lies in the fact that it succeeds in identifying the reason for the different incomes of the land by taking into consideration the simple distance or accessibility to the village (expressed in transportation costs) the reason for the different income of the land (Mauri, 2010).

Von Thünen's model has been traditionally used in urban economics and has given rise to a school of thought (the new urban economics) that sees accessibility as the fundamental genetic principle of a city and the model as the most suitable tool for understanding its profound logic.

1.1.2 Alonso's model of location of productive activities

Drawing from Von Thünen's model, Alonso (1976) views urban land rent as the income derived from land ownership in relation to urban construction use.

Agricultural soil and urban soil are both scarce assets, but their scarcity is of a markedly different nature and degree. Virtually any land can be put to agricultural use, representing this form of use as a natural connotation of the land.

It is important to highlight that on the one hand the urban soils are a limited portion, on the other hand they are the ones in which a historical process of urbanization has taken place.

It can be said that any land can be used for agricultural or forestry purposes with a modest investment; vice versa, only the soils which can be connected to the whole of the urban organization of the territory are usable for building purposes (urban).

Similarly, to Von Thünen's model, Alonso assumes the existence of multiple production units, thus there will be a division of the spaces by concentric rings, which correspond to the willingness of each resident and city user to pay.

Alonso broadens the previous model, and he introduces a new variable consisting of the size of the apartment. The individual may, in fact, decide to move towards the city center, thereby sacrificing the size of the apartment and saving on transportation costs; or vice versa, incurring into greater transportation costs but being able to afford a larger home in return.

The city considered is characterized by a homogeneous and isotropic space with infrastructures that cover its entire extension in a radial sense and by a single center intended as the most attractive location for each productive activity.

In analytical terms, we define as "d" the distance from the city center, "c" the unit costs of production, "p" the price of the good produced, "x" the quantity of good produced, and "π" the profit.

$$(2) \qquad r(d) = [p_x - \pi - c(d)]*x(d)$$

Compared to the formulation of Von Thünen, in the model of Alonso also the revenues are dependent on the distance, thus a less suburban location guarantees the proximity to wider markets, and therefore higher revenues. It logically follows that, moving towards the periphery of a unitary distance, the offered income in order to maintain the same level of profits diminishes to compensate the increase of the transportation costs and the reduction of the revenues.

The individual's utility function will depend on the distance from the center (d), the size of the apartment (q), and the set of all other goods the individual needs (z):

$$(3) \qquad u = u(d, q, z)$$

Starting from this function and considering a given distance from the center, it is possible to construct the so-called indifference curves, i.e. the different combinations of q and z that leave the individual's utility unchanged, that can be observed in Figure 3. A monocentric city is assumed (all sources of employment located at the center).

We denote the individual's budget constraint in Equation 4.

$$(4) \qquad\qquad y=p_z z+r(d0)q+\tau d0$$

Figure 3: Optimal choice of an individual given a certain distance from the center.

Source: author's elaboration
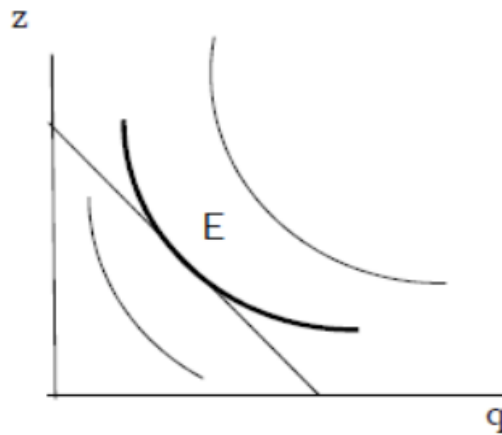
The individual's income function will depend on the distance to the expenses on other goods ($p_z z$), the expense for the apartment (r(d0)q), and the costs of transport depending on the distance ($\tau d0$).

The individual will be positioned at the point which corresponds to the tangency between the budget constraint and the higher of the indifference curves, a condition that can be expressed as equality of the slope of the two curves

$$(5) \qquad\qquad \frac{u_q^I}{u_z^I} = \frac{r(d_0)}{p_z}$$

Figure 4: Optimal choice of an individual given different distances from the center.

Source: author's elaboration
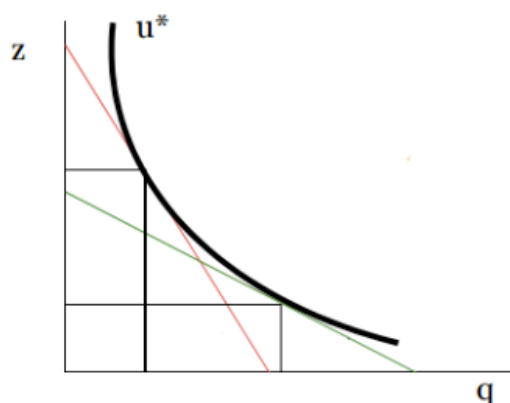
Assuming that asset z has a price equal to unity we will have that the inclination of the budget constraint will be given by the value of the annuity, this can be observed in Figure 4. Given a certain level of utility, the different inclinations of the budget constraint for a given distance from the center will therefore express the different values of the annuity offered, which will have an exponential trend and will allow to identify the condition of indifference localization (or condition of Muth), that is, the alternative locations that keep the utility of the individual constant, which analytically can be expressed as:

$$(6) \qquad \frac{\partial r(d)}{\partial d} = -\frac{\tau}{q}$$

This last relation expresses the increment of the cost of the land that the individual is willing to accept in order to move of a unitary distance towards the center.

The optimal locational choice will be given by the tangency between the effective yield curve and the lowest yield curves (i.e., the one with the shortest distance from the center).

Accessibility is measured as "nearness" (proximity) to a single place: this provided the basis on which the models were built on the aprioristic assumption of the presence of a single center, which is defined as "the most desirable location for any kind of activities", thus implicitly assuming that the part of an urban aggregate that is arranged in correspondence with the center of gravity of the settlement is also the most attractive.

As mentioned above this assumption allowed the immediate extension of Von Thünen's approach to the analysis of urban space, which leads to prefigure the distribution of activities within it on the basis of the respective purchasing power of the land around its center.

Alonso (chapter VI) concluded the body of his study with applications and suggestions for empirical research. He was particularly interested in tracing out the effects of income,

improvements in urban transportation, and population growth on the residential land market, as well as considering causes of city shapes that depart from the circular city suggested by his basic model.

Despite the formal simplicity, the limits that this model shows with respect to the evidence of settlement phenomena are clear. Essentially, this inadequacy derives from the tautological nature of the definition of the center of an urban aggregate: the center is the most attractive area. The model does not provide reason for the factors that have determined its formation, nor to justify the evidence of the actual presence of multiple poles of attraction (or more centers) within the same settlement.

1.1.3 Richard Muth and the urban housing market

Wrongly, frequent reference is made to the Alonso-Muth's model of the urban land and housing markets, and the creation of this model is often considered to be the founding principle in the field of urban economics. Instead, we need to consider two different models that are not identical. Both authors focused on the idea that there is a trade-off between access to a central point and the price of housing, but their models were designed to pursue different purposes (McDonald, 2007).

Richard Muth treats housing as a unidimensional product which bears a specific and valuable relation with other variables in the urban market.

Housing is a bundle of services that is made by stocks of housing capital and land, and the price of housing is the outflow needed to purchase a market basket of those services. He was able to develop predictions about the spatial relationships of density and price by assuming normal substitution effects between space and structure, and by considering competition in the construction market.

Muth constructed a model made of two industries located on a featureless urban plain. The price of output received drops exponentially with distance from the center of the city. Firms produce output with two inputs, land and another input he called labor (where labor stands for all inputs other than land). Muth identified the industries as housing services and as an agricultural service, and he focused on which distance from the city center the land use swifts from urban to rural use.

Urban housing services are produced following a Cobb-Douglas production function:

$$(6) \qquad Q = a\, L^{\alpha} N^{\beta} \ (\alpha + \beta = 1)$$

with Q as output, L as land and N as non-land. The price of output is p, the price of land is r, and the price of non-land is w.

Considering that transportation costs generally increase at a decreasing rate with distance, the price of output is assumed to decline exponentially from the center of the city according to:

$$(7) \qquad\qquad p(t) = p_0\, e^{-ct}$$

The purpose of this model is to explain the linkages between the urban and rural land usage with changes in the variables of the model. Muth assumed that both the industries faced demand functions at the city center and that these functions have finite elasticities and no cross elasticities. He found out that:

- a rise in the demand for housing moves the "city limits" outward, thereby reducing the supply of the agricultural products and increasing their price;
- an ambiguous effect derives from an increase in demand of both goods, the net effects depend on relative elasticities of the two goods;
- the net effect of an increase in the price of non-land inputs depends on the extent to which the price is correlated with its input price and the relative demand elasticities;
- if the housing price gradient increases (flatters), the city borders move inward (outward).

Richard Muth (1967) focused mainly on where the investment in housing occurs: the distribution of population between central city and its suburbs. He studied one of the most striking phenomena of the recent years, the large growth of the population in suburbs and thus the corresponding rapid increase in land addressed to residential use. This growth is views as haphazard and unplanned, and this is an attempt by people to escape from poor housing, population densities and other undesirable aspect of central cities – this phenomenon can be called urban decentralization or urban sprawl.

His analysis suggested that investment in housing would continue disproportionately by building new units instead than by adding and altering exiting ones, and these building will be mainly single houses rather than apartments. This decentralization leads to greater public investment in public facilities and greater expenditure in urban renewal.

1.1.4 Consumer city

The future of a city depends on its capacity to attract and retain urban population: people should continue to want to live close to one another and in order for this to happen the positive effects of agglomeration must overcome the negative effects. To emphasize these positive effects, the city should be seen as center of consumption.

According to Glaeser et al. (2000), there are four critical urban amenities that transform a city into a desirable place to live. The first is the presence of a variety of services and consumer

goods is important. This category includes restaurants, theaters, and a combination of social activities that are located in the city center.

The second amenity is aesthetics and physical settings. The most attractive cities which are rich from a cultural and architectural point of view are the ones which are better valued by consumers.

The third amenity considered is good public services. Among others, good schools and low crime rate appear to be important in attracting highly educated consumers who are also the richest workers.

The fourth amenity is speed, which is seen as the ability to easily move around in the city. As time becomes more valuable, consumers want to decrease the commuting time and thus they will avoid areas where transport costs are high.

The basic viewpoint is that cities are good for production and bad for consumption. There is the need to change this way of thinking and the key is to educate and attract individuals with high human capital, and this can be done only by providing good amenities.

Undoubtedly, cities are good for production. The urban productivity premium comes from two forces. The first one is the lower transportation costs in delivering goods and services, and the second one is the easy access to ideas and technology (a clear example of this is the Silicon Valley).

However, cities can also be attractive because of the presence of consumption amenities. For example, low transportation costs in denser cities may facilitate enjoyable social contact: in fact, the majority of single people prefer to live in crowding cities where meeting other single people is easier.

Another example of the attractiveness of cities for consumers can be the increase of welfare due to the economies of scale for some goods. Living in big cities enable consumers to go to baseball games, the opera or museums regularly. Furthermore, a benefit of economies of scale the possibility to have restaurants that specialize in a wide range of cuisines.

In response to the phenomena of consumer cities there is also another type of phenomena which concerns revers commuting. Revers commuters work in the suburbs but live in central cities. These workers value the most central cities and thus they are willing to pay higher rent to live further from their workplace. The pattern that emerges shows how people produce outside the city and consume in the city. The city center is valued the most because of the presence of important consumer amenities that are difficult to duplicate and that cater the skilled workers. Consequently, high human capital workers increase city productivity growth, and higher human capital area are usually free of social problems and offer better schools.

In order to sustain this circle, local leaders need to create consumer cities: this can only be done by increasing the quality of life. Policies that generate and attract high capital workers should work on the basis of improving quality life as well as on the basis of higher wages.

1.1.5 Urban sprawl

"How cities develop in the years to come will determine progress on addressing key environmental, economic and social challenges including climate change and access to affordable housing […] (studying on urban sprawl) provides an important step towards assessing the state and the implications of urban growth patterns and identifies policies to steer cities toward inclusive and green growth" (Angel Gurría, ORCD Secretary – General, 2018*)*

Sprawl occurs around cities, between cities, and even within cities. It is typical of the richest societies, but by now even third world cities show similar phenomena.

The birth of this concept dates back to the second half of the twentieth century, when the United States became predominantly suburban: the development of transport networks triggered a process of gradual removal from the central urban areas, which found a synthesis between the model of the "mansion" and that of the "pioneer log cabin" in the birth of sprawl (Bruegmann, 2005).

In most of the OECD countries, cities have become fragmented since 1990: while the low-density area experimented an increase in land allocation, on average, urban areas have become denser on average.

Between 1990 and 2014 the total population of urban areas increased by 22.4%, in the same period the total artificial land in urban areas included in the OECD increased by 27.7%. Today 60% of urban space is sparsely populated. The forecasting predicts that by 2050, 7 in 10 people will live in cities.

The quality of the transportation system, land prices, individual housing preferences, demographic trends, traditions, and cultural constraints, the attractiveness of existing urban areas, are all factors that guide and determine the type of development in an urban area.

Uncontrolled urban sprawl occurs when the rate of transformation and consumption of land for urban uses exceeds the rate of population growth for a specific area and in a specific period (AEA Report, 2006).

Over the past 20 years, the extent of built-up areas in many Western and Eastern European countries has increased by 20 %, while the population has grown by only 6 %.

This is not a suburbanization tout court, but a real new city, triggered by a profound process of economic transformation, resulting from the pulverization of production activities in small and

medium-sized companies and the consolidation of industrial districts. In addition to this there is a demographic decrease that affects medium to small size cities (Esposito, 2015).

Urban sprawl is a complex phenomenon which includes much more than average population density: its determinants reflect how population density is distributed and how fragmented urban land is. Urban sprawl is a synonymous for unplanned incremental urban expansion, which is characterized by a low density mingle of land uses on the urban fringe.

Urban sprawl is a driver for multiple urban challenges, including greenhouse gas emission, air pollution, road congestion and lack of affordable housing. This concept is elusive, it may exist in urban area where urban population is relatively high, if the area contains a large number of spaces where density is very low. Urban sprawl can also be manifested in a discontinuous, scattered and decentralized development, for instance in cities where a large part of the population lives in unconnected urban lands. The different dimensions of this phenomenon are measured by different indicators which are defined in the Table 1 below.

Table 1: Seven indicators of urban sprawl
Source : OECD, 2018, page 5

Indicator	Description
Average urban population density	The average number of inhabitants in a km² of land of an urban area.
Population-to-density allocation	The share of population living in areas where population density is below a certain threshold (e.g. 1 500 inhabitants/km²).
Land-to-density allocation	The share of urban footprint of areas where population density lies below a certain threshold (e.g. 1 500 inhabitants/km²).
Variation of urban population density	The degree to which population density varies across the city.
Fragmentation	The number fragments of urban fabric per km² of built-up area.
Polycentricity	The number of high-density peaks in an urban area.
Decentralisation	The percentage of population residing outside the high-density peaks of an urban area.

As already mentioned in most of the 29 OECD countries cities are fragmentated and more people are moving towards the suburbs where the density is lower.

The OECD Table 2 shows that cities become less dense in some OECD countries and denser in others, i.e. in certain countries such as Greece, Ireland, Spain, Sweden and the United Kingdom, the growth in the percentage of urban land containing areas of very low density has been accompanied by increases in average urban population density, meaning that suburbanization co-exists with densification. Other countries such as Austria, Canada, Slovenia and US rank relatively high in the majority of dimensions of sprawl.

Table 2: Evolution of densities in different OECD countries.[1]

Source: OECD, 2018, page 6
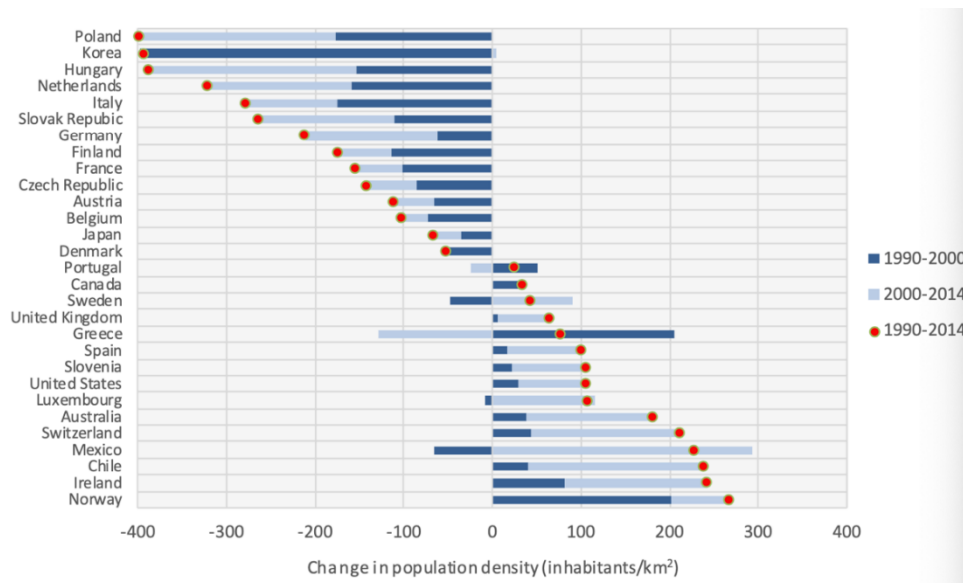
The key drivers of urban sprawl include demographical, economic, social and technological factors. Among others these factors involve rising incomes, preferences for living in low-density areas, natural barriers to urban development and the technological progress in car manufacturing.

The five key drivers can be identified in:

- Preferences for living in low density areas: people prefer to live in area with certain characteristics such as proximity to open spaces, low noise levels, better quality of air, longer exposure to sunlight, etc.…;

- Land-use regulations: building height restrictions create barrier to the emergency of having compact cities; on the contrary if urban growth boundaries and greenbelts policies contribute to a more compact development they lead to a fragmented and leapfrog development;

- Progress in car manufacturing: people are willing to accept longer commuting distances because of cheaper, faster and more reliable cars;

- Low motor fuel taxes: in many countries motor fuel taxes have been permanently low and combined with the increasing fuel efficiency of the vehicles, this has contributed to more dispersed development patterns;

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[1] Red dots represent the total change in average urban population density in the period 1990-2014. The bars decompose the total change into changes occurring during the periods 1990-2000 (darker blue) and 2000-2014 (lighter blue).

- Other policies encouraging car use: urban sprawl can be enhanced by failure to adopt policies to incorporate the social cost of air pollution, climate changes and congestion into the cost of car ownership.

The consequences of urban sprawl can be divided in two wide categories: environmental consequences and economic-social consequences.

In the first one, we consider the consequences correlated with larger distances between residences, job and other frequent daily trips that leads to using more vehicles, creating higher air pollution, more greenhouse gas emission and human interventions that are likely to affect water quality and increase flood risk.

In the second one, we consider the increase of per-user costs of providing public services: water supply, sanitation, electricity, public transport, waste management, policing and other services that are key for well-being and much more expensive to provide in fragmented areas of low-density.

1.1.6 Impact of urban sprawl on travel demand

Sprawl has become faster in response to upgraded transportation links and greater personal mobility. This has made it possible both to live farther away from city centers, while keeping all the advantages of the city center, or to allow people to live in one city and work in another. Transport policies can be seen as a response to urban sprawl and its consequences. There is a profound relationship between urban sprawl and travel demand for all urban modes, thus it is fundamental to evaluate the impact of urban spawl and urban compactness on travel demand (Kakar, 2019).

In sprawled cities, due to extended travel time, commuters are not interested in the public transport and non-vehicle modes. Hence, the quantity of automobiles increased and as a result, congestions and pollutions are evident in the city.

Hence, to safeguard of cities and successfully set-up of transportation systems, urban planners and engineers suggest various solutions such as compact city, smart city and green city to ensure that the urban area is sustainable for current and future inhabitants.

The result of the study conducted Khalil Ahmad Kakar (2019) shows, as urban sprawl increases, the number of commuters who walk and use public transport decreases. While the same condition increases, car dependency and people are more attracted to use private vehicles. However, in the case of compact areas, this study specified that more individuals prefer to use public transport and walk compared to those who live in sprawl areas. As well as, the areas that

have a high level of compactness the use of private transport are less than areas which are affected by a high level of sprawl.

In conclusion, it is evident that sustainable urban development cannot be attained without green urban transport systems and shifting travel demand towards public and non-motorized transport.

To changing the paradigm of urban mobility, the OECD report (2018) suggested some strategies:

- Introducing road pricing mechanisms: car users must be charged for the negative externalities such as congestion, greenhouse gas emission, air pollution and noise. This will discourage log-distance traveling by car;
- Reforming parking policies: increasing on-street parking fees by including the social costs of parking provisions, which includes cruising and loss of open spaces;
- Aligning motor fuel taxes with the external costs of fuel consumption: having low motor fuel taxes leads to excessive car use and may fuel urban sprawl by promoting a dispersion of jobs, residences and other key points of economic activity. There is the need to set the motor fuel taxes to a level that fully accounts for the environmental negative externalities;
- Investing in more sustainable transport systems: in order to deter further urban sprawl, it is necessary to invest in public transportation and soft mobility infrastructures such as cycling paths.

In lieu of the previous discussion about different patterns for public transportation in compacted and sprawled cities, below you will find Figure 5 indicating the most famous cities in Europe.

Figure 5: Distribution of Europe's sprawling and compact cities.

Source: Monlad and Kasanko *et al*., 2006, page 13

	Southern European cities	Eastern and central European cities	Northern and western European cities
Sprawled		Udine	
		Pordenone	
		Dresden	Helsinki
			Copenhagen
			Dublin
			Brussels
			Grenoble
	Marseille	Trieste	Sunderland
	Porto	Vienna	Lyon
		Bratislava	Tallinn
		Belgrade	
	Iraklion	Prague	
	Palermo	Munich	
	Milan		
	Bilbao		
Compact			

To summarize, urban sprawl is characterized by a high consumption of land due to economic, social, cultural, historical factors. In particular, morphologies and local specificities have determined a territorial organization in which prevails, in fact, a dispersed and mixed construction of activities and functions prevails (Fregolent, 2012).

At this point it should be clear that with by "diffuse city" we mean a particular form of organization of space characterized by the following elements (Indovina, 1999): a network of small and medium-sized urban centers; the historical urban mono-centrality in the development of the city has been transformed into multi-centrality; a process which is pushed by "occupation" of the territories between the cities, both by residence and by productive and commercial activities; the building of this territory has low intensity and density; the inhabitants see the territory as being an urban area. People live their own autonomous life (like in the neighborhood of a city) but the individual is strongly integrated with the others; the use of the territory is possible due to a very high rate of mobility of the population so there is no relationship between the population settled in any part of the territory and the population that uses that same part of the territory; over time the territory tends to present some level of social specialization.

In order to reduce urban fragmentation and achieve more sustainable urban development patterns a number of polices have been proposed by the OECD report of 2018. These include:

1. relaxing maximum density restrictions – this will lead to more compact and less car-dependent cities;

2. reforming urban containment policies – creating, reviewing and reforming urban growth boundaries, buffer zones and greenbelts;

3. streamlining land-use taxation – including in the tax system the social cost of various land uses and removing tax incentives to promoting the urbanization of outskirt areas;

4. reforming property taxation – set higher tax rates on the value of the land rather than on the value of buildings;

5. shifting the cost of infrastructure provision to developers – including in the building contractors' expenses the cost of providing public transport, roads, water and sanitation.

1.2 THE REAL-ESTATE MARKET IN ITALY

In Italy in 2016 the value of properties was 4,8 times higher than gross domestic product, and that the value of residential real estate counted for 2,8 times the value of gross domestic product. Real estate prices influence the value of the actives both for families and firms and have effects on investments and consumes. [2]

There is a marked difference between the Centre-North and the South, between urban and non-urban areas but, above all, between center and periphery.[3]

These differences are also based on disparate city configurations: each city is made different for its urban conformation, the infrastructure on which it is built, the economic activity that takes place there, there the quality of services offered, and the population that lives there. In fact, home prices reflect the value of the quality of living in an area, job opportunities, and consumer opportunities. Spatial variability in house prices is thus correlated with the socioeconomic status of the population.

1.2.1 Urban rents withing LLMA [4]

The fundamental factor, which influences the location of urban properties and their prices within LLMA, is the distance of houses from the city center or from the working place.

As expected, the relationship is negative and more pronounced near zero, indicating that the marginal benefit from proximity to the center decreases as distance from it increases.

On average, if we move 10 kilometers away from the center of the LLMA house prices decrease by more than 40%; whereas from 10 to 20 kilometers prices decrease further but less (less than 10%). This pattern is shows in Figure 6.

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[2] At the same time the prices decrease the expense capacity of families and firms that are paying a rent.

[3] This because, as already mentioned, the location (e.g., proximity to downtown) is the primary determinant of prices.

[4] Local labor market areas (LLMA) are defined as the set of neighboring municipalities containing within it both the place of residence and the place of work of most residents. If not stated differently, with LLMA we mean city.

Figure 6: Center-periphery gradient of house prices.

Source: Manzoli, 2016, page 28
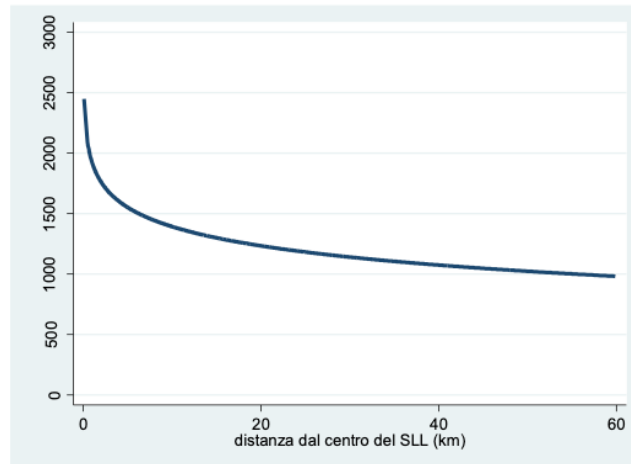
A similar slope can be observed both for the office and shops markets. For the latter, the price of proximity to the center is particularly marked because the city center is where consumer activities are concentrated.

Other social and economic conditions have been studied in respect to the housing prices (Manzoli, 2016):

- housing prices are higher where there is a higher presence of college graduates. This is because on average the most educated have the highest income;
- the percentage of foreigners, on the other hand, is negatively correlated to housing prices;
- a greater presence of hotels and restaurants reflects the degree of attractiveness of the city (due to the endowment of the cultural and landscape heritage), and thus it increases the housing prices;
- finally, better transportation infrastructure makes the municipality better connected and, therefore, more attractive in terms of household location choices.

In particular, we want to take into consideration the relationship between distribution of house prices and residents' incomes.

As per the housing prices, a center-periphery gradient also exists for income: the average income of taxpayers is higher in the central municipality of the LLMA and decreases as it moves towards the more peripheral ones. However, the slope of the income gradient is significantly smaller compared to the house prices.

More specifically, the relationship between income and housing prices shows that the ratio between the value of the property and the average annual income, equal to about 8 in the urban LLMA exceeds 9 in the pivot municipality while it is less than 7 in the rest of the LLMA.

Thus, in the center of the most urbanized LLMAs, the cost of housing, despite its smaller average area, absorbs a larger fraction of taxpayers' incomes. It is the existence of non-monetary benefits associated with living downtown that offset the higher cost of housing.

1.2.2 Urban rents between LLMA

With reference to levels, house prices are higher in the more populous LLMAs where demand for housing services and land consumption are higher[5].

Among the metropolitan LLMAs, house prices on average exceed 3,000 euros per square meter in Rome and 2,000 euros in Bologna, Florence, Genoa, Milan and Venice.

The main variables are population, employment rate and average income. Thus, the demand for housing services, both in terms of the quantity of properties and the spending capacity of residents is the main source of heterogeneity for the observed price variability across LLMAs. Urban LLMAs have 25% higher average taxpayer incomes than nonurban LLMAs; for metropolitan LLMAs, the differential rises to 32%. Agglomeration economies thus generate higher incomes, as can be seen in Figure 7.

Figure 7: LLMA-level relationship between house prices and population density (panel a) and average taxpayer income (panel b).

Source: Manzoli, 2016, page 29
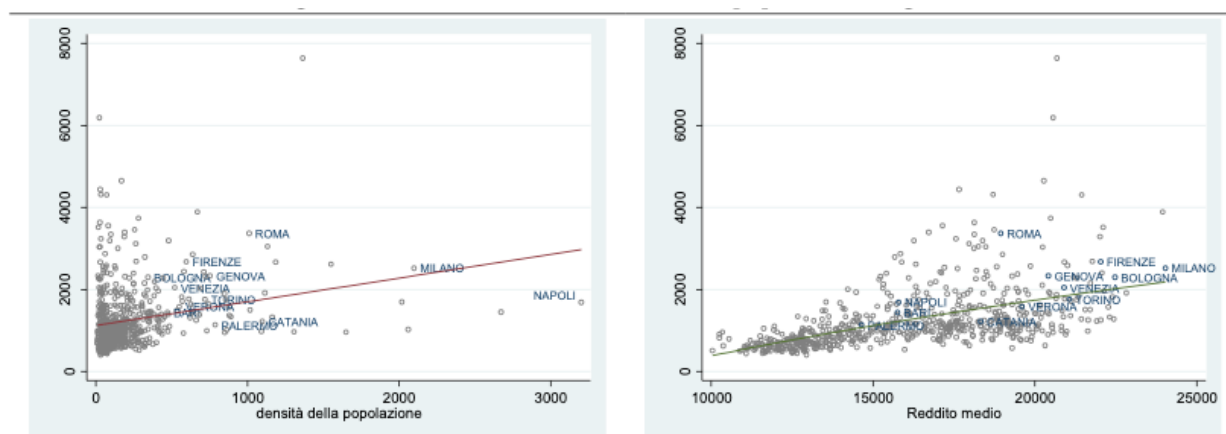
We need to specify that urban LLMAs, and particularly metropolitan LLMAs, not only have higher average prices but they also have a more pronounced slope of the center-periphery gradient as can be seen in Figure 8.

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[5] This relationship is not always necessarily true: the absolute highest house prices are recorded in Capri and Cortina d'Ampezzo (over €6,000 per square meter in both cases), reflecting peculiarities of those places from the point of view of landscape and tourism.

The gradient is steeper in Milan and Rome, the main metropolitan areas in Italy and, for different reasons, in Venice. On the other hand, it is almost flat in some metropolitan areas in Southern Italy (Bari, Catania, and Palermo).

Figure 8: Relationship between house prices and kilometers
of distance from the LLMA's center, for different types of LLMAs
Source: Manzoli, 2016, page 30
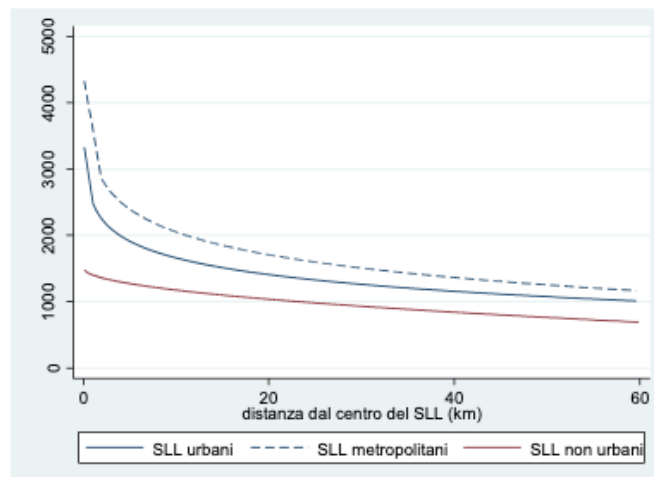
The reasons for a stepper or flatter slope of the center-periphery gradient are different.

Firstly, some LLMAs have a markedly monocentric structure, in which the centroid is the main city, and the remaining municipalities are satellites that contribute to forming a single periphery: the price of the houses decreases, progressively if we move away from the center of the main city. In these monocentric cities thus, the gradient is steeper than in polycentric cities where the capital city is less important in terms of location and the suburbs are less distant.

Secondly, the center-periphery gradient is affected by the different sectoral composition of the local economy as stated in the bid rent curve. The proximity to the center is particularly important for services and trade activities while it is relatively less important for manufacturing and agricultural activities. Therefore, in the LLMAs where highly agglomerated activities are more prevalent, the gradient is more pronounced; on the contrary in the industrial districts where the activities are more sprawled, the need to locate in the center of the LLMA is less stringent and the gradient is less inclined.

Lastly, having considered that most cities in Italy have physical, regulatory, and architectural constraints to building of new properties in the city center, the infrastructural endowment (especially in terms of transport) is an important factor to analyze. Greater connectivity provided by transportation brings the suburbs closer (in terms of travelling time

and convenience) to the center, reducing the locational disadvantage of more distant areas and alleviating price pressure in central areas and consequently resulting in a flatter center-periphery gradient. Therefore, the prices of the houses in the city center are higher compared to the ones in the suburbs, in particular in municipalities where commuting times are higher for workers who reside and work there.

1.2.3 Residential real estate report 2020

The Real Estate Report 2020 (Festa, 2020), dedicated to the residential sector, takes an in-depth look, at the market phenomena recorded in the previous year. In the report, therefore, the main data on the housing market in Italy in 2019, is taken from the various administrative archives of the Catasto, Pubblicità immobiliare, Registro and OMI.[6]

Overall, 2019 turns out to be a good year for growth in bought and sold housing units (NTNs). The nationwide increase in NTN in 2019 is +4.3% compared to the previous year. Quantities of homes bought and sold have been on the rise since 2014, peaking in 2016 and then maintaining an average annual growth rate of around 5% over the following three years.

This positive trend of 2019, however, is characterized by variability in the level of trend rates across quarters: it has a steeper increase in the first quarter, and in the second quarter it is possible to see a slowdown in growth, then in the third only the northern area has a steeper increase, and then it slows down sharply in the fourth quarter of 2019. The fourth-quarter slowdown in the residential market is likely related on one hand to a decrease in the gross domestic product, and on the other hand it is due to growth in terms of prices.

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[6] The publication of this report and its contents relate to a year, 2019, that will mark a phase shift in the residential market after about 6 years of recovery. With 2020, the economy and society, internationally, are in fact undergoing the crisis induced by the Covid-19 pandemic. The scenarios that are foreseen for the residential market are uncertain, they depend on numerous variables, the trend of which is at present uncertain. It is certain, however, that the lockdown between March and May 2020 and then the closures of fall/winter 2020 has caused a downturn in purchases and sales, and recovery during the summer period was only partial and very difficult.

Something that can be anticipated right now is the population dynamics during the Covid-19 pandemic in year 2020 as per Istat Report of March 26th, 2021. On December 31st, 2020, the resident population was nearly 384,000 less than it was at the beginning of the year, as if a city the size of Florence had disappeared. The negative effects produced by the Covid-19 epidemic have amplified the trend of population decline that has been underway since 2015.

The 2020 experienced the lowest birth rate since the unification of Italy, the highest death rate since World War II, and a sharp reduction in migratory movements. The population in Italy decreased of -0,6%: as of December 31st, 2020 only 59,257,566 people reside in Italy. Also, the births show a decrease of -3,8%, circa 16 thousand less than 2019. Lastly there was an increase in death: almost 112 thousand more than in 2019, circa +17,6%.

The volume of housing sales in Italy was 603,541 NTNs in 2019, with an increase of 4.2% year-on-year, thus continuing the positive trend recorded since 2014. The most significant growth rate was recorded in northern areas (Northeast +5.4%, Northwest +5.1%).

The trend in the residential cycle over the last fifteen years has seen various phases: the expansionary cycle stops in 2006 (the last year of increase)[7]. After that year there is a slowdown that, besides from a two-year period of relative stability (2010-2011), sinks in 2013: a downsizing of almost 52% compared to 2004 levels and more than 56% compared to the peak of 2006. Starting in 2014, with the sole exception of the municipalities of the Islands, there is a recovery of the residential market, which recovers 26.5% points nationally.

The analysis of purchases and sales in terms of size of homes (surface area in m^2) shows dynamics not dissimilar to those already observed in relation to the NTN: homes were sold for a total of over 64 million square meters, with an average surface area per housing unit purchased equal to 106.2 m^2 slightly higher than in 2018 (+0.2 m^2).

In the Northwest, where the average surface area is absolutely lower than in the other areas, there is the only negative figure in terms of difference in average surface area (-0.1 m^2), while in the Northeast there is the highest average area bought and sold, equal to 114.4m^2, but the greatest increase compared to 2018 (+1.2 m^2) is found on the Islands.

The subdivision between non-capital municipalities and provincial capitals confirms, as expected, how the average surfaces bought and sold at the former are systematically higher than the corresponding ones bought and sold in the latter.

The housing sales for the eight main Italian cities also confirm an expansionary trend, with the exception of Naples (-2.4%) and Florence (-7.5%). Milan recorded the most significant increase in transactions (+6.9%), followed by Bologna (+6.2%).

With regards to the historical series of housing exchanges for the capitals, it should be noted that after a phase of generalized growth between 2004 and 2006, starting from 2007 and, in some cases, as early as 2006 (Rome, Naples, Milan and Palermo), the downward phase of the cycle began, triggered by the crisis of 2008-2009. The contraction in the volume of purchases and sales continued until 2008 and eased in 2009; in 2010, with the exception of Bologna, the negative trend was reversed. All cities turned positive in 2011, in 2012 none was spared from the collapse of the real estate market caused by the second recession, with the sole exception of Naples, whose dynamic is largely attributable to the substantial divestment of the municipality's

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[7] The crisis in housing market was anticipated in 2006 in the larger municipalities, particularly Rome and Milan, followed in 2007 by all other markets.

real estate assets. In 2013 there was a general deceleration of the negative rates, with some first signs of recovery.

Cornering the rent market, the number of new leases amounted to 1,752,742, up 4.2% compared with last year. There were 1,414,350 residential units subject to new leases, almost 80% of the total, an increase over last year's figure (+2.7%). Overall, rented housing in 2019 amounts to more than 6% of the potentially available stock, corresponding to 5.4 billion euros of total rent for almost 81 million square meters of rented housing surface. The average surface area of rented housing is around 85 square meters with an average annual rent per unit of surface area of 67.1 €/m².

Between the various types of renting contract, the rental of student housing (95% of which is concentrated in municipalities with high housing tension) amounts to 37,560 units, equal to about 0.2% of the potentially rentable stock. The overall annual rent exceeds 250 million euros with an average annual rent per unit of surface area equal to 76.6 €/m². In the Center of Italy, there are particularly high rents, with an average of around 92 €/m². These regions are therefore confirmed, together with those of the Northeast, as being among the most dynamic markets for students. Among large cities, subsidized leases for students also in 2019 tend to be concentrated mainly in Turin and Florence

1.2.4   Non-Residential real estate report 2020

This paragraph will outline the data on the market for non-residential properties relating to the "Tertiary-Commercial" (TCO). In particular, the dynamics of purchases and sales of office units (A/10) and retail units (C/1) are examined in great detail (Festa, 2020).

The non-residential market sectors also expanded overall in 2019, confirming an ongoing positive dynamic since 2014.

As mentioned for the residential real-estate sector, the condition of substantial growth, in units bought and sold observed from 2015 through the year 2019, has been challenged in 2020 due to the impact of the COVID-19 pandemic on trends in the national economy, household and business incomes, and consequently on housing markets.

Offices

In 2019 almost 640 thousand real estate units of the office type, corresponding to the cadastral category A/10 (offices and private offices), were registered in the cadastral archives.

It is necessary to specify that the cadastral category A/10 does not include the actual national real estate stock intended for this use because is it frequent to use the residential real estate unit

as an office without this resulting in a change in cadastral category, which clearly makes it impossible to identify them separately from the Catasto database.

Having said this, it can be stated that the North has more than half of the units surveyed as offices (almost 54% of the national total), just over 20% are located in the Centre, and just over 25% in the South and the Islands.

After the decrease in 2018, the purchases and sales of real estate units for office use marked a new growth in 2019 in terms of volume (+4.8%), with a national NTN that again exceeds 10,000 units. The dynamics path that the office segment followed in the last years is the following: from 2004 to 2006 there was an increase in the units sold, then a gradual decline in trade until 2014, with the first positive signs in 2015 consolidating in 2016 (with the exception of the Islands) and 2017 in all areas; in 2018 the expansion stopped but resumed in 2019. The national level of office sales and purchases in 2019 is half of the base year (2004).

At the national level, the average annual reference quotation for the office is 1,356 €/m² in 2019, following the ongoing downward dynamic, albeit slowing down (the 2019 rate is -0.7%, after -1.1% in 2018).

The only area that recorded a slight increase was the Northwest (+2.1%), driven by Lombardy (+0.7%) and Piedmont (+2.4%) by virtue of the corresponding high volume of purchases and sales.

Retails

The stock of real estate units registered in the Land Registry in the C/1 and C/3 categories, which includes properties for stores and laboratories, has more than 2.5 million units in 2019 on the national territory. The territorial distribution shows that over a quarter of the total number of real estate units is concentrated in the South (27%), followed by the Northeast (24.2%) and the Centre (21.9%).

Data on buying and selling volumes also confirm the expansive trend of recent years in 2019, rising from +4.6% in 2018 (compared to 2017) to +6.5% in 2019 (compared to 2018).

The historical series from 2004 to 2019 (Figure 21) confirms a substantially similar trend in all the areas analyzed: an initial sharp drop in market volumes from 2006 to 2009, accentuated especially in the last two years, was followed by a stabilization in the two-year period 2010-2011; in 2012 there was a new slump, particularly evident and generalized, which had a tail, though not disruptive, in 2013. Since 2014, upturns have been widespread and persist with few exceptions.

The average reference quotation, per unit area, for the store type nationwide is €1,523/m², further down (-1.1%) compared to 2018.

1.2.5 The real estate market in Veneto

This paragraph will analyze the composition and dynamics of the real estate market in the year 2019 of the residential sector in Veneto, through the use of data collected and processed by the *Direzione Centrale Servizi Estimativi and Osservatorio Mercato Immobiliare* (Mazzoccoli, 2020).

As mentioned earlier, the impact of Covid-19 presumably will change all the analysis below for 2020 and for the following years.

Although we do not have a full analysis on the data regarding the real-estate for 2020, it is possible to provide some highlights on how Veneto regional economic activity related to real estate was severely impacted by the effects of the Covid-19 pandemic thanks to a report published by *Banca D'Italia* in November 2020.

The levels of activity in the construction sector declined sharply in the first half of the year, only partly mitigated by the positive trend in spending on public works by local authorities. Forecasts for 2021 are positive, favored by expectations on the effects that may arise from the tax incentives introduced by the *decreto "rilancio"* for anti-seismic interventions and energy efficiency of homes.

Residential real estate market has experimented a slowdown in sales in the second quarter of 2020: sales fell by 21.0% compared to the same period in the previous year. In the period June-September the number of homes offered for sale, which plummeted in the two-month period March-April, gradually recovered reaching levels that are on average higher than those of the previous year.

The growth of loans for the purchase of homes, which account for about two-thirds of total household debt, slowed slightly in the first half of 2020 (2.9%; 3.1% at the end of 2019) affected by the 4.0% decline in the flow of new mortgages (net of subrogation and replacement) compared to the same period last year. Based on estimates of the monthly dynamics of new home mortgage disbursements in the summer months, there were signs of recovery with respect to the most acute phase of the crisis. Favorable conditions in terms of interest rates favored the growth of subrogation and replacements that doubled to 16.1% of total disbursements in the first half of 2020 compared to the same period last year. In fact, in the second quarter of the year, the average interest rate on mortgages disbursed for home purchases fell to 1.7% (1.9% in the final quarter of 2019). The more pronounced decline for the fixed-rate component (from 1.9 to 1.6%) further boosted households' preference for this type of contract (77% of disbursements in the first half of 2020, down from 59% in 2019).

The territory of the Veneto region, due to the effect of the municipal aggregation process, in 2019 consists of 563 municipalities which are divided amongst the metropolitan city of Venice (44) and the six administrative provinces of Belluno (61), Padua (102), Rovigo (50), Treviso (94), Verona (98) and Vicenza (114), while the municipalities that are surveyed and emerge from the cadastral database are 559 due to the absence of the municipalities of Colle Santa Lucia (BL), Cortina d'Ampezzo (BL), Livinallongo del Col di lana (BL) and Pedemonte (VI) as they adopt the tavolar system.

The residential sector in the Veneto region, with 2,640,241 housing units, represents about 7.82% of the national stock; while the volume of housing sales, which in 2019 was 57,466 NTNs, is equal to 9.67% of the entire Italian market, demonstrating a specific vitality of the region.

In fact, the housing market, which in the Veneto region has been growing steadily since 2014 and in 2019 marked an increase in transactions of 5.4% compared to 2018, although lower than that recorded last year (+10.0%) is, however, higher than that achieved throughout Italy (+4.14%). The number of housing units bought and sold last year (57,466) is equal to 2.18% of the regional housing stock.

The graph below, which shows the indices relating to the trend of buying and selling volumes in the region of the provincial capitals and the remaining municipalities not capitals from the year 2004, highlights the period of recession, which began in 2007 and culminated in 2013.

In Figure 9, it is clear then how Veneto has been on the road to recovery for six years and has regained about 35% of the market lost since 2004, reaching levels now close to 2007, the first year of crisis in the residential real estate market. It is evident that since 2009 the market of the capitals has been less depressed than that of the non-capitals.

Figure 9: NTN for the whole region, capital and non-capital municipalities
Source: Mazzoccoli, 2020, page 6
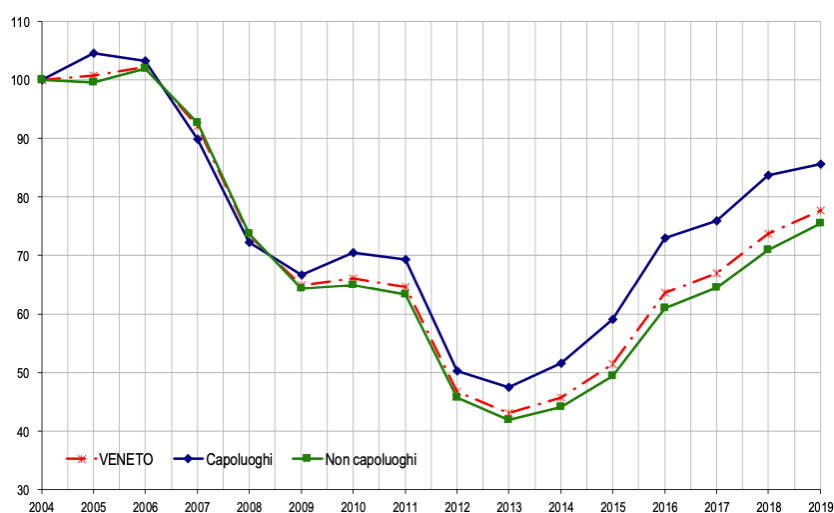
The provinces that recorded the greatest increase in NTNs in 2019 were Vicenza with +10.8% and Treviso with +7.2%, although it is still the province of Venice to hold the largest NTN (11,912), while it is still the provinces of Belluno and Rovigo to have the least active market in the region with, respectively, 2,332 and 2,391 NTNs, respectively.

The Figure 10 shows it is possible to visualize which are the areas with the greatest intensity of the real estate market (in green). It shows that the areas between Padua, Treviso and Venice, the coastline from Caorle to Sottomarina, Verona and its surroundings and the Garda Riviera are the places have the highest frequency of residential real estate transactions in the region. Compared to last year, in 2019 there was a widespread increase in the vitality of the market, and not only in the immediate surroundings of the capitals.

Figure 10: Frequency of residential real estate transactions in Veneto region.

Source: Mazzoccoli, 2020, page 8
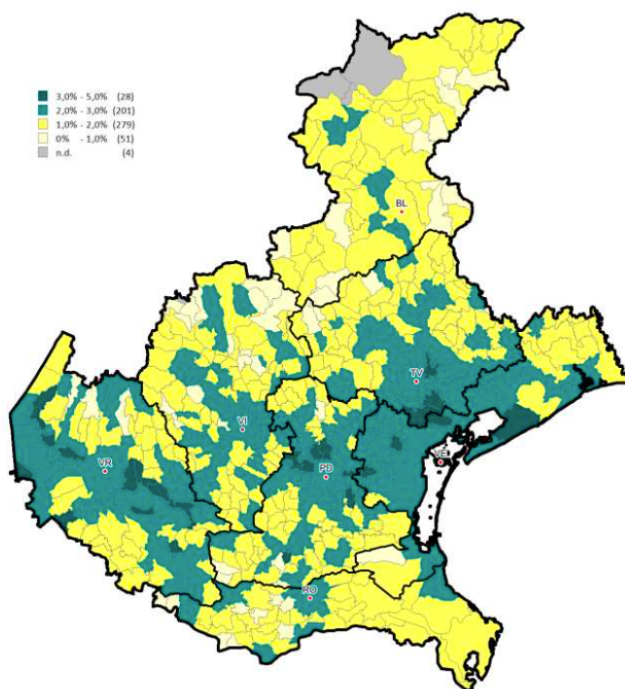
The data collected indicate, albeit modestly, a drop in prices equal to -0.70% for the capitals, while there was a slight increase in prices in the rest of the provinces (+0.1%). The only counter-trend values were recorded in the provinces of Belluno and Verona (capitals excluded), where quotations marked a positive sign, +0.2% and +1.8%, respectively, which are small but significant signs that bode well for the future of the residential real estate market in the region.

The average price in Veneto is 1,896 €/m² for the capital cities and 1,263 €/m² for the other municipalities. The capital city with the highest price is confirmed to be Venice which, with 2,583 €/m², significantly overtakes the other capitals, all of which have average prices still below 2,000 €/m².

The regional quotations have continued to rise since 2004 despite the crisis that invested the residential real estate market, only since 2012 they have recorded decreasing values, a trend that seems to have ended: the average regional value in 2019 is 1,396 €/m² which is the same of 2018.

The Figure 11 shows the areas with the highest real estate values in Veneto, i.e., the Valle del Boite (BL), influenced by the presence of Cortina d'Ampezzo, Venice (not only the historic center), the seaside area of Jesolo (VE) and the coast of Lake Garda (VR).

Figure 11: Differential of average municipal quotes 2019 (national average value =1)

Source: Mazzoccoli, 2020, page 12
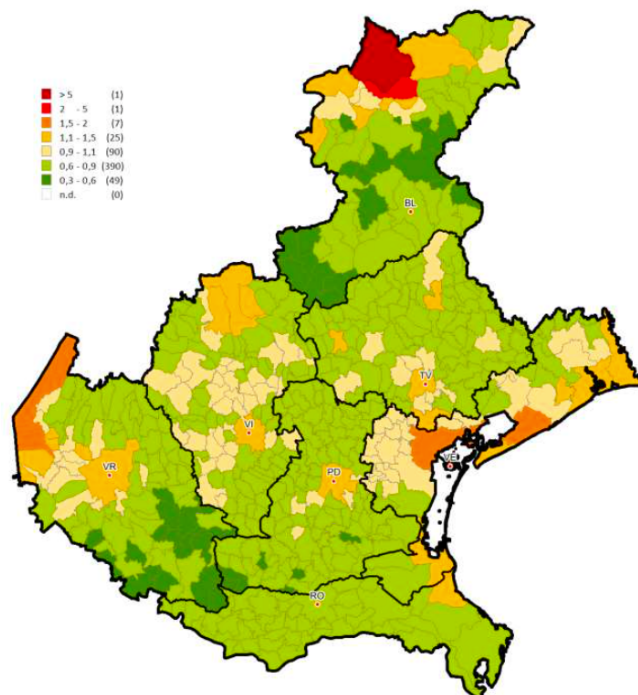
1.2.6 The real estate market in Padua

The province of Padua is divided into 102 municipalities that can be agglomerated in seven province-specific macro areas, pooled according to some common morphological, infrastructural, and real estate characteristics. The macro areas are the following:

The macro areas are the following:

- Capoluogo;
- Bassa Padovana;
- Cintura Urbana;
- Colli Euganei;
- Piovese;
- North-West region;
- North-Est region.

Table 3 and Table 4 present the IMI figure (real estate market intensity) and the corresponding yearly change. Purchases and sales record an increasing trend to the extent of +3.6% (going from +21.28% observed in 2016 to +12.5% in 2018) compared to last year with 10,790 NTNs (compared to 8,740 NTNs in 2016 and 10,406 NTNs in 2018).

Rather small increases are also recorded in the provincial macro-areas that for the first time show changes with a negative sign even if slight, -2.6% *Colli Euganei*, -3.8% *Piovese*, -1.0% Northwest Region; contained also the increases on the Capital +1.9% (compared to +25.68% in 2016 and +17.2% in 2018) and the whole Province +3.6% (+21.28% detected in 2016 and +12.5% in 2018). Average listings, compared to 2018, continue to show declines in all macro-areas. The negative peak was detected in the city of Padua with -0.9% with an average quotation of € 1,613/m². The provincial average quotation stands at 1,250 €/m² marking a decrease of -0.4%.

Table 3: NTN, IMI and its yearly change by province-specific macro area
Source: Mazzoccoli, 2020, page 28

MACROAREE PROVINCIALI	TNT 2019	TNT Variazione % 2018/2019	Quota NTN per provincia	IMI 2019	Differenza 2018/2019
Bassa Padovana	1436	18,10%	13,30%	1,90%	0,29
Cintura Urbana	3062	3,80%	28,40%	2,83%	0,09
Colli Euganei	571	-2,60%	5,30%	1,91%	-0,06
Piovese	629	-3,80%	5,80%	1,93%	-0,08
Regione Nord-Occidentale	885	-1,00%	8,20%	1,77%	-0,02
Regione Nord-Orientale	903	4,20%	8,40%	2,06%	0,07
Padova Capoluogo	3303	1,90%	30,60%	2,85%	0,04
Provincia di Padova	10790	3,60%	100%	2,36%	0,07

Table 4: Provincial average quotation and annual differential for the different macro areas

Source: Mazzoccoli, 2020, page 30

MACROAREE PROVINCIALI	Quotazione media €/m² 2019	Quotazione media variazione % 2018/19
Bassa Padovana	1023	-0,30%
Cintura Urbana	1199	-0,20%
Colli Euganei	1165	-0,10%
Piovese	1070	-0,20%
Regione Nord-Occidentale	1140	0,00%
Regione Nord-Orientale	1122	0,00%
Padova Capoluogo	1613	-0,90%
Provincia di Padova	1250	-0,40%

Figure 12 shows that after having overcome the negative peak of 2013 there is a recovery which is more marked in the territory of the capital, found, although less clearly, even in the entire province and municipalities.

The data of the IMI follows the same upward trend recorded in the NTN from 2013 until today, involving in the same measure province, capital and not capital.

The Figure 13 shows that the quotations after touching the major upward peaks in the years 2011 and 2012, marks an abrupt descent in 2014 and then gradually continues with the same trend.

Figure 12: Index number of NTN for the whole province, capital municipality and other municipalities

Source: Mazzoccoli, 2020, page 29
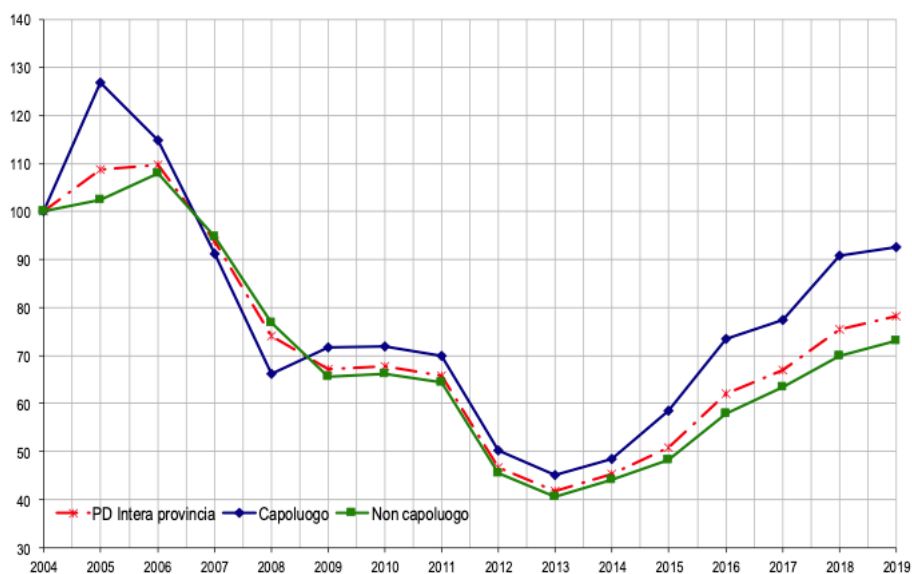
Figure 13: Index number of the quotation for the whole province, capital municipality and other municipalities

Source: Mazzoccoli, 2020, page 30
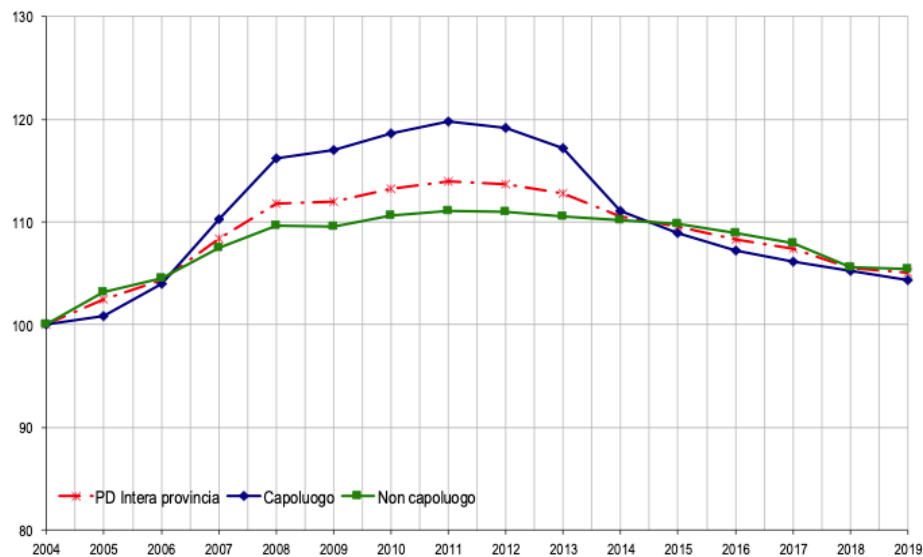
Lastly, regarding the data only for the city of Padua, the urban space has been divided in 22 different zones that are bundled in four zones based on the distance from the city center. These are listed below:

- Central: OMI zones B1, B2;
- Semi-central: OMI zones C1 to C6;
- Peripheral: OMI zones D1 to D8;
- Suburban: OMI zones E1 to E3;
- Extra urban: R1 to R3 OMI zones.

The majority of the transactions took place in the semi-central zone C5 (*Madonna Pellegrina, S. Rita, Nazareth e Sant'Osvaldo*) near the Hospital (419 NTN), followed by the most populated neighborhoods such as Zona *Arcella* (D7) with 354 NTN and D3 (*Bassanello, Guizza, Voltabarozzo*) with 315 NTN.

The average municipal house price is 1,669 €/m² where 3,303 NTNs have been recorded, while the old city center that has the highest average quotations with 3,142 €/m² , and 2,706 €/m² respectively in the OMI B1 and B2 zones.

CHAPTER 2 - THE RELATION BETWEEN THE UNIVERSITY OF PADUA AND THE CITY OF PADUA

2.1 THE HISTORY OF THE UNIVERSITY

"*Universa universis patavina libertas*" is the slogan that characterizes the University of Padua, and it is also the reason why a group of students and professors decided to leave the University of Bologna to seek for greater freedom of expression.

Therefore, the University of Padua was not born from a papal bull or an imperial decree, but it was the result of the combination of two favorable factors: a new team of professors from the University of Bologna and the support of the municipality of Padua.

The year 1222 is considered to be the year of the foundation of the University of Padua because that is the year when a rigorous plan of organizing the university's activities was implemented.

2.1.1 Middle Age and Renaissance

At the beginning, the university of Padua had a similar organization to the one in Bologna; it was characterized by the guilds of pupils, the colleges of professors and the chancellor. During the first years of 1300, Padua reached its glory as it had professors from all over Europe: e.g., Pietro D'Abano, a medical expert who moved from Paris. Padua became a very prestigious pole of research, just like the universities of Bologna, Cambridge and Oxford.

The University was established originally as *Universitas Iuristarum*, which was based on the teaching of civil and canon law, but around 1250 it also started teaching medicine and arts. In 1399 the *Universitas Artistorus* was created and thus from that date were two universities with the same rights and privileges, and with their own Rector.

Between the 1400 and 1700 the city of Padua was controlled by the Venetian republic, and this marked a peak in the University of Padua's cultural prestige.

The University became an international study and research center thanks to the relative freedom and independence guaranteed by the Republic of Venice, of which Padua became the cultural center, and also thanks to the economic and political power of the Serenissima itself. Some of the most remarkable professors of this period were Andrea Vesalio, Gabriele Falloppio and Girolamo Fabrici d'Acquapendente. Galileo Galilei taught in Padua for eighteen years between 1592 and 1610.

2.1.2 The Venetian Republic

Until 1400, students had the right to approve the university statute, elect the rector and choose the professors. As the Carraresi domain tried before in 1560 the Venetian Republic decided to remove the possibility for students to choose their own professors and decided to pay outside researchers to work as professors for the university.

This period was important because the building which was owned by the university was renovated and expanded. All the departments were joined in one single block of buildings, and this is where *Palazzo Bo* would subsequently be built.

The year 1545 saw the foundation of the first botanic Garden of Europe, *Orto Dei Semplici*.

On January 15, 1595, the anatomical theater, the first of its kind in the world, was inaugurated by Girolamo Fabrici d'Acquapendente.

In 1629 the first Italian university library was built, based in the *Sala dei Giganti*.

Finally, the *Specola* (an astronomical observatory) was built in the castle owned by the Carraresi, and thanks to the creation of the faculty of Agriculture a new area developed into the heart for agrarian experimentation.

2.1.3 The foreign domination

The Nineteenth century was marked by the double domination of France and the Austro-Hungarian Empire.

This period of instability determined the change in the university organization: the distinction between *Univesitas Iuristam* and *Universitas Artistorum* was eliminated; the Rector was elected by the king, and he acted as the major link between the university and politicians.

From 1813 there was a period of relative stability despite the fact that all the professors were elected by the government and lectures were subject to strict rules and censorship. Students' dissatisfaction reached its highest point during the riot of February 8th, 1848, when the students and the citizens of Padua fought together.

In that period a lot of students decided to leave the university to fight in the first war for independence ("*Prima Guerra d'Indipendenza*") or to join *Garibaldi* in the renowned "*spedizione dei Mille*".

2.1.4. Il Regno d'Italia

Veneto was annexed to the Kingdom of Italy in 1873, and ever since that date, the university has been one of the most prestigious in the country for its contributions to research.

In the field of mathematics, among the most prestigious were professors like Gregorio Ricci Curbastro, Giuseppe Veronese, Francesco Severi and Tullio Levi Civita.

The change in the political scenario led to the closure of the schools of Agrarian, Veterinarian and Theology; the leading professors were transferred to the University of Rome, with the objective of making the latter the most important university in the country.

In that period, the University of Padua only had four faculties: Law, Medicine and Surgery, Literature and Philosophy, Mathematics, Physics and Natural Sciences. However, at the end of 1800 the University of Padua began a slow period of expansion that led to the creation of the faculties of Engineering (1876), Pharmacy (1933) and Political Sciences (1933).

In the following years, Padua re-gained its international identity, and it experienced a radical expansion and a building redevelopment reversing the centralization process.

Scientific institutes were organized in campuses; a new building (Palazzo del Liviano designed by Giò Ponti) was built to become the headquarters of the Arts and Philosophy faculty, the Astro-Physics Observatory was built in Asiago, and the old Palazzo del Bo was fully restored (1938–45).

2.1.5 First and Second World War

During the First World War many students and professors left the academic life to join the Italian army and therefore the university's development slowed down. On the contrary, during the "Ventennio Fascista" a lot of new buildings were built; among these the institute of Pathological Anatomy, the surgical clinic, the institutes along the Piovego, the school canteen, and the student residence.

The vicissitudes of the Fascist period—political interference, the Racial Laws, etc.—had a detrimental effect on the development of the university, and so did the Second World War. During those years leading professors were expelled because they were Jewish; among these Marco Fanno, Bruno Rossi and Tullio Terni, but hundreds of students were also turned away.

On November 9th, 1943, during an inaugural speech, the Rector Concetto Marchesi (1878 – 1957) publicly invited the students to rebel and fight against fascism, an action that would then force him to move to Switzerland. This speech was interpreted as a declaration of war of the University to the tyrannic Italian government.

A lot of students and professors died during the fights, and this is why on November 12th, 1945, the University of Padua was the only university in Italy to be awarded the Medal of Military Valor.

2.1.6 The postwar period

The post-war period was characterized by the decisions of the Rector Guido Ferro (1898 - 1976) who was rector of the University of Padua for almost twenty years. During that period there was a significant building expansion and the decentralization of the faculties to other cities in the region of Veneto.

The rectors were able to address problems caused by overcrowded facilities by implementing a capillary decentralization over the region of Veneto as a whole.

The year 1968 is considered by many to be a milestone for the university system. In Padua there was a sudden rise in enrollments, and the University went from about 10,000 in 1960 (a fairly stable figure since the end of the war) to over 30,000 in the 1968-69 academic year. In other words, children born after the war started to see university as an opportunity for social change. At the national level, the power to decide upon the university organization and structure was concentrated exclusively in the hands of a small group of professors, and other teachers and especially students were excluded. In Padua the power was divided between the rector and the mayor of the city, and this led to many students' dissatisfaction.

Although the number of degree courses grew, and students started having more rights, with the creation of the "*Tribuno degli studenti*", in 1967 students started to occupy the faculties. These developments can be seen as a generational conflict between students and teachers, with growing political and social implications.

Padua would soon prove to be a particularly disturbing and violent political environment: starting from the bombs, even placed in the office of the new rector Enrico Opocher (1914 – 2014), to the first murder committed by the *Brigate Rosse* at the headquarters of the MSI in *via Zabarella* (1974).

The situation in Padua was different from other cities in Italy for a number of reasons: the university launched its first-degree courses in Psychology which attracted thousands of students from all over Italy. These individuals were the leaders of the protests because they were disappointed and enraged for not having suitable accommodation, canteens and classrooms.

New faculties were founded: the faculty of Agriculture in 1946, Education sciences in 1951, Veterinarian sciences in 1992, Economics in 1993. In these years the university resumed its position as an important scientific-cultural center in the Western world thanks to very important professors who were able to take the University to a very high level internationally in many disciplinary fields

In 1990, the course of Management Engineering was set up in Vicenza; after this summer courses were organized in Brixen (Bressanone) and in 1995 the Agripolis campus was inaugurated in Legnaro (for Agricultural Science and Veterinary Medicine).

Drawing from the idea of de-localization of faculties, other campuses were founded in the following cities: Rovigo, Treviso, Feltre, Castelfranco Veneto, Conegliano, Chioggia and Asiago.

From the year 2000, the area of Piovego started to become an important pole given the multiple faculties located there and other facilities such as study rooms and libraries.

The departments of Biology, Mathematics and Psychology were created and in 2014 the biomedicine building was completed, which had been entrusted to the architect Mario Botta. In 2014 the Biodiversity Garden was inaugurated as an extension of the Botanical Garden.

Today, the University of Padua plays an important role in scholarly and scientific research, not only at a European level, but also on a global scale; it has numerous publications, and it organizes international conferences and conventions.

The University is constantly ranked among the best universities in Italy: in 2020 the Times Higher Education World University Rankings listed the university of Padua fourth.

In 2020, the US News & World Report World Best Global Universities Rankings the University of Padua is considered the world's 116th and 48th in Europe.

2.2 CAMPUS DIFFUSO: THE ALLOCATION OF THE UNIVERSITY AREAS

The university of Padua is considered to be a widespread city campus.

The city hosts a community of 60.000 students attending 188-degree courses: 30% of the entire population of Padua works or studies in the university. This portion led to the transformation of the urban space into a space which is tailored for students.[8]

2.2.1 The virtuous relationships between the city and the university

"The history and evolutionary dynamics of European universities are linked from the very beginning to those of the urban fabric in which they unfold. […] the European one is, in fact, a story of "widespread campuses" that permeate the city as crucial hubs of a complex cultural, educational and research network. Universities and cities share the fate of the other, in a continuous and inevitable exchange of knowledge, resources and human capital, like two parts of the same magnet. "(Paleari, 2015)

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[8] Data provided by UNIPD website - Su misura per te: https://www.unipd.it/corsi/su-misura-per-te

As indicated from Balducci (2010) the relationships between university and city are synergic. The university is a strategic resource for both the city in which it is located and the territory around it for three main reasons: (1) it is a key point for the exchange of intelligence and knowledge in the international/local scenario; (2) it is the regional reference hub for the production, innovation and development and sharing of knowledge, and thus it becomes a pole of attraction for young talents; (3) it plays a key role for urban re-design and regeneration policies, reinventing the industrial spaces into the new center of the urban economy which is based on knowledge and not on mass production.

At the same time, the city is fundamental for university life: (1) it constitutes a field of direct and continuous interaction; (2) it represents a laboratory where the effectiveness of research can be tested; (3) it constitutes a link between the social and cultural forces of the city.

The relationship between city-university has always experienced multiple transformations: as the city changed, the university did too, but this relationship was always intact. Therefore, it makes sense to talk about "the city seeking for a university" and in reverse "the university seeking for a city".

   With regards to the relationship between Universitas and the middle age cities, todays these two actors are not just the results of the economic revolution of '800, they experiment a new tension being part of the post-industrial economy in which the knowledge is considered the condition for the economic, social and cultural development.

The urban space and education are fundamental resources for individuals' well-being, and they significantly improve the quality of life of future generations (Fedeli, 2010).

The competitive capacity of the post-industrial cities is no longer related to the presence of industries, but it is correlated to the presence of services and goods of quality, research centers which are able to produce innovations, attract talents, enterprises and capitals from the outside, and nevertheless offer a good standard of quality for its citizens.

The city offers essential factors which contribute to university's success: spaces, services, events.

On the other hand, the university not only has an educational purpose, but it also acts as a key factor for the development of a territory. The university can be seen as an incubator and local development engine that functions through the enhancement of local capital resources, in the creation of skilled workforce, and it seeks innovation of the production process for local development (Magnaghi, 2005).

In this context is important to highlight that the success of the university is not only due to the effectiveness of the educative performances, but also to its accessibility in the urban space, through the activation of collaborative dynamics (Siegfried et al., 2007). In general, universities are seen as institutions that produce and share knowledge and thus lead to a general increase in the quality of life, also in relation to all the economic reflections in the space around it.

Over the decades, the university has gone from being a place of elite teaching to mass teaching, with a radical change of the needs in terms of facilities and services.

The consumption of resources and services needed to offer a decent university system, on the one side, and the creation of human capital, know-how, and the possibility of economic development of the territory, on the other side, create a significant impact in the short run and in the long run to the extent that the universities act as a catalyst for local development (D'Alpaos, 2017).

In general, especially when they are included in appropriate integration programs between research and local businesses, there is a strong need to identify and evaluate the repercussions and possible effects induced by the construction of new university settlements on the economic, social, productive, and urban systems.

The economic impacts of the university can be divided in two major categories[9]:

- Long-run impacts: the university is considered an institution that shares and generates knowledge and therefore mainly produces an increase in the stock of human capital;

- Short-run impacts: the university is considered a firm with a precise role in the local economy. These impacts include the local impacts on employment and income, generated both by the expenses incurred by the university for its own functioning, and by those incurred by the main users who express particular requests for goods and services.

How and on which terms does the building of a new, more fertile and aware relationship between city and university pass?

Starting from this general question, there are a number of fields in which the role of the university can be furthered experimented and redefined.

The list below highlights the issues on which future development lines had affect the role of university should be strengthened in order for it to be a development factor for the city (Fedeli, 2010):

- role of the university as an urban actor and territorial development operator: to be effective, the university action must be increasingly closely intertwined with that of other actors,

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[9] This classification has been proposed by Lechat (1979), Huggins e Cooke (1997), Armstrong et al. (1997) e Mille (2004).

through participation in formal and informal networks, strategic tables, urban coalitions, in which the university should be an actor among the actors;

- role of the university regarding the city's problems: this is a question of investing today in its local roots in a perspective that sees the city as a field in which to experiment and search for a new dimension of academic excellence, which also relates to the ability to deal with society consciously taking part in the dynamics of the city;

- by strengthening the university system, it could be possible find reasons for effectiveness in the planning and management of joint actions: the emergence of new challenges, such as the progressive reduction of public resources and the need to compete more and more internationally, requires the launch of pilot projects defined by a greater interaction and co-planning between university bodies;

- internationalization and the university's ability to attract talent on a global scale: for universities, the benefits are linked to having easier access to international research and knowledge channels. On the other hand, the same flows of foreign students, but also of professors and researchers, could trigger positive dynamics for the city, enhancing those virtuous circuits of economic and social settlement and cultural innovation connected to their presence.

These considerations are strictly linked to the idea of a city, which is understood as the basis of the knowledge of a society and refer to the university itself as an active agent on a double front: in terms of attraction of flows and population, but also on that of a territorialization assumed in a dynamic and strategic form.

There is a problem related to the capacity of reproducing and enhancing the contextual knowledge and the territorial heritage that is the real development engine to a local level.

Thus, the university has the role of protecting and promoting local diversity - in doing this, the university needs to decentralize the faculties and all the annexed facilities by adopting a polycentric and reticular system: decentralizing several faculties in the nearby suburbs or even nearby cities.

This model hypothesizes, through the 'economies of scope' allowed by telematic and information technologies, to structure a system of local university centers where the teaching (and research) typologies are connected in a relationship of reciprocity and mutual utility to the specificities of local socio-economic and physical environment.

The innovative and strategics aspects of this organizational model can be summarized as follows:

- A network connection enabling every pole to get access to the learning services and the facilities of the university, and enabling the university to enrich its cultural heritage through the enhancement of local culture;

- A public-private partnership that creates an incubator for local development through the creation of social and economic innovation which is based on the local socio-territorial heritage;

- A widespread campus decongests the center of the city, increasing the accessibility to peripheral areas;

- The offer of spaces, services and equipment by local administrations (usually in prestigious abandoned areas and buildings in central urban locations with high public accessibility) decreases or eliminates the settlement costs and promotes the revitalization of the heritage of historic cities by activating services for students, in particular by contributing to enhancement of public transport.

2.2.2 The university of Padua as a well-organized city-campus

Since 1222, the University of Padua has developed a model which adheres to the type of "university city", through a shared evolution of urban and social dynamics, and therefore it places itself as an emblematic case of city campus (Stellin et al. , 2007)

The University of Padua is one of the biggest athenaeums in Italy, and the biggest in the north-east area, and it is always on the podium of the Censis ranking for factors such as the general quality of services and facilities.

It is possible to find streets populated by girls and boys who study at the University, classrooms in the heart of the historic city (it is one of the oldest universities in Europe which was born in 1222), endless opportunities to alternate study and leisure, to admire the artistic heritage and documents kept in the archives, museums and libraries of the University.

It is possible to move between all the classes, libraries, and all the university spaces on foot, by bike or public transportation: not only within the city center but also outside the city, such as in the campus of Agripolis.

The main facilities which are dedicated to students are:

- Accommodation: there is the possibility for students to opt for an apartment in one of the fifth-teen university residences of the ESU regional company, with prices calculated on the basis of income and merit.

In addition, Padua offers the opportunity to stay in more than 10 residences, colleges and hundreds of private apartments. In order to deal with the phenomenon of "black rents" there is a facilitated lease agreement scheme prepared by Unipd, ESU, the Finance Police and the Municipality of Padua;

- University catering: for quality and cheap lunch and dinner, there are eleven university restaurants managed by ESU or affiliated with them which are also open on Saturdays and Sundays: the cost of a full meal varies from 2.70 to 5.70 euros depending on an individual's income and merit;

- Classrooms, study rooms, libraries, computer labs: Unipd university facilities dedicated to study unfold within a radius of just 1 kilometer, between the streets of the pedestrian center or in the university district par excellence (the Portello): hundreds of classrooms, study rooms and computer laboratories, twenty-nine libraries, a hospital Polyclinic of excellence - which represents a reference point for patient health throughout Italy - and a veterinary hospital just 10 km from the city center.

- Transportation: Regional and high-speed trains, trams and city buses, two airports less than 50 km away (one in Venice and one in Treviso). Thanks to a good public transport network, getting to and from Unipd to other cities is easy. The city also has well-organized bike sharing and Mobike services. The night bus service offers night minibuses on call so that students can experience the city in a safe and sustainable way.

2.2.3 From the centralization to the delocalization of the university buildings

The urban planning of a "university city" like Padua is confronted with peculiar dynamics and services compared to other university models in which the university locations are isolated or even external to the city (Stellin, 2017).

The urban and building planning of Padua has always been strongly affected - for better or for worse - also by growing demands for food, accommodation and services: it is the flows of students that determine the expansion and contraction phases of the university settlements.

Through a historical analysis and based on the phases mentioned at the beginnings of the chapter, it is in fact possible to outline the growth methods of the university city. The goal is to determine the dynamics that the university flows generate in the urban plant through thematic maps that connect urban development, university settlements and the services which are necessary for them.

The evolution of the settlements can be divided in three main phases:

- From 1222 to 1900 centralizations of the university locations. Recovering and reusing historical and institutional buildings in the city center;

- From 1900 to 1945 beginnings of the decentralizations. New buildings have been created ex novo outside the city center;
- From 1945 to 1965 decentralization: massive constructions of headquarters outside the city center and creation of branch offices in other cities in Veneto.

The reasons why the disposition of the university headquarters moved from the city center to the peripheral area of the city are mainly due to the access to public transportation, students' services as libraries, bars, restaurants and shops (Magnaghi, 2005) It is important to highlight that the university moved because of this but at the same time the development of new economic activities is the result of a great influx of students and professors.

First period: until 1900

In the first period the university did not own any buildings. The headquarters of the *Universitas Iuristarum* and the *Universitas Artistorus* were all in the city center and they were near to some hotspots of the city as *Palazzo della Ragione*, *Vescovado*, *Basilica del Santo*.

All the areas dedicated to teaching were inside the city walls.

In 1542 there was the idea to create a space in which all the university headquarters could be placed: Palazzo Bo. The refurbishment of Hospitium Bovis (*Palazzo Bo*) is therefore not only the assignment of a first "owned" headquarters of the University of Padua, but also the first opportunity for urban redevelopment.

In 1545 there was the foundation of the *Orto dei Semplici*, the first university scientific laboratory near the Basilica del Santo. At the end of the VI century the *Teatro Anatomico* was built inside Palazzo Bo. The faculty of medicine had its building in some rooms inside the hospital of San Francesco.

In the XVIII century, thanks to the university reform, there were a number of architectural and functional upgrading of buildings in use with the acquisition of additional space. Firstly, the Astronomical Observatory is set up inside "*Torlonga*" - the Carrarese castle -, and also the new school of architecture is housed in this castle (1771).

The faculty of Veterinary medicine was placed in the renovated "*Convento delle Maddalene*"; the faculty of Medicine, instead, moved from the hospital "San Francesco" to the hospital "*Giustinianeo*".

At the beginnings of 1800 the University of Padua had a diffuse structure within the city. The project that foresaw moving the historical university buildings to another place was not approved and consequently some interventions of requalification and enlargement of the

historical buildings were necessary: buildings near Palazzo Bo were acquired (1858 and 1865) and in the last thirty years of the XIX century a policy of decentralization of the university settlements was launched.

In 1942 the railway line connecting Padua and Marghera was inaugurated. This facilized the access to the city and thus the commuting phenomenon.

In Figure 1, in black you can see the building dedicated to teaching, in red the services offered to the students by the university.

Figure 1: Maps of the city of Padua containing the university settlements.
Source: Stellin, 2017, page 22

Just to summarize, as you can also see from the plants, the university was first housed in a number of institutionnel buildings of an evolving medieval city, and then it acquired locations of its own, both for teaching and for its services. This is when it is possible to start talking about city-campus.

Second period: 1900 - 1945

This is period when the second most important plan of decentralization of the university in the city took place. This phase was marked by the desire to create a more rational arrangement of the University's buildings, thanks to the availability of residual surfaces outside the city center. It is also worth mentioning the interventions to build the new university district in the area that extends from the gardens of the Arena to Porta Portello.

It is possible to identify an axis connecting the area of Santa Sofia (Via Marzolo - Via Loredan) and the "hospital pole" in the area of San Mattia.

In 1912 the Institute of General Chemistry, Zoology and Comparative Anatomy, General Pathology, Hygiene, Pharmacology and Anthropology were all grouped in the area of S. Sofia, whereas the anatomical institutes were placed in the St. Matthias.

In the following years, the Institutes of Biological Chemistry and Physiology and the School of Engineering were built in the area of Santa Sofia; in 1940 the Institutes of Physics, Pharmaceutical Chemistry and Technical Physics were completed in the same area.

In this period the city-campus of Padua can be associated with the image of a clover: the university area in the center, and the one in St. Sophia and St. Matthias. Unfortunately, the project of *San Mattia* University Pole, the first establishment of the Faculty of Medicine near the eighteenth-century hospital, was never completed.

From 1933 there was an expansion of existing buildings and the construction of new ones in the so-called "University Central Area". In this period *Liviano* was built – this would later become the humanistic center. It is important to highlight that both *Liviano* and *Palazzo Bo* experienced a new intern decoration and new furniture that made them resemble a modern art museum: the first of their kind in those years. In Figure 2 in black you can see the building dedicated to teaching, in red the services offered to the students by the university.

Figure 2: Maps of the city of Padua containing the university settlements.
Source: Stellin, 2017 page 22

To summarize, this period was characterized by big construction initiatives: starting from settlements on vacant areas immediately near the historical core, up to the creation of real university districts.

Third period: 1945 - 1961

After the Second World War, the university of Padua had a building heritage which had not been compromised greatly by the war events but was, however, extremely in need of maintenance and renovation works. This was mostly due to an explosion in the numbers of enrollments and of the university population, which passed rapidly from the 4-5000 units during the period in which the rector Anti was in office, to the 12,000 that were registered under rector Meneghetti.

The period of intense interventions, which was carried out in the logic of the saturation of available spaces, is subject to numerous criticisms from the urban, functional, economic and environmental point of view.

Evaluating it ex post, over time it reproduced the model of growth by extending and adding ex post new rooms in the buildings after their completion. This led to distortions both aesthetically and functionally but, above all, it reduced outdoor spaces - green or parking - with consequent traffic problems.

Drawing from this, in those years, in order to facilitate the access to vehicles, a system defined "*tombinatura*" as implemented; this affected a significant portion of the canals that cross a large part of the city. This work increased urban accessibility for vehicles, but it also led to the disruption of the organization and image of the urban space in the historic center.

The third evolutionary phase of Padua's university buildings thus marked by the development of new buildings that changed the overall image of the city of Padua in the wake of post-war recovery.

Fourth period: 1962 - 1990

The expansion of the University of Padua from the years following the Second World War to the 1990s underwent a sharp acceleration both outside and inside the city limits.

In fact, in addition to the observatory of Asiago and the Hydrobiology Center of Chioggia, the following buildings were added: the University Youth House of Bressanone, the buildings of the new university established in Verona (1965-1976), the Mountain Ecology Center of San Vito di Cadore (1977) and, more recently, the buildings in the detached campus of Vicenza.

It is important to highlight that the urban sites of Padua, which are components of the City Campus, have always maintained their centrality also in terms of importance and flows, compared to the detached sites of Asiago, Bressanone, Vicenza and Chioggia.

The expansion of existing locations occurred with the saturation of available space, as in the case of engineering seats. The opportunities for renovation occurred with the restoration of historic buildings owned, purchased or received in bequest, in the city center.

In Figure 3 below, in black you can see the building dedicated to teaching, in red the services offered to the students by the university.

Figure 3: Maps of the city of Padua containing the university settlements.

Source: Stellin, 2017 page 22
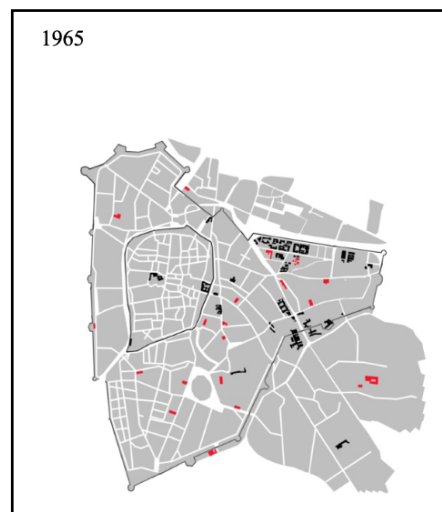
Fifth phase: 1990 - today

This last phase is a continuum of the fourth phase which is characterized by new construction, extension and renovation - but also a focus on conveying more rationality to urban planning.

The idea was to use the historical spaces for humanistic activities, and thus renovate these buildings, and build new buildings for scientific activities, e.g., the area north of the Piovego river was further developed (Teaching complex Piovego 1992 - Psicologia 1 1994 - Psicologia 2 1994 - Economics 2004 - Torre Archimede 2005 - pole of Earth Sciences 2009).

At the beginning of the '90s the University of Padua also experimented a different settlement model for the first time. In fact, new facilities were built in Legnaro, outside the boundaries of the city of Padua, but still functionally connected to it.

The campus which was built is external to the city, where some faculties have their buildings: Nuclear Physics, Agricultural and Veterinary sciences.

For the first time the urban planner Bruno Dolcetta (2000) introduced the idea about shared objectives between the university and the city, combining the needs of the university and territorial policy.

After centuries of separate planning, the need for the university to give urban rationality to an already existing context was acknowledged at the urban planning level.

Figure 4: Maps of the city of Padua containing the university settlements.

Source: Stellin, 2017 page 23
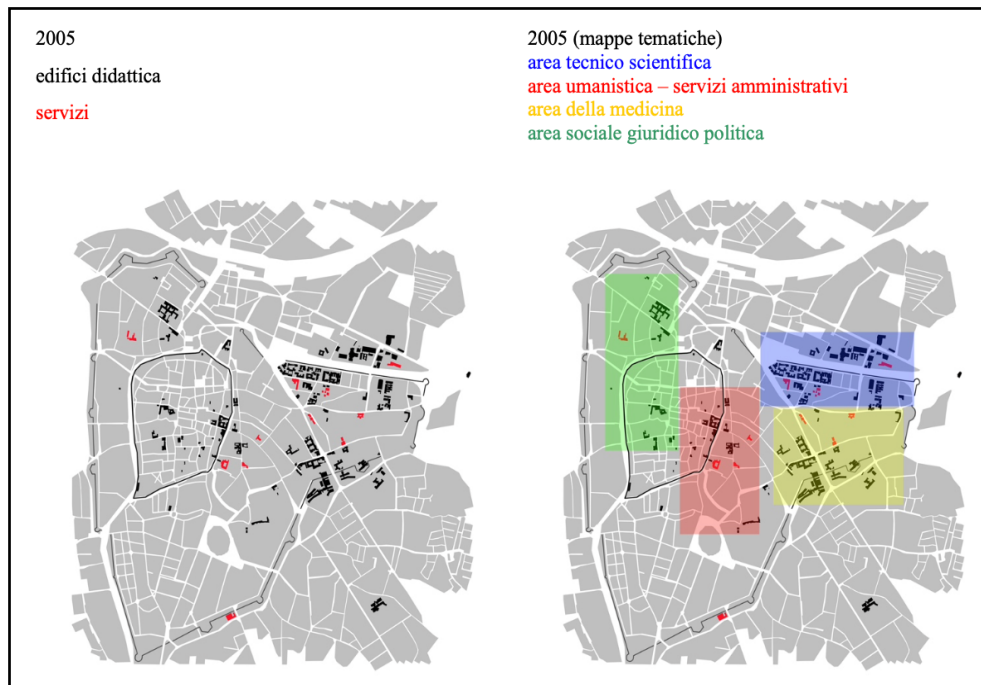
Today, the traditional "cloverleaf" settlement model has become a "four-leaf clover" model with the division of university settlements into four principal area, relating to the humanistic, medical, scientific, and more strictly administrative areas. This can be observed in Figure 4.

In the Table 1 below it is indicated all the departments of the university of Padua, the number of students each, the area and the address of their seats. This chart is a clear explanation of the "four-leaf clover model".

In the "*centro*" area there are humanistic faculties; in the "*ospedale*" area there are all the medical faculties; in the "*cittadella universitaria*" area, that is the Portello zona, there are the scientific faculties.

To summarize all the phases, the university and urban flows have evolved in parallel with the historical events of the city, first with university settlements in institutional locations, then in their own locations making the university autonomous from the urban fabric, and then reabsorbed with a widespread settlement structure characterized by shared services and targeted to meet the needs of the population.

Table 1: Allocation of university buildings

Source: author's elaboration

DIPARTIMENTI DI PADOVA	STUDENTI	AREA	INDIRIZZO
Dipartimento di Diritto Pubblico, Internazionale e Comunitario - DiPIC	1975	CENTRO	piazza Capitaniato 3, 35139 Padova
Dipartimento di Beni Culturali: archeologia, storia dell'arte, del cinema e della musica (DBC)	2248	CENTRO	piazza Capitaniato 7, 35139 Padova
Dipartimento di Biomedicina Comparata ed Alimentazione (BCA)	2	CENTRO	via 8 Febbraio 2, 35122 Padova
Dipartimento di Diritto Privato e di Critica del Diritto (DPCD)	758	CENTRO	via 8 Febbraio 2, 35122 Padova
Dipartimento di Scienze Statistiche	920	CENTRO	via Battisti 241, 35121 Padova
Dipartimento di Scienze Politiche, Giuridiche e Studi Internazionali SPGI	3256	CENTRO	via del Santo 28, 35123 Padova
Dipartimento di Scienze Storiche, Geografiche e dell'Antichità (DiSSGeA)	787	CENTRO	via del Vescovado 30, 35141 Padova
Dipartimento di Studi Linguistici e Letterari (DISLL)	3305	CENTRO-CITTADELLA UNIVERSITARIA	Piazzetta Gianfranco Folena 1, 35137 Padova
Dipartimento di Scienze Economiche e Aziendali "Marco Fanno" (DSEA)	1991	CITTADELLA UNIVERSITARIA	via Bassi Padova
Dipartimento di Fisica e Astronomia "Galileo Galilei" - DFA	1420	CITTADELLA UNIVERSITARIA	via Gradenigo 6, 35131 Padova
Dipartimento di Ingegneria Civile, Edile a Ambientale - ICEA	2007	CITTADELLA UNIVERSITARIA	via Gradenigo 6/b, 35131 Padova
Dipartimento di Ingegneria dell'Informazione - DEI	3750	CITTADELLA UNIVERSITARIA	via Gradenigo 6/b, 35131 Padova
Dipartimento di Scienze Chimiche - DiSC	1108	CITTADELLA UNIVERSITARIA	via Marzolo 1, 35131 Padova
Dipartimento di Scienze del Farmaco - DSF	1754	CITTADELLA UNIVERSITARIA	via Marzolo 5, 35131 Padova
Dipartimento di Filosofia, Sociologia, Pedagogia e Psicologia Applicata (FISPPA)	6465	CITTADELLA UNIVERSITARIA	via Marzolo 8, 35131 Padova
Dipartimento di Geoscienze	336	CITTADELLA UNIVERSITARIA	via Marzolo 9, 35131 Padova
Dipartimento di Ingegneria Industriale DII	4964	CITTADELLA UNIVERSITARIA	via Trieste, 63 - 35121 Padova
Dipartimento di Biologia (DiBio)	1567	CITTADELLA UNIVERSITARIA	via U. Bassi 58/b, 35121 Padova
Dipartimento di Scienze Biomediche - DSB	431	CITTADELLA UNIVERSITARIA	via Ugo Bassi, 58/B 35131 Padova
Dipartimento di Psicologia dello Sviluppo e della Socializzazione - DPSS	2467	CITTADELLA UNIVERSITARIA	via Venezia 8, 35131 Padova
Dipartimento di Psicologia Generale - DPG	1808	CITTADELLA UNIVERSITARIA	via Venezia 8, 35131 Padova
Dipartimento di Medicina Molecolare - DMM	148	OSPEDALE	via Gabelli 63, 35121 Padova
Dipartimento di Scienze cardiologiche, toraciche e vascolari	85	OSPEDALE	via Giustiniani 2, 35128 Padova
Dipartimento di Matematica "Tullio Levi-Civita" - DM	1517	OSPEDALE	via Giustiniani 2, 35128 Padova
Dipartimento di Medicina - DIMED	3521	OSPEDALE	via Giustiniani 2, 35128 Padova
Dipartimento di Neuroscienze - DNS	523	OSPEDALE	via Giustiniani 2, 35128 Padova
Dipartimento di Salute della Donna e del Bambino - SDB	80	OSPEDALE	via Giustiniani 3, 35128 Padova

2.3 STUDENTS FLOW: THE ALLOCATION OF STUDENTS RESIDENCES OVER THE YEARS

Another side of the relationship between the university of Padua and its city, can be examined by measuring the flow of students. This can be done by verifying the evolution of the processes of student mobility in the Veneto-Northeast area focusing on the student populations in the period between 1977-2004 (Carbone, 2011).

In the '70, the University of Padua was the point of reference for the education system in the Northeast of Italy, both in terms of the number of faculties activated and the number of students. The students came from:

- on west side from Lombardia, mainly from Milano;
- on est side from Treviso, Venezia and even Udine;
- on the north from Trent;
- on the south from Este and Monselice.

In reality, the force of attraction extended throughout the country, reaching the heel of peninsula: Leuca.

The university population was purely urban, and students moved their domicile to the main city in Veneto.

In the '80, there was an increase of the students from the belts of central municipalities, and then see the belts welded into a diffuse university.

The process first sees the density of students grow in the most densely populated municipalities, then, with a phenomenon of contagion, the first and second belts of these municipalities are melted to create a metropolitan welding, with no distinction between city and country, urban and rural territory.

Densification processes were taking place in central Veneto area with an increase in the intensity of commuter flows towards Padua.

This process led to an increase in the population of suburban and belt municipalities, to the detriment of urban populations of the city of Padua.

Specifically, the students from the Veneto region increased from 40,781 to 59,178 (from 66.99% to 81.65% of the total). In 2007, only slightly more than 18% of students came from other regions, as opposed to the previous 33%. These changes can be observed in Figure 5.

Figure 5: Changes in students origin
Source: Carbone, 2011, pages 73/74
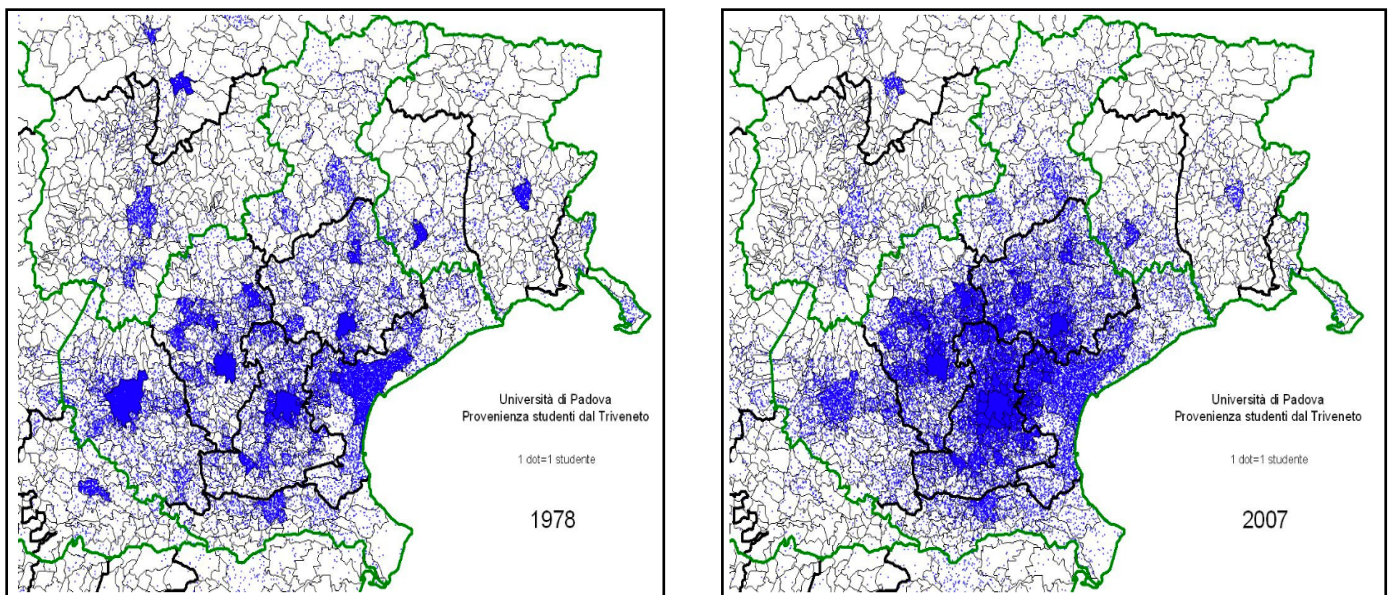
Students coming from the AMU (University Metropolitan Area, understood as that area within 80 minutes travel time from the center of Padua by public transportation, obviously excluding the municipal area of Padua), increased from 19,718 to 36,946 units (from 34.71 to 50.98%), and including the municipality of Padua from 27,652 to 44,848 units (from 45.43 to 61.88%).

The majority of students come from the west area - cities of Rubano, Selvazzano and Abano- and from the south area - cities of Albignasegno, Ponte San Nicolò. In Figure 6 it is possible to

observe that from 1977 to 2007 there were an increase in the number of students residing in the AMU of Padua.

Figure 6: changes in students residences in AMU of Padua

Source: Carbone, 2011, page 77
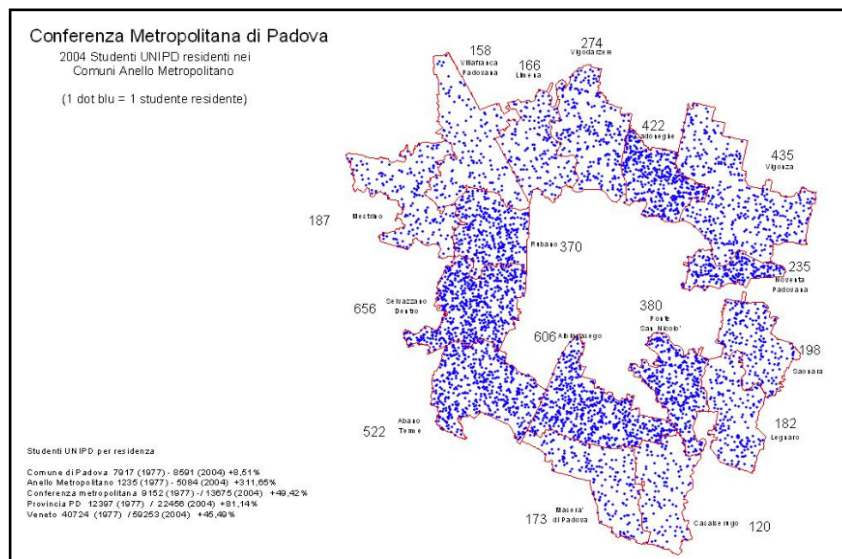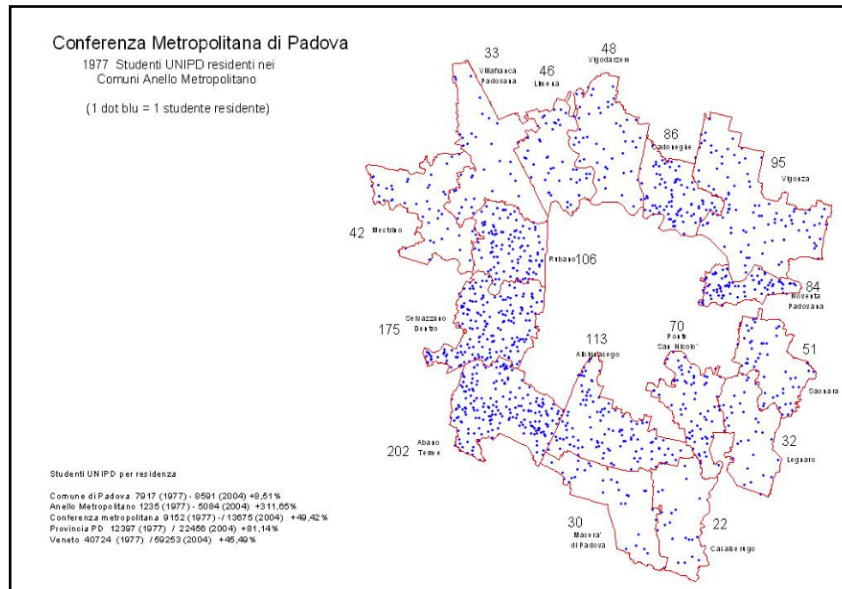
Ultimately, the University of Padua has lost its national vocation (in 2007, 87% came from the Triveneto area and about 81% from the Veneto region, compared with the previous 77% and 67% in 1978) and regional because, although the number of students from the Veneto region has increased, they are concentrated in the province of Padua (30%), Vicenza (14.8%) and Treviso (13.2%).

The majority of students are represented by the commuter and low-cost student (low-cost for the university, who travels by using local transportation, who does not need housing nor dining

facilities; we also use low-cost because maintenance costs are limited to local transportation and university fees).

This has not created new city students but new metropolitan students.

Thus, the university tries to privilege this type of student with policies and conventions aimed at drastically decreasing the costs of mobility and progressively expanding the educational offer. This is done by creating small and medium-sized branches of the university in nearby cities.

Today, therefore, the universities choose where to locate their branches or main offices on the basis of the services offered by the local authorities.

This leads to obtaining new local pools of sedentary or commuting students.

Therefore, it is inevitable that the factors which families take into account when deciding their children's academic future is the cost of living and housing prices in a city. In essence, individuals tend to favor universities which are closer to home and offer low cost communiting.

This can be summarized in the following sentence: the University of Padua has been transformed during the years from a national hub to a regional hub, then to a metropolitan university hub.

CHAPTER 3. EMPIRICAL ANALYSIS

In this last chapter we will analyze the impact that the presence of students has on the local real estate market, with particular reference to the price dynamics of the properties and the volume of commercial transactions using the data of the Patavine market from 2015 to 2020.

The analysis will be particularly useful in understanding whether the presence of the University stimulates the demand for urban land, and at the same time, if other urban amenities do influence the price dynamics for houses, offices and stores within the city of Padua.

3.1 Data

All the data used in the model came from three major sources: the Italian Tax Agency (*Agenzia delle Entrate*), the University of Padua (*Università degli Studi di Padova*), and the municipality of Padua (*Comune di Padova*).

3.1.1 Real estate markets data

The *Osservatorio del Mercato Immobiliare* (OMI) collects and processes the information on real estate values and for the rental market.

Among its activities there are also the analysis, research, development and experimentation of theoretical, applicative and innovative profiles in institutional matters, with specific reference to the definition of real estate values.

The Observatory's database is an important source of information on the national real estate market. It is a useful tool for all market operators, researchers and scholars in the real estate sector, for public and private research institutes, for the public administration and, more generally, for individual citizens.

Every year OMI produces reports, sector studies, editorial products and databases.

For the purpose of this chapter analysis, we used the following sources:

- the database of real estate values that provides the quotations of property values and rents throughout the country every six months;
- volumes of real estate purchases and sales that report data on the purchase and sale of real estate in the residential and non-residential sectors, provided at a national level with provincial and municipal details.

The semi-annual real estate values identify for each delimited homogeneous territorial zone (OMI zone) of each municipality a minimum/maximum range per unit of surface area in euros per square meter, of market and rental values, by property type and state of preservation.

The minimum and maximum values represent normality and, therefore, quotations for properties of particular value or decay. or which present characteristics that are not ordinary for the type of building in the area to which they belong, are not included.

In Figure 1, it is possible to identify the different OMI zones in Padua. The blue ones are the more expensive and the white ones are the less expensive.

Figure 1: OMI areas in Padua

Source: Marcato, 2016
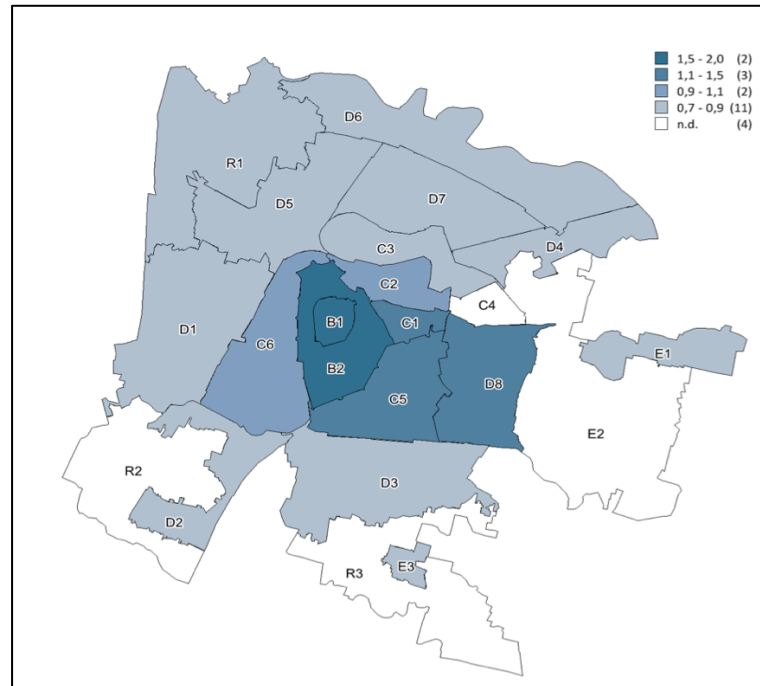
The data used for the calculations are the data of the city of Padua between the first semester of 2014 to the second semester of 2020.

For each OMI zone of Padua (22 zones in total), we extracted the data for the residential, commercial and service sector. For the first sector we selected only the data of private homes in normal state of conservation; for the second sector we selected only the data of stores in normal state of conservation; and for the latter we selected only the data of offices in normal state of conservation.

In Table 1, it is possible to see all the data regarding one single OMI zone, in this case B1. It is possible to see the data for the time period 2014-2019, for the three sectors already mentioned, and for each it is possible to determine the minimum and the maximum market value, the minimum and the maximum rental value and lastly the average of each.

The average values have been calculated since they are not provided by OMI database.

The market value is expressed in Euro/m^2 referred to the surface area; the rental value is expressed in Euro/m^2 per month referred to the surface area.

Table 1: Value of properties located in B1 zone – Padua

Source: Author's elaboration

	Comune_descrizione	Zona	Descr_Tipologia	Compr_min	Compr_max	Loc_min	Loc_max	MEDIA compr	MEDIA loc
2015	PADOVA	B1	Abitazioni civili	2550	3700	8,3	13	3125	10,65
2015	PADOVA	B1	Negozi	2300	3900	11,5	25	3100	18,25
2015	PADOVA	B1	Uffici	2100	2800	8,8	10,4	2450	9,6
2016	PADOVA	B1	Abitazioni civili	2500	3600	8	11,5	3050	9,75
2016	PADOVA	B1	Negozi	2300	3900	11	25	3100	18
2016	PADOVA	B1	Uffici	1900	2600	7	10	2250	8,5
2017	PADOVA	B1	Abitazioni civili	2500	3600	7,8	11	3050	9,4
2017	PADOVA	B1	Negozi	2300	3900	10,8	23	3100	16,9
2017	PADOVA	B1	Uffici	1900	2600	7	10,5	2250	8,75
2018	PADOVA	B1	Abitazioni civili	2400	3600	7,5	11	3000	9,25
2018	PADOVA	B1	Negozi	2300	3900	10,8	22	3100	16,4
2018	PADOVA	B1	Uffici	1800	2600	7	10,5	2200	8,75
2019	PADOVA	B1	Abitazioni civili	2400	3500	7,5	11	2950	9,25
2019	PADOVA	B1	Negozi	2300	3900	10,8	22	3100	16,4
2019	PADOVA	B1	Uffici	1800	2600	7	10,5	2200	8,75

The *Agenzia delle Entrate* makes available data on property sales in the residential sector (RE - homes) and non-residential sector (TCO - tertiary-commercial, productive, agricultural and other properties) in terms of Number of Normalized Transactions (NTN).

We used the data on TNT for the city of Padua only, both aggregate and divided per OMI zone, and we used the average value for both the residential and the non-residential sector, without considering the different dimensions in m^2 of each property.

In Table 2, it possible to see all the data of NTN regarding one single OMI zone, in this case B1.

Table 2: TNT data for in B1 zone – Padua

Source: Author's elaboration

B1	RES	TCO
2014	72,53	46,25
2015	81,5	39,5
2016	88,91	42,75
2017	124,41	40,57
2018	115,85	33,32
2019	113,93	35,83

3.1.2 University of Padua

In the online portal of the University of Padua there is a section named "athenaeum governance and locations", in this page we can find "*università in cifre*" and "*sedi e strutture*" that are the two sources of all the data regarding the University that we used in the model.

Firstly, in "*università in cifre*" is possible to browse the main statistical data of the University itself. Specifically, a web page, called Statistical Data, collects all the data about students, professors and technical-administrative staff from the academic year 2000/2001 to 2018/2019. For our analysis we used the data about students enrolled in the first year of the course (*Immatricolati*), students enrolled in one of the years of the course (*Iscritti*) and students who graduated (*Laureati*) from 2013/2014 to 2018/2019.

For each group, it is possible to find in the database about faculty, course of study, gender, age, high school grade, province of residence, citizenship. The only data used for the purpose of this study are the data regarding the faculty and the specific course of study of each student in order to localizes students in the city of Padua or in other cities nearby – where we can find decentralized courses - and even localize the students within the city of Padua in the different OMI zones.

Secondly, in "*sedi e strutture*" we found data on the locations of different university seats.

There are data about all the buildings in which the University has its facilities, including the faculties, the classrooms, the libraries, and the administration offices.

For our purposes, we consider the location of the following structures:

- the classrooms of each faculty;
- the study rooms;
- the libraries;
- the university study centers;
- the university student houses.

Once collected the address of the these facilities, we distinguish among those located within the city of Padua and those located in the cities nearby. The University of Padua has developed a widespread presence on the territory: there are many research and study sites located throughout the region, with entire degree courses decentralized in cities like Rovigo, Treviso, Venice, and Vicenza.

3.1.3 City of Padua Website

On the website of the city of Padua, we found all the data regarding the urban amenities. Padovanet.it is the website created by the city administration to provide all the information to the citizens about the organization of the city itself. The main subjects presented in the website concern:

- city government;
- environment and territory;
- culture and tourism;
- family, social welfare and sport;
- education and employment;
- security and law enforcement;
- taxation.

From each category, we have retrieved the data about the address of each building and thus we are able to assign them to a specific OMI area. More in detail, the data concern the following amenities and infrastructures:

- from the 'environment and territory' section, we have found data on the number of parking and green areas;
- from the 'culture and tourism' section, we have gathered data on the number of public libraries and on the most relevant museums and monuments of the city, such as churches, cinemas, and theaters;
- from the 'security and law enforcement' page, we have taken data on the locations of the stations of *carabinieri*, urban police, national police, urban defense.

To this, we have added the location of the rail station, and of the main city hospital.

3.2 VARIABLES

3.2.1 Dependent variable

The dependent variable is the real estate value and rent in the municipality of Padua between 2015 and 2020. Yearly data on real estate prices and rents re computed as the average across the two semesters. The following is the list of all the dependent variables that we consider in the econometric analysis.

P_{HOUSE} This variable indicates the average market value €/m² for housing properties. The value is the average between the maximum and the minimum value provided by OMI database. The properties considered are the ones in a normal state of conservation.

P_{COMM} This variable indicates the average market value €/m² for commercial activities, like stores and shops. The value is the average between the maximum and the minimum value provided by OMI database. The properties considered are the ones in a normal state of conservation.

P_{OFFICE} This variable indicates the average market value €/m² for offices and tertiary activities. The value is the average between the maximum and the minimum value provided by OMI database. The properties considered are the one in a normal state of conservation.

R_{HOUSE} This variable indicates the rental value expressed in Euro/m² per month referred to the surface area for housing properties. The value is the average between the maximum value and the minimum value offered by OMI database. The properties considered are the ones in a normal state of conservation.

R_{COMM} This variable indicates the rental value expressed in €/m² per month referred to the surface area for stores and retailers. The value is the average between the maximum value and the minimum value offered by OMI database. The properties considered are the ones in a normal state of conservation.

R_{OFFICE} This variable indicates the rental value expressed in €/m² per month referred to the surface area for offices. The value is the average between the maximum value and the minimum value offered by OMI database. The properties considered are the ones in a normal state of conservation.

TNT_RES   Sum of real estate units bought and sold "normalized" with respect to the transferred share of residential properties.[10]

TNT_TCO   Sum of real estate units bought and sold "normalized" with respect to the share transferred for tertiary-commercial properties, including stores and private offices.

3.2.2 Explanatory variables

The second group of variables refers to the data on students flows over the years, from 2014 to 2019. For each variable we defined two other variables: the second group of three variable differs in that the data are not divided in OMI zones, meaning that the total of the students enrolled in each year represents the data of every OMI zone in that specific year; the third group of three variables differs in that we consider B1 zone and B2 zone as one single zone. All the data from zone C1 to R1 do not change, the only data which change are the one in B1. Considering that in zone B1 no faculty has its building, we duplicate the data of zone B2.

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[10] Normalized means that if a real estate unit property is bought and sold as a share, for example 50% of the property, it is not counted as one unit (1 TNT), but as 0.5 NTN.

Students enrolled   Students enrolled in UNIPD for courses in the city of Padua only, broken down by OMI zone. This variable has been calculated by the data on the University website considering the number of students each year in each study course.

We subtracted all the students that are not studying in the city of Padua (but in the subsidiaries in the nearby city) from the data of each faculty. In Table A1, which can be found in the appendix, there will be a list of all the courses which are not taught in the city of Padua.

As for the students that are studying within the city of Padua, based on the address of the headquarters, we divided the courses in the different OMI zones. In Table 3, we listed all the courses taught in Padua divided in OMI zones.

In Table 4 instead we can see all the data for the enrolled students: in the first table we count the total enrolled, in the second one we subtracted the students enrolled in courses which are not taught in Padua and in the third we divided the students enrolled for the courses in Padua in the different OMI zones.

Table 4: Data on students enrolled

Source: Author's elaboration

ISCRITTI TOTALI							
	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018	2018/2019
Economia e Scienze politiche	5633	5476	5452	5386	5317	5419	5595
Giurisprudenza	4301	4120	3829	3651	3495	3331	3217
Ingegneria	10849	11090	11484	11836	12005	12789	13289
Medicina e Chirurgia	9087	9159	9258	9236	8901	8813	8661
Psicologia	5829	5720	5692	5670	5578	5586	5539
Scienze	5929	6141	6134	6498	6550	6575	6877
Scienze Umane, Sociali e del Patrimonio Culturale	12309	12115	11900	11952	17783	11673	11732
TOT	58037	57745	57646	58136	57272	57914	58625

ISCRITTI SOLO UNIPD							
	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018	2018/2019
Economia e Scienze politiche	5295	5202	5452	4955	4892	5094	5315
Giurisprudenza	3226	3255	2987	2848	2761	2598	2348
Ingegneria	8788	9205	9991	9232	9484	10359	10233
Medicina e Chirurgia	4544	5221	6203	5080	5252	4935	4677
Psicologia	5829	5720	5692	5670	5578	5586	6877
Scienze	5929	6141	6134	6498	6550	6575	11732
Scienze Umane, Sociali e del Patrimonio Culturale	12309	12115	11900	11952	16894	10973	10911
TOT	45919	46858	48359	46235	51410	46120	52093

ISCRITTI SOLO PD DIVISI							
ZONA	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018	2018/2019
B2	15153	15463	15958	14333	13881	13375	16149
C1	20204	20618	25147	20343	24163	21215	23441
C2	10561	10777	7254	11559	13367	11530	12502
TOT	45919	46858	48359	46235	51410	46120	52092

Economia e scienze politiche:

economia	C2
scienze politiche	B2
scienze politiche relazioni internazionali diritti umar	B2
servizio sociale	B2

Giurisprudenza:

consulente del lavoro	B2
diritto e tecnologia	B2

Ingegneria:

Aerospaziale	C1
biomedica	C1
chimica e dei materiali	C1
civile	C1
dell'energia	C1
dell'informazione	C1
elettronica	C1
informatica	C1
meccanica	C1
per l'ambiente e il territorio	C1
gestione dell'edilizia e territorio	C1

medicina e chirurgia:

dietistica	C1
fisioterapia	C1
infermieristica	C1
logopedia	C1
ortottica e assistenza oftalmologica	C1
ostetricia	C1
scienze farmaceutiche applicate	C1
scienze motorie	C2
tecniche audioprotesiche	C1
tecnica prevenzione ambiente e lavor	C1
tecniche di laboratorio biomedico	C1
tecniche di neurofisiopatologia	C1
tecniche di radiologia media e radioter	C1
terapia della neuro e psicomotricità	C1

psicologia:

psychological science	C2
scienze e tecniche psicologiche	C2
scienze psicologiche cognitive e psic	C2
scienze psico sviluppo, personalità,.	C2
scienze psico sociali e del lavoro	C2

scienze:

astronomia	C1
biologia	C2
biologia molecolare	C2
biotecnologie	C2
chimica	C1
chimica industriale	C1
fisica	C1
informatica	C1
matematica	C2
ottica e optometria	C1
scienze dei materiali	C1
scienze e tecnologie per ambiente	C1
scienze geologiche	C1
scienze naturali	C2
scienze per economia e impresa	C1
statistica per le tecnologie e scienze	C1

scienze umane, sociali, patrim cultur

archeologia	B2
comunicazione	B2
arti, musica e spettacolo	B2
filosofia	B2
lettere	B2
lingue, letterature e mediazione cultu	B2
progettazione e gestione turismo cult	B2
scienze educazione e formazione	C2
scienze sociologiche	C2
storia	B2
storia e tutela dei beni artistici e music	B2

The last two tables concerning the courses outside the city of Padua and the addresses required to allocate the university seats in the OMI areas are kept constants for all the variables regarding the students' values in the following variables.

Table 5 shows the shares of students enrolled in courses provided in the city of Padua by academic discipline and year. For example, in 2018/19, 73% of students enrolled in the Faculty of Law are supposed to attend courses provided in the city of Padua, the rest being provided in other cities, like Rovigo.

Table 5: percentage of students studying in the city of Padua

Source: Author's elaboration

	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018	2018/2019
Economia e Scienze politiche	94%	95%	100%	92%	92%	94%	95%
Giurisprudenza	75%	79%	78%	78%	79%	78%	73%
Ingegneria	81%	83%	87%	78%	79%	81%	77%
Medicina e Chirurgia	50%	57%	67%	55%	59%	56%	54%
Psicologia	100%	100%	100%	100%	100%	100%	100%
Scienze	100%	100%	100%	100%	100%	100%	100%
Scienze Umane, Sociali e del Patrimonio Culturale	100%	100%	100%	93%	95%	94%	93%

Table 6, instead, shows how enrolled students are distributed across OMI areas. These percentages are computed distributing the annual number of enrolled students to academic courses (or academic subjects) and using the headquarter address of these latter to assign courses to OMI areas.

Table 6: percentage of students divided in OMI zones

Source: Author's elaboration

%	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018	2018/2019
B2	33%	33%	33%	31%	27%	29%	31%
C1	44%	44%	52%	44%	47%	46%	45%
C2	23%	23%	15%	25%	26%	25%	24%

Net enrollment   This variable is the difference between the annual number students enrolled in UNIPD, in courses provided only in the city of Padua and by OMI zone, and the number of students graduated in each academic course. This variable has been calculated from the data on the University website considering the annual number of students in each course. Table 7 shows the distribution of net enrolled students by OMI area. We further merge OMI are B1 into B2 and consider them as a single area of the city.

Table 7: distribution of net enrollment by OMI area

Source: Author's elaboration

ISCRITTI NETTI PD						
ZONA	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018	2018/2019
B2	12266	12929	11248	11101	10414	12787
C1	16356	20373	15965	19323	16520	18561
C2	8549	5877	9071	10689	8978	9899
TOT	37171	39178	46235	41113	35912	41247

After having discussed the three main variables, we will now focus on the variable that best represents the real flow of students for the city of Padua.

It is worth stressing that *net enrollment* does not capture the demand of housing from the students enrolled in the University of Padua; rather it is a proxy of the demand of public land from the students. This is because the central zones B1/B2 are also the zone in which there is a massive presence of university building and thus these areas have a gravitation power towards students. Of course, the massive presence of students also enables the proliferations of services and students' facilities.

Amenities. We now turn to the variables measuring the stock of amenities in the city. As emphasized by Glaeser et al. (2000), cultural and entertainment facilities, transport infrastructures, civic buildings, and many other elements constituting the urban shape, are relevant to influence the value of houses, shops, and offices in the city.

Churces.   The variable indicates the number of the most famous churches in the city of Padua divided by OMI zone. The main churches which are taken into account are the following: *Cappella Scrovegni, Basilica Sant'Antonio, Chiesa Santa Sofia, Battistero del Duomo, Chiesa Eremitani, Basilica Santa Giustina, Oratorio San Giovanni, Chiesa Santa Maria dei Servi, Cattedrale Santa maria assunta, Parrocchia San Nicolo, Chiesa San Gaetano, Oratorio San Michele, Complesso San Francesco, Chiesa San Clemente, Chiesa Ognissanti, Santuario Arcella*.

Cinema and theaters.   The variable indicates the number of cinemas and theaters in the city of Padua divided by OMI zone, based on their locations. The theaters which are considered are the following: *Corde Palco, Teatro Popolare di Ricerca – CUT, Gran Teatro Geox, Teatro ai Colli, Terepia – Teatro di Figura, Tam – teatromusica, Teatro stabile del Veneto – teatro*

Verdi, teatro Barbarigo, Teatro Torresino, Barco Teatro, Teatro Pirata, Teatro Excelsior, Teatrocontinuo piccola Soc.Coop.A.RL. The cinema included are the following: *Cinema Esperia Padova, Multiastra, Cinema Garden Barbarigo, LUX Padova, Cinema Porto Astra, Cinema Rex Padova, Cinema Don Bosco, River Festival Padova, Circolo* The Last Tycoon.

Museums. The variable indicates the most important museums in the city of Padua divided by OMI zone. The museum which are considered are the following: *Museo delle Associazioni d'arma coordinate da Assoarma Padova, Museo della Terza Armata, Museo del Precinema, palazzo Zuckermann, Museo Diocesano, Musei civici agli Eremitani, Museo delle Macchine Enrico Bernardi, Museo di Antropologia, Orto Botanico, Museo di Anatomia Patologica, MUSME.*

Cultural centers. The variable indicates the most important cultural centers in the city of Padua divided in OMI zones based on their locations. The list of the centers can be found on the website of the city of Padua. Among them are: Centro Culturale Altimate/San Gaetano, Lanterna Magica circ. Culturale, Carichi Sospesi, Centro Tara Cittamani, Associazione Fantalica.

Police station. *Police station.* The variable indicates the number of local police, national police, Carabinieri, Financial Guard stations in Padua, by OMI zone. They are used as an element that can increase the average safety of the area.

City Hospital. This variable indicates the hospital of Padua, which is located in C1 zone – *Portello.*

Railway station. This variable indicates the railway station of Padua, which is located in C2 zone – *Stazione, Scrovegni, C.so del Popolo, Fiera, Cittadella.*

Students houses. This variable considered all the accommodations for students offered by the University of Padua, which were divided in OMI zone based on their location. Students can find accommodation in university residences, which may be private or provided by ESU (the regional agency for the right to university study) or in private colleges. All the data can be found on the website of the University. The ESU residences and housing which are considered are *Carli, Colombo, Copernico, Nievo, Agripolis, Gallileo Galieli, Goito.*

The private residences are the following: *Camplus, Collego Bottani, Collegio Marianum, CUAMM, IRPEA, Residenza Forcellini, Residenza Murialdo, Sorelle della Misericordia.*

Parking This variable includes all the parking spaces in the city of Padua which are divided by OMI zones. The information can be found on the website of the city of Padua. We considered both parking spaces along the streets and multi-storey car parks. Furthermore, park-and-drive slots were also considered. It is possible to download a map of the city with the

location of each park, the available slots and the fees[11]. The total number of parking spaces is 72, the majority of them is subject to an hourly fee but some spaces are free.

Green Areas. This variable indicates all the public gardens in the Municipality of Padua, which by OMI zone. The list also includes playgrounds, non-equipped green areas and fitness trails. On the website of the city of Padua it is possible to see more details for each area: the name of the area, the type of structure (playground, historical garden, areas for children, fitness trails) and the size of the area.

Civil libraries. This variable indicates all the civil libraries in the city of Padua, which are divided by OMI zones based on their locations. The information about these libraries can be found both on the website of the university of Padua and on the website of the city of Padua. The libraries which we considered are: *Biblioteca civica - Centro Culturale Altinate/San Gaetano, Biblioteca Arcella – San Carlo, Biblioteca Brenta – Venezia, Biblioteca Forcellini – Camin, Biblioteca Bassanello – Voltabarozzo, Biblioteca Savonarola, Biblioteca Brentella, Biblioteca Valsugana.*

Table 8 shows all the urban amenities divided by OMI.

Table 8: Amenities in Padua divided by OMI zone

Source: Author's elaboration

AMENITIES												
zone	chiese	cinema_teatri	museo	centro_culturale	polizia	ospedale	stazione	studentati	parcheggi	aree_verdi	biblioteche_urbane	TOT_AMENITIES
B1	2	0	0	0	0	0	0	0	4	0	0	6
B2	10	13	5	11	4	0	0	5	32	14	1	90
C1	0	0	1	3	0	1	0	2	6	6	0	16
C2	2	1	3	0	4	0	1	6	20	7	0	37
C3	1	4	0	1	3	0	0	1	2	4	2	17
C5	0	2	0	1	1	0	0	1	4	11	1	20
C6	0	1	0	1	0	0	0	2	2	7	0	11
D1	0	2	0	0	0	0	0	0	2	13	1	18
D2	0	2	1	0	0	0	0	1	0	10	0	13
D3	0	2	0	0	0	0	0	0	3	10	1	16
D4	0	0	0	0	0	0	0	0	1	3	0	4
D5	0	2	0	0	0	0	0	0	2	9	1	14
D6	0	0	0	0	0	0	0	0	2	10	0	12
D7	0	0	0	1	0	0	0	0	0	20	0	21
D8	0	2	0	0	0	0	0	1	0	9	1	12
E1	0	0	0	0	0	0	0	0	0	2	0	2
E3	0	0	0	0	0	0	0	0	0	3	0	3
R1	0	0	0	0	0	0	0	0	0	0	0	0

Tramvia. This variable includes the number of stops that the tramway in the city of Padua does in each OMI zone. The tramway line was inaugurated in 2017 so in the years before this variable does not count. The information about the tramway of Padua – in particular, the tables
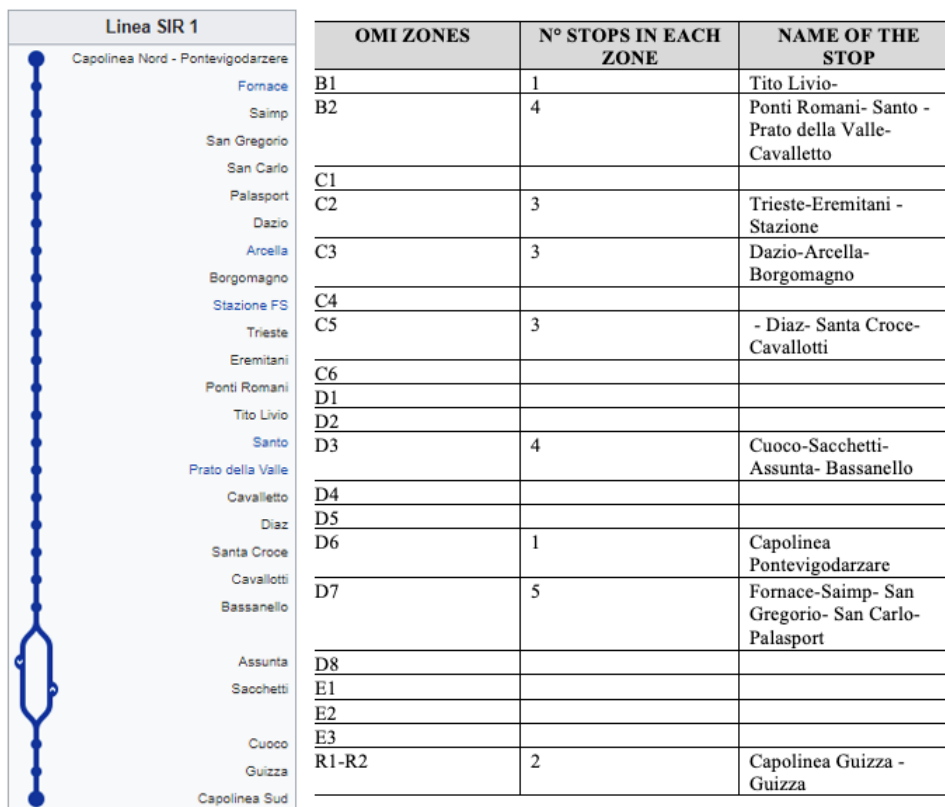
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[11] https://www.padovanet.it/sites/default/files/attachment/parking_map_Padova_14.12.2018.pdf

with hours and stops – can be found on the website of the city of Padua and on the website of BusItalia that is the service provider.

In Figure 2, you can see the path of the tramway and the different stops divided in OMI zones.

Figure 2: Tramway stops in Padua

Source: Author's elaboration

Linea SIR 1
Capolinea Nord - Pontevigodarzere
Fornace
Saimp
San Gregorio
San Carlo
Palasport
Dazio
Arcella
Borgomagno
Stazione FS
Trieste
Eremitani
Ponti Romani
Tito Livio
Santo
Prato della Valle
Cavalletto
Diaz
Santa Croce
Cavallotti
Bassanello
Assunta
Sacchetti
Cuoco
Guizza
Capolinea Sud

OMI ZONES	N° STOPS IN EACH ZONE	NAME OF THE STOP
B1	1	Tito Livio-
B2	4	Ponti Romani- Santo - Prato della Valle- Cavalletto
C1		
C2	3	Trieste-Eremitani - Stazione
C3	3	Dazio-Arcella- Borgomagno
C4		
C5	3	- Diaz- Santa Croce- Cavallotti
C6		
D1		
D2		
D3	4	Cuoco-Sacchetti- Assunta- Bassanello
D4		
D5		
D6	1	Capolinea Pontevigodarzare
D7	5	Fornace-Saimp- San Gregorio- San Carlo- Palasport
D8		
E1		
E2		
E3		
R1-R2	2	Capolinea Guizza - Guizza

Bus Lines   This variable includes the number of bus running lines in the city of Padua in each OMI zone. The information about the number of bus lines in the city of Padua – tables with hours and stops – can be found on the website of the city of Padua and on the website of BusItalia which is the service provider. In Table 9, there is the summary of all the lines in each OMI zone.

Table 9: Bus stops in each OMI zone

Source: Author's elaboration

OMI ZONE	N° RUNNING LINE
B1	8
B2	9
C1	6
C2	12
C3	4
C4	3
C5	4
C6	4
D1	3
D2	2
D3	6
D4	3
D5	3
D6	4
D7	3
D8	3
E1	1
E2	3
E3	2
R1-R2-R3	3+3+2

The last variables that we considered were about the university buildings and settlements. As it is possible to understand, the presence of this type of amenities is strictly correlated with the students' flow. Considering that the students' flow changes over the years, instead the presence of this building is stable over the year, we decided to do not include these variables in the model. Anyway, just to give an idea of the location of the university settlements, we include in Table 10 the count of all the University building divided by OMI zones.

Table 10: University buildings

Source: Author's elaboration

STRUTTURE UNIVERSITARIE					
zone	dipartimenti	biblioteche_ universitarie	aule_studio	centri_d'aten eo	TOT_UNI
B1	3	5	2	1	11
B2	11	18	10	6	45
C1	7	1	16	3	27
C2	6	0	1	5	12
C3	0	0	0	0	0
C5	0	0	0	0	0
C6	0	1	0	0	1
D1	0	0	0	0	0
D2	0	1	0	0	0
D3	0	1	0	0	0
D4	0	0	0	0	0
D5	0	0	0	0	0
D6	0	0	0	0	0
D7	0	0	0	0	0
D8	0	0	0	0	0
E1	0	0	0	0	0
E3	0	0	0	0	0
R1	0	0	0	0	0

3.3 DESCRIPTIVE EVIDENCE

In this section, we will analyze the trends of the variables previously described. We will put the attention on the variables concerning the pricing of the real estate market and the variables concerning the student flows. These variables are the only that change over time in the different OMI zones, whereas the amenities are time in-variant.

3.3.1 Real estate pricing variables

The variables that will be included in the analysis below are:

- P_{HOUSE}
- P_{COMM}
- P_{OFFICE}
- R_{HOUSE}
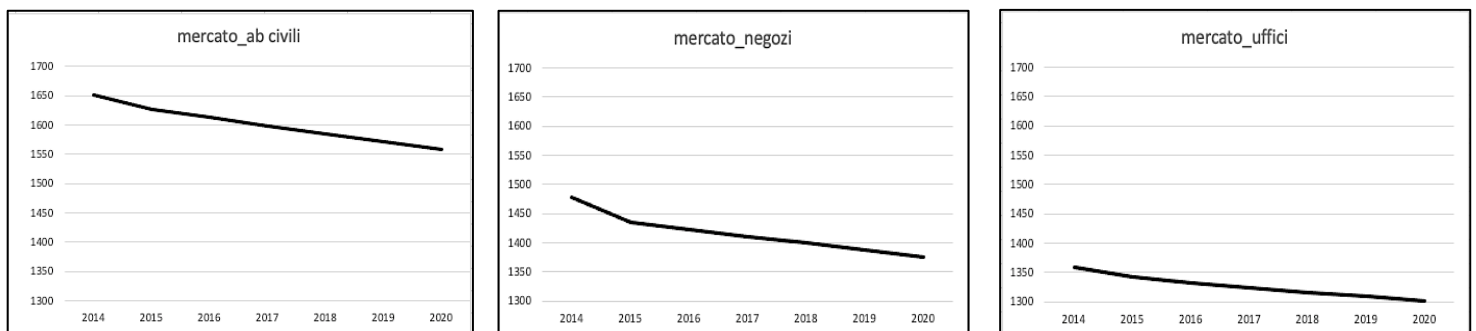- R_{COMM}
- R_{OFFICE}
- TNT_RES
- TNT_TCO

First, we will analyze the trends without splitting the data by OMI zone. We calculate the average of the data of each OMI zone for each year considered, from 2014 to 2020.

In Figure 3, we can see the trend of the variables P_{HOUSE}, P_{COMM}, P_{OFFICE} on an aggregate level from 2014 to 2020.

From the three graphs, it is possible to observe that there is a negative trend in the three variables. In the housing and commercial real estate markets, the average unit price decreased by €100 from 2014 to 2020, whereas in the office market the decrease is about €50. It Is also worth noting that the prices of housing are the highest and the prices for offices the lowest.

Figure 3: Market values of houses, stores and offices in Padua

Source: Author's elaboration

In Figure 4, we can see the trend of the variables R_{HOUSE}, R_{COMM}, R_{OFFICE} on an aggregate level from 2014 to 2020.

From the three graph is possible to see that there is a negative, but smooth, trend in the three rental markets from 2014 to 2020. In the housing and office market, the average rental price decreased slightly; in the store market the decrease is more evident. It is also possible to note that the rental price of a store is the highest and the rental price for houses is the lowest.

Figure 4: Rent values of houses, stores and offices in Padua
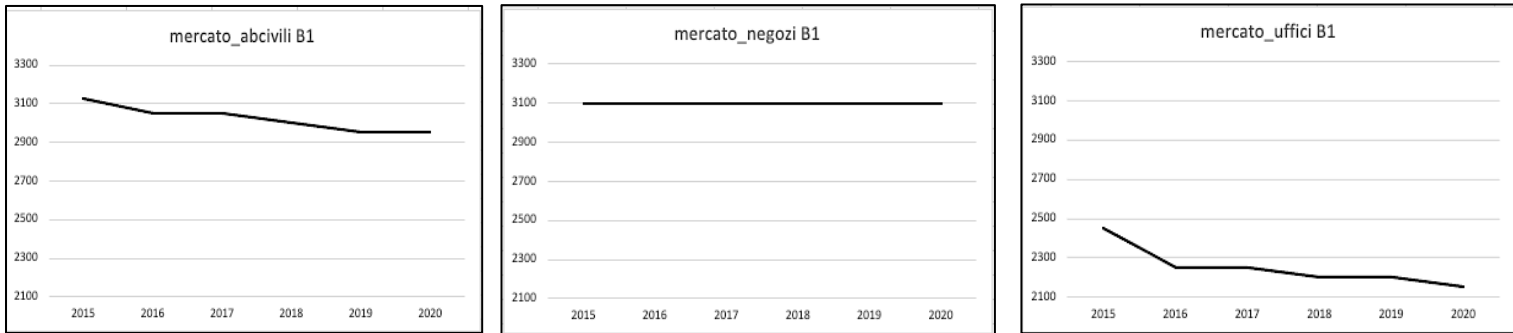
Source: Author's elaboration
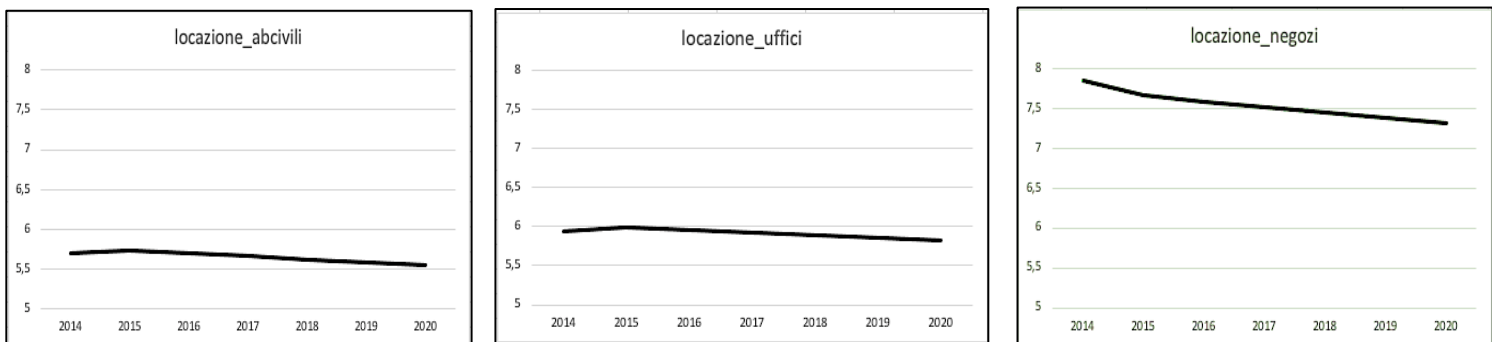
Bearing in mind that in Padua there are 22 OMI zones, it will be too long showing all the variables for all the zones. Rather, we will show the trends for one OMI zone in each of the following area of the city, i.e., central, semi-central, peripheral, and suburban. Since many real estate information in 2014 were missing, or zero in value, we have decided to begin our analysis from 2015.

In Figure 5, we can see the trend of the variables P_{HOUSE}, P_{COMM}, P_{OFFICE} for the central B1 zone (*Zona Centro, Riviere via XX Settembre*) from 2015 to 2020.

From the graphs it is possible to highlight that the market prices show a decreasing trend in both housing and offices markets, whereas the value is stable in the store market. The prices of housing and store markets are aligned, whereas the prices for the office are much lower. This can be because B1 zone is the historical center of the city, and thus the demand for offices is limited.

Figure 5: Market values of houses, stores, and offices in B1 zone

In Figure 6 we can see the trend of the variables R_{HOUSE}, R_{COMM}, R_{OFFICE} for the central B1 zone from 2015 to 2020.

As observed before the rental value of the three categories has a decreasing trend, thus is possible to highlight that the rental value for commercial activities is the highest. This is in line with the bid-rent theory: department stores and chains store are located in the inner center because they are willing to pay more for this location as they need a face-to-face interaction and thus, they are more accessible to a large population. The city center counts most of the human presence also due to the presence of other services in the food sector, for instance, thus this is the zone in which commercial activities can enjoy high visibility exposure.

Figure 6: Rent values of houses, stores and offices in B1 zone

Source: Author's elaboration
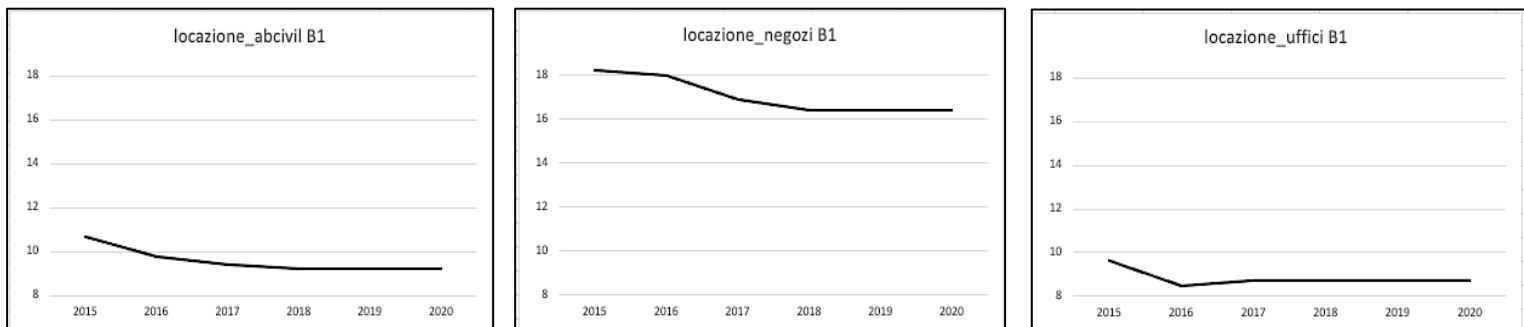
In Figure 7 we can see the trend of the variables P_{HOUSE}, P_{COMM}, P_{OFFICE} for the semi-central zone C1 zone (*Portello*) from 2015 to 2020.

From the graphs it is possible to highlight how the market prices have a decreasing trend in housing market, the value of commercial activities after an initial decrease remained constant, and lastly the value of office market after a stable trend gently decreases in 2019.

The prices of housing and stores offices are aligned in last years while the prices for the commercial market are much lower. This could be due to the fact that C1 zone is the zone in which there is a majority of university building, and thus in this zone the presence of stores is very limited. The market value of C1 zone is much lower than B1 zone and this is because of the difference between the inner-city center and the student areas.

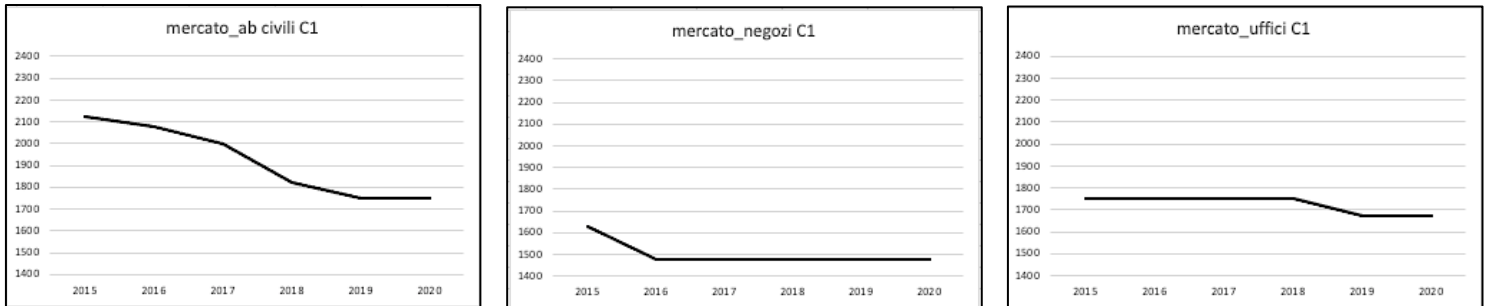Figure 7: Market values of houses, stores and offices in C1 zone

Source: Author's elaboration

In Figure 8, we can see the trend of the variables R_{HOUSE}, R_{COMM}, R_{OFFICE} for the semi-central zone C1 from 2015 to 2020.

As observed before the rental value of the three categories almost has a stable trend, but it is possible to highlight that the rental value for commercial activities is the highest. The rental price for commercial activities after a peak is stable to a higher level than other markets. This could be due to the fact that in this area the commercial activities are limited, and thus renting commercial spaces is preferred over buying commercial spaces.

Figure 8: Rent values of houses, stores and offices in C1 zone

Source: Author's elaboration
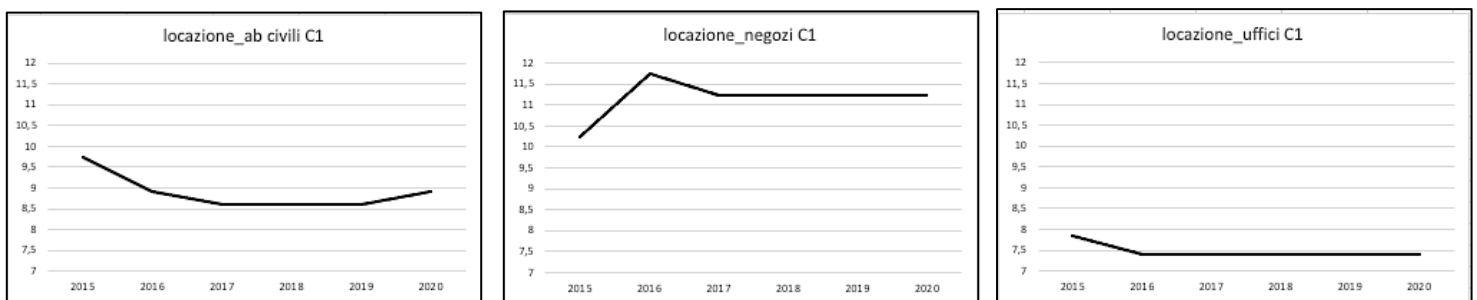
In Figure 9 we can see the trend of the variables P_{HOUSE}, P_{COMM}, P_{OFFICE} for the peripherical zone D7 (*Arcella Nord, Mortise*) from 2015 to 2020.

The housing market had a steadily decrease of €300, and the office market had a sudden decrease of about €200. The commercial market is the only that levelled off and its prices are

much higher than the ones of other categories. These decreasing trends could be due to criminal activities and the escalation of police interventions to contrast the drug problem. This area is not considered to be as safe as others thus in the last years the rent prices have decreased due to the increase of organized criminality in the area, and less people are willing to live in this area of Padua.

Figure 9: Market values of houses, stores and offices in D7 zone

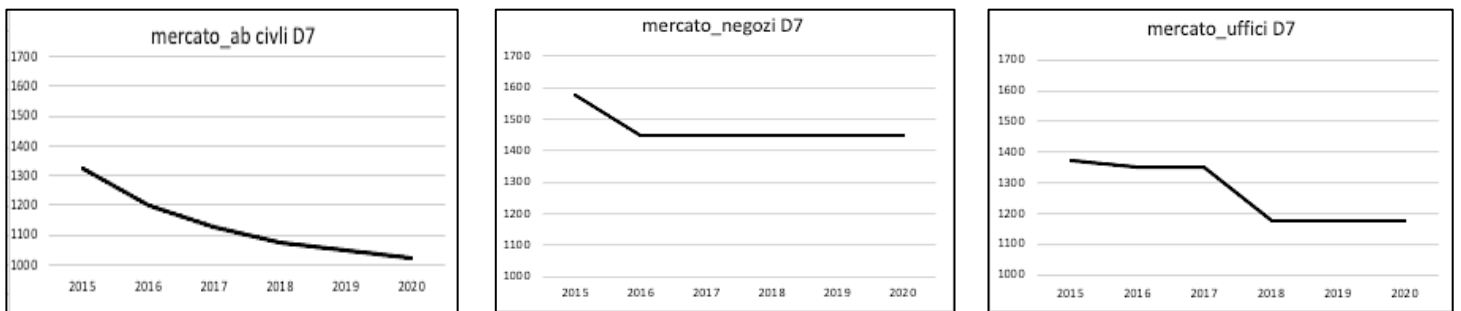Source: Author's elaboration

In Figure 10 we can see the trend of the variables R_{HOUSE}, R_{COMM}, R_{OFFICE} for the peripherical zone D7 (*Arcella Nord, Mortise*) from 2015 to 2020.

In all the markets the rental prices remained steady during the years, the prices for the commercial activities are the highest, on the contrary, the prices for the housing are the lowest. Although this area is not considered to be as safe as others, the rent prices remain constant mostly because of the presence of students, who decide to rent an apartment in this area due to budget constraints.

Figure 10: Rental values of houses, stores and offices in D7 zone

Source: Author's elaboration
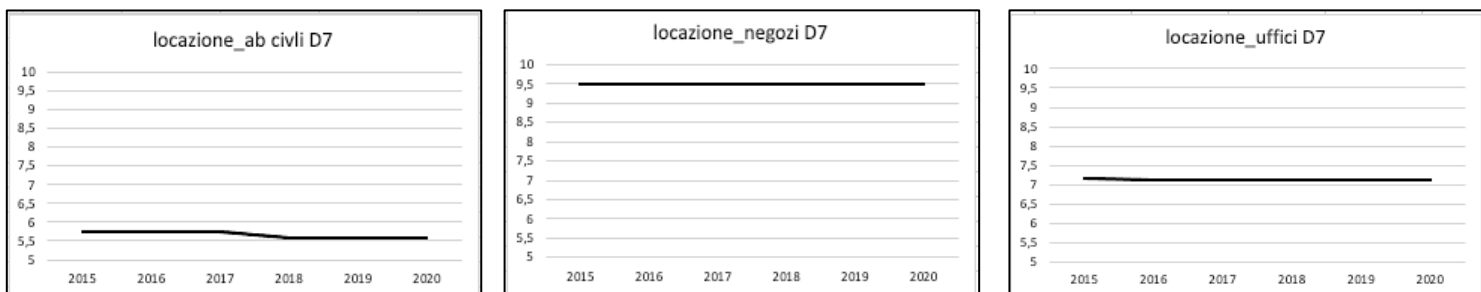
Lastly, in Figure 11 we can see the trend of the variables P_{HOUSE}, P_{COMM}, P_{OFFICE} for the suburban zone E1 (*Camin*) from 2015 to 2020, and in Figure 12 we see the trend of the variables R_{HOUSE}, R_{COMM}, R_{OFFICE}. As it can be easily observed, all the variables have a consistent trend except for the market value of housing. This area has experienced an intensification of vehicular transit,

becoming very busy and problematic from an environmental and livability point of view. Since 2000, the new residents are mainly foreign citizens. Due to the improvement of infrastructures, the market value and the rent value of commercial activity sector are higher: this type of businesses are willing to pay more because this location is easy to reach by car and because there are spaces both for parking and for big stores.

Figure 11: Market values of houses, stores and offices in E1 zone

Source: Author's elaboration
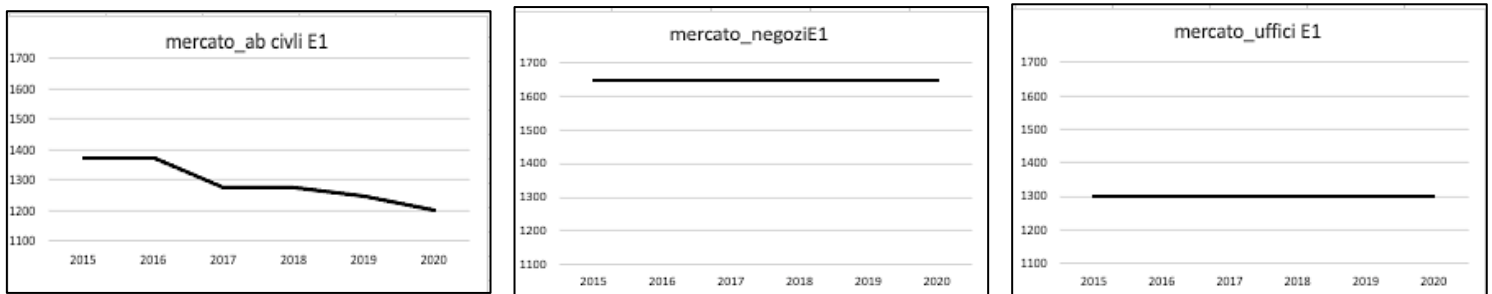
Figure 12: Market values of houses, stores and offices in E1 zone

Source: author's elaboration
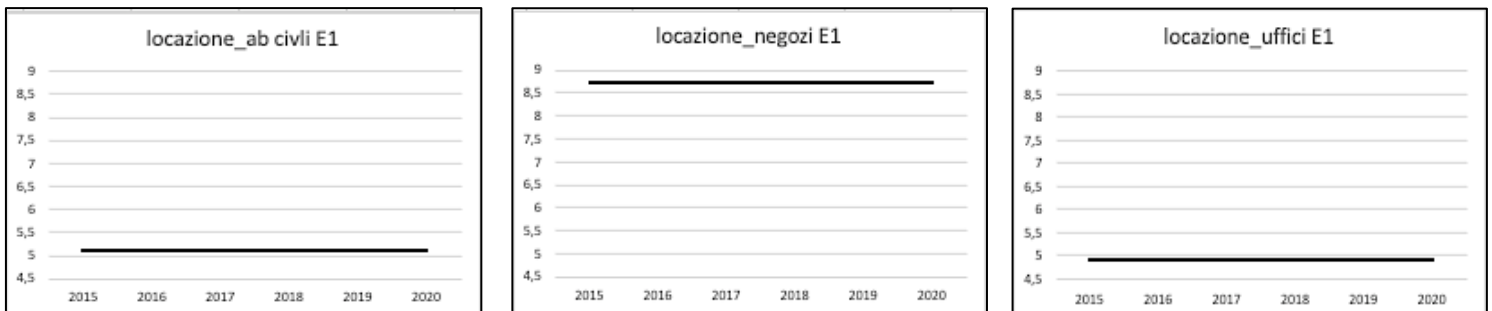
We will now present the data about TNT from 2014 to 2019 for the same OMI zones previously analyzed, and we will observe the trend of buying and selling volumes in different OMI zones. In Figure 13 it possible to see the trend both for the residential sector (RES) and services/commercial sector (TCO). In the first group we found the data about houses, in the second group instead we found data about stores and offices.

Although in the previous graphs we observed that the housing values are not always the highest, in the graph 13 it is possible to see that the housing market is the most dynamic in all the four areas observed: the number of TNT for residences are always better that TNT for commercial and tertiary sector, but also TNT for residences have an increasing trend in all the areas observed after 2016, and this is a signal of the recovery of the real estate sector after the economic crisis of 2007-2008. The major increase can be found in D7 zone (*Archella Nord, Mortise*), this could be due to the recent expansion of building constructions in that area. More precisely,

in the last years the municipality of Padua started to invest in this peripherical area: the project "Hub *Arcella* – Quality of Living, 2030" aims to move the center of gravity of the regeneration of the neighborhood towards the northern area of *Arcella*, where the most critical issues remain. The funds allocated aim to implement durable solutions for the regeneration of the socio-economic quality of live, the improvement of social cohesion, cultural enrichment, with a focus on innovation and sustainability.

Figure 13: TNT for B1, C1, D7 and E1 zones in Padua

Source: author's elaboration
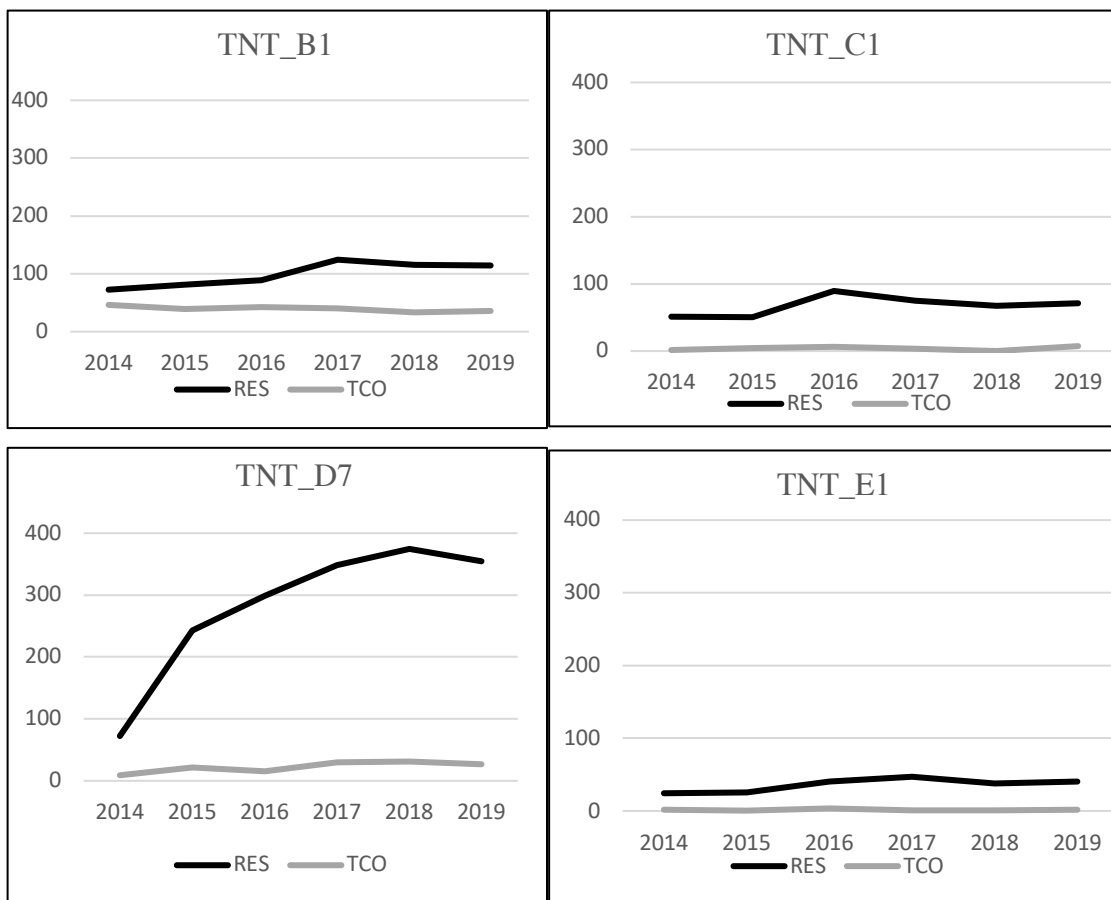
3.3.2 Students' flow variables

This section will show some graph regarding the variables related to the student flows in the city of Padua during the period 2014-2019.

Firstly, we will analyze the trends without dividing the data in the different OMI zones. We will calculate the average of the data of each OMI zone for each year considered from 2014 to 2020. After having done this, we will present the data for zone B2 (*Carmine, Savonarola, Riviere est, Porta San Giovanni, Città Giardino, Santa Giustiniana, Santo, Santa Sofia*), zone

C1 (*Portello*) and zone C2 (*Stazione, Scrovegni, C.so del Popolo, Fiera, Cittadella*), which are the zones in which all the university building are located.

On the aggregate level, as Figure 14 shows, the flow of students fluctuate over the years, still it is possible to observe a gently increase. The number of students enrolled, in first graph, counts most of the students: this is a gross variable that includes all the students enrolled in every year of study and without subtracting all the students that graduate that year. The last graph shows the number of students enrolled just in the first year of each study course: this means that on average each year the University of Padua count a surplus of 7.000 students.

Figure 14: total students' flow

Source: Author's elaboration
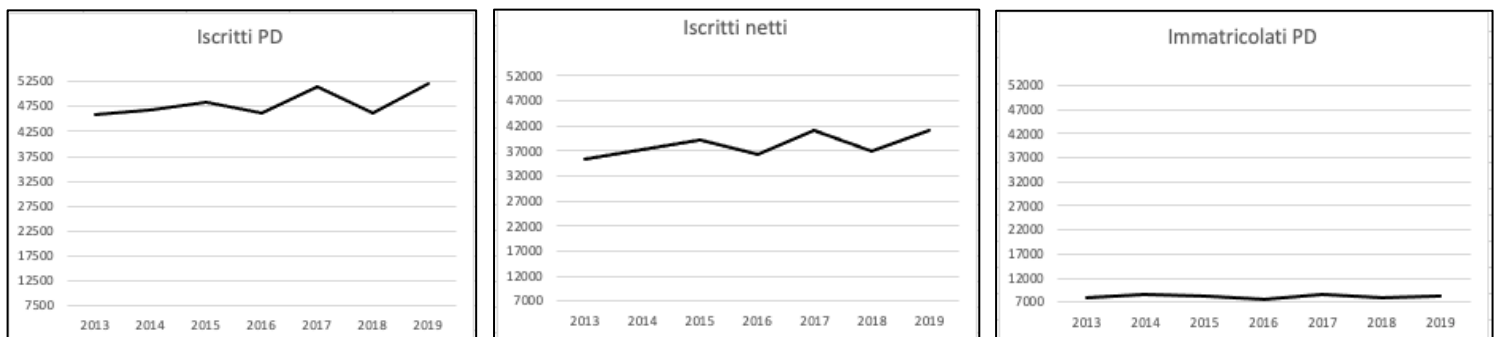
In Figure 15 we can observe the trends for B2 zone. As mentioned in chapter 2, in this zone we found the majority of humanistic and social-political departments. In Table 3 of this chapter, it is possible to learn about all the departments that have their headquarters in this zone, for example the Department of Law, History, Letters, Political Science.

In the graph it is possible to see that the number of students fluctuates. More specifically, after 2015 number of students plummeted and only in 2019 the students returned to the value pre-2015. As we can see from the third graph, each year the demand of land in B2 zone increases by 2.500 new enrolled students.

Figure 15: Students' flow in B2 zone

Source: Author's elaboration
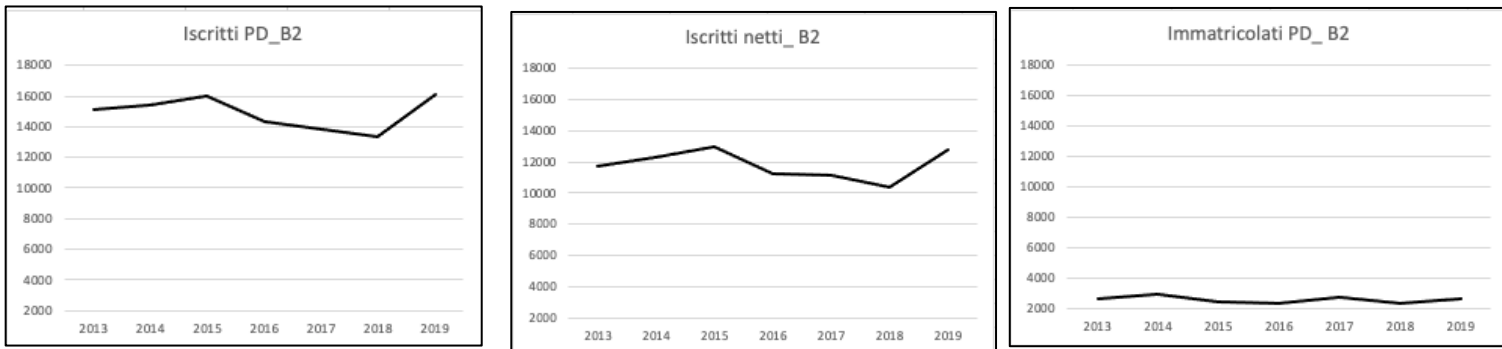
In Figure 16, it is possible to observe the student flows in C1 zone (*Portello*). This is the students zone par excellence. Here we found the majority of scientific departments, for example all the courses of engineering, chemistry and physics, and the medicine departments; this zone is also where we found the hospital.

If we compare this zone to B2 zone, we can observe a stable trend in the three variables but the number of students in this area exceed the number of students in the previous one. More precisely, in 2019 circa 3.800 new students enrolled in courses located in this zone.

Figure 16: Students' flow in C1 zone

Source: Author's elaboration
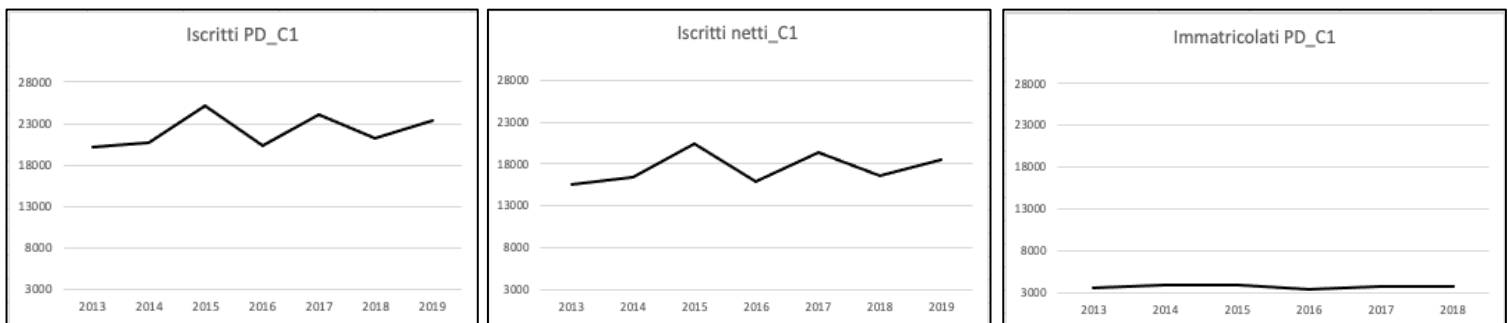
Finally, in Figure 17, we can evaluate the trend of student flows in C2 zone. In this zone we can find other scientific departments as mathematics, biology, economics and psychological sciences. This is the zone with less student population: in fact, the students in C2 zone are double the students in C1 zone. Still, it is possible to see an increasing trend in the number of students, the number of students bottomed out in 2015 and then peaked in 2017. In 2019 the students enrolled in course with headquarters in this zone were 12.500. The number of new students remained constant from 2014 to 2019, and each year about 2.000 new students were in this zone.

Figure 17: Students' flow in C2 zone

Source: author's elaboration
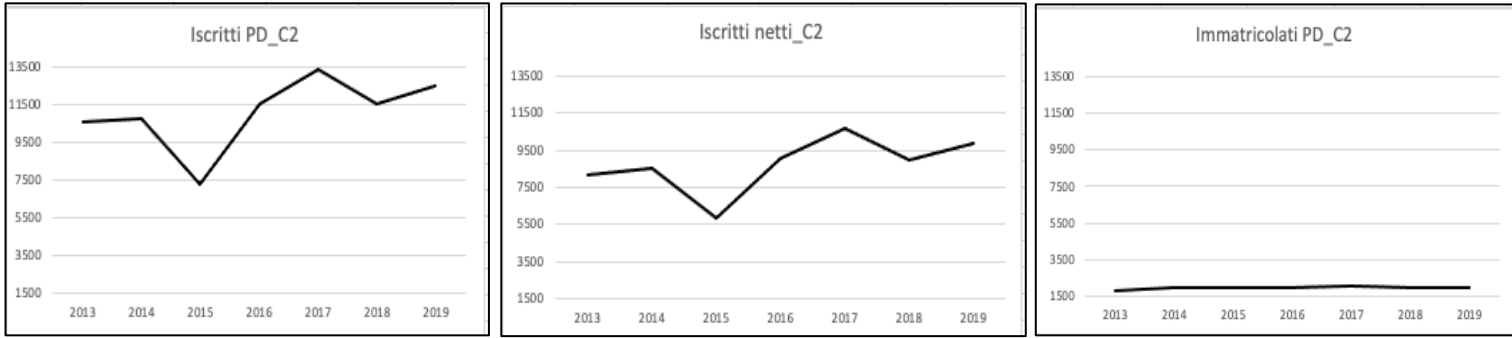
3.4 ECONOMETRIC STRATEGY AND RESULTS

We estimate the effects of students' presence on the real-estate market by running the following regression:

$$(1) \qquad P_{it} = \beta_1 STUD_{it-1} + (\mathbf{X}'_i \beta_X) + \mu_i + \theta_t + \varepsilon_{it}$$

where:
- P_{it} is the market value or rent value for housing, commercial activities and office in OMI zone i in year t;
- $STUD$ is the net enrollment, i.e. the number of students enrolled in the University of Padua once subtracted all the graduated students, distributed by OMI zone i;
- X is the vector of all the time-invariant variables, such as the urban amenities by OMI zone i;
- μ_i corresponds to the OMI (unobserved) fixed effects;
- θ_t are the year-specific fixed effects;
- ε is the stochastic error.

The study can be considered a panel study since that all the variables are panel data, involving measurements over time.

Since μ_i is unobserved, and potentially correlated with $STUD$, we estimate Equation 1 using a fixed effects (FE) estimator. This helps to control for omitted variable bias due to time-invariant unobserved heterogeneity. On top of this, we also estimate Equation 1 using a random effects (RE) estimator: this will not only provide a matter of comparison with the FE estimates, but it will be necessary when we will include our set of time-invariant amenity variables $\mathbf{X}$. we also clustered the standard errors at OMI area level to control for unobserved arbitrary within-groups correlation in the error term.

In Table 12, we report the summary statistics[12] of the main variables used in the work.

Table 12: summary statistics

Source: author's elaboration

Variable	Mean	Std. Dev.	Min	Max
P_{HOUSE}	1557.78	509.14	1050	3125
P_{COMM}	1493.89	766.51	0	3100
P_{OFFICE}	1535.56	317.47	1050	2450
R_{HOUSE}	6.32	1.44	5.1	10.65
R_{COMM}	8.10	4.75	0	18.25
R_{OFFICE}	6.77	2.05	0	9.75
$STUD_{t-1}$	2802.38	5549.92	0	20373

As can be observed, the average value of housing is the highest, followed by the office prices and the prices for commercial businesses. The housing prices are the highest only due to higher maximum prices (€3125) that are find in the central zone B1, considering that the minimum values are identical both for residential and office markets. This means that people value the most purchasing properties in the city center.

Regarding the rent markets, the higher prices can be found in the commercial market, followed by offices and lastly by the residential market. The maximum rent price can be found again in the central B1 zone, whose value is double that of the other values. This means that stores and shops prefer renting spaces in the city center, and this is in line with bid-rent theory.

In Table 13 we present the results of the regression model.

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[12] The table reports the main descriptive statistics of the main variables used in the analysis. For each variable, we report the name, the mean, the standard deviation and their minimum and maximum value.

Table 13: Students and real estate values

Source: author's elaboration

	(1) P_{HOUSE}	(2) P_{HOUSE}	(3) P_{COMM}	(4) P_{COMM}	(5) P_{OFFICE}	(6) P_{OFFICE}
METHOD	FE	RE	FE	RE	FE	RE
$STUD_{t-1}$	0.008**	0.017***	-0.001	-0.001	-0.008	0.002
	(0.003)	(0.004)	(0.001)	(0.001)	(0.009)	(0.010)
Marg eff	*0.014*	*0.027*				
2016	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
2017	-38.253***	-36.048***	-1.613	-1.592	-6.219*	-3.648
	(9.907)	(10.811)	(1.316)	(1.307)	(3.548)	(5.689)
2018	-79.214***	-79.265***	-1.384	-1.384	-29.119**	-29.179**
	(16.797)	(17.076)	(1.557)	(1.544)	(13.296)	(14.221)
2019	-93.275***	-90.489***	-3.061	-3.034	-42.871**	-39.622**
	(19.462)	(19.490)	(3.062)	(3.087)	(16.415)	(17.238)
2020	-110.574***	-111.502***	-2.683	-2.692	-42.886**	-43.968***
	(21.137)	(20.536)	(2.528)	(2.545)	(15.731)	(16.510)
N	90	90	90	90	90	90
R^2 within	0.567	0.557	0.033	0.033	0.284	0.253
R^2 between	0.494	0.494	0.153	0.153	0.412	0.412
R^2 overall	0.322	0.448	0.144	0.143	0.317	0.146
Sargan (p-value)	0.067		0.120		0.017	

OMI area-clustered standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

In each Column, the estimated coefficient of $STUD_{t-1}$ indicates the sensitivity of the market prices with respect to the variation on the net number of students present in the OMI area each year. Considering the year 2016 our point of reference, all the other years are dummies reflecting the changes in the average prices. In this case, the average for all the real-estate markets has a decreasing trend, that is more marked in the housing sector.

Looking at Columns 1 and 2, it is possible to see that there is a positive and significant correlation between the number of students and the market values of houses. We can observe that an increase of +1000 students corresponds to an average increase of +€8/m² in the housing sector. Looking at the marginal effect, a 10% increase in the net number of students corresponds to an average increase of +0.14% in housing values. No significant effects, instead, have been found for STUD on the commercial and tertiary real estate values.

We can also observe that RE coefficients are higher than the FE ones: from Column 2 we find that an increase of +1000 students corresponds to an increase of +€17/m² in the housing sector. In marginal terms, a 10% increase in the number of students corresponds to an average 0.27% increase in the value of houses.

Interestingly, we also observe that in Columns 1 and 2 both the R^2 within and the R^2 between are rather high, meaning that our model can explain a rather high proportion of both the within

and the between variance of house prices. Finally, we run a Sargan test for panel data to check for possible omitted variables: we find that in Columns 1-2 and 5-6, the test rejects the null hypothesis of no omitted variables at, respectively, 10% and 5% level, while in Columns 3 and 4 the test does not reject H_0. For this reason, we decided to further investigate the role of urban amenities more in detail.

Before doing this, in Table 14, we present the results of Equation 1 when the dependent variable is the rent value instead of the market price. The effects that we obtained are weak, especially when using the FE estimator. We only find positive and significant coefficients in Columns 2, 3, and 4, but the magnitude of the effect is very small. In marginal terms, we find that doubling the presence of students in an area corresponds to an average 2-3% increase in urban rents. We suspect that rents must be influenced by other factors than students' flows, such as the amenities.

Table 14: Students' flow and rent values of housing and tertiary-commercial activities

Source: author's elaboration

	(1) R_{HOUSE}	(2) R_{HOUSE}	(3) R_{COMM}	(4) R_{COMM}	(5) R_{OFFICE}	(6) R_{OFFICE}
METHOD	FE	RE	FE	RE	FE	RE
$STUD_{t-1}$	0.000	0.000**	0.000*	0.000**	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Marg eff		0.022	0.027	0.030		
2016	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
2017	-0.035*	-0.029	-0.053	-0.050	-0.005	-0.002
	(0.018)	(0.019)	(0.051)	(0.051)	(0.020)	(0.017)
2018	-0.003	-0.004	-0.103	-0.103	-0.041	-0.041
	(0.046)	(0.047)	(0.091)	(0.091)	(0.038)	(0.042)
2019	0.011	0.019	-0.033	-0.030	-0.073	-0.068
	(0.043)	(0.044)	(0.077)	(0.074)	(0.063)	(0.065)
2020	0.027	0.024	-0.087	-0.088	-0.031	-0.033
	(0.048)	(0.049)	(0.101)	(0.101)	(0.041)	(0.043)
N	90	90	90	90	90	90
R^2 within	0.098	0.089	0.128	0.127	0.254	0.253
R^2 between	0.578	0.578	0.249	0.249	0.119	0.119
R^2 overall	0.562	0.569	0.246	0.246	0.114	0.114
Sargan (p-value)	0.000		0.019		0.034	

OMI area-clustered standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

The next step is to check whether our results can be biased by reverse causality. In principle, to the extent that higher prices can detect the most beautiful and vibrant areas of the city, students, as well as university facilities, can self-select into them: if this is the case, the direction of causality would run from the real estate market to students' flows.

To check for this, we run a series of additional regressions where we house prices and rents are in 2015-2020 are explained by the average stock of resident students in the past, namely between 1997 and 2007. The idea is that a positive and significant coefficient of past resident students on recent real estate values would be a sign of the persistent attraction of high-rent areas of the city for students. Instead, if the coefficient is not statistically significant, this would be the sign that the variability of the real estate market prices and rents is explained only by current dynamics of student flows, meaning that the direction of causality is from students to prices.

The information on the number of students who were resident in Padua between 1977 and 2007, are retrieved from Carbone (2010). In the following analysis, $STUD_{1977\text{-}2007}$ is the average of students living in Padua between 1977 and 2007. Since this variable does not vary between 2015 and 2020, we can use only the RE model.

Table 15 shows that there is no correlation between past resident students and the current market and rent prices, excepts for the case of office rents. The reason why an increase in the past stock of students residing in the city of Padua correspond to an increase of the current rent value of offices is the active entrepreneurial fabric of Padua. It is easy to detect that the presence of the university, thus the students, in the city is a source of potential local entrepreneurial dynamism, through the creation of activities related to science and technology, as well as the triggering of multiplicative mechanisms on the local labor market.

The city of Padua has been subdivided into four macro-zones relevant to the office real estate sector: *Centro-zona Riviere, Stanga-Tribunale-Fiera, Zona Direzionale Padova 1, Padova Est Zip*. If we compare these zones with the data of Carbone (2011) we can observe that central zone is also the area with the majority of students living, there. The central zone B1 is appealing for professional firms and representative offices, as notary and lawyers.

Also, the zone C2 count a number of students, and in this zone, we can find firm of medium size: banks, insurance companies, law firms and accountants.

We can conclude that the phenomenon of market pricing is not correlated with data of residents in the past. The results shows that there is no causation between the two variables, meaning that any changes in the current value of market prices is mainly explained by recent dynamics of student enrollment.

Table 15: Average student's residents over the period 1970-2007 and current market values of Padua

Source: author's elaboration

METHOD: RE	(1) P_{HOUSE}	(2) P_{COMM}	(3) P_{OFFICE}	(4) R_{HOUSE}	(5) R_{COMM}	(6) R_{OFFICE}
$STUD_{1977\text{-}2007}$	0.336	-0.867	0.287	0.001	-0.003	0.003***
	(0.312)	(0.547)	(0.219)	(0.001)	(0.004)	(0.001)
Year FE	✓	✓	✓	✓	✓	✓
N	90	90	90	90	90	90
R^2 within	0.294	0.236	0.285	0.087	0.032	0.133
R^2 between	0.048	0.137	0.090	0.078	0.043	0.169
R^2 overall	0.053	0.137	0.096	0.078	0.043	0.169

OMI area-clustered standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

We now change the dependent variable, and we move to the number of real estate transactions. In Table 16, we will try to understand if the presence of students influences the number of TNT in that specific area, where TNT represents the sum of real estate units bought and sold "normalized" with respect to the transferred share of residential properties.

In the table we detect the effects only in the TNTs for residential and commercial sectors.

Taking year 2016 as reference year, we can see that in the residential sector in 2018 and 2019 the TNTs show a significantly increasing trend.

We run both the FE and the RE regressions, and we can conclude that in both cases the students' flows do not have any effect on TNT. Thus, moving back to Table 13, we can conclude that the increase of +€8 that corresponds to the +1000 students increase, should not be considered as a price increase originating from an increase in the demand for housing, but it is a sign of a general demand for public land that implicitly increases the average value of the surrounding houses.

Another plausible reason is that students usually do not purchase houses, and thus there are no effects of their presence on the number of transactions in that specific zone. The positive correlation with prices found in Table 13 can be considered as a sort of hedonic increase: the price of building is determined by the characteristics of the neighboring area, and the presence of the university, and its students, is one of them.

Table 16: TNTs and students' flow

Source: author's elaboration

METHOD	(1) TNS$_{HOUSE}$ FE	(2) TNS$_{HOUSE}$ RE	(3) TNS$_{COMM}$ FE	(4) TNS$_{COMM}$ RE
STUD$_{t-1}$	0.005	0.002	0.001	0.001
	(0.003)	(0.003)	(0.001)	(0.001)
2016	Ref.	Ref.	Ref.	Ref.
2017	7.082	6.256	2.845	2.922
	(5.386)	(5.140)	(3.414)	(3.424)
2018	29.099***	29.119***	1.334	1.332
	(6.590)	(6.636)	(2.061)	(2.087)
2019	35.227***	34.183***	1.799	1.896
	(10.021)	(10.005)	(1.473)	(1.422)
N	72	72	72	72
R^2 within	0.366	0.359	0.022	0.022
R^2 between	0.020	0.020	0.197	0.197
R^2 overall	0.003	0.001	0.163	0.164

OMI area-clustered standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

After having considered the effects of students in the real-estate market, we now want to understand if there are other factors that can contribute to the increase or decrease of properties value in the city of Padua. Among these factors, we select urban amenities. As stated by Glaeser et al. (2000), urban rents have increase faster than urban wages, suggesting that the demand for living in cities has risen for reasons beyond rising wages. Amenities make cities increasingly attractive places to live, amenities cater higher human capital workers that are willing to pay more to reside in the city center. Also, it is important to stress that the areas in which skilled workers live are relatively free of social problems, so benefiting from higher market value of houses.

The main problems associated with the study of amenities are related to their nature: first, we have found a multitude of different amenities in the OMI areas of the city; second, all the amenities have different characteristics, which makes impossible to compare one with the other; third, the amenities are highly correlated one to another.

To overcome these problems, we run a principal components analysis (PCA). PCA is the method of computing the principal components and using them to achieve a change of basis on the data, sometimes using only the first few principal components and overlooking the rest. It is generally used for dimensionality reduction by projecting each data point into only the first few principal components to obtain lower-dimensional data while preserving as much of the data's variation as possible. PCA is an orthogonal linear transformation that converts the data to a new coordinate system such that the greatest variance by some scalar projection of the data comes to lie on the first coordinate called the first principal component. Such dimensionality

reduction can be a very useful step for visualizing and processing high-dimensional datasets, while still retaining as much of the variance in the dataset as possible.

This approach is used when there are strong correlations between different possible explanatory variables. It exploits the correlation between variables and reduces them to a few principal components that are orthogonal and easy to interpret.

Table 17 shows the outcome of the PCA over all the amenities described in Section 3.2.2, where for simplicity, we have summed the number of bus and tram stops. The table on the top shows that we can extract three components from our data, as the corresponding eigenvalue is greater than one. The proportion of total variance explained by these three components is 85%. In the bottom part of the table, we can analyze the contribution of each amenity to each component. The three principal components can be described as following:

- Comp1 – CULT: this component is the most powerful, but it is also very heterogeneous, and it is mainly explained by the cultural facilities (such as museums and churches) and urban infrastructures (such as transport lines and parking);
- Comp2 – RAILST: this component is mainly explained by the presence of the railway station;
- Comp3 – HOSP: this component is almost entirely explained by the presence of the city hospital.

After having determined the three principal components, we run the RE regression in order to detect if the amenities do have an effect in the real-estate values of housing.

Table 17: Principal components analysis

Source: author's elaboration

```
Principal components/correlation                    Number of obs    =        108
                                                    Number of comp.  =         11
                                                    Trace            =         11
          Rotation: (unrotated = principal)         Rho              =     1.0000
```

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	6.52274	4.78098	0.5930	0.5930
Comp2	1.74176	.602905	0.1583	0.7513
Comp3	1.13886	.259327	0.1035	0.8549
Comp4	.879531	.520237	0.0800	0.9348
Comp5	.359295	.145491	0.0327	0.9675
Comp6	.213803	.155122	0.0194	0.9869
Comp7	.0586812	.0118554	0.0053	0.9922
Comp8	.0468257	.0244517	0.0043	0.9965
Comp9	.0223741	.0101155	0.0020	0.9985
Comp10	.0122586	.0083933	0.0011	0.9996
Comp11	.00386531		0.0004	1.0000

Principal components (eigenvectors)

Variable	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6	Comp7	Comp8	Comp9	Comp10	Comp11
chiese	0.3559	-0.2280	-0.0412	-0.2324	-0.1189	-0.2883	0.2008	-0.1678	0.0147	0.7702	0.0807
cinema_tea~i	0.3214	-0.3699	-0.1383	-0.1239	0.0963	0.3394	-0.0758	0.7120	0.0918	-0.0173	0.2821
museo	0.3765	0.0047	0.0892	-0.0164	0.2688	-0.3281	0.2870	0.1565	-0.6753	-0.2612	-0.1976
centro_cul~e	0.3236	-0.3833	0.1907	-0.0486	-0.0184	-0.0574	-0.1380	-0.5146	0.0658	-0.4206	0.4907
polizia	0.3442	0.1911	-0.1252	-0.1315	0.0010	0.7485	0.2998	-0.3357	-0.0738	0.0035	-0.2093
ospedale	0.0041	-0.0048	0.9069	0.2408	-0.0540	0.1935	0.1757	0.1397	0.0395	0.1640	0.0167
stazione	0.1744	0.6571	-0.0773	0.1318	0.2196	-0.1291	0.2656	0.0767	0.1926	0.0182	0.5794
studentati	0.3464	0.2575	0.1230	0.0595	0.3553	0.0372	-0.7704	-0.0659	-0.0482	0.2124	-0.1486
parcheggi	0.3848	0.0249	0.0520	-0.0382	-0.0044	-0.2677	0.1427	0.0824	0.6718	-0.2621	-0.4779
aree_verdi	0.1177	-0.2639	-0.2655	0.8934	0.1145	0.0355	0.0940	-0.0879	0.0260	0.1154	-0.0540
trasporti	0.3045	0.2436	-0.0485	0.1795	-0.8447	-0.0471	-0.1965	0.1364	-0.1807	-0.0837	0.0291

In Table 18, we find that, *ceteris paribus*, the amenities do have an impact on the average price of housing; in particular, the presence of cultural amenities (CULT) corresponds to an increase of the value of housing, whereas the presence of the hospital (HOSP) does not have any significant effect, and the presence of the railway station (RAILST) corresponds to a lower value of housing. The presence of railway station is most of the time associated with the presence of crime and homeless people, not just in the station itself but also in the surrounding area.

Moreover, we find that both the number of students and the amenities have a significant effect on the real estate prices. However, it may happen that students and amenities are not randomly distributed in the city, but tend to cluster in the same areas. To check for this, we use the Variance Inflation factor (VIF) statistic, through which we measure the degree of multicollinearity among the independent variables. Detecting multicollinearity is essential because while multicollinearity does not reduce the explanatory power of the model, it shrinks the statistical significance of the independent variables. A large VIF on an independent variable indicates a highly collinear relationship to the other variables. In statistical terms, a multiple

regression model where there is high multicollinearity will make it more difficult to estimate the relationship between each of the independent variables and the dependent variable.

In our case, Column 4 shows a value of the VIF statistic of 2.30, well below 5, so that we can conclude that multicollinearity is not an issue.

Table 18: Amenities and housing market value

Source: author's elaboration

	(1)	(2)	(3)	(4)
METHOD: RE	P$_{HOUSE}$	P$_{HOUSE}$	P$_{HOUSE}$	P$_{HOUSE}$
STUD$_{t-1}$	0.013***	0.018***	0.017***	0.017**
	(0.004)	(0.004)	(0.004)	(0.008)
Marg eff	*0.020*	*0.031*	*0.026*	*0.026*
CULT	72.774*			68.375***
	(40.986)			(20.324)
RAILST		-100.453		-99.861***
		(70.303)		(31.245)
HOSP			61.113	58.730
			(43.519)	(46.946)
Year FE	✓	✓	✓	✓
N	90	90	90	90
R^2 within	0.563	0.553	0.557	0.556
R^2 between	0.336	0.430	0.312	0.443
R^2 overall	0.338	0.423	0.309	0.444
Mean VIF				2.30

OMI area-clustered standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Lastly, we want to identify if the presence of amenities also influences the rent value of housing. In Table 19 we show the results of this analysis, and again we find that the presence of amenities does influence the rent prices for housing. In this case, both the presence of cultural amenities and of the hospital has a positive effect on the housing prices, on the contrary the presence of railway station has a negative effect on prices. In this case the presence of the city hospital has a positive effect on rent prices because, even if this zone is chaotic with high presence of traffic and outside the city center, there is a dynamic rent market: on the one hand, most students enrolled in the Faculty of Medicine use to live in this zone and, on the other, the high relevance of the hospital of Padua pushes the relatives of patients to look for a temporary stay in the area. Interestingly, when controlling for the availability of amenities, we do not find a significant correlation between the number of students and the rents.

Table 19: Amenities and housing rent value

Source: author's elaboration

METHOD: RE	(1) R_{HOUSE}	(2) R_{HOUSE}	(3) R_{HOUSE}	(4) R_{HOUSE}
$STUD_{t-1}$	0.000	0.000**	0.000*	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Marg eff		*0.023*	*0.016*	
CULT	0.156**			0.164***
	(0.072)			(0.053)
RAILST		-0.193		-0.185***
		(0.121)		(0.062)
HOSP			0.417***	0.432***
			(0.108)	(0.119)
Year FE	✓	✓	✓	✓
N	90	90	90	90
R^2 within	0.093	0.088	0.094	0.096
R^2 between	0.364	0.533	0.360	0.458
R^2 overall	0.362	0.527	0.359	0.456
Mean VIF				2.30

OMI area-clustered standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

CONCLUSIONS

This thesis can be included in the bigger project Unicity, which aims to understand the links that arise from the interaction of "university and city" within the economic and social systems. We wanted to analyze the impact of the presence of university students on the local real estate market, with particular attention being devoted to the price dynamics (of sale or lease) of the properties and the volume of commercial transactions.

The literature on housing covers an immense range of topics and approaches. This is due to the complex nature of housing properties and the wide-ranging interaction between housing with other elements of the urban economy. The real-estate values are not only determined by the distance from the city center, as stated in the bid-rent curve, but they also depend on the presence of amenities that attract high human capital workers and make the city a desirable place to live.

In the case of Padua, the most important amenity is the University. Since 1222, the university has grown both in number and importance worldwide. The city hosts a community of 60.000 students attending 188-degree courses: 30% of the entire population of Padua works or studies in the university. This portion has led to the transformation of the urban space into a space which is tailored for students. The major characteristics of the University of Padua is that it can be considered a city campus which has witnessed a centralization of university buildings and a decentralization process throughout the years. The reasons why the disposition of the university headquarters moved from the city center to the peripheral area of the city are mainly due to the access to public transportation, students' services such as libraries, bars, restaurants and shops.

Our analysis amins to assess whether the annual presence of students and of all the other amenities have an impact on the real-estate market, and how. We come to the conclusion that the presence of the university, which is measured by the student flows, positively influences only the market prices of the residential sector and it has no effects on the rent values. Also, by analyzing past trend of students living in the city of Padua we find that no causation effect takes place: the past presence of students does not increase the actual prices. The last part of our analysis focused on time-invariant variables such as amenities: the presence of some types of amenities, mostly cultural amenities, corresponds to both higher market prices and rent housing prices.

Comparing the OMI 2019 and 2020 data on housing market, we can conclude that in the face of a spike in supply, prices are holding in 2020. The housing market is slower than others in absorbing the backlash from external events, such as Covid-19, and it is too early to tell if there will also be an impact on the price of rooms for rent. Indeed, the analysis shows a situation of substantial cost stability.

A study by Immobiliare.it on the data of the last year, reveals that without tourists and students the houses have emptied, leading to an explosion of the supply with an increase of 180% in the city of Padua. The surge in supply mainly due to the student's rental market dropping by 60% in the 2021/2021 academic year leading to a monthly loss of 200 thousand euros for the city, has not yet been accompanied by a significant drop in average price of rents. Just in the first quarter of 2021, twelve months after the start of the pandemic, rental prices show a first concrete decline with a 0.9% decrease.

The university of Padua is committed to start the new semester with in-class lessons. Right now, however, without knowing the future evolution of the pandemic, we can suppose that the courses will be delivered both on-line and face-to-face. In order for the real estate market to flourish, prices need to be lowered so as to attract students who will benefit from in-class lectures.

APPENDIX

Table 1A: Courses of the university of Padua provided in other cities

Source: author's elaboration

Agraria e Medicina Veterinaria	ANIMAL CARE - TUTELA DEL BENESSERE ANIMALE - LEGNARO (PD)
	BIOTECNOLOGIE AGRARIE - LEGNARO (PD)
	BIOTECNOLOGIE SANITARIE - PADOVA
	RIASSETTO DEL TERRITORIO E TUTELA DEL PAESAGGIO - LEGNARO (PD)
	SCIENZE E CULTURA DELLA GASTRONOMIA E DELLA RISTORAZIONE - CASTELFRANCO VENETO (TV)
	SCIENZE E CULTURA DELLA GASTRONOMIA E DELLA RISTORAZIONE - LEGNARO (PD)
	SCIENZE E TECNOLOGIE AGRARIE - LEGNARO (PD)
	SCIENZE E TECNOLOGIE ALIMENTARI - LEGNARO (PD)
	SCIENZE E TECNOLOGIE ANIMALI - LEGNARO (PD)
	SCIENZE E TECNOLOGIE VITICOLE ED ENOLOGICHE - CONEGLIANO (TV)
	SICUREZZA IGIENICO-SANITARIA DEGLI ALIMENTI - VICENZA
	TECNOLOGIE FORESTALI E AMBIENTALI - LEGNARO (PD)
	BIOTECNOLOGIE AGRARIE - LEGNARO (PD)
	TECNOLOGIE FORESTALI E AMBIENTALI - LEGNARO (PD)
	TECNICHE VIVAISTICHE - LEGNARO (PD)
	SICUREZZA IGIENICO-SANITARIA DEGLI ALIMENTI - VICENZA
	SCIENZE E TECNOLOGIE VITICOLE ED ENOLOGICHE - CONEGLIANO (TV)
	SCIENZE E TECNOLOGIE ALIMENTARI - LEGNARO (PD)
	SCIENZE E TECNOLOGIE AGRARIE - LEGNARO (PD)
	SCIENZE E CULTURA DELLA GASTRONOMIA E DELLA RISTORAZIONE - CASTELFRANCO VENETO (TV)
	TUTELA E RIASSETTO DEL TERRITORIO - LEGNARO (PD)
	BIOTECNOLOGIE PER L'ALIMENTAZIONE - LEGNARO (PD)
	FOREST SCIENCE - SCIENZE FORESTALI - LEGNARO (PD)
	ITALIAN FOOD AND WINE - ALIMENTI E VINI D'ITALIA - LEGNARO (PD)
	SCIENZE E TECNOLOGIE AGRARIE - LEGNARO (PD)
	SCIENZE E TECNOLOGIE ALIMENTARI - LEGNARO (PD)
	SCIENZE E TECNOLOGIE ANIMALI - LEGNARO (PD)
	SCIENZE E TECNOLOGIE PER L'AMBIENTE E IL TERRITORIO - LEGNARO (PD)
	SCIENZE FORESTALI E AMBIENTALI - LEGNARO (PD)
	SUSTAINABLE AGRICULTURE - AGRICOLTURA SOSTENIBILE - LEGNARO (PD)
	SCIENZE E TECNOLOGIE AGRARIE - LEGNARO (PD)
	SCIENZE FORESTALI E AMBIENTALI - LEGNARO (PD)
	MEDICINA VETERINARIA - LEGNARO (PD)
	MEDICINA VETERINARIA - LEGNARO (PD)
	SCIENZE AGRARIE - LEGNARO (PD)
	SCIENZE FORESTALI - LEGNARO (PD)
	SCIENZE FORESTALI E AMBIENTALI - LEGNARO (PD)
Economia e Scienze politiche	SCIENZE FORESTALI E AMBIENTALI - LEGNARO (PD)
	DIRITTO DELL'ECONOMIA - ROVIGO
	DIRITTO DELL'ECONOMIA E GOVERNO DELLE ORGANIZZAZIONI - ROVIGO
	DIRITTO DELL'ECONOMIA - ROVIGO
Giurisprudenza	GIURISPRUDENZA - TREVISO

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Area	Corso di Laurea
Ingegneria	INGEGNERIA DELL'INNOVAZIONE DEL PRODOTTO - VICENZA
	INGEGNERIA GESTIONALE - VICENZA
	INGEGNERIA INFORMATICA - ROVIGO
	INGEGNERIA MECCANICA E MECCATRONICA - VICENZA
	INGEGNERIA MECCATRONICA - VICENZA
	INGEGNERIA GESTIONALE - VICENZA
	INGEGNERIA INFORMATICA - FELTRE (BL)
	INGEGNERIA INFORMATICA - PADOVA
	INGEGNERIA MECCANICA - PADOVA
	INGEGNERIA MECCANICA - VICENZA
	INGEGNERIA MECCATRONICA - VICENZA
Medicina e Chirurgia	ASSISTENZA SANITARIA (ABILITANTE ALLA PROFESSIONE SANITARIA DI ASSISTENTE SANITARIO) - CONEGLIANO (TV)
	EDUCAZIONE PROFESSIONALE (ABILITANTE ALLA PROFESSIONE SANITARIA DI EDUCATORE PROFESSIONALE) - ROVIGO
	FISIOTERAPIA (ABILITANTE ALLA PROFESSIONE SANITARIA DI FISIOTERAPISTA) - CONEGLIANO (TV)
	FISIOTERAPIA (ABILITANTE ALLA PROFESSIONE SANITARIA DI FISIOTERAPISTA) - SANTORSO
	FISIOTERAPIA (ABILITANTE ALLA PROFESSIONE SANITARIA DI FISIOTERAPISTA) - VENEZIA
	IGIENE DENTALE (ABILITANTE ALLA PROFESSIONE SANITARIA DI IGIENISTA DENTALE) - TREVISO
	INFERMIERISTICA (ABILITANTE ALLA PROFESSIONE SANITARIA DI INFERMIERE) - CONEGLIANO (TV)
	INFERMIERISTICA (ABILITANTE ALLA PROFESSIONE SANITARIA DI INFERMIERE) - FELTRE (BL)
	INFERMIERISTICA (ABILITANTE ALLA PROFESSIONE SANITARIA DI INFERMIERE) - MESTRE (VE)
	INFERMIERISTICA (ABILITANTE ALLA PROFESSIONE SANITARIA DI INFERMIERE) - MIRANO (VE)
	INFERMIERISTICA (ABILITANTE ALLA PROFESSIONE SANITARIA DI INFERMIERE) - MONSELICE (PD)
	INFERMIERISTICA (ABILITANTE ALLA PROFESSIONE SANITARIA DI INFERMIERE) - MONTECCHIO PRECALCINO
	INFERMIERISTICA (ABILITANTE ALLA PROFESSIONE SANITARIA DI INFERMIERE) - PORTOGRUARO (VE)
	INFERMIERISTICA (ABILITANTE ALLA PROFESSIONE SANITARIA DI INFERMIERE) - ROVIGO
	INFERMIERISTICA (ABILITANTE ALLA PROFESSIONE SANITARIA DI INFERMIERE) - TREVISO
	ORTOTTICA ED ASSISTENZA OFTALMOLOGICA (ABILITANTE ALLA PROFESSIONE SANITARIA DI ORTOTTISTA ED ASSISTENTE DI OFTALMOLOGIA) - PADOVA
	OSTETRICIA (ABILITANTE ALLA PROFESSIONE SANITARIA DI OSTETRICA/O) - TREVISO
	OSTETRICIA (ABILITANTE ALLA PROFESSIONE SANITARIA DI OSTETRICA/O) - VICENZA
	TECNICHE AUDIOPROTESICHE (ABILITANTE ALLA PROFESSIONE SANITARIA DI AUDIOPROTESISTA) - TREVISO
	TECNICHE DELLA PREVENZIONE NELL'AMBIENTE E NEI LUOGHI DI LAVORO (ABILITANTE ALLA PROFESSIONE SANITARIA DI TECNICO DELLA PREVENZIONE NELL'AMBIENTE E NEI LUOGHI DI LAVORO) - FELTRE (BL)
	TECNICHE DI RADIOLOGIA MEDICA, PER IMMAGINI E RADIOTERAPIA (ABILITANTE ALLA PROFESSIONE SANITARIA DI TECNICO DI RADIOLOGIA MEDICA) - ROVIGO
	TECNICHE DI RADIOLOGIA MEDICA, PER IMMAGINI E RADIOTERAPIA (ABILITANTE ALLA PROFESSIONE SANITARIA DI TECNICO DI RADIOLOGIA MEDICA) - TREVISO
	TECNICHE DI RADIOLOGIA MEDICA, PER IMMAGINI E RADIOTERAPIA (ABILITANTE ALLA PROFESSIONE SANITARIA DI TECNICO DI RADIOLOGIA MEDICA) - VICENZA
	TERAPIA OCCUPAZIONALE (ABILITANTE ALLA PROFESSIONE SANITARIA DI TERAPISTA OCCUPAZIONALE) - CONEGLIANO (TV)
	EDUCAZIONE PROFESSIONALE (ABILITANTE ALLA PROFESSIONE SANITARIA DI EDUCATORE PROFESSIONALE) - ROVIGO
	INFORMAZIONE SCIENTIFICA SUL FARMACO - PADOVA
Scienze	BIOLOGIA MARINA - CHIOGGIA (VE)
Scienze Umane, Sociali e del Patrimonio Culturale	EDUCATORE SOCIALE, CULTURALE E TERRITORIALE - ROVIGO
	MANAGEMENT DEI SERVIZI EDUCATIVI E FORMAZIONE CONTINUA - ROVIGO
	PROGRAMMAZIONE E GESTIONE DEI SERVIZI EDUCATIVI E FORMATIVI - ROVIGO

REFERENCES

Alonso, W., (1967), A reformulation of classical location theory and its relation to rent theory, *Papers of the Regional Science Association,* XIX, n. 1. 1976, pp. 22-44

Balducci, A., Cognetti, F., Fedeli, V., (2010), La città degli studi, storia geografia e politiche delle università milanesi*, AIM- Associazione Interessi Metropolitani, Abitare Segesta*, Milan. 2010

Bruegmann, R., (2005), Sprawl. A compact history, *University of Chicago Press*. 2005

Carbone F., (2011), *Università, territori, mobilità e pendolarismo. Dall'Università di massa all'università di massa pendolare. Caso studio Padova (con riferimenti anche allo Iuav, e alle Università di Venezia, Trento, Udine, Ferrara, Verona), PhD Pianificazione Territoriale e politiche pubbliche del territorio - IUAV Venice*. 2011

Ciampolini, A., Magnaghi, A., (2005), Il polo empolese universitario e le sue prospettive, *L'innovazione per lo sviluppo regionale, Florence University* Press. 2005

D'Alpaos, C., Marella, G., Picchiolutto, E., Stellin, G., (2017), Campus universitari e modelli economico-territoriali. Integrazione o isolamento?, *XXXV Conferenza Italiana Delle Scienze Regionali*. 2017

Dilorenzo, P., Stefani, E., (2015), Università e città. Il ruolo dell'università nello sviluppo dell'economia culturale delle città, *Conferenza dei Rettori delle Università Italiane,* Rome. September 2015 p. 4

EEA, (2006), Urban sprawl in Europe — the Ignored challenge, EEA Report No 10/2006. November 2006

Esposito, F., (2015), Territori a bassa densità, *Lessico dell'urbano 2, U3 – Urbanistica 3*. April 2015

Fedeli, V., Cognetti, F., (2010), Università come nodo dello sviluppo urbano. Riflessioni a partire dal caso milanese*, XXXII Conferenza Italiana Di Scienze Regionali*. 2010

Festa, M., (2020), Rapporto immobiliare 2020. Il settore residenziale, *Pubblicazione OMI, Direzione Centrale Servizi Estimativi, Osservatorio Mercato Immobiliare, Agenzia delle Entrate*. 21 May 2020

Festa, M., (2020), Rapporto immobiliare 2020. Immobili a destinazione terziaria, commerciale e produttiva, *Pubblicazione OMI, Direzione Centrale Servizi Estimativi, Osservatorio Mercato Immobiliare, Agenzia delle Entrate*. 28 May 2020

Fregolent, L., (2012), The Low-Density Cities: Problems and Management, TeMA – Journal of Land Use, Mobility and Environment, 5(1). 2012, pp. 7-20

Glaeser, E., L., Kolko, J., Saiz, A., (2001), Consumer City, Journal of Economic Geography, Volume 1, Issue 1. January 2001, pp. 27-50

Indovina, F., (1999). La città diffusa: cos'è e come si governa, *position paper*. 1999

Kakar, K., A., Prasad, C.S.R.K., (2019), Impact of Urban Sprawl on Travel Demand for Public Transport, Private Transport and Walking, *World Conference on Transport Research – WCTR 2019,* Mumbai. 26-30 May 2019

Manzoli, E., Mocetti, S., (2016), I prezzi delle case e il gradiente centro-periferia: evidenze dalle città italiane, *Banca d'Italia Eurosistema, Occasional Papers n. 348*. September 2016

Marcato, G., (2016), Nota territoriale. Andamento del mercato immobiliare nel I semestre 2016. Settore residenziale. Padova., Pubblicazione OMI, Ufficio Provinciale-Territorio della Direzione Provinciale di Padova. 25 November 2016

Mauri, F., (2010), La valutazione economica di grandi progetti urbani: la metodologia dei prezzi Edonici, *Politecnico di Milano, Department of Engineering*. March 2011

Mazzoccoli, F., S., Gerardini, M., (2020). Statistiche regionali. Il mercato immobiliare residenziale, *Pubblicazioni OMI, Direzione Regionale Veneto*. 19 June 2020

McDonald, J., F., (2007), William Alsonso, Richard Muth, resources for the future and the founding of urban economics, *Journal of the History of Economic Thought*, Volume 29, Issue 1. March 2007, pp. 67-84

Muth, R., (1967), Determinants of Investment Behavior, *Chapter: The distribution of population withing urban areas*, Robert Ferber Editor. 1976

OECD, (2018), Rethinking Urban Sprawl: Moving Towards Sustainable Cities, *OECD Publishing,* Paris. June 2018

Picchiolutto, E., Stellin, G., (2017), Crescita dell'ateneo patavino e politica urbana: reciproche influenze, armonie e conflitti, *XXXV Conferenza Italiana Delle Scienze Regionali*. 2017

Siegfried, J., J., Sanderson, A., R., McHenry, P., (2007), The economic impact of colleges and universities, *Economics of Education Review, vol. 26*. 2007 pp. 546–558

Stanca, L., (2008), Le determinanti dei prezzi delle abitazioni: aspetti microeconomici, Working Papers 143, *University of Milano-Bicocca, Department of Economics*. Revised July 2008

Whitehead, C., M., E., (1999), Urban housing markets: theory and policy, *London School of economics*. Chapter 40