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Local Economy, Housing Prices and Neighborhood Change

Abstract. This paper investigates the impact of real estate prices on local economic activities within cities. It combines a novel geo-located dataset of retailers and services with information on the sale and rental prices and develops an empirical strategy based on IV panel techniques to address endogeneity con- cerns. The instrument adopted is novel and unique, i.e the city heating district system. The results reveal that housing prices affect positively the variety of products and services offered in an area, and negatively the tradable and non-tradable sectors. Nonetheless, price demand-induced changes lead to a massive positive effect on all activities and the variety supplied, with varying intensities in gentrified and non-gentrified areas of the city. Moreover, the paper identifies changes in population density and composition as the main channels through which the demand side affects housing price shifts. The findings highlight the role of neighborhood change and gentrification patterns in reshaping cities.

Keywords. Housing Price, Gentrification, Local Economy

1. Introduction

How does the city structure respond to shifts in real estate prices? Cities are not homogeneous. Changes in neighborhood and local consumer demand may influence housing prices. Thus, differences in housing prices across areas can shape the availability and variety of goods and services. This can happen through two primary channels. Firstly, changes in prices may directly hit endogenous activities. Secondly, demographic and gentrification patterns within the city may lead to shifts in real estate prices and sub- sequently to local activities. The way in which city activities respond to shifts in sales and rent prices ultimately determines the significance of these channels.

In this paper, I investigate the impact of variation in real estate prices on local economic activities within urban areas and determine whether such changes have an effect on the diversity of products and services offered, as well as the balance between tradable and non-tradable sectors. Furthermore, the paper aims to distinguish between the direct effect of housing price changes and the demand-induced shifts in housing prices resulting from demographic and gentrification trends across city zones.

The research focuses on the city of Turin and covers the period from 2012 to 2019. For the analysis, I obtained a collection of unique and highly specific datasets, including semestral sale and rent asking prices at the census tract level from Idealista, as well as a list of active

licenses for retailers and services in the city, which includes information on their location and category. These data are used in the empirical strategy composed of a panel fixed effects model. However, the causal effect between real estate prices and local economic activities is challenging to establish due to potential reverse causality and unobserved factors. To address this, the empirical strategy is complemented with an instrumental variable approach. The IV specification takes advantage of the unique heating district system in the city of Turin, the "Teleriscaldamento" (TLR). Given the exogenous variation in the heating unit installed across time and space, I construct an instrumental variable that counts for the power of heating units in each area. This system provides cost savings for homeowners, which is reflected both in the sale and rent prices.

The results highlight the impact of housing sales and rents on local economic activities by differentiating between the direct effect of housing price changes and the demand-induced effect. The study reveals a significant and positive effect between housing prices and the variety of local economic activities. However, when examining the impact on tradable and non-tradable sectors separately, both sectors exhibit a negative reaction to housing prices. Nonetheless, I identify a remarkable positive demand-induced effect caused by demographic and gentrification processes within the city. In areas with low to medium income levels, the impact is more significant for non-tradable activities and low-income levels for tradable activities. Likewise, in sparsely populated areas, the effect is more pronounced for tradable activities, while for non-tradable activities, the effect is more pronounced in areas with low to medium population density. Finally, the results highlight population density and in its composition as main demand side channels through which the housing price may affect local activities.

This study is situated within two distinct areas of literature: the literature on gentrification and neighborhood changes (Vigdor *et al.* 2002, Vigdor 2010, Ding and Hwang 2016, Glaeser *et al.* 2020, Brummet and Reed 2019, Stroebel and Vavra 2019, Borraz *et al.* 2021, Glaeser *et al.* 2023), and the growing body of research on urban consumption and American urban revival (Glaeser *et al.* 2001, Couture 2013, Almagro and Dominguez-Iino 2022, Davis *et al.* 2019, Baum-Snow and Hartley 2020, Couture and Handbury 2020, Behrens *et al.* 2022). Specifically, this paper is related to the work of Stroebel and Vavra (2019) and Borraz *et al.* (2021), as both investigate the relationship between the housing market and retail prices, with a focus on grocery stores. Stroebel and Vavra (2019) examines the impact of housing prices on retail prices in the USA and finds an elasticity of 15-20%. The authors assert that their estimates are not influenced by shifts in demographic or gentrification trends. Instead, they suggest that the behavior of existing homeown- ers is altered by changes in their housing wealth caused by fluctuations in house prices. This change in behavior, in turn, prompts firms to increase their markups. Meanwhile, Borraz *et al.* (2021) studies the effect of new housing stock on retail prices and product variety in Montevideo, Uruguay. According to the author's findings, local prices tend to decrease in response to an increase in demand. This can occur if there is either an increase in the number of competitors entering the market or a rise in the variety of products or services available to consumers. Unlike these previous studies, I examine the entire range of economic activities within cities.

Finally, a similar perspective is adopted by Glaeser *et al.* (2020), who examines the impact of gentrification on a variety of local economic activity sectors in five USA cities. Their measure of gentrification is based on rent growth and the poverty rate, and their results show a correlation indicating a substitution effect of tradable sectors in favour of non-tradable sectors. In a second version of the paper (Glaeser *et al.* 2023), the authors measure gentrification as the share of college students and they find that gentrifying neighborhoods experience faster growth in both the number of retail establishments and business closure rates than their non-gentrifying counterparts. I instead study the housing prices as a measure of gentrification, under specific conditions.

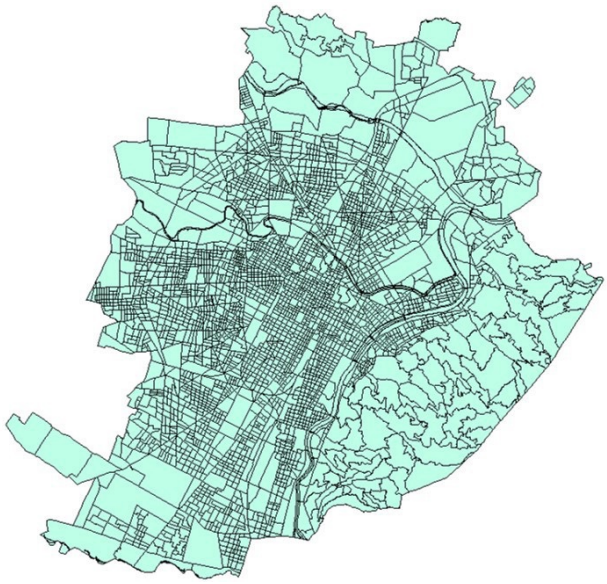
The paper contributes to the literature as follows. Firstly, it offers new insights on the relationship between real estate prices and all local economic activities, including retailers and services, by providing evidence of causal effects. Secondly, it identifies the housing price effect changes induced by demographic and gentrification patterns distinguishing different effect across city zones. Thirdly, it introduces a new and unique instrumental variable to address the endogeneity concerns, the "Teleriscaldamento". Lastly, the study shifts its attention to a European city and investigates the efficacy of several demand-induced channels in this context. This approach represents a twist from most previous literature on this topic, which has focused on examining US cities. By exploring a European city, the findings can be compared to those of previous studies, despite the notable differences between US and European urban environments.

The paper proceeds as follows. Section 2 presents the primary data sources, while Section 3 outlines the involved variables. Section 4 rationalizes the conceptual framework utilized for building the identifi- cation strategy, which is then discussed in Section 5. The results are presented and analyzed in Section 6. Finally, Section 7 provides a conclusion, including the next steps of the project.

2. Data

This paper exploits multiple and unique data sets for the empirical analysis. The primary source is the list of licenses for retailers, bars, restaurants, beauticians and hairdressers in Turin from 2012 to 2019 provided by the City Council. To open a new business or expand an existing one, the owner must request a license without any additional cost. The database includes information about the type of merchandise, location, and opening and closing dates for each license. The licenses are divided into 41 categories (see Table A.1) by the City Council. Since the request for a license is a more reliable indicator of economic activity than the opening or closing of a physical establishment, I use the opening and closing dates of the licenses to construct a variable that counts the number of active licenses per semester and category.

FIGURE 1 • TURIN DIVIDED IN CENSUS TRACKS



Notes: The plot shows the census tracks, namely the spatial unit used in the baseline specification.

FIGURE 2 • TLR NETWORK SNAPSHOT

Notes: The orange lines are the TLR pipelines and the black points are the heat- ing units.

Secondly, the data for both house and rental prices come from Idealista, a popular online real estate platform in Italy. The data is semestral, covering the years 2012-2019, and reports the "median asking price" per squared meters at the census track level. This median is computed by taking the mean of prices listed on the platform once the outliers and duplicated advertisements have been removed, therefore it may not reflect the final market price for either houses or rentals. These measures have advantages and disadvantages. On one hand, it does not allow for a direct comparison of posted prices with actual prices. Despite this, Chapelle and Eyméoud (2022) have shown that posted prices can be a good indicator of actual prices. Moreover, since bargaining is a common part of the buying and renting process, the asking price could show the house owner's attempt to monetize several possible features related to the house or the neighborhood.

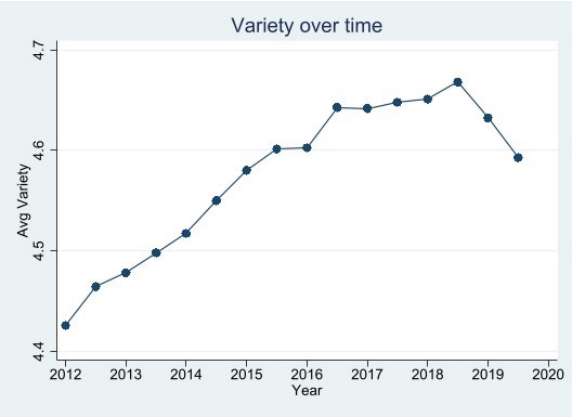
Thirdly, I use data on the Teleriscaldamento (TLR) district heating network, operated by Iren, a company that provides electricity, natural gas, and other products and sectors to individuals, companies, and public entities. In the 1970s, Iren sought to utilize the waste heat generated by its electricity pro- duction plants to heat water for buildings. To achieve this, the company began constructing a pipeline system to connect its plants to its customers. Firstly, Iren started connecting the closed plant area and subsequently in several parts of the city. The network currently covers about 50% of the city and includes both the pipeline infrastructure, PIs, and heating units (or boilers), HUs, installed in buildings connected to the system. One HU can serve either one or more surrounding buildings according to the agreements taken between the company and the building administrators. Each HU

has a defined power, whose ca- pacity depends on the dimension of the buildings served. If a building administrator, appointed by the apartment owners, chooses to utilize the service, they must contact the company. The company will offer various options that typically do not involve any installation fees for the HU. The TRL's HU will replace the existing centralized HU and all management and maintenance costs will be covered by the company. Table A.2 reports a list of costs avoided thanks to the TLR system. However, this cost savings opportu- nity is only available if the building already has a centralized HU, as the replacement would not be feasible otherwise. For instance, TRL's HU can not be used in cases where the building has autonomous HUs, since one autonomous HU is located in each apartment. The data set, directly provided by Iren, is com- posed of the entire system, both PI and HU. Due to the sensitive nature of these data for the company, all subsequent representations of the data will be in aggregate form at the census track level. To provide an idea of the granularity and detail of the data, a small sample is shown in Figure 2. For each HU, the data set includes in- formation such as its coordinates, installation date, and power in kilowatts for residential HU only.

FIGURE 3

Notes: The graph plots the incremental variation over time of sale and rent price with respect to 2012, with the standard deviation per semester.

FIGURE 4



Notes: The graph plots the evolution of the activi- ties' variety over time. The value is the areas' aver- age.

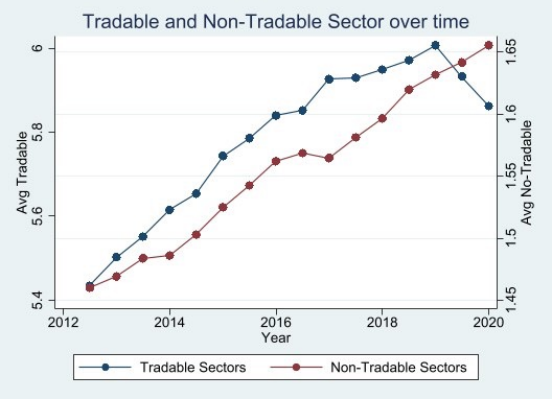


FIGURE 5

Notes: The graph plots the evolution of the activ- ities over time, divided into tradable good sellers and non-tradable services providers. The value is the areas' average.

Lastly, I supplement the primary data sets with additional information that includes time-variant socio-demographic variables from the Turin City Council's statistical department, as well as some time-invariant characteristics from the 2011 National Census.

3. Descriptive statistics

This study is conducted in Turin, Italy, and focuses on 3850 census tracks (see Figure 1) within 23 different neighborhoods. The analysis covers the period from 2012 to 2019, during which the city experienced a significant decrease in real estate prices (see Figure 3), following the average national trend. Over the period of 2012 to 2019, sale prices experienced an average decrease of nearly 25%, with a steeper de- cline observed from 2012 to 2014, followed by a more gradual decline. Similarly, rent prices also decreased, hitting a low point of approximately -15% in 2016. Although the rental prices agreed upon through such arrangements reflect market trends, they exhibit significantly less variation compared to sale prices, indicating a more uniform distribution of prices within the city.

Contrarily, the average number of local economic activities significantly increases over the same pe- riod. Figure 5 illustrates the evolution of tradable and non-tradable sectors over time, with non-tradable sectors being bars, restaurants beauticians and hairdressers, and tradable goods being everything else. The two types of sectors show a similar trend until the latter half of 2018 when tradable sectors experienced a sharp decline. The variety of different goods and services for residents also follows a similar trend, with a consistently increasing supply until a few years before the pandemic when the trend turns. Anecdotally, this decrease in establishments number follows the European trend already started before the pandemic and continued even after (see Figure A.1, A.2 and A.3).

4. Conceptual framework

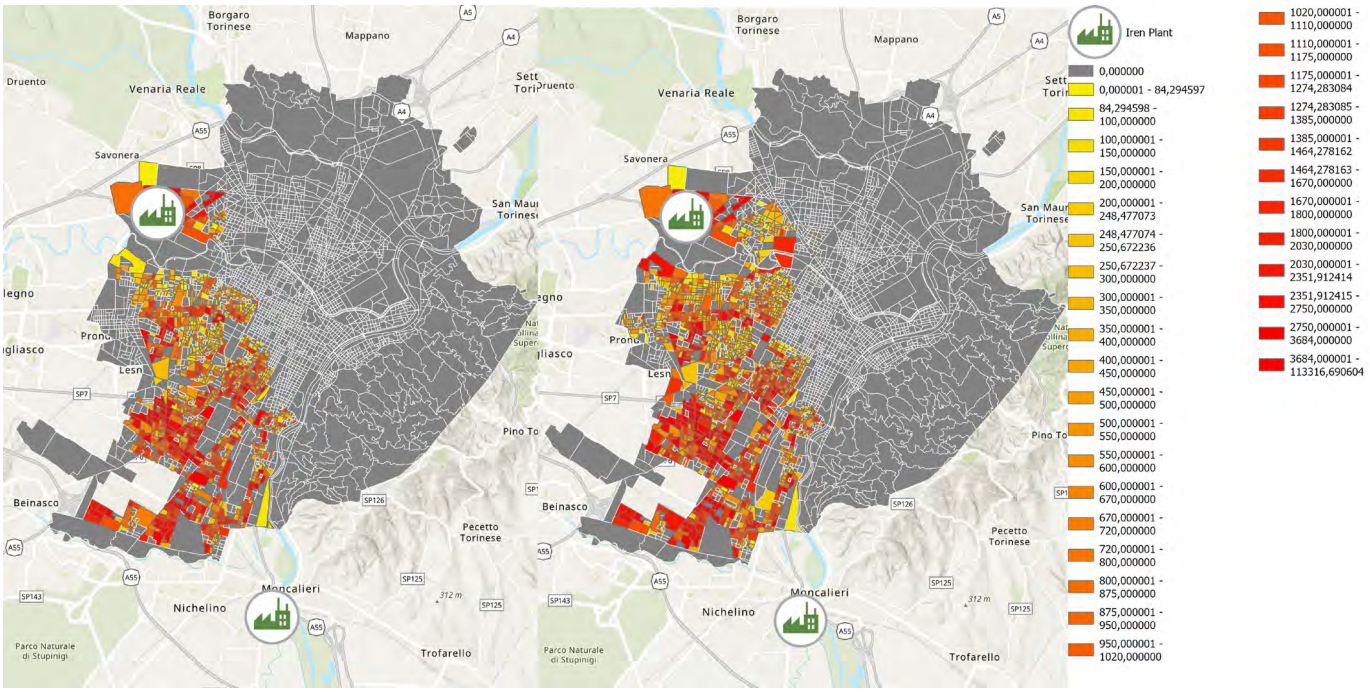
This section presents a conceptual framework to explain how housing prices may impact local economic activities. Additionally, the framework provides guidance for empirical analysis, including considerations around model specification, potential threats to identification, estimation strategies, and the interpretation of results.

I assume two plausible channels through which housing price variation may occur and consequently the effect on the local economic may differ.

Indirect Effect. The first channel is the *Indirect Effect*, which refers to changes in housing prices re- sulting from shifts in demand. Such changes may stem from gentrification processes that alter the average income in the area, such as shifts in population density, population composition, consumer behaviours, or a combination of these factors. Assuming that demand increases, this would lead to an increase in housing prices, thereby boosting the profits of local economic activities. As a result, both tradable good sellers and non-tradable service providers may see an increase in the number of activities due to positive profits. Given this increase in activities, it is plausible to assume that the variety of activities provided in the area should also increase.

Direct Effect. The second channel, the *Direct Effect*, identifies the unambiguous impact of housing prices on the endogenous consumption amenities in the city. Unlike the *Indirect Effect*, this channel is not influenced by any other confounding factors. Therefore, an increase in housing prices would lead to higher costs for activities, such as higher rental costs, which may cause marginal activities to exit the market, while incumbents may not enter the market. The effect on the variety of activities in the area is less predictable since the impact induced by demand shifts is not considered.

FIGURE 6 • A) KWATT OF TLR SUPPLIED IN 2012 (LEFT) - B) KWATT OF TLR SUPPLIED IN 2019 (RIGHT)



Notes: Distribution of TLR across the city, the colour of the census tracks is proportional to the power of TLR supplied in the area. The grey area does not have TLR.

5. Empirical strategy

The objective of this study is to determine the impact of real estate prices on urban economic activity. In Section 4, I presume two possible channels that may result in a shift in the activities distribution, the *Direct* and *Indirect Effect*. The baseline specification aims to identify *Direct Effect*, therefore I rely on the following panel fixed effect model:

$$Y_{ikjt} = \beta log(P)_{ikjt} + \gamma X_{ikjt} + \mu_k + \delta_j + \tau_t + \theta_{jt} + \epsilon_{ikjt} \quad (1)$$

The dependent variable is denoted by *log(Y)ikjt*, which is the logarithm of the outcome variable in a specific census tract *i* and neighborhood *k*, at a given semester *j* and year *t*. The independent variable of interest is denoted by *log(P)ikjt*, which is the logarithm of housing prices in the same census tract *i* and neighborhood *k*, at semester *j* and year *t*. Since the rent market price is regulated, the focus is on sale prices. The model includes semester and year fixed-effects, denoted by δ_j and τ_t, respectively. ϑ_{jt} refers to the interaction between the semester and year fixed-effects. While the observations in this study are at the census track level, the model incorporates neighborhood fixed-effects, represented by μ_k, as gentrification changes typically occur at the neighborhood level (Vigdor *et al.* 2002). However, I include a set of control variables, X_{ijt}, at the census tract level, to control as possible for differences across census tracts and to rule out as much as possible the *Indirect Effect*. The control variables account for differences such as sociodemographic time-variant characteristics, including the share of foreign residents, young residents (ages 0-30), old residents (over 66 years old), the natural logarithm of population density, and the natural logarithm of the number of families. Additionally, the model includes several time-invariant census tract features from the 2011 National Census, such as the level of education and residential building composition in the area. As a result, β represents the *Direct Effect*.

Eq. 1 has been applied to several outcome. The primary objective of the analysis is to examine the impact of housing prices on the availability of diverse products and services in an area, as it can significantly affect residents' welfare. To achieve this, a variable is constructed, defined as the share of category variety and computed as the number of categories experienced in an area divided by the total number of categories in the dataset. Secondly, the focus shifts to the composition between tradable good sellers and non-tradable service providers, examining changes in their levels due to fluctuations in housing prices.

When trying to identify the causal relationships in Eq. 2, a major concern arises due to endogeneity. Indeed, housing prices may be affected by local economic factors and the variety of products and services available to consumers. Additionally, they may be correlated with unobservable characteristics and census tract specificities, which are grouped into the error term. To address these endogeneity issues, an instrumental variable approach is implemented. This approach leverages the variation in time and space of TLR in terms of power supplied in a given area. The intuition relies on the fact that TLR represents a more cost-efficient option than centralized heating systems (see Table 2). As a result, individuals selling or renting a house may try to capitalize on these savings by raising their asking price. Furthermore, the capitalization effect is expected to be stronger when the amount of kilowatts supplied in the area is higher.

The first stage regression assumes the following structure:

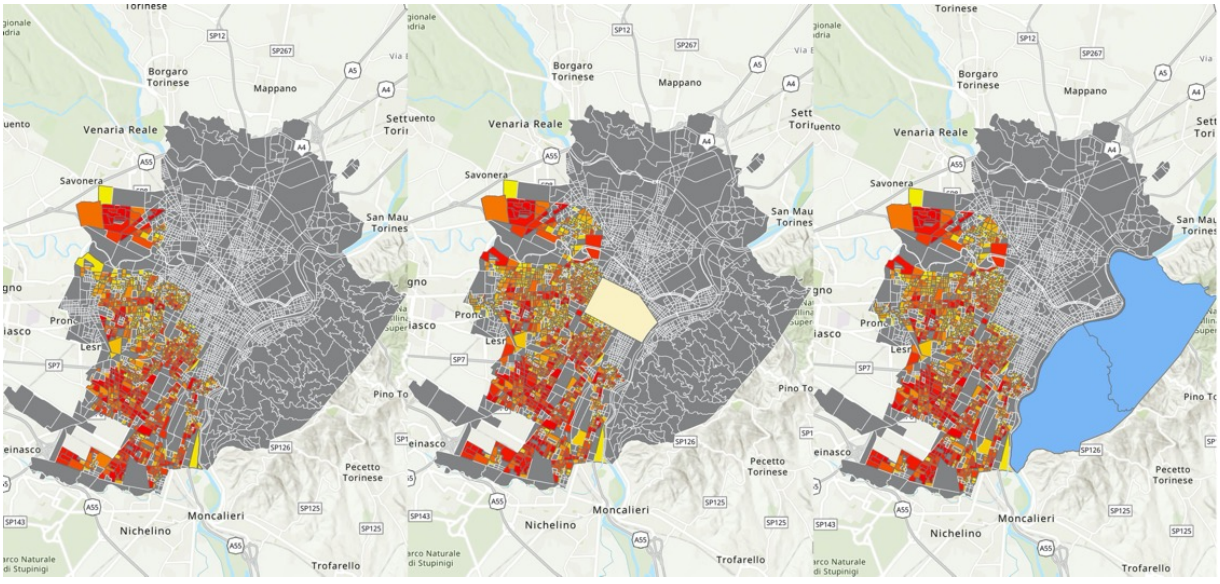
$$log(P)_{ikjt} = \omega\gamma log(TLR)_{ikjt} + X_{ikjt} + \mu_k + \delta_j + \tau_t + \theta_{jt} \qquad (2)$$

where $log(TLR)_{ikjt}$, is computed as the logarithm of the whole HUs power supplied in the census tract. Following the intuition, the coefficient should display a positive effect of TLR on the sale price. Moreover, to test the relevance of the instrument, I provide the F-test of excluded instruments which is well above 10, the standard rule of thumb accepted (Angrist and Pischke 2009). Thus, by employing the instrumental variable approach, Eq. 2 reveals the Direct Effect of the compliers. Standard error are clusterized at the level of the instrument's variation (Abadie *et al.* 2023).

Figure 6 demonstrates how the instrumental variable varies over time and across space during the period analysed. Starting in the 1970s, the TLR was initially constructed to link Iren's plants, creating a network that could connect both facilities. From 2012 to 2019, the firm expanded the system to cover multiple areas in the western part of the city and extended it to the northern zone. Additionally, the intensity of power supplied varied over the years in the census tracks that were already supplied.

The exclusion restriction requires that the TLR power in area i affects the outcome variable solely through its variation in selling or renting price. However, this requirement would be violated if the TRL construction was prioritized based on areas either with higher levels of income or more/less gentrified in general. Nevertheless, this scenario seems unlikely, because the company clearly states that the construction of TLR was determined by a thorough assessment of the costs involved in laying the pipeline and a market analysis of potential customers, specifically those buildings that can convert from centralized HU. This viewpoint is further supported by graphical evidence in Figure 7. The figure shows that Iren made rational decisions to avoid certain areas of the city, such as the Centro and the hilly areas, even though they are some of the richest areas of the city, as shown in Table A.3. Specifically, TLR was not constructed in the neighborhood of Centro, the city centre (see Figure 7b), due to the numerous historical landmarks in the area, which could result in costly delays in construction due to archaeological discoveries.

Figure 7 • (a) kWatt of TLR supplied in 2019 (left) - b) plus the neighborhood Centro (in the middle) - (c) plus the hilly part of the city (right)



Notes: The three plots show the TLR distribution across the city, the colour of the census tracks is proportional to the power of TLR supplied in the area. The grey area does not have TLR. (b) The yellow area is the "Centro" neighborhood of the city. (c) The blue area is the hilly neighborhood of the city.

Similarly, Iren did not expand the TLR network in the hilly part of the city (see Figure 7c) due to the high cost associated with the area's morphological structure.

Another issue arises from Figure 7a, since the instrument may not be randomly assigned among census tracts within the same neighborhood. This is because several census tracts in neighborhoods served by TLR may not be connected to TLR due to either lack of demand in the area (i.e., a census tract with only a public park and no residential buildings) or specific consumer choices or characteristics. To ensure the random assignment of the instrument, Eq 2 includes several control variables, X_{ikjt} that account for the differences across census tracts.

6. Main results

The organization of this section is as follows. First, I present the initial findings from the first stage analysis, examining both sale and rent prices. Second, I present the baseline results for the considered outcome variables. Third, I investigate how the effects vary for all outcome variables by subsampling the dataset in response to differences across the city. Finally, I conduct an empirical analysis to assess the plausibility of potential mechanisms that could drive changes in demand and results in in housing prices.

TABLE 1 • FIRST STAGE OF IV ESTIMATES - TLR VERSUS SALE AND RENT PRICES

	(1) First Stage - Sale	(2) First Stage - Rent
log(TLR)	0.0045***	-0.0005***
	(0.0002)	(0.0002)
Sociodem. Control	Yes	Yes
Census 2011 Control	Yes	Yes
Buildings Control	Yes	Yes
Semester FE	Yes	Yes
Year FE	Yes	Yes
Semester*Year FE	Yes	Yes
Neighborhood FE	Yes	Yes
Number of Obs.	61568	61568
KP F-statistic	580.593	10.169

TABLE 2 • OLS AND IV ESTIMATES - SHARE OF VARIETY VERSUS SALE PRICE CHANGES

	(1) OLS	(2) IV	(3) IV
log(Sale Price)	0.0178***	2.4113***	0.1357***
	(0.0030)	(0.1292)	(0.0340)
Sociodem. Control	Yes	No	Yes
Census 2011 Control	Yes	No	Yes
Buildings Control	Yes	No	Yes
Semester FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Semester*Year FE	Yes	Yes	Yes
Neighborhood FE	Yes	Yes	Yes
Number of Obs.	61568	61568	61568
Mean in 2019	0.1120	0.1120	0.1120
1% Increase wrt Mean	0.15%	21.5%	1.2%

Notes: The Table reports the OLS and IV specifications. Significance is indicated by * p<0.1. ** p<0.05, and *** p<0.001. Standard errors, in parenthesis, are clustered at the level of IV's variation. Controls are grouped in i) Sociodem. Control includes the share of foreign residents, the share of young residents (0y-30y), the share of old residents (more than 66y), the log of population density, the log number of families; ii) Cesus 2011 Contr includes the share of illiterates people in 2011, the share of people with a primary school licence in 2011, the share of people with secondary school license in

2011, the share of undergraduate people in 2011, the share of graduate people in 2011, and log of families in rent apartment in 2011; iii) Building Control includes the log number of residential buildings in 2011, log number of residential building construction in the 80s, log number of residential building construction in the 90s, log number of residential building construction in the 00s.

6.1 First stage results

Before proceeding to the regression results, Table 1 displays the first stage results, Eq. 2, both for sale and rent prices, in their most demanding specification, including semester, year, semester-year, and neighborhhod fixed effect, beyond sociodemographic, 2011 National Census and Buildings controls. The results for sale prices are as expected, indicating that an increase in the instrumental variable leads to an average rise in sale prices. This finding supports the intuition that housing owners attempt to capitalize on their cost savings through the TLR. Additionally, the instrument appears to be strong, with an F-statistic considerably greater than 10. In contrast, column (2) reports a less consistent outcome. Changes in TLR power in the area seem to imply an average negative effect on rent prices, and the instrument loses power compared to the previous case. Nevertheless, this result is also expected since the rental price market is regulated, and the instrument's loss of power is predictable.

6.2 Baseline results

The expected results, as rationalized in Section 4, are presented in the following findings. Table 2 displays the outcomes of a panel fixed effect model (Eq. 1), which examines the impact of sale price on the share of product/service varieties within cities. The dependent variable is defined as the ratio of the number of single categories provided in the area to the categories exhibited in the dataset. The OLS coefficient, Column (1), is positive and significant, but suffers from reverse causality and omitted variable bias. Therefore, Columns (2) and (3) integrate the instrumental variable approach to solve these issues and report the IV results, which capture the effect on the compliers. Column (3) presents the *Direct Effect* of the sale price on variety, accounting for demand differences across areas through the control variables. The findings indicate that a 1% increase in sale price leads to a significant 0.0013 units increase in share variety, representing a 1.2% variation in the variety share mean. In contrast, Column (2) combines the *Direct* and *Indirect Effect* of the sale price on the compliers, with no control variables. The baseline specification in the instrumental variable extension, Eq. 2, uses control variables to tackle demand-induced effects on the housing price shift and control for heterogeneous characteristics across census tracks. As a result, the coefficient is biased and serves as an upper bound. The outcome is still positive and significant, but the effect is more than 20 times greater than that of Column (3). Comparing the effects in Columns (2) and (3), it is observed that the control variables reduce the coefficients' magnitude, indicating a considerable positive impact of housing prices driven by demand and city gentrification processes. However, despite controlling for as many variables as possible, the significant difference in coefficients suggests that any omitted variables not considered in the model would

further decrease the magnitude. Hence, the effect presented in Column (3) can be considered an upper-bound effect of housing prices on the share of variety in the area.

TABLE 3 • OLS AND IV ESTIMATES - NUMBER OF TRADABLE PRODUCT SELLERS/ NON-TRADABLE SERVICE PROVIDERS VERSUS SALE PRICE CHANGES

	Tradable Sectors			Non-Tradable Sectors		
	(1) OLS	(2) IV	(3) IV	(4) OLS	(5) IV	(6) IV
log(Sale Price)	0.8216***	137.9139***	-5.0821**	0.0631	26.8976***	-5.6798***
	(0.2291)	(2.4078)	(2.4091)	(0.0787)	(0.7672)	(0.8445)
Sociodem. Control	Yes	No	Yes	Yes	No	Yes
Census 2011 Control	Yes	No	Yes	No	No	Yes
Buildings Control	Yes	No	Yes	No	No	Yes
Semester FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Semester*Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Neighborhood FE	Yes	Yes	Yes	Yes	Yes	Yes
Number of Obs.	61568	61568	61568	61568	61568	61568
Mean in 2019	55150	55150	55150	20031	20031	20031
1% Increase wrt Mean	0.15%	25.00%	0.92%	0.03%	13.42%	-2.83%

Notes: The Table reports the OLS and IV specifications. Significance is indicated by * p<0.1. ** p<0.05, and *** p<0.001. Standard errors, in parenthesis, are clustered at the level of IV's variation. Controls are grouped in i) Sociodem. Control includes the share of foreign residents, the share of young residents (0y-30y), the share of old residents (more than 66y), the log of population density, the log number of families; ii) Cesus 2011 Control includes the share of illiterates people in 2011, the share of people with a primary school licence in 2011, the share of people with secondary school license in 2011, the share of undergraduate people in 2011, the share of graduate people in 2011, and log of families in rent apartment in 2011; iii) Building Control includes the log number of residential buildings in 2011, log number of residential building construction in the 80s, log number of residential building construction in the 90s, log number of residential building construction in the 00s.

Table 3 illustrates the impact of sale prices on the number of tradable goods sellers (Columns 1-3) and non-tradable services providers (Columns 4-6). As in the previous table, both OLS and instrumental variable estimates are provided for each dependent variable. With regards to tradable goods sellers, the OLS result, Column (1), is biased due to endogeneity. However, the expected negative Direct Effect in Column (3) is significant. An increase of 1% in the sale price corresponds -0.92% variation in the number of tradable product sellers mean. Column (2) reports the *Direct* and *Indirect Effect* combined, although the coefficient is an upper bound due to omitted variable bias, as previously explained. Despite this, the effect is significant, with

a substantial magnitude. A 1% increase in the sale price corresponds to a 25% variation in the average number of tradable product sellers. However, the comparison between Columns (2) and (3) indicates that the effect induced by demand changes is great and that the identified *Direct Effect* is likely an upper-bound effect.

The findings for non-tradable service providers are similar to those of tradable goods sellers. Endogenous issues persist in the OLS specification. However, the instrumental variable results demonstrate the effect on compliers. In the most rigorous specification (Column 6), the effect is negative and highly significant, resulting in a -2.83% change in the mean of the non-tradable sectors due to a 1% increase in housing prices. Conversely, the effect biased by demand is positive and significantly greater than zero in Column (5). A 1% increase in the sale price corresponds to a variation of around 13% in the mean number of tradable product sellers. The effect in non-tradable sectors appears to be smaller than in tradable sectors in Column (2), but the *Indirect Effect* has still a significant and high impact, moreover, the *Direct Effect* specification is likely to be an upper-bound effect.

The impact of different combinations of control variables on the results is presented in Tables A.4, A.5, and A.6. The findings suggest that the results are highly responsive to time-varying sociodemographic variables. However, introducing even a single additional variable leads to a significant reduction in the coefficients.

The analysis yields three primary findings. Firstly, real estate prices have a significant positive impact on product and service variety. Secondly, changes in housing prices elicit a similar negative response from both tradable goods sellers and non-tradable service providers. Lastly, the effect of gentrification on both sectors, tradable and non-tradable, is substantial.

6.3 Heterogeneous effect

The baseline results indicate a massive impact of housing price changes induced by the demand side. In this section, I explore how this effect varies across areas, specifically by examining the IV specification, Eq. 2, without control variables, which includes both the *Direct* and *Indirect Effect*. I focus on two vari- ables, the share of college-educated individuals and population density, as they are representative of both demographic and gentrification patterns in the city. I extracted their distribution per area in 2011 and subsampled the initial sample based on quartiles of each variable.

Since the level of education is a reasonable proxy for the level of income in that area, the first quar- tile of the share of college-educated individuals includes areas that were poorer in 2011, while the fourth quartile includes the richest ones. Table 4 in Panel A reports the results on the share of variety supplied in each area. The findings indicate that the increase in variety supplied due to an increase in sale price is much lower in the richest areas (see Columns 4 and 5), whereas the overall effect is driven by poorer areas (see Columns 2 and 3). For the tradable sectors, the effect is primarily driven by the second quartile, although it is also high for the first and third quartiles. In contrast, for non-tradable activities, the greatest effect is observed in the poorest areas of the city as the share of product/service variety. these results sug- gest that tradable and

non-tradable activities are affected differently in different areas. Tradable sectors are highly influenced by housing prices in low and medium-income zones, whereas non-tradable services are primarily fostered in low-income zones. Notably, all specifications indicate highly significant coefficients.

Regarding the population density, the first quartile consists of sparsely populated areas in 2011, while the fourth quartile includes densely populated areas in the same year. Table 4 in Panel B shows that the sale price has a significant effect on the variety of local products and services in thinly populated areas. Similarly, the effect on tradable sectors is still stronger in the first quartile of the population distribution. However, non-tradable activities are highly impacted by sale prices in both the first and second quartiles, and the effect is negative in the last part of the distribution (see Column 5). Even in this setting, the results are significant, and there seems to be a difference in the impact between tradable and non-tradable activities, with the latter mostly affected in the first and second quartiles, while tradable sectors are affected only in the first quartile.

TABLE 4 • IV ESTIMATES - EFFECT OF THE SALE PRICES ON THE OUTCOMES

Inp. Var: log(Sale Price)					
	(1)	(2)	(3)	(4)	(5)
Quartile	All	1^{st}	2^{nd}	3^{rd}	4^{th}
Panel A Share College Student 2011 Distribution					
Dep var:					
Variety Share	2.4113***	3.9416***	3.8195***	1.5719***	0.3861***
Tradable	137.9139***	125.1159***	204.9355***	97.7083***	25.8370***
Non-Tradable	26.8976***	83.1140***	55.8328***	10.0060***	5.9010***
Panel B: Population density Distribution					
Dep Var:					
Variety Share	2.4113***	1.5880***	0.8004***	0.5580***	0.1712***
Tradable	137.9139***	89.6540***	38.3452***	34.3494***	8.0171***
Non-Tradable	26.8976***	30.6740***	21.6251***	12.2073***	-9.0449***
N	61568	15392	15392	15392	15392

Notes: The Table reports the IV specifications. Significance is indicated by * p<0.1. ** p<0.05, and *** p<0.001. Standard errors, in parenthesis, are clustered at the level of IV's variation. All specifications do not include control variables. Fixed effects: semester, year, semester*year and neighborhhod.
Panel A subsamples the dataset following the distribution of the share of college students across areas in 2011. Panel B subsamples the dataset following the distribution of the population density across areas in 2011.

TABLE 5 • OLS ESTIMATES - (1) POPULATION DENSITY EFFECT ON THE SALE PRICES - (2) CROSS-SECTIONAL EFFECT OF THE SHARE OF COLLEGE PEOPLE ON THE HOUSE PRICE IN THE FIRST SEMESTER OF 2012

	(1) OlS - Panel	(2) OLS - Cross-sectional
Pop. Density	165.3327***	
	(2.0916)	
Share Collage 2011		6.2893***
		(0.9224)
Semester FE	Yes	No
Year FE	Yes	No
Semester*Year FE	Yes	No
Neighborhood FE	Yes	No
Number of Obs.	61568	3848

Notes: The Table reports OLS specifications. Significance is indicated by * p<0.1. ** p<0.05, and *** p<0.001. Standard errors, in parenthesis, are clustered at the level of IV's variation. (1) The OLS applies to the whole panel dataset and shows a positive correlation between population density and sale prices. (2) The OLS applies just to the first semester of 2012 and shows a positive correlation between the share of college students and sale prices.

6.4 Mechanisms

In this section, I aim to examine possible demand channels that could account for the impact of housing prices on local economic activities. While (Stroebel and Vavra 2019) explore several mechanisms in their study, their research question differs from mine. Nevertheless, they identify several demographic and gentrification patterns that could result in shifts in population density, changes in population com- position, and changes in consumer behavior. In my study, I focus on analyzing the first two mechanisms. Unfortunately, I don't have sufficient data to examine changes in consumer behavior.

To investigate the possible mechanisms, Table 5 reports the results for two different exercises. In Column (1), I examine the correlation between population density and sale prices. The results indicate a high magnitude and a high degree of significance for the coefficient, supporting the idea that population density is a plausible mechanism through which demand could influence housing prices. In Column (2), I look at the correlation between the share of college students and housing prices. However, since I only have information on the education level for 2011, the coefficient reports the results of a cross-sectional OLS only considering the first semester of 2012. Nonetheless, the positive magnitude and significance of the coefficient suggest that differences in population composition could also be a mechanism affecting housing prices.

7. Conclusions and next steps

This project examines the impact of housing prices on local economic activity. Unlike previous research, which has mainly focused on a single retail market (grocery stores), this paper looks at the effect on the entire range of products supplied to consumers, retailers and services. The study specifically investigates the effects of real estate prices on both the variety of products and services offered and changes with sector composition, distinguishing between tradable and non-tradable. To establish causality, an instrumental variable approach is used, exploiting the unique features of Turin's "Teleriscaldamento" system. The empirical strategy allows identifying both *Direct Effect* of housing price changes and *Indirect Effect*, namely changes induced by either demand shifts or gentrification processes in general. The findings indicate that sale price changes, as *Direct Effect*, positively foster the variety of products/services supply. However, the effect is negative on tradable good sellers and non-tradable service providers. The results indicate that demographic and gentrification processes have a significant and positive impact on local economic activities in both cases. This impact is particularly strong in sparsely populated and economically poorer areas for tradable activities, while in areas with low to medium population density and low medium income, the effect is more pronounced. Moreover, I found that both population density and income composition mainly affect housing prices when evaluating the *Indirect Effect*.

Overall, the study's results provide insights into the role of neighborhood changes and their reshaping effect on cities, highlighting local benefits and costs that can influence policy development. Additionally, these findings contribute to the public debate surrounding gentrification processes, in cities and in the retail market, and the possible next steps to take.

There are still many tasks that need to be accomplished. Further research is required to explore these mechanisms, and several potential exercises exist for this purpose, though they may require additional data. In addition, the empirical analysis should be subject to further examination. While the instrumental variable used appears to be robust, conducting more balance tests could provide additional support. Although the instrumental variable used seems robust, conducting more balance tests could provide addi- tional support for the results. Notably, the OLS and IV specifications reveal a discrepancy, and identifying the compliers could help to further support the findings. Lastly, several robustness checks are required to ensure the reliability of the results.

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Appendix

FIGURE A.1 • NEWSPAPER ARTICLE PUBLISHED BY THE GUARDIAN ON 2 MAY 2019

Retail industry

This article is more than **3 years old**

Thousands of UK shops left empty as high street crisis deepens

Data suggests closures of banks, pubs, estate agents and fashion stores is biggest rise in five years

Sarah Butler
@whatbutlersaw
Thu 2 May 2019 14.42 BST

FIGURE A.2 • NEWSPAPER ARTICLE PUBLISHED BY LA REPUBBLICA ON 28 FEBRUARY 2023

Commercio, 100mila negozi chiusi negli ultimi 10 anni in Italia

di Caterina Maconi

Aumentano le aperture di ristoranti e alberghi, ma non riescono a compensare il deficit. Cresce la presenza straniera, sia come numero di imprese che di occupati

28 FEBBRAIO 2023 ALLE 12:50

1 MINUTI DI LETTURA

Translation: Commerce, 100,000 shops closed in the last 10 years in Italy.

FIGURE A.3 • NEWSPAPER ARTICLE PUBLISHED BY EL PAIS ON 10 FEBRUARY 2023


EL PAÍS Economía SUSCRÍBETE INICIAR SESIÓN

EMPRESAS >

El cierre de empresas en España en 2022 batió récords: 26.207 disoluciones, un 10% más

Las disoluciones mercantiles superaron la cota más alta alcanzada hasta la fecha, de 2013

Translation: Company closures in Spain in 2022 hit a record: 26,207 closures, a 10% more.

FIGURE A.1 • LIST OF LICENSE CATEGORIES IN THE DATASET

Category	Category
Animals Articles	Automatic Machines
Appliances and Electronics	Bar and Restaurants
Building Material	Candies
Children Articles	Clothing
Cosmetics and Perfumery	Coffee Pods
Extralimentary	Food
Fabrics and Rugs	Gift Articles
Flowers and Plants	Hairdressers and Beauticians
Fuels	Mixed
Furniture	Objects
Games	Second Hand
Hardware Store	Sport Articles
Health and Orthopedic Articles	Supermarkets
Home Articles	Newspapers
House and Person Hygiene Articles	Optics
Jewellery	Pharmacy and Herbalist Articles
Laundry	Photography
Libraries	Sexy Shop
Motor and Car	Spare Accessories
Musical Instruments	Stationery Articles
Tobacco	

TABLE A.2 • LIST OF COSTS AVOIDED WITH THE TLR

Cost	approx.
System installation	20000€/installation
Ordinary boiler maintenance	5000€/year
Reading and repairing the boiler	600€/year
Extraordinary interventions	depending on breakdowns
Fire prevention certification renewal	500€ every 5 years
Boiler renewal	

TABLE A.3 • DESCRIPTIVE STATISTICS PER CITY AREA

	All Tracks without Centro & Hill			Centro & Hill			All Tacks		
Share of graduate people in 2011	50896	.1285054	.1101622	10672	.2608681	.1596865	61568	.1514488	.1302394
Share of undergraduate people in 2011	50896	.2529958	.1199731	10672	.2343875	.1320833	61568	.2497703	.1223601
Share of people with secondary school license in 2011	50896	.2416164	.1232215	10672	.1479094	.1014285	61568	.2253735	.1248719
Share of people with a primary school licence in 2011	50896	.1339976	.0785082	10672	.0819234	.0702353	61568	.1249712	.0796161
Share of illiterates people in 2011	50896	.0067286	.0124406	10672	.0032928	.0121921	61568	.0061331	.0124658

TABLE A.4 • IV ESTIMATES - SHARE OF VARIETY VERSUS SALE PRICE CHANGES

	(1) IV	(2) IV	(3) IV	(4) IV	(5) IV
log(Sale Price)	2.4113***	0.0817***	0.6174***	1.2946***	0.1357***
	(0.1292)	(0.0299)	(0.0375)	(0.0776)	(0.0340)
Sociodem. Control	No	Yes	No	No	Yes
Census 2011 Control	No	No	No	Yes	Yes
Buildings Control	No	No	Yes	No	Yes
Semester FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Semester*Year FE	Yes	Yes	Yes	Yes	Yes
Neighborhood FE	Yes	Yes	Yes	Yes	Yes
Number of Obs.	61568	61568	61568	61568	61568

Notes: The Table reports the IV specifications. Significance is indicated by * p<0.1. ** p<0.05, and *** p<0.001. Standard er- rors, in parenthesis, are clustered at the level of IV's variation. Controls are grouped in i) Sociodem. Control includes the share of foreign residents, the share of young residents (0y-30y), the share of old residents (more than 66y), the log of population

density, the log number of families, ii) Cesus 2011 Contr includes the share of illiterates people in 2011, the share of people with a primary school licence in 2011, the share of people with secondary school license in 2011, the share of undergraduate people in 2011, the share of graduate people in 2011, and log of families in rent apartment in 2011 iii) Building Control includes the log number of residential buildings in 2011, log number of residential building construction in the 80s, log number of residential building construction in the 90s, log number of residential building construction in the 00s.

TABLE A.5 • IV ESTIMATES - NUMBER OF TRADABLE PRODUCT SELLERS VERSUS SALE PRICE CHANGES

	(1) IV	(2) IV	(3) IV	(4) IV	(5) IV
log(Sale Price)	137.9139***	-6.7581***	25.0513***	69.4324***	-5.0821**
	(7.7028)	(2.1452)	(2.4078)	(4.6403)	(2.4091)
Sociodem. Control	No	Yes	No	No	Yes
Census 2011 Control	No	No	No	Yes	Yes
Buildings Control	No	No	Yes	No	Yes
Semester FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Semester*Year FE	Yes	Yes	Yes	Yes	Yes
Neighborhood FE	Yes	Yes	Yes	Yes	Yes
Number of Obs.	61568	61568	61568	61568	61568

Notes: The Table reports the IV specifications. Significance is indicated by * p<0.1. ** p<0.05, and *** p<0.001. Standard errors, in parenthesis, are clustered at the level of IV's variation. Controls are grouped in i) Sociodem. Control includes the share of foreign residents, the share of young residents (0y-30y), the share of old residents (more than 66y), the log of population density, the log number of families, ii) Cesus 2011 Contr includes the share of illiterates people in 2011, the share of people with a primary school licence in 2011, the share of people with secondary school license in 2011, the share of undergraduate people in 2011, the share of graduate people in 2011, and log of families in rent apartment in 2011 iii) Building Control includes the log number of residential buildings in 2011, log number of residential building construction in the 80s, log number of residential building construction in the 90s, log number of residential building construction in the 00s.

TABLE A.6 • IV ESTIMATES - NUMBER OF NON-TRADABLE SERVICE PROVIDERS VERSUS SALE PRICE CHANGES

	(1) IV	(2) IV	(3) IV	(4) IV	(5) IV
log(Sale Price)	26.8976***	-5.5159***	0.2429	11.6500***	-5.6798***
	(1.7547)	(0.7434)	(0.7672)	(1.1814)	(0.8445)
Sociodem. Control	No	Yes	No	No	Yes
Census 2011 Control	No	No	No	Yes	Yes
Buildings Control	No	No	Yes	No	Yes
Semester FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Semester*Year FE	Yes	Yes	Yes	Yes	Yes
Neighborhood FE	Yes	Yes	Yes	Yes	Yes
Number of Obs.	61568	61568	61568	61568	61568

Notes: The Table reports the IV specifications. Significance is indicated by * p<0.1. ** p<0.05, and *** p<0.001. Standard errors, in parenthesis, are clustered at the level of IV's variation. Controls are grouped in i) Sociodem. Control includes the share of foreign residents, the share of young residents (0y-30y), the share of old residents (more than 66y), the log of population density, the log number of families; ii) Cesus 2011 Contr includes the share of illiterates people in 2011, the share of people with a primary school licence in 2011, the share of people with secondary school license in 2011, the share of undergraduate people in 2011, the share of graduate people in 2011, and log of families in rent apartment in 2011; iii) Building Control includes the log number of residential buildings in 2011, log number of residential building construction in the 80s, log number of residential building construction in the 90s, log number of residential building construction in the 00s.