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Real Estate Market in Studentified Neighborhoods

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The empirical part is based on Ella R. Diamant's M.Sc. thesis in Economics, Technion, Haifa, ISRAEL.

Abstract

This work explores the impact of "studentification" of a neighborhood on the housing market. The study breaks down the impact of students on the real estate market into two areas: apartments for sale and apartments for rent.

The Israeli housing market provides data for the empirical analysis. In this market 71% reside in owner-occupied apartments and the others are renters.

The classical urban economics claims that purchasing or renting an apartment close to CBD will save on commuting costs and on time of travel. Similarly, we can argue that students renting an apartment adjacent to an academic institution (a studentified neighborhood) will be willing to pay a higher rent and landlords will be willing to pay more for a house.

A contrary argument is that students are poorer than the average population. Their willingness to pay for rent is lower, and the landlords will decrease their willingness to pay for houses for investment.

Our hypothesis in this paper is that there is difference between owner-occupiers and students. While students want to rent adjacent to academic institutions, owner-occupiers

have an aversion to reside adjacent to students due to the fear that they are noisy, generate litter, and have negative effect on the neighborhood. They try to avoid residing next to campus.

The alternative scenarios are examined empirically in a case study of rents and housing prices in Haifa, Israel. Data on real estate transactions (value of rents and price of housing units) in neighborhoods in Studentified and Non-Studentified neighborhoods is collected.

Results of the econometric analysis confirm our hypothesis. Rents are higher and housing prices are lower adjacent to this academic institution. We conclude that we have to study owner occupiers and investors in housing separately since their motivation is different.

Introduction

This study examines the impact of "studentification" on the price of housing in neighborhoods adjacent to academic institutions. Investing in housing can provide the owner with a place of residence (owner-occupier). It can be an instrument of investment either by letting it to renters and collecting rents (landlords) or due to change in the value of the asset (investors) or combination of the above.

Studentification is the phenomenon in which large number of students moves to traditionally non-student neighborhoods, mostly after a university is located in the vicinity. They affect various aspects of behavior and have an impact on the character of the neighborhood: the nightlife in the area, the level of fertility, level of employment, education and countless other aspects. Students are often blamed for ill effects: litter, neglect, noise, vandalism, etc. These changes are expected to affect the neighborhood's housing market and we expect a change in the price of housing

There are contradicting theories regarding the price of housing in studentidfied neighborhoods and consequently contrary hypotheses.

Rugg et al. (2002); Hubbard, (2006); Cortes, A. (2004), argue that in areas adjacent to an educational institution, rents are lower than in equivalent neighborhoods. This argument is derived from the argument that students' income is lower than the average population's income. Similarly, owner-occupiers decrease the demand for housing in the vicinity of academic institutions, due to the aversion from students, discussed below.

An alternative argument is that since neighborhoods turn into "studentified" neighborhoods, (Rugg et al., 2002), landlords will let their properties at a higher price charged from the general public due to the demand generated by students. Although students' population is considered to have a significant bargaining power, students who wish to reside adjacent to campus where they study, have to compete with other populations, in contrary to their residence inside the campus' dormitories. We can argue that since the academic institutions cannot provide the necessary supply of dormitories, students turn to the housing market outside the campus, and become an easy prey in landlords' hands. Thus, in accordance with traditional supply and demand economic theories, the hypothesis is that the students' population will pay a higher price for apartments adjacent to educational institutions, and therefore rents will be higher. According to models by Alonso (1964), Mills (1967) and Muth, (1969), there is a preference and a growing demand for housing adjacent to places of interest like shopping centers, employment locations, etc., since it saves out-of-pocket costs and time of travel. Students will have a high demand for rental units adjacent to academic institutions which results in high rents nearby academic institutions.

Assuming that the students' demand is higher and the rents are higher, landlords' demand will result in higher price of housing.

Can an alternative model be suggested to explain the impact of studentification? What are the impacts on renters, on owner-occupiers? Is it profitable to invest in a studentified neighborhood?

Baron and Kaplan (2010) examine the rental prices in two neighborhoods. One studentified and the other not. They find that the rent prices are lower in the studentified neighborhood contrary to some of the models. This finding is consistent with Rugg, Hubbard and Cortes.

Since we did not have individual data we could not examine the results thoroughly, and we don't know if it results from the lower students' income as suggested.

We argue that owner-occupiers' behavior can explain the empirical results presented below. However, owner-occupiers were neglected as players in the real estate market.

This paper is partly theoretical and partly empirical. Section A is theoretical: Investigating the price of housing, the real estate market. Section B is empirical, and describes results of econometric analysis of rents and housing prices in various neighborhoods. Section C is discussion and conclusions.

A Theoretical Background

A.1 Price of Housing

The price of housing is presented using Hedonic prices (Gundimeda, 2010). The price is reflecting three components: the characteristics of the building (availability of elevator, number of rooms, etc.), the neighborhood characteristics (availability of parks, quality of schools, employment opportunities and the residents' socio-economic characteristics, etc.) and location (the location of the building in terms of the CBD (Central Business District), of employment, universities, etc.)

P=f(ST, N, L)

Where *P* stays for the price of a housing unit (either for rent, Pr, or for investment, Ph); *ST* – is the vector of Structure Characteristics; *N*- the Neighborhood Characteristics and *L*- the Location Characteristics.

Since our concern is the effect of students, as one of the characteristics of the neighborhood, we decompose the neighborhood characteristic and write the function as:

P=f(ST, Stn, N, L)

Where Stn, a variable indicating students

Our hypothesis is that students have an effect on the real estate market, which can be either positive or negative (as is discussed above). The effect of students can reflect their number, a quantitative variable, or just their residence in the neighborhood, a dummy variable.

A.2 Real Estate Market

We look on real estate market as composed of three players: renters, owner-occupiers and investors. The objective functions of each player is as follows:

Renters are maximizing the utility function when they are faced with the rent (see Section A.1, price of housing), the quantity rented, and composite good, given their income constraint.

Denoting qr- rented quantity; Pr- price of rental unit, I- income, Z- composite good; Price of composite good, Pz=1

Max U(qr, z)

s.t Pr qr + Z ≤ I

Owner-occupiers are maximizing their utility function when they are faced with the price of a housing unit and their income constraint.

In the resources' constraint they care about the change of the price of housing over time, since it affects their resources. They will gain with an increase in price of housing or lose, if the price decreases. They are more worried than landlords (investors) about changes in the neighborhood since they bear high transaction costs moving from one neighborhood to another. Moving of students into the neighborhood affects them negatively or positively. We assume that the dominant effect is negative.

Denoting qh- quantity of a housing unit; Ph- price of a housing unit;

Max U(qh, Z, Stn)

s.t. $Ph\ qh + Z \leq I + PV\ (Ph1 - Ph0)\ qh$

The resources' constraint is the household's income plus the present value (PV) of the change (increase / decrease) in the value of the housing unit. If the price of a unit decreases the value of the house can be lower than the mortgage on the house. Since owner-occupiers reside in the neighborhood, students' moving-in affects their utility function.

Investors in the real estate market are interested only in profits.

They are letting the housing unit and collecting rents, while incurring maintenance and rehabilitation costs and enjoying a capital gain (loss) if the price of the house changes.

Max Profit= Pr qr – maintenance costs – r Ph qh + PV (Ph1-Ph0) qh

Pr qr – the receipts from rent, the landlord's income; r Ph - the opportunity cost per unit of investing in a housing unit, the price of a housing unit multiplied by the interest rate (r). See A.4. The landlord could deposit the money in a bank and collect interest payment. The change in the value of the housing unit is a major component in the investors' profits. Since the investors don't reside in the neighborhood, we disregard their utility function.

A.3 Impact of Students

A new academic institution moves into the city. What are the impacts of students moving in? Section A.6 discusses various alternatives.

In general, assuming that students want to reside adjacent to an academic institution, the demand of renters is increasing. Assuming that the supply remains unchanged, rents are increasing. If the outlays remain unchanged investors gain higher rents and their profits increase. Their demand for housing units increases.

At the same time the owner-occupiers can be reluctant to the "new comers" due to their ill effects. In this case the demand for housing has two opposite effects. The investors' demand is increasing. However, owner-occupiers decrease their demand.

The aggregate demand for housing can increase or decrease.

If the decrease in the demand for housing by owner-occupiers is dominant to the investors' demand, the price of housing will decrease. (If the increase of investors' demand is dominant, the demand for housing will increase, and the price of housing increases).

In terms of the real estate market we have two opposite effects. The rents increase while the owner-occupiers are moving out of the neighborhood. Since the price of housing decreases, the investors increase the quantity demanded of housing. Dwelling units occupied by owner-occupiers replace ownership, investors are purchasing these units.

We have to investigate the change in the supply curve and its effect. This is a question of short term vs. long term. As we discuss longer horizons the supply curve can shift to between rent and the price of a housing unit, show higher or lower supply, given the same price.

A.4 Investor's Dilemma: In What to Invest?

We consider the dilemma of an investor. The investor considers three options: investing in a long term risk-free bond with real interest rate Rf; investing in a house in a "non-studentified" neighborhood; and investing in a house in a "studentified" neighborhood.

For comparing the alternatives we use two indicators. Rate of Return and Sharpe Index. Rate of Return is the ratio between rent and the price of a housing unit, it disregards risk or assumes it is the same in all options. Sharpe Index (1964, 1966), calculates the present value of revenues per unit of risk. It combines both the revenues of each option and the risk involved.

$S= E[R] – Rf / std$

Where *S*, Sharpe Index; *E[R]* Expected value of returns; *Rf* rate of return on a risk free bond; *std*- standard deviation, a measure of risk.

In the "non-studentified" and the "studentified" neighborhoods, the investor estimates the stream of rents, the outlays on the house, the current price of a housing unit and the expected future price of housing (to estimate the expected growth rate of housing prices)

and calculates the rate of return. The investor has to calculate the risk of each option, measured by the standard deviation of the option, to calculate the Sharpe Index.

If we look upon students as renters, we realize that sometimes they increase the risk to landlords. It happens if the landlords don't succeed in renting apartments to students in the short period when students are searching for an apartment, before the school year starts. In these cases, either the apartment remains unrented for a long period or the landlord has to reduce the price drastically. Alternatively, students may neglect to pay the rent. We have to look upon the risk as depending on studentification, Std (stn)

In terms of landlords, if they have apartments in a studentified neighborhood, the rent is perhaps higher than in a non-studentified neighborhood; however the increased risk decreases the value of Sharpe index.

Investors face three options, and shift their investment to maximize the Rate of Return (or Sharpe Index). In equilibrium the options generate the same value of Rate of Return (Sharpe Index).

A.5 Demand and Supply of Housing

We analyze two markets the demand and supply of rental units and the demand and supply of housing where the price and quantity are respectively in the base period: rent (Pr0), price of housing (Ph0) quantity of rented apartments (qro) and quantity of housing units (qho)

In a studentified neighborhood we have both students renting apartments as well as non-students. The aggregate demand reflects both groups.

A.6 Impact of Studentification: Alternative Outcomes

Scenario I

Rugg et al. (2002); argue that the level of income of students is significantly lower than the income of the average population

The aggregate demand for rental units is lower than in the base case. See Figure 1, Scenario I. In the base case Dro is the demand for rental units and Sro is the supply of rental units. After students locate adjacent to an academic institution, the demand curve moves down to Dr_1. In the short-run the supply curve remains unchanged Sro. The result of studentification is that the rent decreases to Pr1< Pr0. The landlords that experience a decrease of rents lower the demand for housing units for investment. Dh1 is lower than Dho. In the short-run the supply of housing remains unchanged.

Consequently the price of housing Ph1 decreases.

Disregarding risk (alternatively, we can assume that the risk remains unchanged between periods), in the short run equilibrium, the ratio between rent and the price of a housing unit, the rate of return, remains unchanged:

Pro/Pho=Pr1/Ph1;

We argue that in areas adjacent to an educational institution, assuming this scenario, rents and prices of housing are lower than in equivalent neighborhoods further away from campus, in a non-studentified neighborhood.

Scenario II

Classical models in urban economics, Alonso (1964), Mills (1967) and Muth, (1969), argue that there is a preference and a growing demand for housing adjacent to places of interest, like near the CBD (Central Business District), since it saves out-of-pocket commuting costs and travel time. Students will have a high demand for rental units adjacent to academic institutions, due to the saving in money and time. In Figure 1, Scenario II, we see that the demand for rental units increases from Dro to Dr2. In the short-run the supply of rental units remains unchanged, Sro, which results in higher rents. The rent will increase to Pr2. Landlords will increase the demand for housing for investment, Dho moves to Dh2, which results in an increase in the price of housing to Ph2. In the short-run equilibrium (with the same assumptions as in Scenario I) the rate of return remains unchanged. Pr2/Ph2=Pro/Pho.

A Proposed Model: Scenario III

We examine the hypothesis that concentration of renters and landlords does not explain the housing market in a studentified neighborhood. Landlords are indifferent to letting to students, since they are interested only in maximizing revenues, but they suffer a higher risk (See above), which we disregard. Students want to rent adjacent to an academic institution.

Students want to rent houses adjacent to academic institutions; Investors own the houses for rent. We introduce owner-occupiers as a separate player. Owner-occupiers own houses in the same neighborhood, a studentified neighborhood, but are reluctant to reside in the students' vicinity, due to noise and dirt generated by students. On the disadvantages of residing next to campuses (see Cortes, 2004, Hubbard, 2006, Rugg et al., 2002), Owner-occupiers tend to move out of the neighborhood. If the owner-

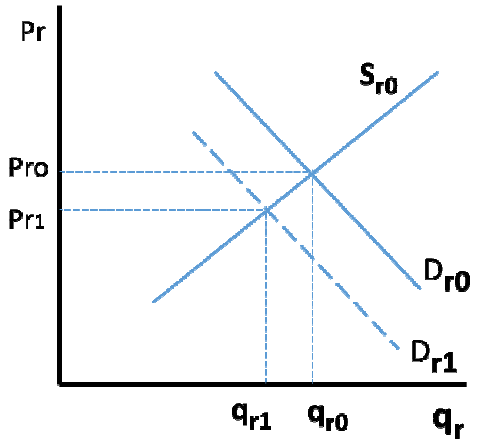
occupiers are dominant, the demand for housing, decreases, and the price of housing for sale decreases. Figure 1, Scenario III describes the short run and the long run. In the short run the supply of rental units remains unchanged. Students' demand increases. The demand of students shifts from Dro to Dr3. The result is an increase in rents to Pr3 (Pr3>Pr0). We decompose the housing market to two players, the demand of investors for housing and the demand of owner-occupiers. In the short run owner occupiers decrease their demand for units. The investors' demand is unchanged or increases. The aggregate demand moves to Dh3. Price of housing units decreases. Ph3<Pho. The Rate of Return, the ratio Pr3/Ph3 increases. Investors realize that the profitability of investing in "studentified" neighborhoods increases.

In the long run, the demand of investors for housing increases. Dh4 is higher than Dho, the result is that Ph4 increases. Despite the reluctance of owner occupiers, in the long run, investors are increasing their investments in a "studentified" neighborhood unless the risk is too high. In the long run both the rent and the price of housing increase. The price of housing units continues to increase, until the Rate of Return returns to its original level.

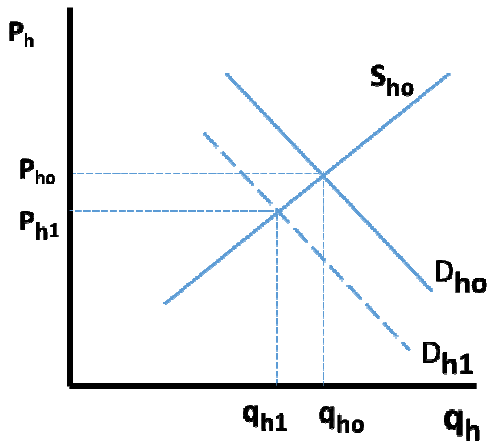
Summary of the Scenarios

Three scenarios were analyzed. We summarize the results in a table

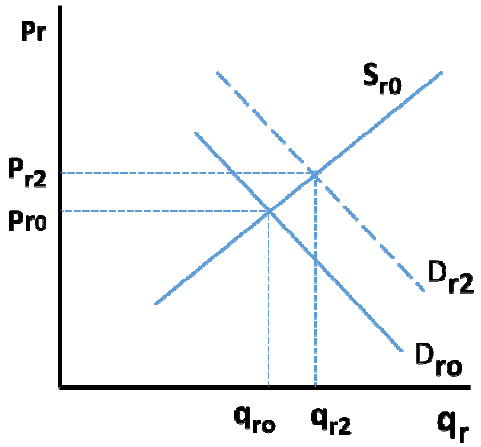
	Housing Prices Increase	Housing Prices Decrease
Rents Increase	Scenario II Scenario III LR	Scenario III SR
Rents Decrease		Scenario I



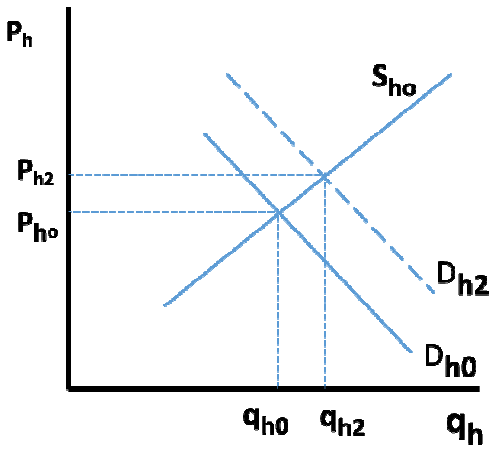
Rental Market Scenario I



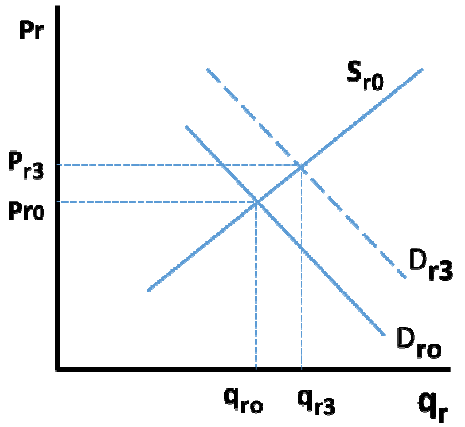
Housing Market Scenario I



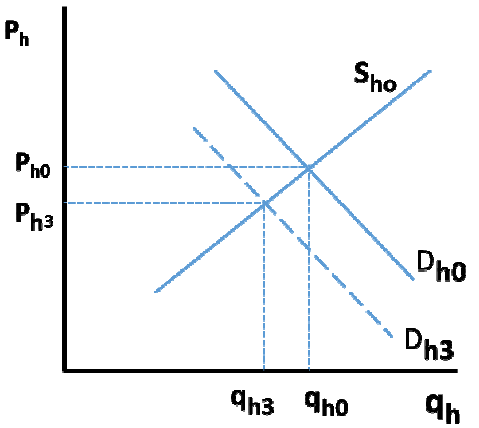
Rental Market Scenario II



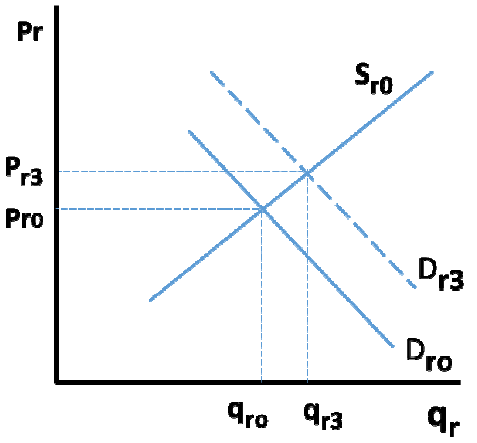
Housing Market Scenario II



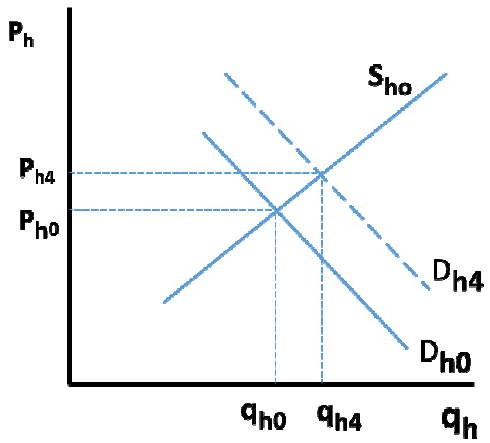
Rental Market Scenario III Short Run



Housing Market Scenario III Short Run



Rental Market Scenario III Long Run



Housing Market Scenario III Long Run

B. Empirical Examination

B.1 The Market for Housing in Israel

The rate of owner-occupied housing in Israel is not much higher than the global averages (Pollock, 2010), as shown in Figure 2. While the rate of home ownership varies in different countries between 35 to 89 percent, in Israel it is 71%.

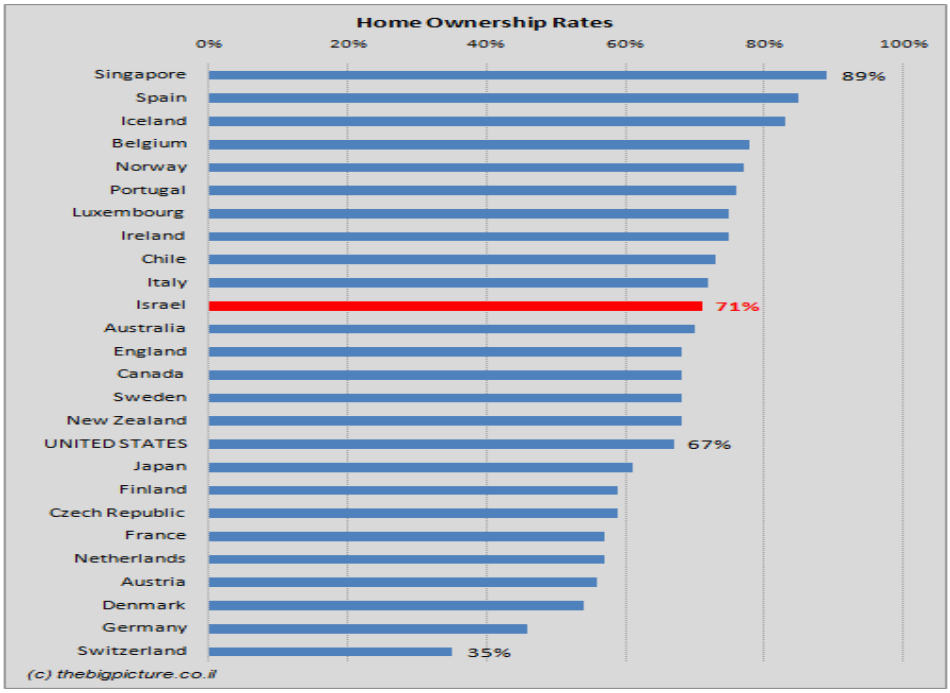


Figure 2: Home ownership rates by country (Pollock, 2010)

B.2 Studentified vs. Non-Studentified Neighborhoods in Haifa Israel

The empirical data is taken from Haifa. Haifa is a city in the north of Israel with a population of 260 thousand, and is the center of a metropolitan area of 500 thousand

people. The city is the home for two institutions of higher education: The Technion - Israel Institute of Technology and the University of Haifa. These two institutions are the home of over 28,000 undergraduate students. (In the last few years a few colleges were opened in the area. We disregard these new institutions and their students since the number of their students is negligible).

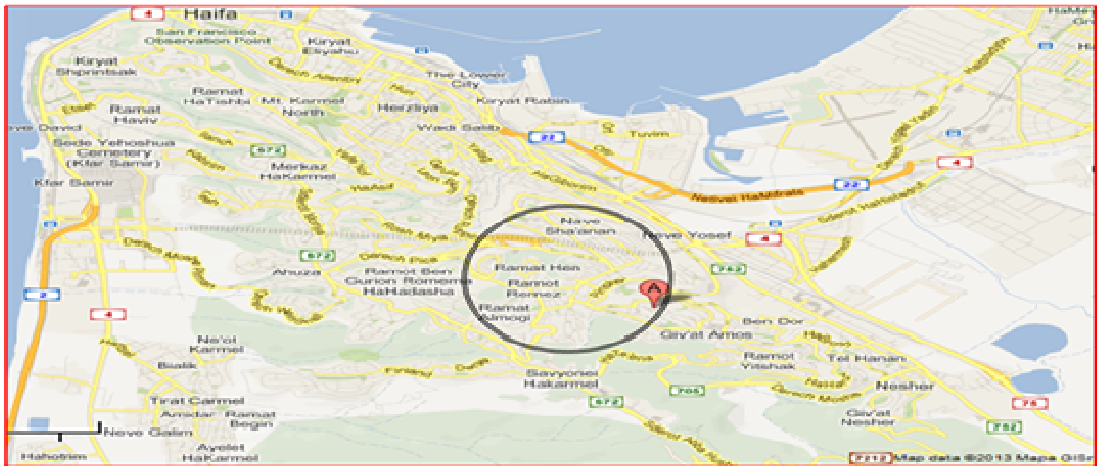


Figure 3: Residential area in Haifa and the area adjacent to the Technion (in circle)

Compared to the population of Israel, students' housing needs are unique. While 71% (Pollock, 2010) of Israeli citizens live in owner occupied apartments, most students are renting apartments or live in dormitories. Therefore, they become significant in the rental market.

We define studentified neighborhoods, as statistical areas (the smallest unit for collecting data, which has about 2000 residents) within 2 km of driving distance from the entrance to the Technion via one of two gates. The rest of the city are non-studentified statistical areas. The studentified neighborhoods are within a circle in Figure 3.

B.3 The Model

The influence of students on the real estate market is examined using hedonic prices of rental units and of apartments for sale, representing the price of housing for investors (landlords) and owner occupiers.

B.4 Datasets

Estimating the model is done using three datasets that were generated using data mining:

A. "Haifa Dataset.dta" - Rental means and selling prices divided into 28 quarterly periods in the years 2005-2011 (Q1 2005 - Q4 2011).
B. "Finaldatabase.dta" - A dataset that includes 5173 observations of rental houses alongside assets for sale in between the years 2005 to 2011 scattered around Haifa.
The data on transactions of rental houses was collected from two sites advertising apartments for rent in the internet (Yad2 and WinWin). The rental price was taken as 95% of the 'asking price'. The data on the price of apartments for sale was collected from a data set issued by the Israeli Tax Authority, Carmen System.

B.5 Empirical Results

The analysis was performed in three phases:

B.5.1 Phase 1 - Comprehensive Analysis of the Real Estate Market in the City of Haifa, Analyzing Means.

An overall picture of the real estate market in the city of Haifa is derived from an analysis of data on means in the housing market in the city (Data A). This analysis was performed on data collected by the Central Bureau of Statistics (CBS) which includes rental prices and price of houses for sale in the period 2005-2011. The data is recorded according to quarters. The purpose of this analysis is to characterize the real estate market in Haifa and form the primary foundation of its characteristics.
To study the housing market of Haifa as a whole, a number of multiple regressions were performed investigating the factors affecting the price of housing.

Source	SS	df	MS
Model	12.8029834	2	6.40149171
Residual	.391335109	81	.004831298
Total	13.1943185	83	.158967693

Number of obs = 84
F(2, 81) = 1325.00
Prob > F = 0.0000
R-squared = 0.9703
Adj R-squared = 0.9696
Root MSE = .06951

lnpricer	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnrentr	-.0037443	.0996269	-0.04	0.970	-.2019706	.1944819
rooms	.4790749	.0263788	18.16	0.000	.4265894	.5315605
_cons	11.66213	.6562377	17.77	0.000	10.35642	12.96784

Table 1: $\ln pricer = \beta_0 + \beta_1 * lnrentr + \beta_2 * rooms$ Regression Results

As shown in Table 1, there is no significant correlation between real housing prices and real rents in Haifa. The number of rooms is the only factor affecting (positively) housing

prices. A positive correlation between rents and prices would suggest that the housing market is an investment-biased market, i.e., the higher the rental prices, the higher the price of housing units for investment resulting from an increase in the demand for housing. The lack of a significant relationship means that the two markets (rental and real estate investment market) are independent.

Examining the factors affecting rents, as shown in Table 2, the number of rooms affects positively, rent increases with each additional room. However, no significant relation exists between real rent and the number of quarters that have passed, i.e. rents increase or decrease over time and don't increase consistently as expected.

Source	SS	df	MS
Model	3.44721775	2	1.72360887
Residual	.478741132	81	.005910384
Total	3.92595888	83	.047300709

Number of obs	= 84
F(2, 81)	= 291.62
Prob > F	= 0.0000
R-squared	= 0.8781
Adj R-squared	= 0.8750
Root MSE	= .07688

lnrentr	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
period	-.0012092	.0010384	-1.16	0.248	-.0032754	.0008569
rooms	.2478192	.0102734	24.12	0.000	.2273784	.26826
_cons	6.593482	.0445619	147.96	0.000	6.504818	6.682146

Table 2: $\ln rentr = \beta_0 + \beta_1 * period + \beta_2 * rooms$ Regression Results

B.5.2 Phase 2 – The Price of Housing and the Impact of Students on Prices

Prior to selecting the independent demographic variables to be included in the hedonic models we explored the complete set of variables and included only those that are significantly correlated to the price and rent of assets in Haifa; other variables were omitted (See Appendix A – a list of all variables).

	"studentified" areas			"non studentified" areas		
Variable	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.
rarabs	1396	.357184	.3077526	3674	.1879631	.154825
rmedianage	1396	.7427015	.0894234	3674	.6971323	.1439442
rdensity	1396	.5650839	.1248946	3674	.5088459	.0814049
rrental	1396	.5192603	.1751544	3674	.6302495	.2499974
rhighschool	1396	.7403356	.1652406	3674	.7900503	.1466187
rlabour	1396	.7732333	.0870236	3674	.8535466	.1128429
industryrank	1402	3.506257	1.669182	3677	5.071353	1.745567
rooms	1486	3.246972	1.20475	3677	3.287055	.6613378
pricer	950	583782.8	575637.8	2645	557054.7	357166.3
rentreal	618	2600.485	971.6295	1031	2624.557	751.3807
studentified	1486	1	0	3677	0	0

Table 3: Summarized Data of "Studentified" and "Non -Studentified" Neighborhoods

Table 3 summarizes the characteristics of "Studentified" vs. "non – studentified" statistical areas. Neighborhoods with students' population have different demographic characteristics than non-studentified neighborhoods, in some of the means or standard deviations. A regression was run to examine which variables affect the rental prices. There is a positive and significant impact of students on the level of the rent. Rental cost of an apartment in the area characterized by "studentification" is 2.51% higher than a similar apartment in non-studentified neighborhood (ceteris paribus). However the coefficient is not significant in 5%, only in 10%.

There is also a positive and significant relationship between the number of rooms and the rent paid. There is an increase of 22.97% in the level of the rent for each additional room, as shown in Table 4 below.

Source	SS	df	MS	Number of obs =	1559
Model	60.770495	7	8.68149928	F(7, 1551) =	214.34
Residual	62.8219249	1551	.040504142	Prob > F =	0.0000
				R-squared =	0.4917
				Adj R-squared =	0.4894
Total	123.59242	1558	.079327612	Root MSE =	.20126

lnrentr	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rarabs	-.228734	.0319018	-7.17	0.000	-.2913092	-.1661589
rmedianage	.1297471	.0395928	3.28	0.001	.0520859	.2074082
rrental	-.1935346	.0317408	-6.10	0.000	-.255794	-.1312753
rhighschool	.4200023	.0414963	10.12	0.000	.3386074	.5013971
studentified	.0252345	.0130979	1.93	0.054	-.0004569	.0509259
rooms	.2296564	.0083484	27.51	0.000	.213281	.2460318
industryrank	.0110659	.0028154	3.93	0.000	.0055435	.0165883
_cons	6.787641	.0528447	128.45	0.000	6.683987	6.891296

Table4: Regression Results of Rental Prices, Preliminary Analysis

Table 5 presents the effect of independent variables on the price of apartments for sale. There is a negative and significant effect of "studentification" on property prices. For areas that are close to the Technion, prices are lower by 6.87%.

Source	SS	df	MS		Number of obs = 3511
					F(9, 3501) = 498.60
Model	847.971532	9	94.2190591		Prob > F = 0.0000
Residual	661.580292	3501	.188968949		R-squared = 0.5617
					Adj R-squared = 0.5606
Total	1509.55182	3510	.430071745		Root MSE = .43471

lnpricer	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
rarabs	-.8417237	.0532016	-15.82	0.000	-.946033	-.7374144
rmedianage	-.4050279	.0855379	-4.74	0.000	-.5727371	-.2373187
rrental	-.6556038	.0481875	-13.61	0.000	-.7500823	-.5611252
rhighschool	.5691241	.1068309	5.33	0.000	.3596671	.7785812
rlabour	.5813322	.1178145	4.93	0.000	.3503402	.8123242
studentified	-.0686244	.0234348	-2.93	0.003	-.1145716	-.0226771
period	.0093787	.0009053	10.36	0.000	.0076036	.0111538
rooms	.2695107	.0087773	30.71	0.000	.2523016	.2867197
industryrank	-.0159599	.0071147	-2.24	0.025	-.0299093	-.0020105
_cons	12.04905	.170284	70.76	0.000	11.71518	12.38291

Table 5: Regression Results of Housing Prices, Preliminary Analysis

Other results are, there is a positive and significant relationship between the number of rooms and the price of the apartment. Each additional room raises the price of the apartment by 26.95%. Moreover, there is a real price increase of 0.93% per quarter on the mean. The results in Tables 4 and 5 have to be examined for multicollinearity, since the demographic level is presented by many variables. To avoid this problem a welfare index was constructed for each statistical area.

Table 6 shows the correlation matrix of the demographic variables and housing prices. As seen in Table 6, some of the demographic variables which characterize a statistical unit are highly correlated. The variables are: "rdensity" and "rarabs", "rhighschool" and "rdensity and "rhighschool" and "rlabour". To avoid multicollinearity, an integrative variable is generated that represents all demographic variables and is calculated per each

	pricer	rarabs	rdensity	rrental	rhighs~l	rlabour
pricer	1.0000					
rarabs	-0.4348	1.0000				
rdensity	-0.3658	0.7251	1.0000			
rrental	-0.3509	0.3285	0.0953	1.0000		
rhighschool	0.3079	-0.4724	-0.6400	0.2627	1.0000	
rlabour	0.1280	-0.2182	-0.3149	0.5216	0.6903	1.0000

Table 6: Correlations Matrix of Demographic Variables and Housing Prices

statistical area. We term this variable "Demographics". It is calculated by summing normalized value of the most influential demographic variables on housing prices (The direction of each variable was determined by the correlation of the variable with assets' prices): Demographics= -rarabs – rdensity – rrental + rhighschool + rlabour

Its value per neighborhood lies in the range (-3) to (2).

A new exploration of the hedonic regressions is performed, with the new variable replacing the demographic variables.

Variable	Obs	Mean	Std. Dev.	Min	Max
rentreal	1649	2615.536	840.5028	950	11400
pricer	3595	564117.8	426007.6	50731.71	5406513
studentified	5163	.2878172	.4527893	0	1
rooms	5163	3.275518	.8540109	1	15
period	3595	14.32128	8.17593	1	28
demographics	5079	3.796013	.9042745	.8186655	4.830715
industryrank	5079	4.639326	1.861197	1.352928	7.467359

Table 7: Summarized Data of Assets in Haifa (Integrated Demographic Variable)

B.5.3 Impact of Students- Final Results

Table 8 below shows the hedonic regression of rental prices derived from the general database "finaldatabase.dta" (Data B) with the new demographic variable.

Source	SS	df	MS
Model	59.936768	4	14.984192
Residual	63.6556519	1554	.040962453
Total	123.59242	1558	.079327612

Number of obs = 1559
F(4, 1554) = 365.80
Prob > F = 0.0000
R-squared = 0.4850
Adj R-squared = 0.4836
Root MSE = .20239

lnrentr	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
demographics	.2107546	.0114115	18.47	0.000	.188371	.2331383
industryrank	.0116489	.0028327	4.11	0.000	.0060925	.0172053
rooms	.2276867	.0084153	27.06	0.000	.2111802	.2441931
studentified	.045721	.0117249	3.90	0.000	.0227227	.0687194
_cons	6.97726	.0313274	222.72	0.000	6.915811	7.038708

Table 8: Regression Results of Rental Prices, Final Results

The analysis of the data following the generation of the “Demographics” variable shows that, indeed, the conclusions change. Renting an apartment adjacent to campus is 4.57% more expensive and significant (was not significant in 5% in Table 4), i.e., the impact of studentification on rents is positive as expected.

There is a positive and significant relation between the variable "Demographics" and rental costs. Rents are higher by 21% for a unit increase in the value of "Demographics". There is a preference for rental apartments nearby major industrial centers, as tenants wish to reside close to centers of employment (was insignificant in Table 4). Similar to previous analysis, each additional room increases the rental price by 22.7%.

The final hedonic regression for rental apartments in Haifa is:

$$\ln rentr = 6.90 + 21.1\% * demographics + 1.2\% * industryrank + 22.7\% * rooms + 4.57\% * studentified$$

Table 9 shows the hedonic regression of price of apartments for sale derived from the overall database "finaldatabase.dta (Data B) with the new demographic variable.

Source	SS	df	MS
Model	839.16486	4	209.791215
Residual	670.386963	3506	.191211342
Total	1509.55182	3510	.430071745

Number of obs = 3511
F(4, 3506) = 1097.17
Prob > F = 0.0000
R-squared = 0.5559
Adj R-squared = 0.5554
Root MSE = .43728

lnpricer	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
studentified	-.0481548	.017748	-2.71	0.007	-.0829523	-.0133573
demographics	.6338694	.016551	38.30	0.000	.6014188	.6663199
period	.0094516	.0009076	10.41	0.000	.0076721	.0112311
rooms	.2700396	.008756	30.84	0.000	.2528722	.287207
_cons	11.85135	.0314639	376.67	0.000	11.78967	11.91304

Table 9: Regression results of Housing Prices, Final Results

As for the analysis of the data of prices, the new variable does not change the main conclusions derived from the former regression (Table 5).

The apartment prices in an area characterized by "studentification" are lower in 4.81%.

There is high and significant correlation between the variable demographics and the price of apartments for sale. The price is higher by 63.3% for a unit increase in the value of demographics. There is a price increase for every quarter, as the correlation between the variable "period" and "lnpricer" is positive and significant. For each additional quarter, there is a price rise of 0.95%. As found in previous analysis, each additional room raises the asset price by 27%.

The final hedonic regression for assets pricing in Haifa is:

$$\ln pricer = 11.85 + 63.3\% * demographics + 27\% * rooms - 4.81\% * studentified + 0.95\% * period$$

From Tables 8 and 9 we see that "studentificaion" has opposite impacts.

An apartment located adjacent to an academic institution (i.e., the Technion in our case) has a higher rent vs. a similar apartment in the rest of the city. However, it has a lower selling price. These opposite impacts were puzzling. The positive impact on renters who want to reside adjacent to academic institutions was expected, however not consistent with some of the literature. The negative impact on selling price was unexpected. The result was significant, and the question was how to explain it.

Our hypothesis is that introducing owner-occupiers as players in the real estate market can explain the results. The hypothesis is that there is a negative effect on owner-occupiers who want to avoid the ill effects of students. If the rent is higher, the other players, landlords, would benefit from higher returns on letting a unit. The demand of landlords for units for rent in the long run increases, and a higher price is expected. The puzzling results can be explained by the housing market being in the short run, where the reluctance of owner-occupiers is dominant and they negate the demand by investors. The empirical results are consistent with our proposed model, Scenario III. They are not consistent with Scenarios I and II.

C. Discussion and Conclusions

The Haifa real estate market is a diverse market, which includes many types of residents (Jews, Non-Jews, including Arabs); it has private construction, public housing, etc. Among the residents are students, about 12 percent of the city residents. There are various challenges in estimating students' impact on the housing market in Haifa. As discussed in the literature, students have a significant impact on the entire market characteristics around the campus, including the housing market. However, this effect varies for different market characteristics, and therefore a comparison to averages seems to be meaningless – this population affects so many other characteristics in their surroundings.

Our question was can we isolate students' impact on the housing market? Which model describes the impact of students? What is their impact on rent, on price of housing? On profitability of investment in housing? The question of profitability will be discussed in (Baron, Diamant, forthcoming).

To isolate the effect, a large number of observations were needed for a proper analysis. The generation of a hedonic function for describing prices (both rents and value of houses) that relies mainly on external variables (demographics, number of rooms, location adjacent to an academic institution, etc.) seemed to be the only way to isolate the impact of students. The bias created by the multicollinearity of some of the variables was another problem to be addressed. Therefore, an integrative demographic index was created, reflecting five different demographic variables for each statistical area and representing the demographic characteristics of the statistical area.

The effect of students on rent is significantly positive, as rents in "studentified" areas are higher by 4.57% than in non-studentified areas.

$$\ln rentr = 6.90 + 21.1\% * demographics + 1.2\% * industryrank + 22.7\% * rooms + 4.57\% * studentified$$

The effect is explained by students' preference to reside adjacent to the campus where they study, which shifts the demand curve. As long as the supply curve is unchanged, the students are charged higher rents in comparison to a unit with the same characteristics of the property in a non studentified neighborhood. Students prefer this location due to the save in commuting costs and in time of commuting.

The effect of students on the purchase prices in the same areas is significantly negative. Purchase prices in studentified areas are 4.81% lower than in areas that are not close to campus.

$$\ln pricer = 11.85 + 63.3\% * demographics + 27\% * rooms - 4.81\% * studentified + 0.95\% * period$$

Our hypothesis is that this phenomenon reflects differences in preferences between owner-occupiers and renters. Students renting apartments will prefer to rent an apartment adjacent to the location of their academic institution and are indifferent to their neighbors. Owner-occupiers prefer an apartment located in areas with a high socioeconomic level as demonstrated by the variable "demographics", which has a much larger effect on home prices than on rents (a larger absolute coefficient). Our hypothesis is that owner-occupiers are reluctant to reside next to students. This question has to be investigated and confirmed via questionnaires in studentified neighborhoods. The Haifa real estate market is a market of residential owner-occupiers and investors. While owner-occupiers prefer living in areas that are not nearby student populations. The aversion from students is very strong. This effect is more dominant than the attraction of investors to units adjacent to campus, where they enjoy high rents. Consequently, the demand for

residential apartments in "studentified" areas is low relative to other areas of the city.
Different reasons can be accounted for the high rents despite lower housing prices in :“studentified” areas

a. Differences in consumer preferences - the rental market in “studentified” areas are directed to students. Students as consumers are highly influenced by the proximity of the apartment to campus where they study. Therefore, they are willing to pay more for a less valuable asset. Other tenants, while searching for an apartment for rent, will examine all aspects of the apartment, paying less attention to the proximity to academic institutions.
When the price of housing decreases and the rents increase, the Rate of Return increases, Investors have an incentive to invest in the studentified neighborhoods. In the long run investment in housing will increase; the supply of housing will increase; and the long run Rate of Return will return to its initial level.

b. Built-in aversion to students' population - students are often perceived by owner-occupiers as problematic neighbors. The student population is generally young, socially active, noisy, etc. Therefore, owner-occupiers move out of the studentified neighborhoods, which results in lower prices of housing units. If landlords are reluctant to rent to students they require from students higher rents than they would demand from other tenants to compensate for the undesired behavior (e.g., the risk of not paying rents in the vacation period). The result of aversion to students results in lower housing prices.

What are the contributions of this work?
A model with new players, owner-occupiers.
While we are separating between renters and investors, here we look upon the owner-occupier as distinct from landlord. This enables to analyze the impact of studentification on each of the players.
It is not clear what is the impact of students. Rents can increase or decrease as discussed. Each model predicts a different result. The impact on owner-occupiers, which was not studied previously, is expected to reflect the reluctance of owner-occupiers to live adjacent to students (and to academic institutions), who are young, noisy, tolerant to dirt, etc. Owner-occupiers maximize their utility which is affected by the negative externalities of an academic campus and of students.
The introduction of owner-occupiers as a distinct player can be applied to many cases.
Investing in a house adjacent to a playground can affect positively landlords. But are owner-occupiers enjoying being close to a playground? Perhaps they suffer from the

noise and the increased traffic, and therefore prefer to move to a different location? There are many similar examples.

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Appendix A: List of Variables

All of the demographic variables were obtained from the population survey of 2008, CBS(2010). In those variables, the rank was determined as the division of the value of the variable divided by the highest value in the relevant category: $r(d_i) = \frac{d_i}{Max(d_i)}$

Where d_i is the value of the variable d in statistical area i and $r(d_i)$ is the rank of d_i.

Rooms - Number of rooms in the property. The values range from 1 to 15 in steps of 0.5

Period - Period serialize defined as the number of quarters elapsed from 1.1.2005 to date of the transaction. The first quarter of 2005, gets the value 1, and the fourth quarter of 2011 is assigned the value 28.

Lnpricer - Logarithmic function of the asset's real price normalized to period 28.

Lnrentr - Logarithmic function of the asset's rental price normalized to period 28.

Studentified - dummy variable that gets the value 1 if the observation is adjacent to the Technion (travel distance up to 2 km) and 0 if it is a larger distance.

Statistical Area – the smallest geographical unit used by the Central Bureau of Statistics to collect statistical information. The definition refers to a small unit that is as homogeneous as possible. A statistical area typically has 4000-6000 people. The homogeneity principle is stronger than the size principle (Haifa Municipality, 1995).

Demographics - Demographic rating of the statistical area. An independent variable that represents a weighted rating of relevant demographic data. The variable ranges from values (-3) to (2). A higher socio - economic level results in a higher value.

Rarabs - an independent variable, which represents the rating of Arabs living in the statistical area. The rating ranges from 0 to 1 where 1 represents the highest percentage of Arabs in any statistical area in the city, and 0 the lowest number of Arabs.

Rhighschool - an independent variable, which represents the percentage ranking high school graduates living in the area. The rating ranges from 0 to 1, where 1 represents the highest percentage of high school graduates in a single statistical area in the city.

Rdensity - an independent variable representing the number of people per room residing in a statistical area. The rating ranges from 0 to 1, where 1 represents the highest number of people per room in a statistical area.

Rmedianage - an independent variable, which represents the median age rating in a statistical area. The rating ranges from 0 to 1, where 1 represents the highest median age in a statistical area.

Rlabour - an independent variable, which represents the percentage rating in labor force participation. The rating ranges from 0 to 1, where 1 represents the percentage of the labor force participation in a certain area divided by the highest value, and 0 is the lowest labor force participation.

Rrental - an independent variable, which represents the percentage rating of rented dwellings in the area. The rating ranges from 0 to 1, where 1 represents the highest percentage of rented dwellings in a statistical area and 0 percent the lowest.

Appendix B: List of Symbols

DD Demand Curve

Dh0, Dh1 Demand for housing units in period 0 (1)

Dr0, Dr1- Demand for rental units in period 0 (1)

E(R) – Expected return

I Income

L location characteristics

N neighborhood characteristics

Ph – price of housing unit

Pr – price of rental unit

qh- quantity of housing units

qr-quantity of rental units

r – interest rate

rf- risk free real interest rate of a bond

S Sharpe Index

Sh0 (Sh1) Supply of housing units in period 0 (1)

Sr0 (Sr1) Supply of rental units in period 0 (1)

ST Structure characteristics

Std – Standard deviation

Stn – Studentification

Z - Composite good