THE CHANGES IN RENT IN ISRAEL DURING THE YEARS OF THE HOUSING CRISIS 2008–2015[*]

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Abstract

In this study, I describe an anomaly I have found in the rental market in Israel: two key figures published by the Central Bureau of Statistics (CBS) regarding changes in rental prices are inconsistent. The first figure—Average Rental Prices—determines that rental prices increased by 59% in nominal terms in the years 2008–15, while the second figure—the allegedly more reliable Rental Price Index—determines that rental prices increased by only 34%. In the article, I examined the usual explanations for possible bias in measurement, and found that they could not explain the anomaly. Therefore, I present an alternative explanation for the sharp downward bias of the accepted index, which stems from different changes in prices for new tenants vis-à-vis existing tenants, and from the manner of monitoring the tenants surveyed in the index. I show that the CBS method of measurement does not include observations of new tenants, where the price increases are the highest. I then propose a correction to the

measurement using the hedonic methodology, based on the source data. The research shows in the years 2008–15, rental prices increased by 60% in nominal terms and by 50% in real terms; an increase twice as high as previously estimated. This finding indicates that the Consumer Price Index (CPI) is biased downward and that the probability of a price bubble in the Israeli housing market is significantly lower than estimated. In addition, this finding changes the perception regarding the reasons for the increase in housing prices between 2008 and 2015, from a rise based on an increase in the demand for investment in housing to a rise resulting from an increase in the demand for housing. Therefore, this finding makes an important contribution to our understanding of the sources of the price increases in the market and its nature and makes it possible to create relevant remedies to the situation in the housing market. Rental prices are the best barometer for estimating the difficulties of expanding supply, since they are not directly and widely affected by changes in individuals' expectations and in the interest rate. Therefore, if rental prices increased more than estimated, dealing with the supply problem is more central to solving the housing crisis.

1. INTRODUCTION

There is an anomaly in the Israeli rental market: two key figures regarding rental prices are inconsistent. The first figure, Average Rental Prices, increased by 59% in nominal terms in the years 2008–15, while the second figure, the Rental Price Index, increased nominally by only 34% during this period. In this study, using "Rent Survey" data – a survey by the Central Bureau of Statistics (CBS) from which the two above figures are derived and changes in rental prices are calculated in Israel – I examine the real changes that occurred in the rental market in Israel in the housing crisis years of 2008–15.

My tests show that the anomaly in the data was created because the Rental Price Index is measured using a methodology involving repeat rentals, which does not include price changes of new tenants (tenants for whom this is their first rental agreement in the apartment). This study shows that when there is a change in tenants the rental fee increases more than the rental fee increase when an existing tenant renews a contract in an apartment in which he is already living. By using hedonic regressions, I examined the changes in rental prices, in such a way that it is possible to deal with the difficulty of measuring the price change of a tenant who has moved to another apartment, and in this way changes the quality of the apartment.

From the results of the main regressions I conducted, it can be determined that the real nominal price change in the rental market in the years 2008–15 ranges from 59% to 69%, compared with the 34% measured in the Rental Price Index. I also found that the hedonic methodology accurately tracks the results of the Rental Price Index when the observations of new tenants are not included in the regression; this finding reinforces the validity of the

results regarding all tenants. In addition, when I examined the price changes on another database, the Household Expenditure Survey, the results are similar.

When evaluating the price changes in the rental market, I adopted a conservative approach, and created an additional estimate of changes in apartment quality based on the Household Expenditure Survey. After taking into consideration an increase in the quality of the apartments, I found that in the 2008–15 period, rental prices rose in nominal term by 59% (compared with 34%) and by 47% in real terms (compared with 24%).

In other words, the findings of this study prove that the Rental Price Index is biased sharply downward, as a result of the use of price changes of only the existing tenants, and that rental prices have risen in real terms twice as much as we have estimated so far.

This finding, that the rise in rental prices was twice what we have estimated so far, changes the perception regarding the increase in housing prices in recent years—from a rise based on the increase in demand for investment in housing to a rise resulting from an increase in the demand for housing. This finding makes an important contribution to our understanding of the sources of the price increases in the housing market, its nature and those most adversely affected by it. In addition, this finding contributes to our understanding of the possible solutions for dealing with the price increases and the probability of the existence of a price bubble in Israel. This finding also shows that the CPI measurement was biased downward by a cumulative 1.5 percentage points between the years 2007 and 2015.

In the first section of the study, I will describe the data series regarding the rental market in Israel and its source—the "Rent Survey", and I will describe the anomaly existing in them and my research hypothesis regarding its source. In the second section of the study, I will review the relevant economic literature. In Section 3, I will present descriptive statistics regarding the contracts and market prices. In Section 4, I will describe the "apartment movers", for whom the highest price increases are recorded, and who are not reflected in the Rental Price Index, and who constitute the source of the anomaly. Then, in Section 5, I will conduct regressions for examining the real price increase in the rental market in the years 2008–15, and in Section 6, I will conduct robustness tests of the main results of the study. Section 7 summarizes the research and proposes a way to correct the bias in the Rental Price Index.

a. Rental prices in Israel and the anomaly therein

1. *Rental prices*

The official information on the Israeli rental market is not extensive. Most of the information available to the government is produced by the Central Bureau of Statistics, and appears in the "Rent Survey". This survey monitors a sample of apartment renters over time, and from this database the CBS produces two data series for measuring changes in the rental prices:[1]

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[1] It should be noted that another index is also produced – Owned Dwelling Services, CPI number 120490, which calculates the changes in the value of housing services in owned apartments. The

a. Rental Price Index: An index produced once a month that measures the change in prices in a given month compared to the previous month.[2] In the monthly calculation of the index, all the apartments in the Rent Survey that appear in both of the relevant months are included. Apartments appearing only in one month of the relevant two months are not included.

The Rental Price Index is a Repeat Rent Index.[3] The change in price is measured for each apartment compared with the previous period, with the same tenant. The monthly change in the price of the index is calculated using the weighted average of the price changes in each apartment included in the Rent Survey in the two months examined (most of which are in the course of a rental contract). Since in recent years, most contracts have been signed in NIS (without indexation), the index changes mainly upon renewal of the contracts of existing tenants.[4]

This is the only index in Israel for measuring changes in rental prices that deals with the heterogeneity of apartments based on a conventional methodology. It is therefore considered the most reliable measure of changes in Israeli rental prices. In addition, it is used to estimate the changes in rental prices in the CPI (5.7% of the CPI).[5]

b. Average Monthly Prices of Free Rent (hereinafter, "Average Rental Prices"): This figure is produced once per quarter and includes all the observations that existed in the Rent Survey in the relevant quarter.[6] The figure does not include a methodology for quality adjustment or a weighting of observations, it is a simple average. However, the observations included in the Rent Survey originate in the main CBS surveys (Household Expenditure Survey, Social Survey, and Labor Force Survey), so it is based to a certain extent on a representative sample of tenants.

This figure has no official use and is used only as an indicator. Sometimes it is used when rental price levels are needed, and this is the only available figure.

b. Rent Survey

The main database I use is the Rent Survey. This is a long-term database of apartment tenants, collected and operated by the Central Bureau of Statistics. The database I used in this research contains data on contracts valid in 2005–15. The database includes data for years prior to

changes in the price of owned housing services are measured based on the changes in rental prices, but weighted according to the inventory of owned housing, rather than those rented.

[2] Rent section, CPI number 120460.

[3] For a discussion on similar indices in the United States, Germany and Japan, see for example: Crone, et al. 2006; Gordon & van Goethem, 2005; Ozimek 2013; Shimizu, et al. 2012; Verbrugge & Poole, 2010; Hoffmann & Kurz, 2004; and Ambrose, et al. 2015.

[4] The rental market's transition to unindexed NIS contracts instead of USD-indexed contracts reduced the volatility of the Rental Price Index. This is due to the fact that currently, most observations are given a price change value of zero (0) instead of the value of the change in the rate of exchange in that month.

[5] The weight of rental fees in the CPI as of January 2017.

[6] Table 6.4, Price Statistics Monthly: "Average Monthly Prices of Free Rent".

2005, regarding contracts signed before 2005 and that extended past January 2005.[7] It includes 6,000 to 14,000 contracts per year. New tenants are entered into the database through the Labor Force Survey, the Household Expenditure Survey and the Social Survey: all the renters appearing in these surveys are then sampled for the Rent Survey. Once a tenant exists in the database, he is sampled again at each end of a contract. The tenants cease to be sampled when they leave the rental market.[8]

The observations in the database include a serial number of the contract, a serial number of the tenant, the month and year of the beginning of the contract, the month and year of the end of the contract, the month and year of the sampling date (usually at the beginning/end of the contract), the rent, the currency in which the contract was drawn, the method of indexation of the rent, the number of rooms in the apartment, the local authority in which the apartment is located, the socioeconomic level of the area in which the apartment is located, the number of months of prepayment, and whether the contract includes payments for municipal taxes, residents' committee, electricity, or water (separately).

In addition, the Rent Survey was constructed to survey the tenant rather than the apartment, so that when the tenant moves to another rental apartment, he will continue to be sampled in his new apartment, and the old apartment will no longer appear in the survey. When the tenant leaves the rental market (and stops renting the apartment in which he resided) the tenant ceases to be sampled in the survey, and the apartment where he resided= will no longer appear in the survey.[9]

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[7] I have been told by the Central Bureau of Statistics that data regarding contracts that ended before 2005 were not saved in a format enabling their use.

[8] In this regard, there is some ambiguity regarding the reason for removing a tenant from the survey. This is important because of the use I make of those leaving the survey. As a rule, a tenant is no longer sampled in the survey after he has left the rental market due to death, leaving the country, purchasing an apartment, moving to assisted living, or to an apartment owned by his family. However, it is also possible that the tenant is removed from the survey even if he has not actually left his rented apartment due to sampling problems. From analysis I carried out on the data given to me by the Central Bureau of Statistics regarding the reason for leaving the survey, I found that on average, approximately 30% of the cases in which a tenant was removed from the survey were due to problems with sampling, and not from actually leaving the rented apartment.

[9] The following are definitions used in this study:

Tenant who entered the survey or **observation that entered the survey** or **a new observation in the survey** – a contract of a tenant who had not previously been in the database (and was entered as mentioned from the main Central Bureau of Statistics surveys).

Contract renewal – continuation of the tenant's rental of the apartment in which he lives under a new contract, in the period following the end of the previous contract of the tenant in the apartment. In the transition between the old contract and the new contract, there may be changes in the rent, in the currency in which the contract is drawn and in the type of indexation.

Long-term tenant – a tenant that exists in the database who lives in an apartment in a contract that is not his first contract in this apartment.

Moving tenant – a tenant who has moved from a contract for a certain apartment in the database to a contract for another apartment in the database.

c. The anomaly in the rental data and its source

The existing anomaly in the measuring of rent prices in Israel is that two key figures for measuring the rent prices indicate very different price changes. Figure 1 presents the price changes in both data series. The Rental Price Index was taken as published by the Central Bureau of Statistics, and I created the Average Rental Price Index based on Central Bureau of Statistics data, which report the average price level in each quarter.

Figure 1
Nominal Indices of Rental Prices, Quarterly Data
1999-2015 (1999:Q1=100)
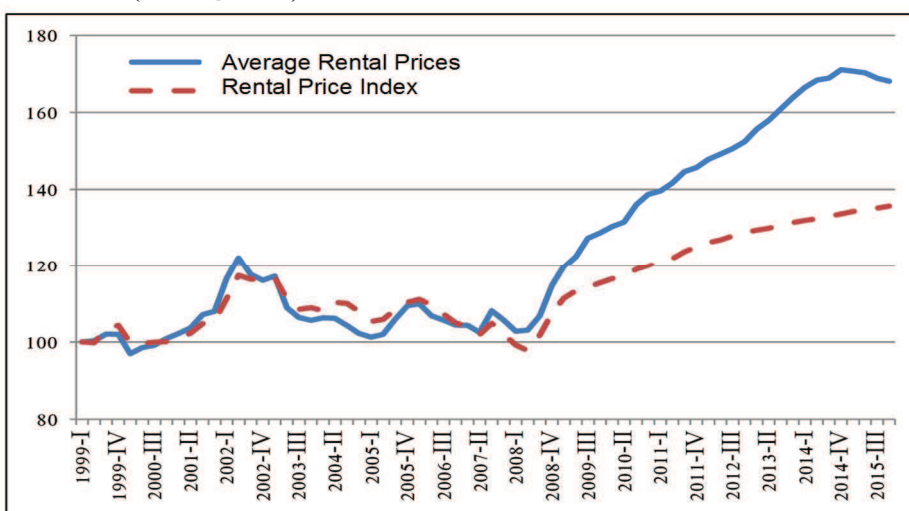
The chart presents a clear picture: starting in 1999, when these data series began to be measured, and until 2007–08, the price changes in these two data series are relatively similar, and there were no large gaps between them. Starting in the years 2007–08, together with the outbreak of the global crisis and the wave of price increases in Israeli housing market, the

New tenant – a tenant who has moved to live in a rental apartment that he had not previously rented (he may have moved from another apartment or now entered the rental market).
Tenant leaving the survey – a tenant for whom, after the end of a contract in a certain apartment in the database, there is no data on another contract for this apartment or for another apartment.
Tenant leaving the rental market – a tenant who left the survey because he no longer rents an apartment in Israel.
Tenant in a contract – a tenant that, at the time examined, is in a contract.
New contract – a contract signed within a certain period of time: a renewed contract for the apartment in which the tenant lived or the first contract the tenant signed in the apartment.
Valid contract – a contract by virtue of which a tenant lives in an apartment at a certain point in time (including a new contract signed at the time, and a contract signed earlier but not yet concluded).

indices diverge. The index based on average rental prices (the blue line) rose more sharply than the Rental Price Index (the red line), and by the end of 2015 a significant gap was created between the cumulative price changes of each data series. According to the Rental Price Index, there was a nominal increase of 34% from December 2007 to December 2015. In contrast, the index based on average rental prices showed a nominal increase of 59% in the corresponding period (2007:Q4 compared with 2015:Q4).[10]

Between 2007:Q4 and 2015:Q4, the CPI excluding housing rose by 8%-9%.[11] Therefore, in real terms, the Rental Price Index rose by 24% in the years 2008–15, and the series based on average rental prices rose by 46% in real terms. In other words, in real terms, the average rental prices rose by twice as much as the Rental Price Index. Since these two series were built from the same database, these gaps are strange, putting it mildly, and require an explanation.

A possible source of downward bias in the Rental Price Index is that this index does not include observations of new tenants: tenants who moved to another rental apartment. This is because, in the repeat rental method, the change in the quality of the new apartment compared to the previous apartment cannot be adjusted.[12] In addition, the Rental Price Index does not include observations of a new tenant in an apartment that existed in the survey and was vacated by the previous tenant (although these observations could have been included in the repeat rental method). This is because the Rent Survey surveys the tenants rather than the apartments.

If there is an inherent difference in the rent paid by a new tenant, as opposed to the rent paid by an existing tenant, the Rental Price Index will be biased toward the change in the price of the existing tenant. For example, when prices rise in the market, a new tenant may pay the spot price on the market, and a tenant who renews a contract will pay on average (considering that there is significant price rigidity when renewing contracts) a price between the previous contract price and the market spot price. Under this scenario, when market prices rise, existing tenants who renew a contract are paying on average less than the market spot price, and the Rental Price Index will be biased downward because it does not include the observations that have the most significant price increase – a new tenant who replaces an existing tenant.

In contrast, during a period of relative stagnation in spot prices, there will be no downward bias, or at least this bias will be significantly weaker, since the difference between the price

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[10] In 2007:Q4, the average rental fee was NIS 2,316 and in 2015:Q4 the average rental fee was NIS 3,684.

[11] The CPI excluding housing rose by approximately 8% between December 2007 and December 2015, and by approximately 9% between 2007:Q4 and 2015:Q4.

[12] The observation is not included in the Rental Price Index in the first month of the contract for the apartment to which the tenant moved. However, in the second month of the contract, the observation is included in the Rental Price Index because the two observations regarding the apartment can be compared in the current month and the previous month. This means that if there were any price increases at the time of the move, they are not included in the Rental Price Index.

paid by the new tenants and the price paid by tenants renewing contracts will be considerably lower (compared to times of rising market prices).

An alternative hypothesis is that changes in the composition of apartments have led to the downward bias in the average rental prices, ostensibly because the Rental Price Index is weighted by the observation weights and includes a quality adjustment, whereas the average prices are a simple average. This is the more intuitive explanation.

To refute this explanation, Table 1 below provides details of the nominal price changes in the years 2008–15 for the Central Bureau of Statistics survey sub-groups (by region and number of rooms).[13] Since none of the 36 sub-groups recorded a nominal price rise of less than 34%, the price rise differences between the sub-groups cannot explain the anomaly.

Table 1
Nominal Price Changes by Survey Region and Room Groups
2007:Q4 compared with 2015:Q4 (percent)

Rooms	Jerusalem	Tel Aviv	Haifa	Gush Dan	Center	South	Sharon	North	Krayot
1.5-2	57	75	43	47	49	36	49	39	39
2.5-3	54	69	46	55	60	60	52	54	46
3.5-4	48	51	51	56	66	68	55	55	50
4.5-5	57	55	51	66	55	78	70	56	54

SOURCE: Based on Central Bureau of Statistics data.

In addition, I weighted the average rent using the Central Bureau of Statistics weights for the sub-groups in each quarter from 1999 to 2015. As shown in Figure 2 below (the green line), even after the creation of weighted average rental prices and the resulting price changes, the nominal price changes on the weighted average during the relevant period is 59% (2007:Q4 compared with 2015:Q4)—similar to the simple average, and very far from the Rental Price Index.[14]

Moreover, based on the Rent Survey, another index was made that constitutes 18% of the CPI and which is supposed to reflect the changes in the cost of owned housing: the Owned Dwelling Services Cost.[15] In Figure 2 below, I also present the changes in this index (the purple line). The figure shows that the gaps between this index and the Average Rental Prices are significantly smaller (although they still exist). This is in line with the fact that the calculation of the Owned Dwelling Services Index includes both new contracts and renewed contracts. The smaller gap between this index and the Average Rental Prices also indicates that the effect of the anomaly on the CPI is mainly limited to rental prices.

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[13] The Rental Price Index weights are based on these subgroups.

[14] In 2007:Q4 the weighted average rental fee was NIS 2,488 and in 2015:Q4 the weighted average rental fee was NIS 3,959.

[15] CPI Section 120490.

Figure 2
Nominal Indices based on the Rent Survey, Quarterly Data
1999-2015 (1999:Q1=100)
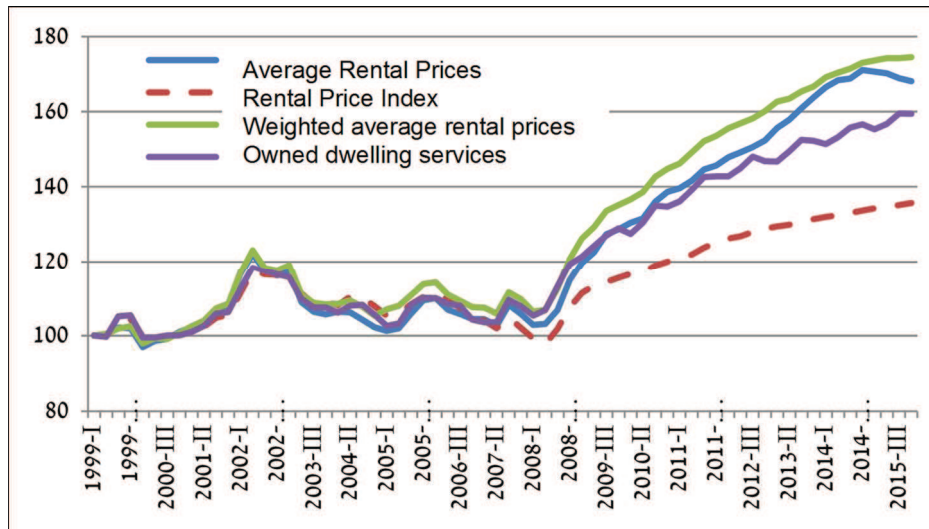
SOURCE: Based on Central Bureau of Statistics data.

2. REVIEW OF THE LITERATURE

Two studies conducted an examination very similar to mine for US rental prices in the years 1940–85 and in the years 1914–2003 (Crone, et al. 2006; Gordon & van Goethem, 2005). Similar to the Israeli case, the researchers found that in the United States, in the years 1942–85, the US rental price index (the CPI Rent Index) did not include the apartments vacated by tenants, and did not include the new apartments into which tenants had moved. According to the researchers, this characteristic created a significant bias in the US index, which led to a large gap between it and the change in the median and average prices (which they termed the Non-Response Bias). The US index was subsequently corrected.

Crone and others infer that the main reason for the US gap is the non-inclusion of apartments with new tenants in the US rental price index (and the ignoring of the aging of apartments). The researchers found that in the years 1940–85, the average annual nominal increase in the median rent in the United States was 5.8%. In contrast, during this period, the average annual nominal price increase of the US rental price index only rose by 3.5%. After adjusting the biases, the US rental price index rose by 1.4 percentage points more per year: 1 percentage point from the correction of the bias resulting from moving tenants and 0.4 percentage points from the correction of the bias resulting from the aging of the apartments (Crone, et al. 2006; Randolph 1988a, Randolph 1988b). Therefore, the US case suggests the

possibility that the anomaly in the measurement of rental prices in Israel stems mainly from differences in prices changes between new tenants and existing tenants.

A similar study was conducted in Italy. Rondinelli and Veronese found that in Italy, the rental component of the CPI rose by 20% in the years 1998–2006, while in the national accounts, rental fees increased by 50% in this period (Veronese & Rondinelli 2011). The researchers did not have access to the database on which indices were built, and therefore, they used data from the Italian Household Expenditure Survey and market data, and conducted hedonic regressions to determine the real price changes. Based on the Italian Household Expenditure Survey, and after quality adjustment, the researchers determined that in 1998–2006 rental fees increased by 40% in nominal terms, and not by 20% as measured in the Consumer Price Index.

The researchers reasoned that the main explanation for the gap was the poor coverage of new tenants in the Italian Consumer Price Index, after finding that the existing tenants had an average discount of 15% of the price for new tenants. However, the researchers examined the possible impact of the poor coverage of the measurement of new tenants and found that it could not explain the entire downward bias in the Italian rental price index (Rondinelli & Veronese 2011).

In addition, in the urban-economic literature, there are a number of additional findings that support the claim that the source of the anomaly is the exclusion of new tenants from the Rental Price Index. First, studies have shown that new tenants constitute a significant share of the rental market: 5–11% in Germany (Hoffmann & Kurz, 2002), 21% in Turkey (Aysoy, et al. 2014), and 19–35% in the United States (Crone, et al. 2006; Genesove 2003). Therefore, the inclusion of the new tenants in the price indices is required and important for estimating the changes in rental prices.

Second, a sub-branch in the literature on rental markets deals with exceptional nominal price rigidity in these markets.[16] High nominal price rigidity was found when new contracts are signed—29% of the contracts in the United States (Genesove 2003), 31% of the contracts in Turkey (Aysoy et al. 2014), and 90% of the contracts in Japan (Shimizu, et al. 2010).

The literature also emphasizes the differences in price rigidities, between the renewal of a contract with a tenant who lives in the apartment, and the signing of a contract with a new tenant. Genesove found price rigidity in 36% of the contracts signed with existing tenants and in only 14% of the contracts signed with new tenants (Genesove 2003). Aysoy and others found 35% price rigidity when renewing a contract, and only 17% when signing with a new tenant (Aysoy, et al. 2014). Shimizu and others estimated the probability of price rigidity when signing with a new tenant at 76%, and the probability of price rigidity in the renewal of a contract with an existing tenant at 97% (Shimizu et al. 2010).

Moreover, after controlling for the price rigidity resulting from the rounding of prices, Genesove found that only 7% of the new residents had nominal price rigidity (Genesove

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[16] In other words, although certain market price changes occurred between the date of signing the previous contract and its renewal (usually a one-year gap), many of the contracts were renewed at exactly the same price as the previous contract.

2003), and in Turkey there was no nominal price rigidity for new tenants (Aysoy et al. 2014). Hence, even if we assume that as long as prices rise for a tenant, there is no difference in the price increases for a new tenant and an existing tenant, the differences in price rigidities lead to the fact that when prices rise in the market, the rate of price increases of new tenants will be higher than the rate of increase in the prices for existing tenants.

Third, and consistent with the previous finding, several studies found higher price increases in apartments with new tenants, compared with apartments with existing tenants who renewed a contract. Crone and others, based on Rivers' and Summers' data on the United States in the 1980s, found that in apartments with new tenants there was a price increase 33% higher than the change in prices in apartments with existing tenants (Crone, et al. 2006). Genesove found that in apartments with new tenants the median price increases were 4 percentage points higher than in apartments of existing tenants (Genesove 2003). Aysoy and others found that the average price increase in apartments with new tenants was 10.9% per year, compared with 6.6% per year in apartments with existing residents (Aysoy, et al. 2014). Guasch and Marshall found that price increases in apartments with new tenants were 10–20% higher than the increases in prices in apartments with existing tenants (Marshall & Guasch, 1987). Verbrugge and others found that the change in tenant was one of the strongest variables for explaining changes in the rental fee, and the change of tenant in an apartment increased the rent by 3% (Verbrugge, et al. 2016).

Fourth, several studies in the literature have found that the rental fees of existing tenants are lower than for new tenants, and they explain this by means of a discount given to an existing tenant (Noland, 1979; Guasch & Marshall, 1987; Goodman & Kawai, 1985; Rondinelli & Veronese, 2011).

The main explanations in the literature for the price gap between a new tenant and an existing tenant are:

a. The desire of landlords to minimize changes in their tenants: to avoid the expenses associated with replacement of the tenant, the landlord will be willing to give the existing tenant a discount up to the cost of replacing the tenant (Miceli & Sirmans, 1999; Borsch-Supan, 1986; Goodman & Kawai, 1985).

b. Asymmetrical information and the desire to attract tenants who will not damage the apartment. For example, under asymmetry in information about the quality of the tenant, a tenant who was discovered as a "good" tenant in the previous period will be entitled to a discount following exposure of his identity. A "bad" tenant will seek to avoid a proper pricing of his identity and will tend to have more frequent apartment transitions. However, there is uncertainty regarding the nature of new tenants, and "bad" tenants are found among them at a higher rate due to more frequent apartment transitions, and therefore the rent pricing for a new tenant will be expressed as an averaging of the rent to a "bad" tenant (with a relatively high weight) and to a "good" tenant (Hubert 1995; Borsch-Supan 1986).

c. Similarly, Guasch and Marshall assert that existing tenants do not receive a seniority discount compared with new tenants, even though the price of new tenants is higher than the price of existing tenants. They argue that the reason for this is that there is a difference

between the groups of tenants. The group of existing tenants consists of tenants who have reached an agreement to renew the contract with the landlord, while the group of new tenants consists of tenants who have not agreed to renew their contract with their landlord, and this may be due to differences in the price asked of the tenants when the contract is renewed (Marshall & Guasch, 1987).

Therefore, the lower the landlord's asking price, the more likely it is that the existing tenant will renew the contract. This logic can explain the differences in rental fees between new tenants and existing tenants. While new tenants receive the spot price in the market, the existing tenants are those for whom the asking price was relatively low, and so they are more likely to stay in their apartment. Therefore, the prices that will be recorded for them will be lower than the prices that will be recorded for the new tenants. In other words, although Guasch and Marshall conclude that it is not possible to prove that existing tenants are given a discount because they are existing tenants, there is no doubt that their rental fees are lower than those of new tenants (Guasch & Marshall 1987).

d. In contrast, Raz-Dror (2018) suggests that the existing-tenant discount is created by a combination of price increases in the rental market and relations based on fairness between a landlord and an existing tenant. Raz-Dror claims that during a period of continuous price increases, when a new contract is signed with an existing tenant, the price rise included in the new price (compared to the rental fee in the previous contract) is only part of the spot price increases recorded during the previous contract of the existing tenant. Therefore, in a rising market, rental fees for existing tenants will be lower than for new tenants. On the other hand, when price levels do not change over time, there will be no discount for existing tenants, and their rent will be similar to that of new tenants. Raz-Dror claims that this can explain the similar behavior of the rental indices in Israel in the years 1998–2007 and the gaps between them during the housing crisis in 2008–15, whereas the alternative explanations of a seniority discount cannot explain the similar behavior of the rental indices in Israel in the years 1998–2007.

3. DESCRIPTIVE STATISTICS OF THE CONTRACTS AND PRICES IN 2007 AND 2015

In order to examine the price increases in 2008–15, Table 2 below presents the average prices of contracts signed in 2007 and 2015 in several cross sections.

In 2007, the average monthly rental fee in contracts signed was NIS 2,273. In contrast, in 2015, the average rental fee in contracts signed was NIS 3,620 per month, an increase of 59% (simple averages). When I applied apartment weights to the average rental fee in these years, the weighted averages are higher: NIS 2,619 in 2007, and NIS 4,200 in 2015—a price increase of 60%. When dividing the signed contracts into three sub-groups: renewed contracts, contracts signed after moving to another apartment and new observations included in the survey, the price increase (with the observation weights) was 61% for contract

renewers, 57% for new observations included in the survey and 61% for tenants who had moved.

Table 2
Average Rental Fee in Signed Contracts
2007 compared with 2015, Current Prices (NIS per month)

	Average Price 2007	Average Price 2015	Price Change
All contracts, simple average	2,273	3,620	59.3%
All contracts, weighted average[17]	2,619	4,200	60.4%
Contracts of contract renewers, weighted average	2,595	4,178	61.0%
Contracts of new tenants included in the survey, weighted average	2,657	4,172	57.0%
Contracts of tenants who have moved apartment, weighted average	2,760	4,451	61.3%

SOURCE: Based on the Rent Survey.

While these are relatively simple averages, they emphasize the dissonance between the Rental Price Index and the raw data. It should be noted that in these averages, I only average the rent at the beginning of the contracts, but since I average the beginning of the contracts throughout an entire year, it is almost a full market replacement.[18]

In order to characterize the differences in terms of the entire rental market, Table 3 below presents data on all contracts in effect in December 2007 and December 2015.[19] These figures indicate that the apartments and contracts in the two months are relatively similar: there was a minor increase in the number of rooms per apartment, and a minor increase in the socioeconomic level of the residential area, as well as insignificant changes in less important characteristics. The main change that occurred was the transition from USD to NIS, but I take this into account by converting the contracts denominated in USD into NIS according to the value of the exchange rate in the relevant month.

However, there was a very significant change in the price—the average monthly rental fee rose from NIS 2,148 to NIS 3,663 (simple average), and the weighted average monthly rental fee rose from NIS 2,471 to NIS 4,224—nominal increases of 71%. In addition, in terms of the rental fee distribution, it was found that in December 2007, 25% of the contracts were

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[17] The data show a significant gap in the price level between the simple average and the weighted average over an extended period. The gap also exists in the processed data of the Central Bureau of Statistics (on this matter, see Figure 2 above).

[18] Over 90% of contracts are signed for a year.

[19] The calculation is based on the exchange rate in these months (mainly relevant to December 2007, because in December 2015 most contracts were in NIS, and therefore the exchange rate is irrelevant).

up to a price of NIS 1,538, the median contract was NIS 1,923, and 75% of the contracts were up to a price of NIS 2,500; whereas in December 2015, 25% of the contracts were at a monthly price of up to NIS 2,600 (an increase of 69%), the median was NIS 3,450 (an increase of 79%), and 75% of the contracts were at a price of up to NIS 4,500 (an increase of 80%).

This also indicates that in order for the Rental Price Index not to be biased downward, an increase of 28% in the quality of the apartments in the entire rental market is required between December 2007 and December 2015 (in 2015, the index included 570,000 rental apartments).[20]

I will try to illustrate the unreasonableness of this argument; such a large increase in apartment quality requires a huge investment in renovations. According to a survey conducted by the Geocartography Institute for the Israeli Building Center, it was found that in 2014, households invested about NIS 8 billion a year in apartment renovations (rental apartments and owned apartments).[21]

Assuming that the rental market constitutes about one-third of the apartments (and assuming that the renovations are proportional to its size), and assuming that the annual renovation amounts are constant (a conservative assumption)—the cumulative investment in renovations of rental apartments was NIS 21 billion in 2008–15.[22] Therefore, it follows that the average renovation carried out in rental apartments was around NIS 37,000,[23] which on average created a price increase of 28% in rental fees (and therefore also in the value of the apartment). In other words, according to this calculation, an investment of NIS 37,000 increase the value of the apartment by NIS 280,000 (assuming that the average value of a rental apartment is NIS 1 million prior to the renovation).

In addition, a comparison of the characteristics indicates that there were no significant changes in the observed quality of the apartments. In order to explain the anomaly by a large increase in the quality of the apartments, we must assume that there was an unprecedented change in the rental market in the unobserved quality of the apartments within eight years, while we know that there was only a minor change in the observed quality of the apartments.

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[20] 1.71/1.34=1.28

[21] A survey of renovations conducted by the Geocartography Institute for the Israeli Building Center for the year 2014. It was accessed on February 8, 2015 from the website:
http://www.eranrolls.com/single-post/2015/02/08/סקר-השיפוצים-השנתי-של-מרכז-הבניה-הישראלי

[22] 8/3*8≅21

[23] NIS 21 billion for renovations divided by 570,000 apartments equals NIS 37,000 per renovation per apartment.

Table 3
All Contracts in Effect: December 2007 and December 2015

	December 2007	December 2015
Number of contracts in effect in the survey[24]	6,611	12,524
Average number of rooms	3.2	3.3
Average socioeconomic level	11.3	11.5
Average advance payment months	1.8	1.3
% of contracts in NIS	28%	99%
% of contracts including municipal taxes	1.9%	2.5%
Average month of contract start	March 2007	April 2015
Average month of contract end	July 2008	July 2016
Average contract duration	16 months	15 months
Average rental fees (simple, current prices)	NIS 2,148	NIS 3,663
Average rental fees (weighted, current prices)	NIS 2,471	NIS 4,224

SOURCE: Based on Rent Survey data.

4. MOVING TENANTS—THE NEW TENANTS IN THE RENT SURVEY

I use the moving tenants to measure the difference in prices between new tenants and existing tenants, and the difference in the price changes between these two groups. Because the Rent Survey surveys the tenants rather than the apartments, the comparison between new tenants and existing tenants is more complex. The database does not include data on the previous contract in the apartment to which a new tenant has moved who is included in the survey, and does not include data on the contract of the new tenant living in the apartment left by a previous tenant included in the survey. In addition, the only new tenants included in the Rent Survey are those who move—that is, new tenants who moved to a new apartment. Therefore, the prices of the same apartment cannot be compared for new tenants in the Rent Survey.

Table 4 below lists data on the dynamics of tenants' apartment moves in the rental market, in which I examine the tenants' choice at the end of a lease in a rental apartment. I divided the tenants who ended a contract into three groups: contract renewers, moving tenants, and market leavers.[25] The data shows that 77% of tenants renew a contract and continue to live in their apartment, 9% move into another rental apartment, and 14% leave the rental market. In other words, an average of 23% of renters leave their rental apartment every year.

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[24] As I did in the regressions below, when a particular contract is first included in a rent survey, I do not take it into account in the months preceding its entry into the survey, even if it was already in effect, but only from the month of its entry into the survey and until its end.

[25] The calculation was conducted for each month in the years 2005–15, and the division into groups is based on the following definitions: Contract Renewers—tenants who renew a contract in the same apartment; Moving Tenants—tenants who have moved to another rental apartment; and Market Leavers—tenants who have left the rental market.

Also note that there is a gap between the share of apartments vacated and the share of new tenants resulting from the change in the scope of the rental market. Because the rental market has expanded consistently during the examined period, the share of new tenants is higher than the share of rental apartments that have been vacated.

Table 4
Tenant Dynamics in the Rental Market 2005–15
(Percent of Total Tenants)

Year	Contract Renewers	Moving Tenants	Market Leavers	Total Apartment Leavers	Change in Scope of Rental Market	Total New Tenants
	(A)	(B)	(C)[26]	(D)[27]	(E)	(F)[28]
2005	76.7	8.8	14.5	23.3	3.7	26.0
2006	78.1	8.3	13.6	21.9	10.6	29.4
2007	77.9	7.6	14.5	22.1	4.1	25.2
2008	76.1	8.3	15.7	23.9	-0.9	23.2
2009	78.2	8.7	13.1	21.8	3.8	24.7
2010	76.9	10.3	12.8	23.1	5.4	27.0
2011	76.9	10.1	13.0	23.1	1.3	24.0
2012	78.4	9.6	12.0	21.6	2.6	23.5
2013	78.6	10.0	11.4	21.4	1.4	22.5
2014	76.5	8.9	14.5	23.5	6.2	28.0
2015	73.1	8.0	18.8	26.9	2.0	28.3
Average (not incl. 2015)[29]	77.4	9.0	13.5	22.6	3.8	25.3

SOURCE: Based on Rent Survey data.

In order to estimate the share of new tenants each year, I used the increase in households renting apartments, which I estimated from the Household Expenditure Survey. After this correction, the rate of new tenants was an average of 25%, and therefore the rate of existing tenants was an average of 75%. From Table 4, it can also be concluded that of those leaving apartments, 40% moved to another rental apartment and 60% left the rental market.[30]

As a first indication of the difference between new tenants and existing tenants, I examined the gap in the average prices they paid. The data show that in 2005–07, before the housing crisis began, when price levels were not on a rising trend, no significant price

[26] (A)+(B)+(C)=100%
[27] (D)=(B)+(C)
[28] (F)=((E)+(D))/(1+(E))
[29] Apparently, 2015 has not been fully updated, so the rate of market leavers, apartment leavers, and new tenants in that year is biased upwards.
[30]

$$\frac{9\%}{9\%+13.5\%} = 40\%$$

differences were recorded at the time of signing the contract, between the prices of new tenants and the prices of existing tenants. During this period, the average monthly gap between new tenants and existing tenants was 2.2% less expensive for existing tenants, and the median gap was -0.9% (in 47% of the months, a positive gap was recorded, and in 53% of the months, there was a negative gap). In contrast, from 2008 onward, the average price for new tenants was significantly higher than the average price for existing tenants. In that period, the average gap in rental fees between new tenants and existing tenants was 9.9% and the median was 9.8% (in 97% of the months, a positive gap was recorded).[31] This indicates that from the beginning of the housing crisis, higher prices have been recorded for new tenants, who are not included in the Rental Price Index.

In Figure 3 below, I examine the price changes each month during the years 2005–15 for the new-tenants group and for the existing-tenants group at the time of signing a contract (after hedonic quality adjustment). Each point on the figure is the product of a separate bimonthly hedonic regression. In the first period, in each bimonthly regression, I included all contracts in effect in that month, for them to serve as a uniform base for measuring price increases in the two groups.[32] In the second period, in each bimonthly regression, I included a different group of tenants in each regression set. The first group included only moving tenants (in the month of the move),[33] and the second group included only contract renewers (in the month of renewal).[34] Each bimonthly regression is in the following form:[35]

$$(1) \quad \mathrm{lnprice}_i = \beta_0 + BX_i + \beta_1 \mathrm{Month}_i + \varepsilon_i$$

where X is a matrix of apartment and location characteristics that includes dummy variables for the number of rooms in the apartment and for the number of advance payments; dummy variables are given the value '1' if the price includes residents' committee, municipal taxes, electricity and water (separately); the socioeconomic level of the statistical area (which is given values between '1' and '20'), and the dummy variables for the local authority where the apartment is located. lnprice$_i$ is the natural logarithm of the rental fee (when the rental fee

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[31] I should also point out that there are also differences between the years in the period 2008–15. The average annual gap is greater than 10% in each of the years 2008–12, and less than 10% in each of the years 2013–15.

[32] This group averages 8,884 contracts per month (with a standard deviation of 2,253 contracts).

[33] This is a relatively small group, which includes a monthly average of 70 contracts, with a standard deviation of 34 contracts, a monthly minimum of 22 contracts and a monthly maximum of 196 contracts.

[34] This group includes a monthly average of 575 contracts (with a standard deviation of 275 contracts).

[35] For example, I prepared bimonthly regressions for the months January-February 2010. The observations for January 2010 are the same in the two regressions, and the February 2010 observations are not the same. In the February 2010 regression in which I included only moving tenants (new tenants), the price increase recorded for them was 21.7%. In the February 2010 regression in which I included only contract renewers (existing tenants), the price rise recorded for them was only 3.2%.

is set in USD, I converted it according to the exchange rate of the month of the observation). Month$_i$ is a dummy variable given the value '1' when the observation relates to the second month in the regression, and '0' when the observation relates to the first month in the regression. β$_1$ is the parameter estimated for the monthly price change.[36]

Figure 3
Price Change for New Tenants vs. Existing Tenants (Quality Adjusted), 2005–15
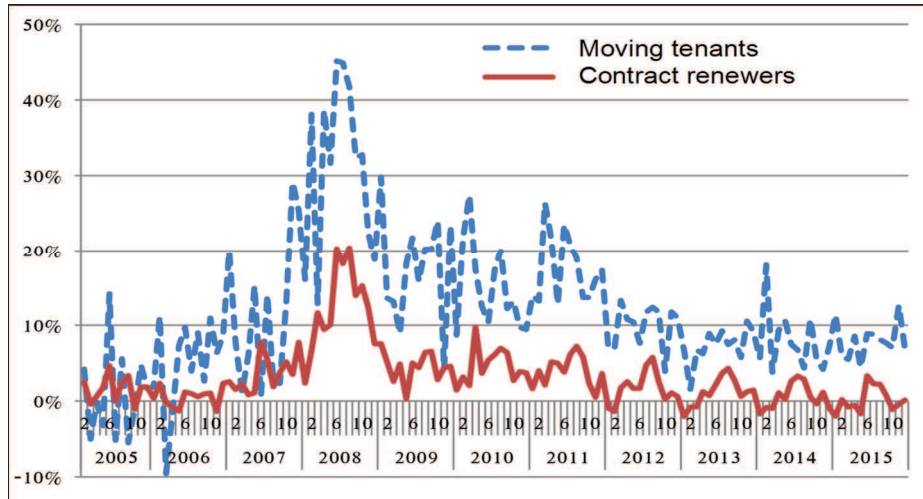
SOURCE: Based on Rent Survey data.

Contract renewers constitute the basis of the price changes in the Rental Price Index, and it can be seen that from the beginning of 2007, price increases were recorded in this group, with 2008 being an exceptional year in terms of monthly price increases. In June–August 2008, when about a third of the year's contracts are signed, the rental fee when renewing a contract was 20% higher than the rental fees for all tenants in the previous month. On average, the price increase for contract renewals in 2008 was 12.3%. In 2009–11, price increases continued when contracts were renewed, and the average price increase was 4.4%. In 2012–15, price increases continued to be more moderate and the average price increase was 0.9%.

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[36] In order to calculate the monthly price change, I calculated the exponent of β$_1$. I note that I chose the monthly configuration to allow accurate monitoring of market changes, and I use these regressions results in several tests below. Of course, monthly configuration testing has a price in terms of estimation significance and volatility. However, even in this test the differences between the groups are mostly significant. For example, out of the 96 months examined in the years in which price increases were recorded (2008–15), only in two months was the lower limit of the confidence interval (95%) of the moving tenants group lower than the price change of the contract renewers group. In my doctoral dissertation, I examined the differences in rental fees between contract renewers and moving tenants, and I showed that they are significant (Raz-Dror 2018).

The group of moving tenants serves as the barometer for the rental market because their rental fees are the best indicator of the spot price of the market. This group experienced a dramatic and steep price jump in November 2007, when the price level they were required to pay was 29% higher than the price level of all tenants in the previous month. In 2008, price increases continued to be exceptional, reaching over 40% in June–August. During this period (November 2007 to December 2008), the average price rise for moving tenants (compared with all tenants in the previous month) was 30.8%–an increase that is 18.9 percentage points higher than the price increase for contract renewers during this period. In 2009–11, the high price increases continued, and moving tenants experienced an average increase of 16.8% during those years—an increase that is 12.4 percentage points higher than the price increase for contract renewers during those years. In 2012–15, when the price increases became more moderate, the average price increase for moving tenants was 8.2%—7.3 percentage points higher than the price increase for contract renewers during these years.

The figure above shows that from the beginning of the global crisis at the end of 2007, there was only one month in which the rise in prices for moving tenants was smaller than the price rise for contract renewers. In the years 2008–15, the average price rise for new tenants (compared to all existing contracts in the previous month, most of which were signed a year earlier) was 14.3%, compared with 3.6% for contract renewers when the contract was renewed—an average gap of 10.7 percentage points. **These findings convincingly show that the Rental Price Index, which does not include the price increases in apartments to which new tenants have moved, was biased downward during these years.**

I note that I do not have enough data regarding years when prices were not increasing, and in those few years, most contracts were indexed to the USD, and the exchange rate was extremely volatile. Therefore, it is difficult to determine on the basis of the data, that when no price increases are recorded, the gap between the moving tenants and the contract renewers does not exist. However, the data for 2005–06 (where no consistent changes in rental prices were recorded) indicate that in many months the change in the rental price of the contract renewers was higher than that of the moving tenants. This finding reinforces the hypothesis that the bias caused by the exclusion of the moving tenants is less in effect when no price increases are recorded, and therefore it can be used to explain the difference in the degree of bias between the periods (1999–2007 and 2008–15).

Furthermore, if the basis of the bias in the Rental Price Index is the new tenants in the rental market (and not just the moving tenants), it means that the total number of apartments vacated must be considered. Table 4 above shows that on average, every year 23% of the tenants leave the rental apartment in which they resided during the previous year.[37] Therefore, an unbiased Rental Price Index, which is based on a repeat rental method, would have to include 23% of apartments with a moving-tenants price rise.

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[37] Assuming that there is no change in the size of the rental market between the periods. When there is an increase in the rental market (as in 2008–15), the rate of new tenants is even higher than the rate of apartments vacated.

In addition, I examined the contracts renewed in 2008–15 and found that the annual nominal price rigidity recorded ranged between 40% and 65%, averaging more than 50% (Appendix A).[38] It follows that if each year one new tenant is added for every four tenants who continued to live in their apartments, and for half of the tenants who continued living in their apartments the rent was not raised, and assuming that when market prices rose, they rose for all new tenants, this means that the Rental Price Index did not include one-third of the apartments that experienced a price rise.[39]

5. ESTIMATION OF CHANGES IN RENTAL PRICES USING HEDONIC METHODOLOGY[40]

As noted above, because the only new tenants included in the Rent Survey are the moving tenants, the Rent Survey does not have any apartments for which the price paid by the previous tenant and the new tenant's current price can be seen. Therefore, in all the tests below on the changes in rental prices in Israel, I will use hedonic methodology, which allows me to deal with this characteristic in the data.

The hedonic estimation method is based on the pricing of the apartment characteristics using a multivariate regression, where the dependent variable is the natural logarithm of the rental fee (or the price of the apartment), and the independent variables are the characteristics of the property. The foundations of the hedonic model were laid by Lancaster and Rosen (Lancaster 1966; Rosen 1974). The hedonic model is used for quality adjustment in products where there are large differences in quality (for example, in computers or cars), and to evaluate the willingness to pay for product properties that cannot be separately priced.

In the housing sector, the use of the hedonic model is very common, as an apartment is a very heterogeneous product, due both to the physical differences between apartments and to the differences arising from their location. In addition, hedonic estimation is also widely used to estimate the effect of various phenomena on housing prices, such as air pollution, public parks, local taxes, schools and crime.

The hedonic estimation in the housing sector is used, inter alia, to create quality-adjusted metrics (for example, by the Central Bureau of Statistics in the Housing Price Index), and especially in studies of rental markets.[41] Hoffmann and Kurz found, based on the German Rent Survey (which surveys apartments, rather than tenants as in Israel), that the results of the hedonic regression on rental prices are robust. The results are similar when using only a

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[38] That is, on average 50% of the contracts renewed were renewed at the same nominal price set as in the previous contract.

[39] $\frac{1}{3} = \frac{1/5}{1/5 + \frac{4/5}{2}}$

[40] In all the regressions, I used Central Bureau of Statistics weights for 2015 in order to create a representative sample of rental apartments in Israel.

[41] See Rondinelli & Veronese, 2011; Hoffmann & Kurz, 2002; Gordon & van Goethem, 2005.

few explanatory variables and when adding numerous other variables. In addition, the researchers found that the hedonic regressions are very similar to the German Central Bureau of Statistics index results, which were built on a paired sample base (Hoffmann & Kurz, 2002).

In the tests I have conducted and that are detailed below, I have examined the change in prices in the Israeli rental market using bimonthly hedonic regressions (i.e., the monthly change between two consecutive months is obtained using a bimonthly regression of only these two months). These regressions enable a relatively good comparison with the repeat rental methodology used by the Central Bureau of Statistics (in which the monthly price change is obtained by comparing two consecutive months). This allows the pricing of apartment characteristics to change over time, and allows the necessary indexations according to the contracts, enabling us to take into account the change in prices in the entire rental market.

a. All contracts in effect

This regression set consists of 131 separate bimonthly regressions. I included in each bimonthly regression all existing contracts in effect in the Rent Survey in the relevant two months. That is, in this test, I also included the observations that are not included in the Rental Price Index (i.e., the new apartments in the survey and the vacated apartments in the survey, which appear only in one month in one of the bimonthly regressions). Each bimonthly regression will be in the following form:

$$(2) \qquad \text{lnprice}_i = \beta_0 + BX_i + \beta_1 \text{Month}_i + \varepsilon_i$$

Where X is a matrix of apartment and location characteristics. lnprice$_i$ is the natural logarithm of the rental fee (when the rental fee is set in USD, I converted it according to the exchange rate of the month of the observation). Month$_i$ is the dummy variable that is given the value '1' when the observation relates to the second month in the regression, and '0' when the observation relates to the first month in the regression. β_1 is the parameter estimated for the monthly price change.[42]

The regression shows that rental prices increased nominally by 69% from December 2007 to December 2015. The results are detailed in Figures 4 and 5 below.[43]

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[42] In order to calculate the monthly price change, I calculated the exponent of β_1. In addition, I examined the explanatory power of the bimonthly regressions. Except for the first half of 2005, the minimum explanatory power of a bimonthly regression was approximately 0.60, and the maximum was approximately 0.73. The average and the median of all the regressions was 0.68. The explanatory power increases over the years, apparently as a result of the increase in the number of observations, and in the years 2014–15 it was an average of 0.73.

[43] Because there are 131 regressions, I did not include the detailed results in the body of the document. To give the reader a better idea of the regression structure, in Appendix B below, I list the results of a similar regression with constant hedonics over the entire period.

Figure 4
Change in Rental Prices – Bimonthly Hedonic Regression on All Contracts in Effect
December 2007=100
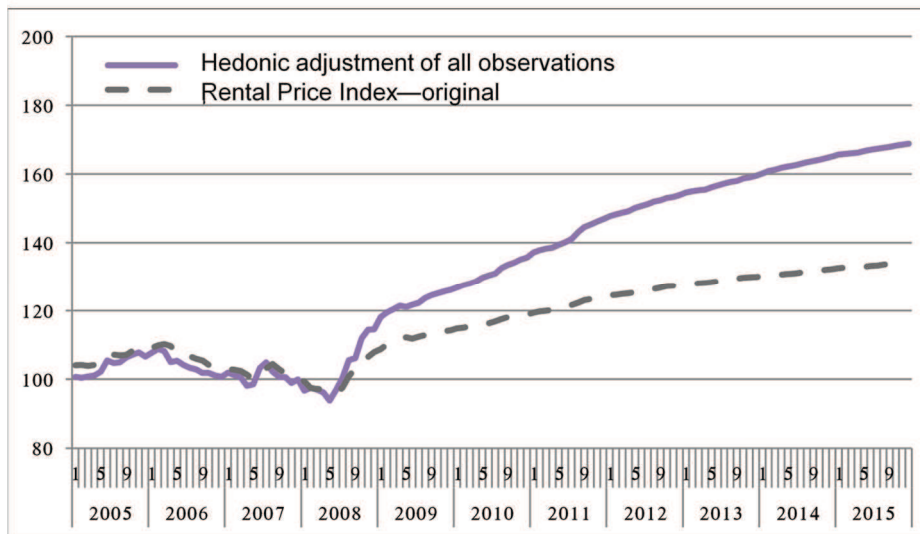
SOURCE: Based on Rent Survey data.

b. Hedonic tracking of the Rental Price Index

The use of hedonic methodology raises the concern that the quality adjustment is insufficient if the scope of information on the housing characteristics is limited (a reasonable concern in the case with which this research is dealing, although as mentioned, the explanatory powers of the regressions are sufficiently high).[44] Therefore, I conduct a test in which the results of the Rental Price Index can be compared to the hedonic regression, which includes only the observations that are included in the Rental Price Index. In this test, each bimonthly regression consists of pairs of observations—an apartment included in the first month is also included in the second month. The regression structure is the same as in the previous section (the difference is in the selection of observations).

In the bimonthly regressions, I included only the observations that were included in the Rental Price Index (to the best of my knowledge). I did not include apartments that appeared in the Rent Survey in the second month but did not exist in the first month, or that existed in the first month but did not exist in the second month. If, for example, the test results show that under the same observations, the price increase in hedonic testing is significantly higher than that in the Rental Price Index, this is due to a biased quality adjustment in the hedonic methodology, and the results obtained in hedonic testing are questionable. However, if the results of the hedonic test are similar to the rise in prices in the Rental Price Index, this test

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[44] As mentioned above, Hoffmann and Kurz found that the hedonic regression with a few explanatory variables is also good at estimating changes in rental price (Hoffmann & Kurz 2002).

reinforces the assumption that the quality adjustment in the hedonic methodology is satisfactory.

The results show that the price increases in this test are in fact very similar to the price increases recorded in the Rental Price Index. While the Rental Price Index rose nominally by 34.2% between December 2007 and December 2015, in the hedonic test that tracks the Rental Price Index observation selection method, nominal prices increased by 35.1% during this period (Figure 5 below).[45]

c. Observations included in the Survey – Annual Hedonics

In this regression, I only included contracts of tenants who participated in the Rent Survey, the source of which, as aforementioned, is in the main Central Bureau of Statistics surveys (Household Expenditure Survey, Labor Force Survey and Social Survey). The observations are included in the regression only at the year and month of their entrance to the Rent Survey, and therefore most often not when signing the contract.

This regression has several advantages for correctly estimating the change in prices in the rental market. First, the observations for each month constitute a representative sample of the rental market in Israel at that point in time, as their source is in Central Bureau of Statistics surveys, which create a representative sample of the Israeli population, and their existence is not affected by their staying in the Rent Survey. Therefore, if the Rent Survey sample does not adequately represent the rental market, the regression bypasses this problem. Second, the regression observations constitute a representative sample of the general rental market each month, as they include new contracts, renewed contracts, and ongoing contracts (and therefore this test deals adequately with the claim of improved quality in apartments that have a change of tenants). Third, because the observations are unique, the price changes are not tested for the same apartments, and therefore the age bias present here is of less importance.[46]

That is, this regression does not depend on contract renewal, tenant monitoring when moving, characteristics of tenants remaining for years in the Rent Survey, or characteristics of tenants leaving quickly, and it does not take into consideration the contract signing date, or the effect of past contract signing rates on future contract signing rates. The observations included are random, representative and unique.

In order for the regression results not to be too volatile as a result of the small number of observations, I estimated the monthly price increase in a regression that included the relevant

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[45] I note that the explanatory power of these regressions is virtually identical to the explanatory power of the set of regressions on all contracts in effect (and that refers to any bimonthly regression).

[46] However, some of the age bias probably still exists (as long as the age of the apartment is not included as an explanatory variable).

month and the preceding 11 months.[47,48] The regressions included only the observations that were included in the survey according to the month they entered into the Rent Survey, and therefore there is no observation that appears twice in the same regression. Each regression will be in the following form:

$$(3) \qquad \text{lnprice}_i = \beta_0 + BX_i + \beta_t\text{Month}_i + \varepsilon_i$$

where X is a vector of apartment and area characteristics. lnprice$_i$ is the natural logarithm of the rental fee (when rent is set in USD, I converted it to NIS according to the rate of exchange in the month of the observation). Month is a dummy variable vector, where an observation is given '1' in the month it entered the Rent Survey and '0' in the remaining 11 months of the regression. β_t is the vector of the estimated parameters of the monthly price change compared to the base month.[49]

As noted above, the test that includes only the observations that enter the survey has many advantages, and is the clearest for estimating price changes. Its only downside, in my view, is the small number of observations, which creates relatively high volatility.[50]

The nominal cumulative price increase recorded in this set of regressions is 59% (between December 2007 and December 2015), and is similar to the hedonic regression set for all observations, although as expected, its volatility is greater.[51] As stated, the observations in the survey are a snapshot of the rental market in Israel in that month.

From the regression results presented in Figure 5, several conclusions are drawn. First, a comparison of the hedonic regression on the observations included in the Rental Price Index with the actual Rental Price Index shows that the behavior of the two series is almost identical. This result strengthens the credibility of the hedonic method in measuring changes in rental prices, as there is no bias in the hedonic index.

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[47] Except for 2005, in which I prepared one regression for all of the observations of that year, and the changes in the monthly prices in that year are derived thereof. There are a total of 121 regressions.

[48] In regressions that I do not specify here, I have examined the change in prices of the new observations coming into the survey in bimonthly regressions. The price change in 2008–15 is similar to the regressions with the annual hedonics I present in this section. However, in 2005–06, the combination of the bimonthly hedonics and the small number of observations produced a very large volatility in the regression results in those years, and so I preferred in that case not to rely on such a short period for hedonics.

[49] In order to calculate the monthly price change, I calculated the exponent of β_t. In the first regression (January-December 2005) I produced β_t compared with January 2005, and I included all the estimated parameters of the months. In the remaining 120 regressions, I included only β_{12}, estimated compared to the preceding month.

[50] There are 26,000 observations in this section compared with 107,000 observations in Section 5.1.

[51] The average explanatory power of the regressions: $R^2 = 0.71$.

Figure 5
Change in Rental Prices in Israel—Contracts in Effect, Changing Hedonics
2005–15 (December 2007=100)
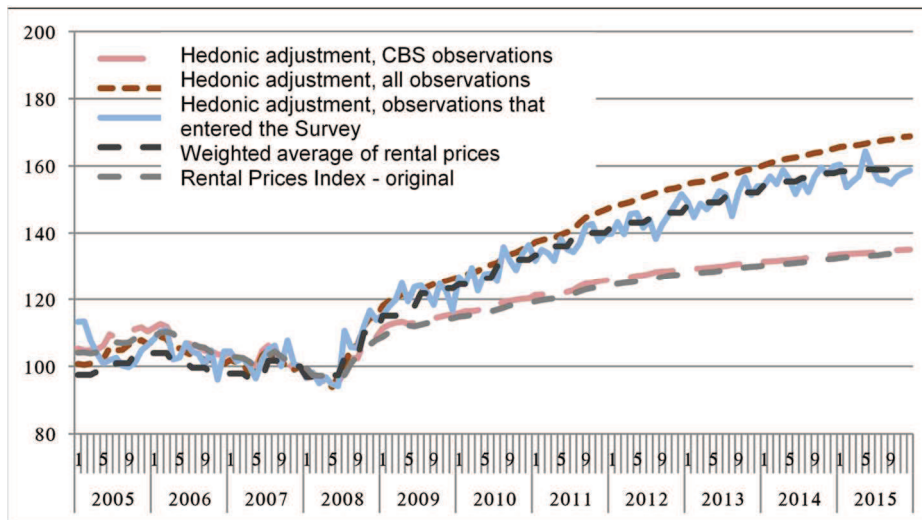
SOURCE: Based on Rent Survey data.

Second, when we include in the bimonthly hedonic regressions all the observations in the Rent Survey, the cumulative price increase jumps from the level of the Rental Price Index (a nominal 34%) to double the level (a nominal 69%). The differences between the two indices began to be recorded only in mid-2008, a short time after the beginning of the price increases. From June 2008 to December 2015, the Rental Price Index rose by 42% in nominal terms, while the hedonic index for all observations rose by 75% in nominal terms. This finding corresponds to the hypothesis that the sharp downward bias of the Rental Price Index was created only from the combination of the exclusion of observations of new tenants and the sharp rise in prices in the market.[52]

Third, in a test that is largely detached from the other tests, which include only the observations that enter into the survey (at the time of entry), and therefore the most unbiased test, the price changes during the crisis years are similar to the estimation results that included all observations (although somewhat lower) and to the weighted and simple averages, and very far from the Rental Price Index.

In Figure 6 below, I plot the cumulative annual price increase each month (12 months back) according to the Rental Price Index and the bimonthly hedonic regression for all observations, as well as the difference between them. The data show a similarity between the series from the beginning of 2005 to mid-2008, and even in this period, the hedonic index is always ahead of the Rental Price Index—declining and rising before it. Therefore, in that

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[52] For more information on the importance of combining these two, see: Raz-Dror 2018.

period, in which intermittent increases and decreases are recorded, a gap does not develop between the series. The divergence between the series begins in mid-2008. From 2008 until the end of 2015, when the new tenants are also considered, the prices in the hedonic regression rise at a higher rate than the Rental Price Index, and it can be seen that for most of the period, the hedonic index rises consistently by almost twice the Rental Price Index. I note that at the end of the period, annual price changes for both indices are nearing one another. The figure also shows that the sharp increase in rental fees occurred in the years 2008–09, in which the maximum annual change in rental fees is very close to 30%![53]

Figure 6
Annual Change in Rental Prices (Last 12 Months), 2006–15
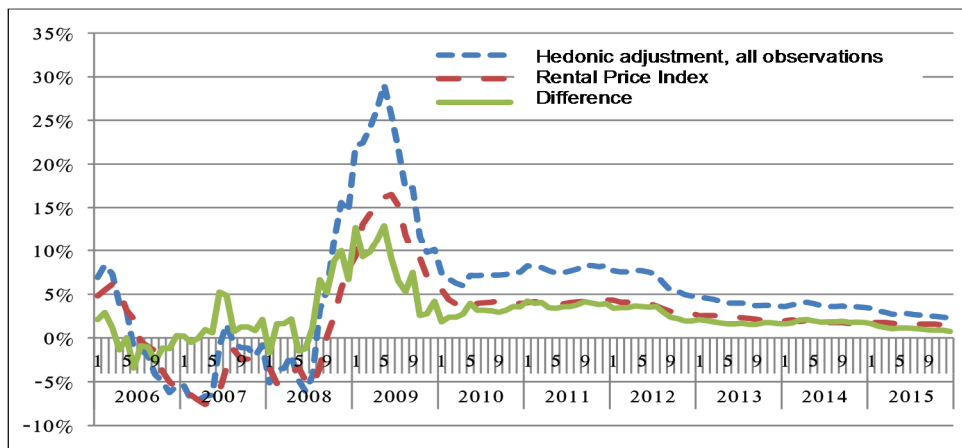
SOURCE: Based on Rent Survey data.

6. ROBUSTNESS TESTS

This section reviews robustness tests conducted for the results obtained in Section 5. First, I conducted an additional test of the price increases that would have transpired had new tenants and their price increases been taken into consideration (Section 6.1), and then I examined the price changes in the rental market through the Household Income Survey, which allows better control of the quality of the apartments (Section 6.2).

[53] Part of this sharp increase in rental prices was due to a sharp rise in the USD exchange rate that occurred from mid-2008 to early 2009. Apparently, this sharp rise in the USD exchange rate, and the sharp decline that preceded it, led to a sharp shift from the USD-indexed to the NIS contracts in the rental market, which occurred mostly in 2008-2009. Indeed, since in that period, a large part of the contracts in effect were still denominated in USD and indexed to the USD exchange rate, part of the increase in rental prices in 2008-2009 was due to the price changes in the contracts in effect. However, not all of the increase in rental prices during these years was due to the sharp changes in the exchange rate, and the spot prices in the rental market also rose exceptionally in 2008: by 15% in nominal terms, and by 11% in real terms. For more information, see Figure 63 in the summary of my doctoral dissertation (Raz-Dror 2018).

a. Weighting the New Tenants into the Index

The integration of the data on the price increases of moving tenants and the share of vacated apartments (see Section 4 above) makes it possible to estimate the impact of the inclusion of new tenants and their price changes on the overall change in rental prices. To the extent that the result is similar to the hedonic test, it will strengthen the hypothesis that these differences were created by the exclusion of new tenants in the Rental Price Index. As a preliminary and rough estimate, new tenants can be included by multiplying the annual increase in the Rental Price Index (3.6%) by 77% (the percentage of existing tenants), plus the product of the average annual price increase for new tenants (14.4%) multiplied by 23% (the percentage of new tenants).[54]

The result is an average annual price increase of 6.1% and a cumulative nominal price increase (2008–15) of 60.4%—very close to the increase in the simple or weighted average rental fees.[55]

In Figure 7 below, I prepared a more accurate estimate of the overall price increase, in which I weighted the change in prices of new tenants using the formula below:[56]

$$(4) \qquad \Delta Pall_t = \%existing_y * \Delta Pindex_t + \%new_y * \Delta Pnew_t/12$$

where $\Delta Pindex_t$ is the price change in the Central Bureau of Statistics' Rental Price Index in month t, which reflects the change in the price of the existing tenants. The $\%existing_y$ variable is the share of existing tenants in the tenant population in year y (which includes month t) according to the data calculated in Table 4 above, $\%new_y$ is the percentage of new tenants in year y (and its complement to 1). $\Delta Pnew_t$ is the annual change in prices of new tenants in that month, as calculated in Figure 3 above using bi-monthly hedonic regressions, divided by 12 in order for it to be averaged in among all new tenants (assuming that 11/12 of them moved in another month).

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[54] According to Table 4 and Figure 3.

[55] 60.4% = (1 + (3.6% * 77% + 14.4% * 23%))^8 – 1

[56] The formula is based on the model built by Crone and others in order to test the effect of the Non-Response bias (Crone et al., 2006).

Figure 7
Estimate of Changes in Rental Prices That Also Include New Tenants
December 2007=100
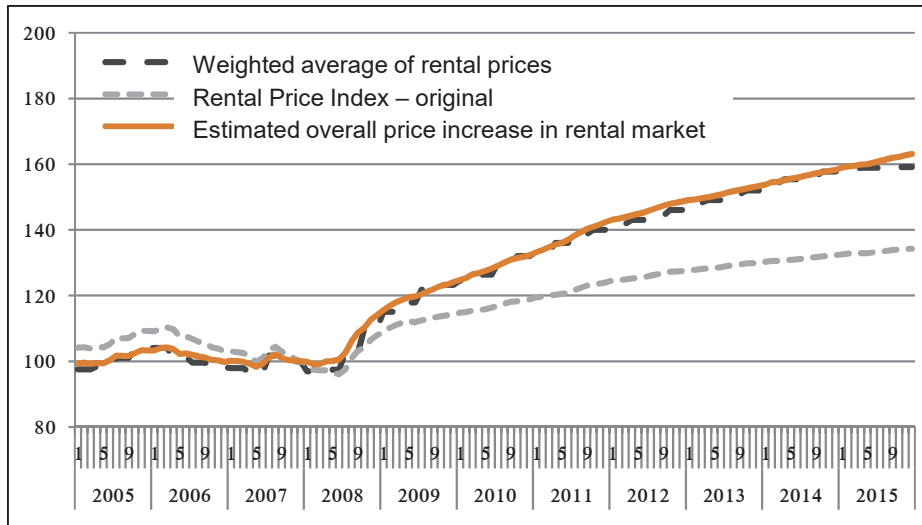
SOURCE: Based on Rent Survey data.

I plot the estimated change in prices in the entire rental market (the cumulative price change of $\Delta Pall_t$), compared with the change in the weighted average rental fees and the Rental Price Index (Figure 7). As can be seen, not only is the estimate of the rental prices higher than the Rental Price Index (an expected result because the price increases of the new tenants are higher than the price increases of the existing tenants), but the estimated price increase is very similar to the weighted average rental fee behavior. According to this estimate, rental fees rose by 63.1% between December 2007 and December 2015.

b. Estimating price changes using the Household Expenditure Survey

In this section, I examine the price increases in the rental market using a hedonic regression on Household Expenditure Survey data. The hedonics of this survey data will enable me to strengthen the argument that price increases in the rental market, as I measured them above, did not result from a sharp increase in the quality of the apartments.

Database: The Household Expenditure Survey is one of the central surveys conducted by the Central Bureau of Statistics, and its data are published once a year. Each year, the survey samples a representative (and changing) sample of the population in Israel. Among other things, the respondents are asked if they live in a rental apartment, and what is the rent they paid. In addition, the survey contains geographic and economic characteristics of the area in which the apartment is located, as well as a number of characteristics of the quality of the

apartment. I have the annual data for the period 2003–14. It should be noted that the tenants included in the Household Expenditure Survey are part of the inflow of tenants into the Rent Survey.

In Figure 8 and Table 5 below, I present the results of a uniform hedonic regression over the period 2003–14, where I used the characteristics of the area and the apartment, in order to adjust for quality changes, and to calculate the price changes in the rental market each year. The regression structure is as follows:

$$(5) \qquad \text{lnprice}_i = \beta_0 + BX_i + \beta_y \text{Year}_i + \varepsilon_i$$

In the regression, I included only apartments rented from a private person and for which no help was received from a government agency for the rental payments. X is a vector of the characteristics of the apartment and the area, which includes dummy variables for the locality and subdistrict in which the apartment is located, whether the apartment is in a "development town" or not, the socioeconomic level of the locality, whether the locality is a rural locality, and whether it is large, medium or small.[57] The regression also included the following apartment characteristics: the number of rooms in the apartment and whether the apartment includes central heating, air conditioning and a dishwasher (separately). lnprice$_i$ is the natural logarithm of the rent (in NIS). Year is the dummy variable vector, in which each observation is given '1' in the year in which the contract was signed and '0' in other years. β_y is the estimated parameter vector of the price change in the relevant year compared to the base year (2007).[58]

I chose to include in the regression all the characteristics that exist in the Household Expenditure Survey that are not physically separable from the apartment. I believe that the change in these variables largely reflects the change in the quality of the apartments. For example, during the period, the share of rental apartments with air conditioning increased from 62% in 2003 to 87% in 2014, and the share of rental apartments with a dishwasher installed increased from 31% in 2003 to 39% in 2014.[59]

The regression that includes all of the explanatory variables listed above indicates that rental fees rose nominally by 55.2% from 2007 to 2014 (Table 5, Columns 1–2 and Figure 8).[60] The regression's explanatory power is significantly low compared to the regressions I prepared based on the Rent Survey: $R^2 = 0.42$.

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[57] I defined a locality as 'large' if it has 200,000 or more residents; 'medium' – 50,000 to 200,000 residents; and 'small' – less than 50,000 residents.

[58] In order to calculate the rate of the price change, I calculated the exponent of β_y.

[59] There was a decrease in the rate of rental apartments with central heating over the period examined.

[60] I also prepared parallel regressions comparing between years, and the results were quite similar.

Figure 8
Change in Rental Prices based on Household Expenditure Survey
2003–14 (2007=100)
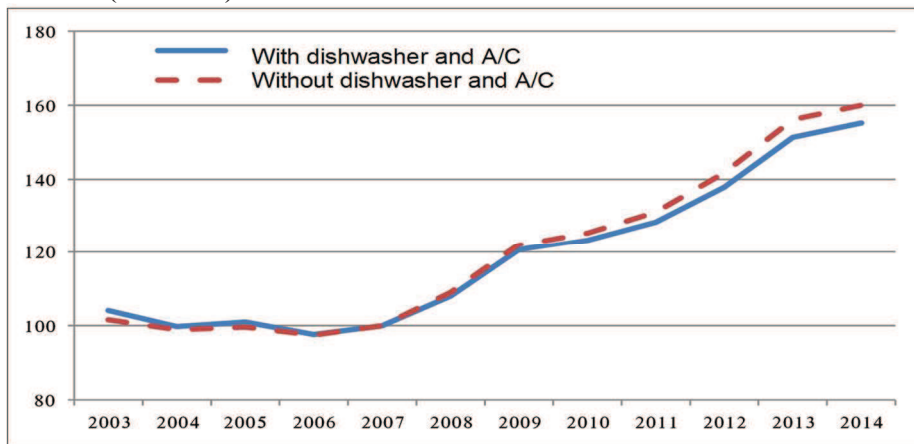
SOURCE: Based on Household Expenditure Survey data.

According to the hedonic examination in Section 5.1 above, rental fees in 2015 increased by 2.7%.[61] Therefore, with the integration of this data, rental fees increased nominally in 2008–15 by 59%. This rate is similar to the nominal increase in rental fees measured in the previous sections. In addition, I prepared a similar regression, in which I do not include variables regarding air conditioner and dishwasher. In this regression, rental fees increased nominally by 60% between 2007 and 2014 (Table 5, Columns 3–4, and Figure 8). When combining the increase in prices for 2015, rental fees increased nominally by 64% in 2008–15.

The gap between these regressions (5 percentage points in the price increase in 2008–15) is a good indication of the required quality adjustment for the unobserved variables in the regressions based on the Rent Survey data. An increase in the share of apartments with air conditioning and a dishwasher indicates a certain amount of renovation activity (beyond direct investment in their purchase), or the purchase of rental apartments that are relatively new compared to the existing inventory. If the housing market underwent significant renovations to explain the anomaly, we would expect that a considerable part of them would be reflected in the pricing of these characteristics. And indeed, the regression results show that their pricing is greater than their cost or reasonable contribution to rental fees. An apartment with a dishwasher is priced 16% higher than an apartment without dishwasher, and an apartment with air conditioning is priced 14% higher than an apartment without air conditioning. In other words, if an apartment has been renovated and an air conditioner and dishwasher have been installed, its rental fees will increase by 32%. This rate indicates a massive renovation in an apartment.

[61] The 2015 average compared to the 2014 average.

Table 5
Results of the Regressions based on the Household Expenditure Survey

	Dependent variable: Log rents			
	(1)	(2)	(3)	(4)
2003	0.0403 (0.0204)**	4.1%	0.0155 (0.0207)	1.6%
2004	-0.0025 (0.02)	-0.3%	-0.0107 (0.0203)	-1.1%
2005	0.01 (0.0202)	1.0%	-0.0039 (0.0205)	-0.4%
2006	-0.0242 (0.0193)	-2.4%	-0.0258 (0.0197)	-2.5%
2008	0.0768 (0.0180)***	8.0%	0.0863 (0.0183)***	9.0%
2009	0.1873 (0.0179)***	20.6%	0.1997 (0.0182)***	22.1%
2010	0.2104 (0.0178)***	23.4%	0.2266 (0.0181)***	25.4%
2011	0.2496 (0.0177)***	28.4%	0.2707 (0.0179)***	31.1%
2012	0.3214 (0.0177)***	37.9%	0.349 (0.0180)***	41.8%
2013	0.4143 (0.0177)***	51.3%	0.4456 (0.0179)***	56.1%
2014	0.4398 (0.0177)***	55.2%	0.4701 (0.0179)***	60.0%
3 rooms	0.1442 (0.0099)***	15.5%	0.1591 (0.0101)***	17.2%
4 rooms	0.2909 (0.0113)***	33.8%	0.3403 (0.0112)***	40.5%
5 rooms	0.4667 (0.0164)***	59.5%	0.5543 (0.0160)***	74.1%
Developing town	-0.1325 (0.0315)***	-12.4%	-0.1526 (0.0320)***	-14.2%
Socio-eco level	0.0679 (0.0097)***	7.0%	0.0752 (0.0099)***	7.8%
Heating	0.168 (0.0172)***	18.3%	0.1828 (0.0175)***	20.1%
Dish washer	0.1466 (0.0107)***	15.8%		
AC	0.1302 (0.0089)***	13.9%		
Village	0.0719 (0.0412)*	7.5%	0.1079 (0.0419)***	11.4%
Medium	-0.2823 (0.0567)***	-24.6%	-0.3502 (0.0575)***	-29.5%
Small	-0.3171 (0.0501)***	-27.2%	-0.3875 (0.0508)***	-32.1%
Municipalities dummies	YES		YES	
Constant	7.1499 (0.0933)***		7.2139 (0.0948)***	
Obs.	12,753		12,753	
R-squared	0.42		0.40	

Standard deviation in brackets. *, **, and ***, express significance level 10%, 5%, and 1%, respectively.

Even after including the variables indicating a massive renovation in the regression, there was a 59% increase in prices, which is not similar to the price increase recorded in the Rental Price Index (34%). Therefore, this test indicates that there were no major renovations in the rental market that could explain the anomaly. Nevertheless, the regression results indicate that a certain downward correction may be required (of approximately 5 percentage points, cumulatively) in the increase in rents measured based on the Rent Survey.

In this regard, in my doctoral dissertation I show that the price changes in the rental market can be closely estimated even without taking into account the observations of new tenants (by hedonic tests of only existing tenants with similar seniority). In this test, the extent of the change in the quality of the apartment as a result of renovations at the time of the move is minor, as the distribution of the seniority of tenants in each period is similar. In this test as well, the nominal rental fee increased by 60% in 2008–15 (Raz-Dror 2018).

However, it should be noted that the Rent Survey does not include data on the age of the apartment, and during the period the average age of rental apartments could have declined, due to the entry of new and higher quality apartments into the rental market. The data on the US market indicate that an apartment that is one year younger equals 0.3%-0.4% more, and the data regarding the Israeli ownership market are similar.[62] For the sake of the discussion, let us assume that as a result of the apartment's aging by one year, the change in rental fee is similar to the change in the price of the apartment. Therefore, even if we make an unreasonable assumption that from 2007 to 2015, the entire rental market has become 10 years younger, this means that we need to reduce the nominal price increases by 3–4% in order to control for the change in the average apartment age. However, under more reasonable (but still conservative) assumptions, even if the average age of rental apartments has decreased, we would probably need to reduce a maximum of 0.2 percentage points from the nominal price increase in order to control this effect.[63]

7. SUMMARY AND DISCUSSION

a. Summary of Results - Changes in Rental Prices in 2008–15

The main goal of this study was to estimate the actual changes in rental fees in Israel in the years 2008–15. I showed that in times of price increases in the rental market in the years 2008–15, the price increases recorded for apartments with new tenants were much higher than the price increases for apartments with existing tenants renewing a contract. I also

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[62] In the regression I prepared in my doctoral dissertation, I found that in the years 2000–14, the aging of an apartment by one year reduces its value by 0.3%-0.4% (Raz-Dror 2018).

[63] For example, if we assume that the average apartment age in the rental market in 2007 was 30 years, and that in 2008-2015 only new apartments entered the rental market each year (and the existing apartments remained), and that by the end of 2015 the apartment entries constituted 25% of the rental market—the average age of apartments in the rental market in 2015 will be 29.5. That is, the average apartment age in the rental market has fallen under these assumptions by only six months.

showed that the weight of the new tenants is not at all negligible. Therefore, the exclusion of the new tenants from the Rental Price Index creates a downward bias of the Rental Price Index, starting in 2008.

To estimate the changes in rental prices, I used the hedonic method in a series of variations. In Table 6 below, I summarize the regression results. In all the regressions I prepared, there was a nominal price increase of 59–69%, and a real price increase in the range of 47–56%.[64] This is compared to a nominal increase of 34% and a real increase of 24% in the Rental Price Index. **All of the above leads me to the conclusion that the Rental Price Index is sharply biased downward, and the price rises in the rental market are significantly higher than previously estimated.**

In addition, when I used the hedonic method to imitate the Rental Price Index, by excluding the new and vacating tenants' observations in the bimonthly regressions, the hedonic test results were virtually identical to the Rental Price Index, indicating that hedonic testing does not suffer from substantial biases that could result from insufficient apartment characteristics.

Table 6
Summary of Results

Test Method	Rate of Nominal Price Increase 2008-2015
Rental Price Index (Central Bureau of Statistics)	34%
Simple average (Central Bureau of Statistics)	59%
Weighted average (Central Bureau of Statistics)	59%
Rental Price Index observations, bi-monthly hedonics (Section 5.2)	35%
All observations, bi-monthly hedonics (Section 5.1)	69%
Observations that enter the survey, annual hedonics (Section 5.3)	59%
Household Expenditure Survey, including variables indicating renovation (Section 6.2)	59%
Household Expenditure Survey, not including variables indicating renovation (Section 6.2)	64%

The test I conducted on the Household Expenditure Survey data shows that some reduction in the price increase may be required due to an insufficient adjustment for the increase in quality that occurred during these years (a further reduction of 3.1% is required).[65]

In order to reach a single definitive number that will express the price increase that occurred in 2008–15 in the Israeli rental market, I average the price increases of the tests in

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[64] The Consumer Price Index without housing increased by 8% between December 2007 and December 2015.

[65] $1.60/1.552 - 1 = 3.1\%$

Sections 5.1 and 5.3 (with an average nominal price increase of 64%), and adjust further for change in quality (Section 6.2).

In light of all this, my conclusion is that in the Israeli rental market, in the years 2008–15, there was a nominal price increase of 59% and a real price increase of 47% (see Appendix C for the monthly data).[66]

b. Proposed Corrections for Measuring Rental Prices

In my estimation, much of the bias in the Rental Price Index can be corrected by making a change to the monitoring of apartments, so that apartments with new tenants can be included in the repeat rental method; and the age bias should be permanently corrected. I should note that even after this correction, the share of vacated apartments in the repeat rental method would still be lower than their share in the rental apartment population, and therefore, the weights of these apartments should be inflated in order for the price changes in apartments with new tenants to receive the appropriate weight in the index.[67]

To test the reliability of the correction, it is also proposed to expand the characteristics of the surveyed apartments, and at the same time to examine the price changes with the hedonic methodology for all observations, and for the new observations that enter the Rent Survey. This is in order to produce a parallel estimate of changes in the rental fees. Changes in spot prices should also be estimated (which could serve as a leading indicator for what occurs in the housing market).[68]

In addition, through the tests I conducted, I found that there was a significant difference in the <u>price level</u> between the simple average and the weighted average of the national rental fees (see Table 2 above). In practice, the weighted average of the rental fees is higher than the simple average.[69] It is therefore advisable to stop publishing the simple rental fee average and publish the weighted average instead, since publication of the simple average results in a downward bias of the estimated rates of return on housing purchases.

c. Impact of the Correction on Other Issues

This study, and the sharp correction needed to measure changes in rental prices derived from it, contributes to the economic literature and to our understanding of the Israeli housing market in several ways.

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[66] 1.64/1.031 = 1.59
    1.59/1.08=1.47

[67] The share of new tenants in the repeat rental method after the correction will still be lower than their share in the population. This is, for example, due to the fact that some of the apartments vacated by the tenants will be sold and move to the ownership market, and therefore these apartments cannot be used in the repeat rental method.

[68] For the importance of estimating spot prices in the rental market and how it should be done, see: Raz-Dror 2018.

[69] I could not accurately trace the Central Bureau of Statistics calculation, but also by their method, the weighted average is higher than the simple average (see Figure 2 above).

First, this study contributes to the literature on measuring changes in rental prices. The results of this study emphasize the great importance of the way in which observations are selected and of the Non-Response bias to the proper measurement of rental prices. As a result of the direct use of the database on which the Rental Price Index was calculated, this study provided the most direct results (compared to the studies that dealt with this issue) regarding the implicit bias in the incorrect use of the repeat rental index, as a result of disregarding of new renters, or in the more severe case, as a result of the built-in monitoring of tenants rather than apartments.

Second, the study looked at the potential differences (which, in the Israeli case, were realized) between the change in prices for existing and new tenants and on the effect of the existing tenant's discount on sharp price increases experienced by existing tenants who become new tenants.

Third, the study outlined a more coherent perspective of rental market dynamics. According to this, the rental market norm is tenants living under one-year contracts for an average of four years in the same apartment, with high nominal price rigidity when prices rise in the market, which produces the existing tenants' discount (or at least most of it). The combination of all of this produces a moderate price increase for existing tenants and a sharp increase when they leave the apartment and receive the spot price of the market when moving to another rental apartment.

Fourth, greater price increases in the rental market have implications for the CPI. Even under the assumption that the share of the owned apartments is not at all impacted by the bias described in this article (see Figure 2 above), a bias was recorded in the CPI in the rental section. In 2008–15, the CPI rose by 15.7%, and at the end of the period, the weight of rentals in the CPI was 5.7%. I estimate that as a result of the increase in rental prices by 59% (and not by 34%), and as a result of the required increase in its weight in the CPI, it would be reasonable for the CPI to have increased by an additional 1-2 percentage points over the increase actually measured.

For example, assuming that the rental weight was 5.7% for the entire period, then the CPI rose by 17.1% during this period and not by about 15.7%, a bias of 1.4 percentage points (0.2% per year) in the CPI measurement in the years 2008–15.[70]

Fifth, this study has a significant impact on the estimates of the existence of a price bubble in the Israeli housing market during the current housing crisis. The existence of a price bubble in the economic sense is the detachment of home prices from the fundamentals.[71] Rental fees are the most important fundamental, and this study shows that the gap between the increase in rental prices and the increase in apartment prices is much smaller than previously estimated (Figure 9 below). The likelihood that there is a price bubble in the housing market in the economic sense has diminished significantly following the conclusions of this study.

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[70] 5.7% * 34% + 94.3% * 14.5% = 15.7%
   5.7% * 59% + 94.3% * 14.5% = 17.1%
[71] See for example: McCarthy & Peach, 2004; Case & Shiller, 2003.

Figure 9
Comparison of the Nominal Change in Rental and Housing Prices[72]
2005–15 (December 2007=100)
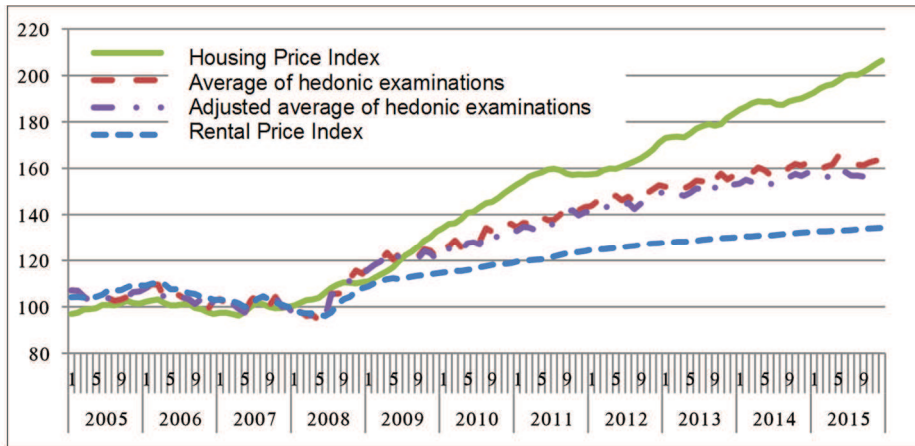
SOURCE: Based on Central Bureau of Statistics data.

Sixth, this study has implications for the analysis of the sources underlying the increase in housing prices since 2007. As Sarel has pointed out (2014), if rental prices increased in real terms by 20%-25% (based on the biased Rental Price Index), the majority of the increase in housing prices cannot be explained by the increase in rental prices and therefore, most of the increase in prices in the housing market was created by changes in demand for investments in housing, and not as a result of issues related to the demand for housing services. I have shown that this is not the case. Rental prices are the best barometer for estimating the difficulties of supply expansion, as they are not directly and extensively influenced by changes in individual expectations and by interest rates. Therefore, if rental prices have risen more than we had estimated, the supply problem is more central for policy decisions concerning the housing crisis.

[72] The "Rental Price Index" is the Central Bureau of Statistics index that is the subject of this study. The "Hedonic Tests Average" is an average of the hedonic test of all observations (Section 5a) and of the test of only new observations (Section 5c). The "Corrected Hedonic Tests Average" is a correction to the average hedonic tests according to the Household Expenditure Survey (Section 6b) which I introduced linearly (to a cumulative reduction of 3.1%). The "Housing Price Index" is the hedonic index of the Central Bureau of Statistics for measuring changes in housing prices. All changes are nominal.

Appendix A

Nominal price rigidity[73]

The economic literature finds an exceptional level of nominal price rigidity in the rental market relative to other areas (Aysoy et al., 2014, Genesove 2003, Shimizu et al. 2010, and Verbrugge et al. 2016). The examination I carried out indicates that Israel as well has a high nominal price rigidity (hereinafter, "rigidity" or "price rigidity"). The findings also indicate that the rate of price rigidity is not fixed, but rather changes over time. In Table 7 below I present annual data on rates of price rigidity, and Figure 10 presents these data broken down by month on shekel contracts.

I note that the data on nominal price rigidity have two main disadvantages. First, until 2009 most contracts signed in Israel were in dollars. Therefore, I present separate data for the rate of nominal price rigidity in shekel contracts and in dollar contracts, as well as for the rate of general price rigidity (which was greatly impacted by the switch to shekel contracts). Second, as the monitoring in the Rents Survey is of the tenants, and not of the apartments, I cannot present data on the rate of price rigidity for new tenants, but only for existing tenants.

Due to the greater complexity in measuring price rigidity as a result of the sharp switch from dollar contracts to shekel contracts, I examined the share of rigidity separately for each currency, and exclusively between two contracts in the same currency. As such, Table 7 below measures the share of shekel rigidity in all apartments in which both the expiring contract and the new contract were signed in shekels (column A). In parallel, I measured the share of dollar rigidity in all apartments in which both the expiring contract and the new contract were signed in dollars (column C). In the table, I present as well the share of contracts in each group out of total contracts (columns B and D).[74] In addition, I present in the table the share of overall rigidity (column F), which measures the total contracts with nominal price rigidity in the two groups out of total contracts that year.[75]

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[73] Nominal price rigidity is defined as a situation in which the landlord and tenant renew a lease at a nominal price that is identical to the price of the previous lease for the home.

[74] When the sum of the two groups is not 100 percent, it indicates that part of the leases switched currency during the year.

[75] That is, the calculation assumes that when switching between currencies, the rent changes.

Table 7
The share of renewing contracts with nominal price rigidity, 2005–15 (percent)

Year	Rate of shekel rigidity	Share of shekel contracts followed by shekel contracts	Rate of dollar rigidity	Share of dollar contracts followed by dollar contracts	Total relevant contracts	Overall rate of rigidity
	(A)	(B)	(C)	(D)	(E)[76]	(F)[77]
2005	67%	6%	73%	88%	94%	68%
2006	65%	8%	67%	85%	93%	61%
2007	55%	11%	55%	68%	79%	44%
2008	37%	35%	51%	24%	59%	25%
2009	47%	77%	59%	12%	89%	43%
2010	47%	89%	67%	7%	97%	46%
2011	44%	94%	71%	4%	98%	44%
2012	53%	97%	64%	3%	99%	53%
2013	58%	98%	77%	2%	100%	58%
2014	63%	99%	73%	2%	100%	64%
2015	62%	99%	67%	1%	100%	62%
Average	54%		66%			52%

SOURCE: Rent survey data and author's calculations.

The average rate of nominal price rigidity in the shekel contracts (in renewing contracts) is approximately 54 percent for the period overall, and about 53 percent in 2009–15, in which most contracts were unindexed and denominated in shekels. I also found that the rate of rigidity in Israel in shekel contracts changes over time: in 2005–07, the rate of nominal price rigidity was approximately 62 percent, on average; in 2008–11 the rate of rigidity was 44 percent, on average, and in 2012–15 the rate of rigidity increased gradually to a level higher than 60 percent.

I note that as a result of the small number of shekel contracts in the first years of the rental index, the monthly volatility in the rate of shekel rigidity is high (Figure 10). However, beginning in 2009, more than three quarters of the contracts were denominated in shekels, and their monthly volatility declined markedly. In 2009–15 as well, there were notable changes in the rate of rigidity measured. For example, in 2011, when 94 percent of the contracts were in shekels, there was an overall rate of rigidity of about 44 percent. In contrast, in 2014, there was an overall rate of rigidity of about 64 percent (and about 98 percent of contracts were in shekels). Dollar contracts also displayed rigidity rates that are not seen elsewhere. For example, in 2005–06, when dollar contracts made up approximately 90 percent of the market, there was a share of dollar rigidity of about 70 percent, on average.[78]

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[76] (E)=(B)+(D).

[77] (F)=(A)*(B)+(C)*(D).

[78] I note that it is likely that the rate of dollar rigidity was biased upward at the time of the switch from dollar contracts to shekel contracts, a switch that occurred mainly in 2007–09. This is because the landlords who wanted to change the rental price exploited this desire, and combined

As noted, there is some difficulty in estimating the rate of rigidity due to the currency change in rental contracts. Nonetheless, we can learn about the scope of price rigidity and fluctuations in it by examining the overall rate of rigidity.[79] Besides 2008, in which the share of relevant contracts (column E) was relatively low (59 percent), in the other years the share of relevant contracts exceeds 78 percent each year. When taking 2007–09 out of consideration, the share of relevant contracts exceeds 92 percent each year.

From the standpoint of the overall rate of rigidity, it can be seen that in years in which there were not large fluctuations between dollar and shekel contracts, the rate of overall rigidity changed over time. Thus, for example, in 2005 there was an overall rate of rigidity of 68 percent, (with relevant contracts making up a share of 94 percent).[80] In contrast, in 2010–11, there was an average overall rate of rigidity of 45 percent (and relevant contracts making up a share of 97 percent), and in 2014–15 there was an average overall rate of rigidity of 63 percent (and relevant contracts making up a share of 100 percent).

Figure 10
The share of shekel contracts and the nominal price rigidity rate in them, 2005–15
Monthly data (percent)
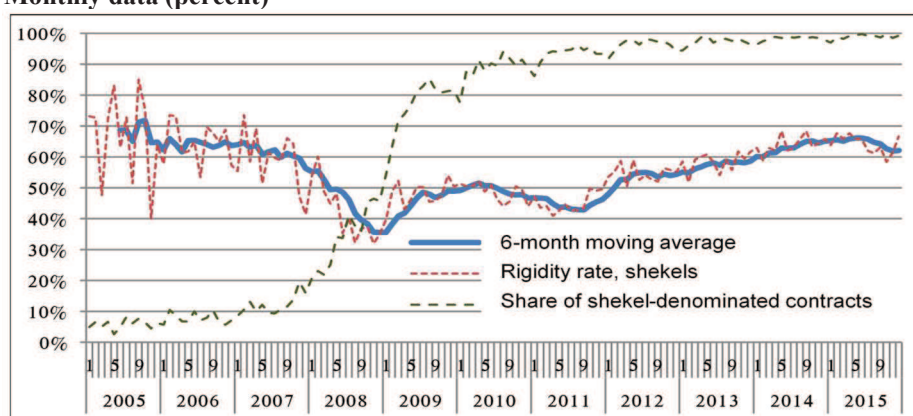
SOURCE: Based on Rent Survey data.

it with the switch to a shekel contract. However, the use of dollar contracts makes it possible to estimate the rate of rigidity in the overall rental market.

[79] I assume that when the contract changed currency, the price changed as well. The logic behind this assumption is that the switch from a dollar contract to a shekel one was based on the wide moves in the dollar exchange rate that occurred during those years. That is, the assumption is that the decision to switch from a dollar contract to a shekel contract derived from the interest in changing the actual price of the contract.

[80] The meaning of a high share of relevant contracts is that the assumption of changing the price during the switch from a dollar contract to a shekel contract is not very meaningful. For example, when the share of relevant contracts is 94 percent, and the rate of overall rigidity is 68 percent, it means that even if I would assume the opposite claim—that every currency switch means price rigidity—then the rate of overall rigidity would increase to 74 percent, and thus the effect of the said assumption is relatively tiny in those years.

It can be concluded from this that the rate of rigidity in Israel in calm years is 60–70 percent (in renewing contracts), a higher rate than in the US and Turkey, but lower than in Japan. In addition, there is no doubt that this rate changed and declined markedly in the first years of the housing crisis, to below 50 percent (even without taking into account the assumption regarding price rigidity at the time of switching currency), and that the overall rate of rigidity increased back to 60 percent in 2014–15.

Appendix B

Table 8

Observations that were entered into the survey, date of entry, fixed hedonic[81]

Dependent variable: lnprice		
	(1)	(2)
Socio-eco level	0.0486 (0.0048)***	5.0%
3 rooms	0.1802 (0.0022)***	19.7%
4 rooms	0.374 (0.0024)***	45.4%
5 rooms	0.5584 (0.0028)***	74.8%
6 rooms	0.5977 (0.0084)***	81.8%
Dec 2005	-0.0345 (0.0103)***	-3.4%
Dec 2006	-0.0076 0.0107)(	-0.8%
Dec 2008	0.1504 (0.0097)***	16.2%
Dec 2009	0.1714 (0.0092)***	18.7%
Dec 2010	0.3033 (0.0093)***	35.4%
Dec 2011	0.3332 (0.0089)***	39.5%
Dec 2012	0.4572 (0.0100)***	58.0%
Dec 2013	0.4375 (0.0104)***	54.9%
Dec 2014	0.5025 (0.0084)***	65.3%
Dec 2015	0.4761 (0.0081)***	61.0%
Municipalities dummies	Yes	
Constant	7.1524 (0.0274)***	
Obs.	26,195	
R-squared	0.75	

Standard deviations in parentheses. *, **, and ***, indicate significance at the 10%, 5%, and 1% level, respectively.

[81] In column 2, I calculated the exponent of the regression coefficients. In addition, I included in Table 8 only the price changes in the month of December of each year. All price changes in the months reported are as of December 2007.

Appendix C

Raz-Dror Index of changes in rent prices[82]
2005–15 (December 2007=100)

Jan-05	107.04	Jan-07	103.21	Jan-09	116.17	Jan-11	132.86	Jan-13	148.97	Jan-15	158.52
Feb-05	106.90	Feb-07	101.36	Feb-09	118.12	Feb-11	134.72	Feb-13	146.84	Feb-15	155.31
Mar-05	104.41	Mar-07	101.52	Mar-09	119.54	Mar-11	134.42	Mar-13	148.88	Mar-15	156.22
Apr-05	102.53	Apr-07	99.10	Apr-09	122.51	Apr-11	133.37	Apr-13	148.16	Apr-15	156.95
May-05	101.56	May-07	97.51	May-09	119.58	May-11	137.04	May-13	149.40	May-15	160.73
Jun-05	103.68	Jun-07	102.65	Jun-09	122.02	Jun-11	135.76	Jun-13	151.26	Jun-15	158.52
Jul-05	103.68	Jul-07	105.05	Jul-09	122.48	Jul-11	135.75	Jul-13	151.06	Jul-15	156.87
Aug-05	102.63	Aug-07	104.19	Aug-09	122.03	Aug-11	137.95	Aug-13	148.03	Aug-15	156.82
Sep-05	103.08	Sep-07	100.42	Sep-09	120.63	Sep-11	141.24	Sep-13	151.61	Sep-15	156.44
Oct-05	104.17	Oct-07	104.22	Oct-09	124.02	Oct-11	141.83	Oct-13	154.09	Oct-15	157.62
Nov-05	106.31	Nov-07	99.89	Nov-09	123.17	Nov-11	139.70	Nov-13	151.60	Nov-15	158.22
Dec-05	106.52	Dec-07	100.00	Dec-09	120.47	Dec-11	141.03	Dec-13	153.02	Dec-15	158.65
Jan-06	107.99	Jan-08	96.63	Jan-10	125.74	Jan-12	141.44	Jan-14	153.40		
Feb-06	109.65	Feb-08	97.84	Feb-10	125.01	Feb-12	143.42	Feb-14	155.05		
Mar-06	109.55	Mar-08	95.96	Mar-10	127.62	Mar-12	141.81	Mar-14	154.12		
Apr-06	103.61	Apr-08	96.40	Apr-10	124.51	Apr-12	144.95	Apr-14	156.35		
May-06	104.08	May-08	94.14	May-10	127.51	May-12	145.52	May-14	155.19		
Jun-06	105.56	Jun-08	95.36	Jun-10	127.85	Jun-12	143.56	Jun-14	153.06		
Jul-06	103.90	Jul-08	105.31	Jul-10	127.00	Jul-12	145.03	Jul-14	155.16		
Aug-06	103.31	Aug-08	105.36	Aug-10	132.78	Aug-12	142.46	Aug-14	153.67		
Sep-06	101.19	Sep-08	105.58	Sep-10	131.20	Sep-12	144.71	Sep-14	156.12		
Oct-06	103.35	Oct-08	111.61	Oct-10	130.06	Oct-12	146.39	Oct-14	157.54		
Nov-06	98.57	Nov-08	115.13	Nov-10	132.99	Nov-12	148.02	Nov-14	156.78		
Dec-06	102.64	Dec-08	113.77	Dec-10	134.44	Dec-12	149.76	Dec-14	158.09		

[82] This estimation is the average of the bi-monthly hedonic examination on all the observations (Section 5a) and of the annual hedonic examination of only the new observations (Section 5c). It includes a revision to the average of hedonic examinations based on the Household Expenditures Survey (Section 6b) that I entered gradually (up to a reduction of 3.1 percent).

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