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SOME THOUGHTS ON THE HOUSING COMPONENT OF THE CONSUMER PRICE INDEX[†]

REUBEN GRONAU[*]

1. INTRODUCTION: THE HOUSING COMPONENT OF THE CONSUMER PRICE INDEX

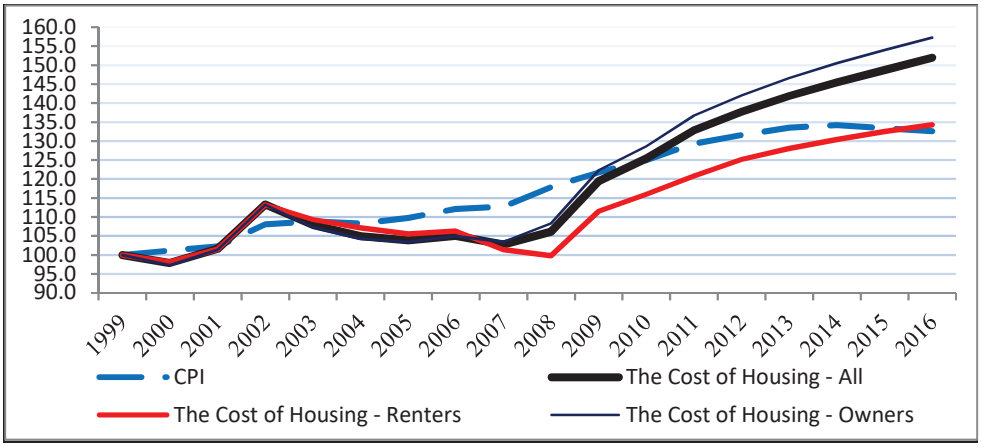
The past two decades were a turnaround as far as inflation concerned. For the first time in Israel's history, it enjoyed "price stability". In 2003, the government set the inflation target at its current level of 1–3 percent, and though the inflation rate stayed within this range in only five of the next fourteen years, the average annual inflation rate since then was well within the target (1.2 percent). The combination of the modest pace and the small number of "hits" reflects the considerable volatility of price changes of the consumption basket. No component of the Consumer Price Index (CPI) contributed more to this volatility than the housing price component, measuring the cost of housing "services" (as distinct from the "Dwellings Price Index" index which measures that of the "assets").[1] As Figure 1 shows, whereas in the first 3 years, 1999–2002, the housing price component rose 1.6 times faster than the total CPI for those years, in the following five years, it sank at an annual pace of nearly 2 percent, and was the main reason for the modest CPI inflation in those years. Since then, the housing price component rose 2.5 times more rapidly than have the other components of the CPI, boosting the weight of housing in the basket from 21.4 percent in 1999 to 24.7 percent in 2016.

[†] I would like to thank Gabi Gordon, my Research Assistant at the Bank of Israel, who was in charge of all the computations. I would also like to thank Ofer Raz-Dror, who made his data generously available to us.

[*] Dept. of Economics, Hebrew University of Jerusalem, Reuben.gronau@mail.huji.ac.il

[1] The weight of the second most volatile component, fruit and vegetable prices, is only 12 percent of that of housing in the index.

Figure 1
The CPI and the Cost of Housing Component in the CPI 1999 - 2016 (1999= 100)



The gap between the changes in the housing price component and the total CPI, however, is not the only disparity that stands out in the figure. No less salient is the disparity between the two main parts of the housing price component—the housing cost to renters and the cost to households who own their own dwelling ("owners"). Whereas in the early years (2002–2007) the cost of housing of the two groups sank in tandem, in the post-2007 surge, the cost to owners rose much faster than that of households who rent their place. Over the period (1999–2016), this differential has added up to 23 percentage points (i.e., 1.2 percent p.a.).

This sizable difference would not have been surprising had the two indices been estimated separately. Since January 1999, however, the measurement of the cost of housing to owners has been based on rent prices for similar dwellings. The Israel Central Bureau of Statistics (CBS) phrases it thus: "The component is measured by means of the cost-of-use method (valuation of the consumption of a service). In this approach, the expense associated with using an owned dwelling is measured by weighting the alternative of using a rented dwelling of equal quality. In accordance with this approach, measurement takes place not directly but by imputation, i.e., valuation of housing services by means of the rent imputed to an owner-occupied dwelling. The cost-of-use approach answers the question: What is the change over time in the cost incurred by a tenant who chooses to live in a dwelling that she or he owns?"[2] Given the observed disparity in the costs of the two groups, the question arises: Can this difference be explained by the differential quality of rented housing as compared with housing inhabited by their owners?

The similarity in the method of calculation of the two components of the housing cost gives rise to a more disturbing question: It has been argued, recently, that the housing cost of

[2] Moshe Ben-Aharon, (Central Bureau of Statistics), "Indicators from the Field of Property Prices—Description of the Current Situation," presentation given the Public Committee on Housing and Property Prices, October 2017.

renters as reflected in the CPI suffers from a systematic downward bias. It is only natural to ask whether this bias also affects the index of housing cost to owners? Renters constitute only a small fraction of the housing market (and the housing cost). A measurement error in this component of the CPI would cause only a negligible bias in the overall index. However, this would not be the case if the bias spills into the measurement of the cost of housing to owners. Such a bias may affect both the weight of housing expenditure in the CPI, and the accuracy of the index as a whole. It is to these questions that this article is devoted.

2. BACKGROUND—CHARACTERISTICS OF THE ISRAELI HOUSING MARKET

Table 1 describes the characteristics of the Israeli housing market[3]: average dwelling size (in terms of the number of rooms), housing density, and percent of owner-occupied dwellings . At first glance, the changes in dwelling quality seem minor. Over the 1999–2015 period, the average number of rooms grew by 5 percent and, due to a decrease in average household size, housing density declined by 11 percent.

The modest change in home quality stands out particularly against the background of the dramatic changes in real estate prices. The price increase is reflected in the last three columns of the table. As part of the Household Expenditure Surveys, households living in their own dwelling have been asked to estimate the value of the place. These valuations, adjusted for the CPI change, appear in the first of these columns, illustrating the turnaround in the real estate market over the period: the slump in 1999–2007 and the rapid price increase that followed. According to the owners' valuation, their property prices grew 1.5 times faster than the CPI. In the second column, the home valuations are adjusted by the housing price component of the CPI (i.e., the rental value of the house). According to the owners' valuation, the price of their home rose 36 percent faster than its rental value, reflecting either the downturn in interest rates, excess demand for housing, or the formation of a bubble in the real-estate market (Genesove, 2018).

In the last column of Table 1, the owners' valuations are standardized by the CBS "Dwelling Price Index". The CBS "Dwelling Price Index" purports to measure the change in the price of "the stock of housing" (i.e., the average dwelling real estate price). If the owners' valuation and the index are correct, adjusting for home quality, the owners' valuation should change at the same pace as the CBS index. However, as the last column shows, owners were slow at adjusting the value of their homes downward during the slump years, and lagged behind in their evaluation during the real estate "frenzy" years that followed.[4]

[3] Table 1 is almost entirely based on Table 1.13 in Central Bureau of Statistics, *Housing in Israel, Findings from the Household Expenditure Survey 1997–2015* (Hebrew) (February 2018). The publication covered the period until 2015 and, for the sake of consistency, I did not add the data for 2016.

[4] An alternative explanation of the lag is migration—changes in the geographic mix, as people moved from large and expensive cities (Tel Aviv, Jerusalem, and Haifa) to less expensive satellite towns or to the Northern and Southern districts, where real estate prices are lower.

As Table 1 shows, the increase in real estate prices was accompanied by a downturn in the share of ownership, and an increase in that of rentals. This trend, however, was not confined to the boom years. It seems that households did not take advantage of the downturn in housing prices in 2000–07 to buy a home when prices were "low".

Table 1
Selected housing-market data, 1999–2015

	Housing expenditure as percentage of total consumption expenditure	Housing density			Home ownership[a] (percent)			Value of owned dwelling (NIS '000 in 2015 prices)[b]		
		Average number of rooms	Number of people	Average housing density per room	Owned home	Rented home	Other	Adjusted by CPI	Adjusted by housing component of CPI	Adjusted by Home Prices Index
1999	22.7	3.63	3.52	0.97	71.1	24.7	4.2	1,084	1,208	1,471
2000	22	3.54	3.33	0.94	70.8	24.8	4.4	1,011	1,165	1,458
2001	22.6	3.59	3.3	0.92	71.2	24.5	4.3	966	1,084	1,459
2002	24	3.6	3.35	0.93	69.6	25	5.4	1,022	1,087	1,550
2003	22.8	3.61	3.36	0.93	70.4	24.6	5	965	1,086	1,563
2004	22.3	3.66	3.33	0.91	70.6	24	5.4	974	1,122	1,582
2005	21.9	3.66	3.33	0.91	70.7	24.5	4.8	999	1,178	1,640
2006	21.4	3.65	3.32	0.91	69.5	25.5	5	961	1,143	1,603
2007	22.3	3.67	3.3	0.9	69.3	26.1	4.6	942	1,151	1,605
2008	22.9	3.69	3.32	0.9	68.8	25	6.2	1,090	1,350	1,806
2009	24.4	3.71	3.34	0.9	69	26	5	1,161	1,320	1,748
2010	25	3.74	3.33	0.89	69.2	25.7	5.1	1,318	1,465	1,733
2011	25.1	3.71	3.34	0.9	68.8	26.3	4.9	1,459	1,585	1,796
2012	25.5	3.74	3.29	0.88	67.9	26.9	5.2	1,423	1,516	1,726
2013	23.6	3.77	3.28	0.87	67.9	26.6	5.5	1,449	1,522	1,636
2014	24.5	3.76	3.27	0.87	67.3	27.4	5.3	1,587	1,633	1,691
2015	24.7	3.81	3.28	0.86	67.6	26.7	5.7	1,647	1,647	1,647

[a] Rented houses do not include key-money homes, except for the years 1968/69–1975/76. These homes are included in "other", in addition to homes for free and student housing.
[b] The value of owned homes is based on self-assessment. The adjustment to the Home Prices Index and the housing component of the CPI is based on the author's calculations.
SOURCE: Central Bureau of Statistics, housing data for Israel based on the Household Expenditures Survey for 1997–2015 (February 2018), Table 1.13 and the author's calculations.

The characteristics of the two segments of the property market are described in Table 2. On the face of it, the main difference between the two segments lies in the age of the household-head. People who own homes are older than people who rent them, and, as a result, have a larger household size, their households enjoy a higher consumption level (on average, by 15 percent), and they live in larger homes—owner-occupied homes having about one-third more rooms than rental dwellings. However, there is no significant difference between the segments in housing density, and the increase in the number of rooms occurred mainly in owner-occupied dwellings.

Table 2
Homes market characteristics for renters and owned-home dwellers, 1999–2016

	Number of rooms		Number of people		Housing density (people per room)		Expenditure on consumption[a], 2010 prices	
	Owners	Rent payers	Owners	Rent payers	Owners	Rent payers	Owners	Rent payers
1999	3.85	3.04	3.69	2.73	0.96	0.9	10,081	6,653
2000	3.89	3.02	3.6	2.66	0.93	0.88	10,436	6,860
2001	3.93	3.02	3.58	2.64	0.91	0.87	10,619	6,808
2002	3.98	2.98	3.65	2.66	0.92	0.89	10,305	6,729
2003	3.94	3.11	3.62	2.73	0.92	0.88	10,030	6,496
2004	4.01	3.03	3.6	2.6	0.9	0.86	10,544	6,483
2005	4.02	3.03	3.62	2.58	0.9	0.85	10,736	6,779
2006	4.03	3.12	3.57	2.71	0.89	0.87	10,729	7,449
2007	4.04	3.06	3.56	2.71	0.88	0.89	11,024	7,529
2008	4.09	3.11	3.59	2.69	0.88	0.87	11,286	7,319
2009	4.13	3.04	3.61	2.68	0.88	0.88	11,309	7,368
2010	4.13	3.12	3.61	2.71	0.87	0.87	11,340	7,277
2011	4.12	3.04	3.61	2.76	0.88	0.91	11,346	7,276
2012	4.17	3.12	3.55	2.74	0.85	0.88	11,263	7,589
2013	4.18	3.11	3.54	2.7	0.85	0.87	11,562	7,664
2014	4.2	3.08	3.54	2.65	0.84	0.86	12,036	7,482
2015	4.23	3.14	3.5	2.76	0.83	0.88	12,081	8,238
2016	4.22	3.12	3.54	2.72	0.84	0.87	12,691	8,215

[a] Expenditure on consumption excluding housing costs.
SOURCE: Based on Household Expenditures Survey, 1999–2016.

The "housing expenditures" used in the table are based on a survey of rental dwellings. The sample includes around 12,000 dwellings that were surveyed over the years as part of the Household Expenditure Survey, the Labor Force Survey, and the Social Survey. Out of these, the Household Expenditure Surveys contributed each year 1,500–2,300 dwellings. These data are used in Table 3 to track the changes of the housing expenditures of the owners and renters.

The first two columns of the table present the average expenditure on housing of the two groups in current prices. According to the survey, the imputed expenditure on owned housing at the beginning of the period (in the years 1999–2001) was 1.4–1.5 times greater than the average expenditure on rented housing. However, while rent expenditure (in current prices) increased by a factor of 2.2, the imputed expenditure on owned housing rose only by a factor of 1.7. As a result, homeowners' imputed expenditure at the end of the period (in the years 2013–2016) was only 17 percent higher than the average expenditure on rented housing. Since the imputed expenditure on owned housing is based on the rent in a similar apartment, and since the change in dwelling size, if any, should have caused expenditure on owned housing to accelerate relative to that on rented housing, the different rates of increase in

expenditure can be explained only by a change in the geographic mix or by other improvements in dwelling quality that are tilted in favor of rented housing.

Columns 3 and 4 of Table 3 present the expenditure on housing adjusted by the CPI. The adjustment, naturally, narrows the increase in expenditure (a rise of 1.3 in owners' expenditure vs. 1.66 in that of renters) but since the adjustment is by the same deflator, the ratio of expenditure on owned housing to that on rented housing is identical to that in the previous two columns.

Direct expenditures on housing constitute about 90 percent of the housing component in the CPI (the other expenditures are government taxes, and other housing expenses). Columns 5–6 present these expenditures adjusted by the housing component of the CPI (in 2010 prices). Finally, columns 7–8 in Table 3, along with Figure 2, describe the change in direct expenditure on housing deflated by the indices of imputed rent (for homeowners) and the actual rent index (for renters). The deflation of expenditure by the corresponding price index yields the change in "real" consumption—i.e., the change in the quantity (quality adjusted) of the good. In our case, if one disregards changes in quality, one would expect expenditure on housing, deflated by the appropriate price index, to remain constant (Most households "consume" only one house/apartment.) This is not the case. As Figure 2 shows, though the quality of rented dwellings has hardly changed over the period, "real" expenditures by renters increased at an annual rate of 3.3 percent. The picture is even more complex when it comes to "real" (imputed) expenditure on housing of homeowners. These expenditures rose at an annual rate of 1.9 percent in the "downward" years (1999–2007), and declined at an annual rate of 0.6 percent in the boom years. As a result, the gap between the sectors in "real" spending narrowed from 80 percent to 20 percent. These data are definitely inconsistent with the changes in the housing quality of the two sectors' reported in Table 2.

Figure 2
Real Expenditure on Housing (in constant 2010 prices)

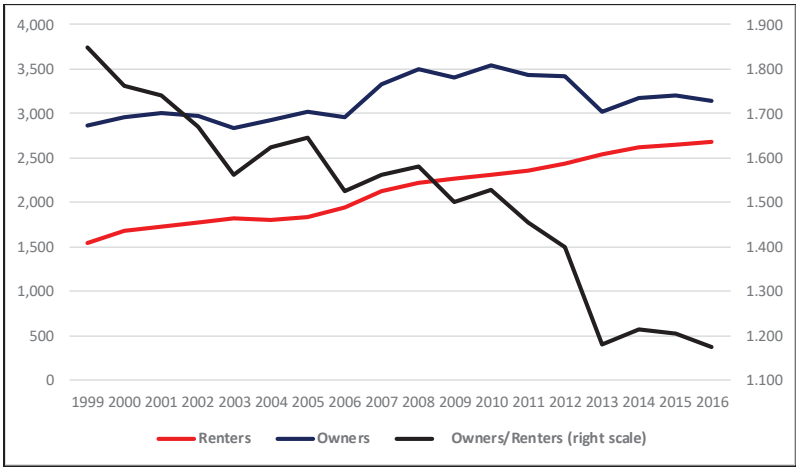


Table 3
Expenditure on rental housing and on owner-occupied housing, 1999–2016

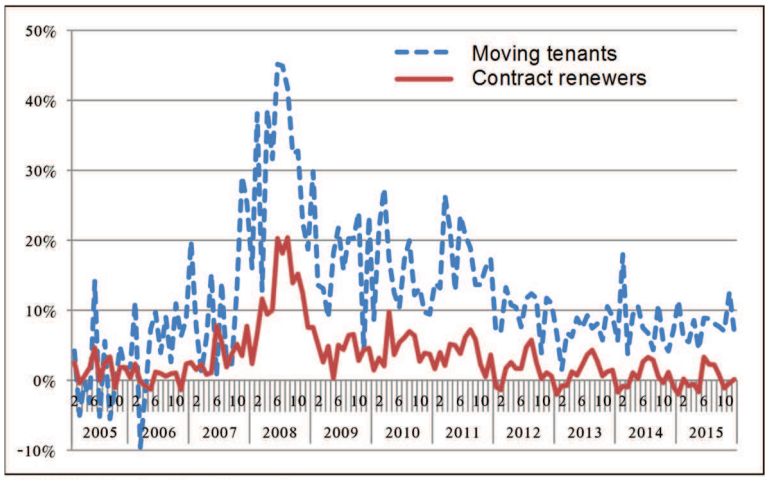
	Total expenditure on housing, current prices		Total expenditure on housing, 2010 prices		Consumption attributed to housing (rent) in 2010 prices		"Real" expenditure on housing in 2010 prices	
	Owners	Rent payers	Owners	Rent payers	Owners	Rent payers	Owners	Rent payers
1999	2,320	1,552	2,901	1,940	2,783	1,670	2,864	1,549
2000	2,312	1,682	2,859	2,079	2,763	1,752	2,954	1,676
2001	2,457	1,725	3,004	2,109	2,892	1,846	3,003	1,726
2002	2,699	2,003	3,122	2,318	3,023	2,005	2,968	1,776
2003	2,452	1,891	2,818	2,173	2,721	1,969	2,838	1,818
2004	2,466	1,911	2,846	2,206	2,740	1,924	2,929	1,805
2005	2,521	1,927	2,871	2,194	2,760	1,900	3,015	1,834
2006	2,525	1,989	2,816	2,219	2,697	1,985	2,963	1,942
2007	2,766	2,107	3,070	2,338	2,962	2,060	3,320	2,124
2008	3,052	2,225	3,238	2,361	3,129	2,020	3,502	2,214
2009	3,360	2,486	3,451	2,553	3,328	2,241	3,410	2,270
2010	3,659	2,635	3,659	2,635	3,534	2,310	3,534	2,310
2011	3,769	2,808	3,643	2,714	3,523	2,372	3,430	2,357
2012	3,899	2,949	3,706	2,802	3,587	2,505	3,418	2,443
2013	3,559	3,092	3,332	2,895	3,212	2,632	3,012	2,548
2014	3,857	3,284	3,593	3,060	3,464	2,739	3,179	2,616
2015	3,975	3,393	3,727	3,181	3,589	2,842	3,200	2,654
2016	4,015	3,420	3,786	3,225	3,628	2,927	3,149	2,682

SOURCE: Based on Household Expenditures Survey, 1999–2016. Definition of rent payers is based on all those who paid rent.

3. THE BIAS IN ESTIMATING THE RENT INDEX

According to the Household Expenditure Survey data, the rental expenditure of households who rent their place over the period 1999–2016 increased by 2.3, whereas the rent index in the CPI went up by only one-third. Given the modest improvement in rented dwelling quality, the disparity between the increase in expenditure and the increase in the price-index data suggest the existence of a sizable downward bias in estimating the increase in rent prices. This disparity did not escape the researchers' notice. Ofer Raz-Dror (in this issue) tried to trace the sources of this bias in his Ph.D. dissertation. The factor that aroused Raz-Dror's suspicion was the gap between the rent component in the CPI and the variability of average rent over time (Figure 3). According to Raz-Dror's calculations, in the period December 2007–December 2015, the rent index in the CPI climbed by 34 percent whereas average rent prices surged by 59 percent.

Figure 3
Price Change for New Tenants vs. Existing Tenants (Quality Adjusted), 2005–15



SOURCE: Based on Rent Survey data.

Raz-Dror traces the disparity to the unique nature of the rental-housing sample, which is biased in favor of long-term leases. To preserve a sample of fixed housing quality, and since the source of the CBS reporting is the renter (rather than the owner), the CBS has for a long time deleted from the sample renters who change their dwellings. According to Raz-Dror's estimation, about one-fourth of the renting population moves each year (to an owned dwelling or to another rental unit). Since "veteran" (long-term) renters enjoy better terms of rent, and are liable to smaller rent hikes, an index of rent prices based on this population is biased downward.[5]

Using various estimation methods to neutralize the change in dwelling quality, Raz-Dror estimates the adjusted price increase in 2008–15 at 57–69 percent.

To neutralize the change in dwelling quality, I used a method similar to that employed by Raz-Dror. For each year between 2003 and 2016, I calculated a linear regression that links rent expenditure, deflated by the CBS rent index, to dwelling characteristics (dummy variables representing the number of rooms, locality size, dwelling accessories, and the socioeconomic index of the locality). [6] As explained, if the CBS rent deflator is correct the

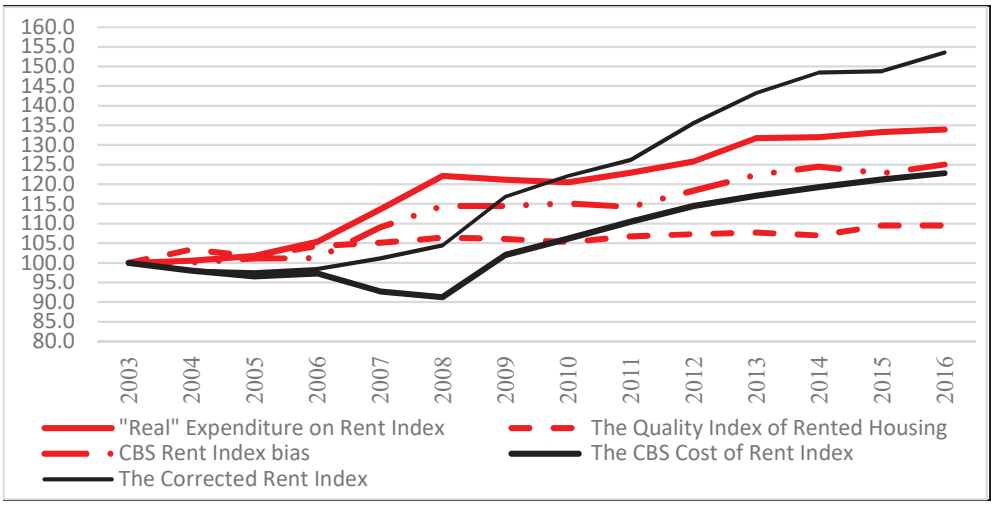
[5] The lower rent paid by "veteran" renters is explained by their being of higher "quality" (in terms of being renters) and by a selection bias: the larger the rent increase is, the greater the probability of moving house.

[6] Raz-Dror used, instead of a linear regression a semi-logarithmic regression that was run on a sample of bimonthly observations for the period 2005–16. Raz-Dror implicitly assumes that the effect of the home-characteristics on price has been constant over time, and that the long-term change in rent is reflected in change in the coefficient of the dummy variable that denotes the month. The data in my regression, unlike Raz-Dror's, are annual. I chose 2003 as the first year of the sample because it is the first year that the Household Expenditure Survey data reports whether the dwelling is rented or owner-

regression coefficients should not change over time, and the change in "real" spending would reflect, solely, the effect of change in dwelling characteristics on the level of rent. Figure 4 shows that the "real" expenditures of renters rose throughout the 2003–16 period by more than one-third, considerably beyond the modest changes in rental-dwelling quality reported in Table 2.

The annual regression coefficients reflect the "shadow prices" of the various determinants of rent. To estimate the effect of the changes in rental characteristics on rent levels, the various annual characteristics were weighted by the *average* shadow price of each characteristic. As Figure 4 shows, the contribution of the improved quality to the increase in rent was only 10 percent. Most of this change is explained by the apartment being better equipped (i.e., more, or better, accessories).

Figure 4
The CBS Rent Index, the Index of the "Real" Expenditures on Rent, the Index of Quality, and the Estimated Bias 2003 -2016 (2003 = 100)



To calculate the bias in the rent deflator, we examined the changes in "real" rent of a dwelling of given characteristics. The characteristics used to standardize the expenditure were the average characteristics of a rental dwelling in the course of the period.[7] According to our estimate, the bias in the rent price index added up, across the period, to 25 percent. It was minimal during the housing market recession years, but it gathered momentum as real estate prices started their rise. On the basis of the Household Expenditure Survey data, it is

occupied. The year 2003 was also the first year to report the home accessories (air-conditioner, central heating, and dishwasher), a variable of proven importance in determining rent rents.

[7] The results were identical when the shadow prices were standardized by the characteristics of the first or the last year of the sample (2003 and 2016).

found that rents started their rise a year ahead of house prices.[8] According to our estimate, average rent (in current prices) in the period 2005–07 increased by 7 percent, whereas the CBS rent index reports a decline of 4 percent. The estimates show a bias of 9 percent in 2007 that widened to 14.5 percent in 2008, and leaped to 22 percent in 2012–13. Thus, while the CBS rent index rose over the period 2003–16 by 23 percent, the "corrected" index did so by 54 percent.

As stated, Raz-Dror confined his estimation to the period 2005–15. Comparing his results with ours (Figure 5), the results are quite similar. The data in the figure show negligible differences between the two methods of estimation for the period as a whole. There are, however, differences in estimating the "turning point" of the indices. While according to the CBS measurement the "turning point" occurred only in 2008, a year after the "turning point" in the real estate market, Raz-Dror puts it at 2007, and according to my estimate, it occurred already in 2005.[9]

Figure 5
The CBS Rent Index and the Corrected Indices according to Raz-Dror and Our Estimate 2005 - 2015 (2005 = 100)

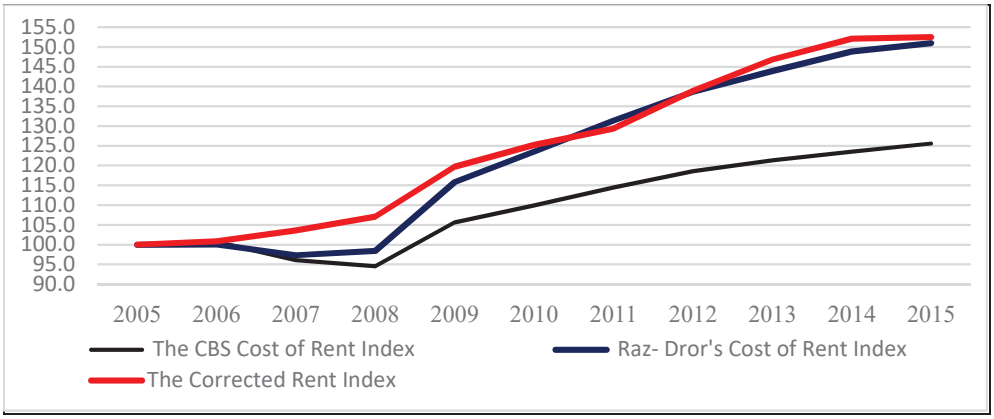


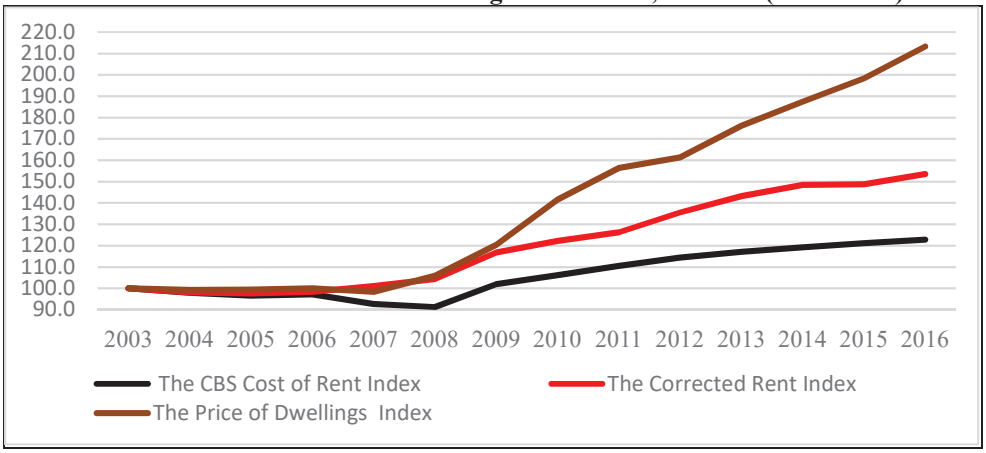
Figure 6 plots the development of the "corrected" rent index comparing it with the CBS "Dwellings Price Index". The increase in property prices that accompanied mass immigration from the former Soviet Union was arrested in 1999, marking the onset of a retreat that lasted until 2008. Rent, in contrast, continued to rise until 2002, when the economic crisis brought it to a halt. According to my estimates, the downturn, however, was short lived. The indices of property and rent prices moved almost in tandem during 2003–08, and only in 2008 they

[8] According to this estimate, in the year 2005 rents were almost stable. (They rose by 0.8%).

[9] It should be noted, that the average rent (in current prices) in the CBS and in Raz-Dror's data started its rise in 2005 (Figure 3). The finding that the "predicted" rent continued to fall during that period seems to be the result of the implicit assumption that the effect of dwelling characteristics on rent was constant over time.

parted ways, when capital gains generated by the price hike, coupled with falling interest rates, attenuated the increase in rent prices relative to those of home purchase prices.

Figure 6
The Corrected Rent Index and the Dwellings Price Index, 2003–16 (2003 = 100)



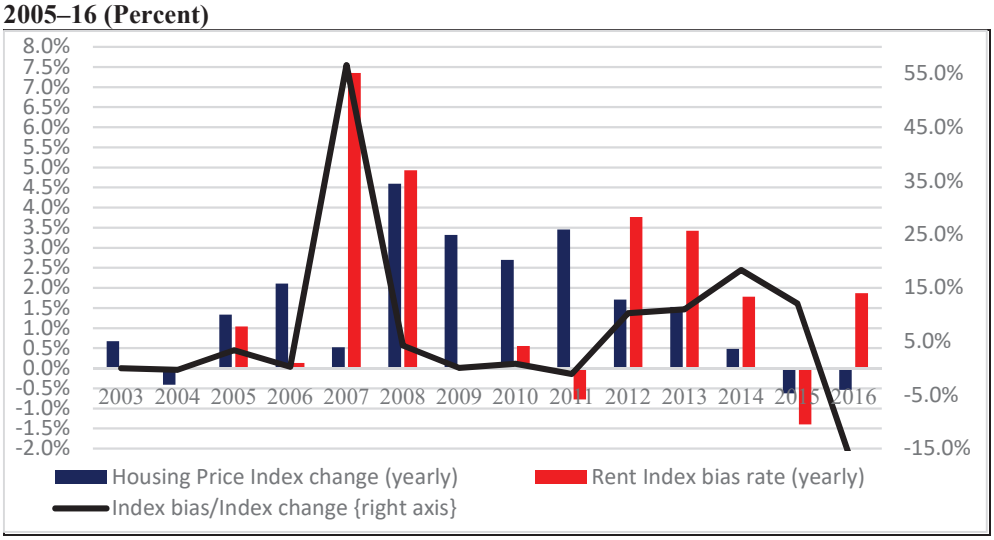
In 2003–16, the CPI increased by 22 percent—1.54 percent p.a. The CBS rent index posted a similar increase and, hence, according to the CBS measurement, did not affect the estimate of the average annual inflation rate. By how much would the total index have changed had we used the "correct" rental index? According to my estimates, the average annual bias in the rent index was 1.73 percent. Given the small weight of the rent index in the CPI (4.5 percent on average across the period), the absolute bias in the total index was miniscule (0.08 percentage points). However, given the modest increase in prices, the relative bias in the CPI induced by the incorrect measure of rents was 5 percent.

Even though the average bias in the CPI is negligible, one of the characteristics of the total CPI is its volatility. The volatility of the CPI, and that of the bias, are demonstrated in Figure 7.[10] Even though the bias in the rent index did not change the annual inflation rate, on average, by more than 5 percent, the figure indicates a negative correlation between the size of the bias and the CPI. It shows that in years when the bias was especially large (2007–08 and 2012–13), or when the inflation rate was particularly low (2007 and 2014–16), the bias affected the CPI (in relative terms) by 10–20 percent. Of special interest is the year 2007, the beginning of the global crisis and the beginning of the Israeli real estate boom. According to the CBS, rents during that year declined by 4.6 percent, whereas our estimate shows an

[10] The share of the total bias in the CPI is calculated as the product of the bias in the rent index and the share of rent in total expenditure, divided by the annual inflation rate.

increase in rents of 2.7 percent, yielding a bias of 7.3 percent. However, given the low inflation rate (0.5 percent), the relative error in the CPI estimate exceeded one-half.[11]

Figure 7
The CBS Rent Index, the Correct Index and the Dwellings Price Index, 2005–16 (Percent)



D. THE BIAS IN ESTIMATING THE IMPUTED RENT INDEX AND THE SHARE OF HOUSING IN THE HOUSEHOLD EXPENDITURE BASKET— SOME PUZZLES

Given the size of the bias in the rent index and its implications for the CPI, it is only natural to be concerned that the defects in measuring the housing cost of renters spilled into the index of housing costs of owners. The weight of the latter in total household expenditures grew between 2003 and 2016 from 16 percent to 18 percent – 4 times that of housing expenditures of renters. Any error in measuring price increase in an expenditure component as large as that should affect the accuracy of the CPI as a whole. Furthermore, since the housing cost of owners is based not on measurement but on imputation, an error in estimating this component should project also onto the weight of housing in the CPI.

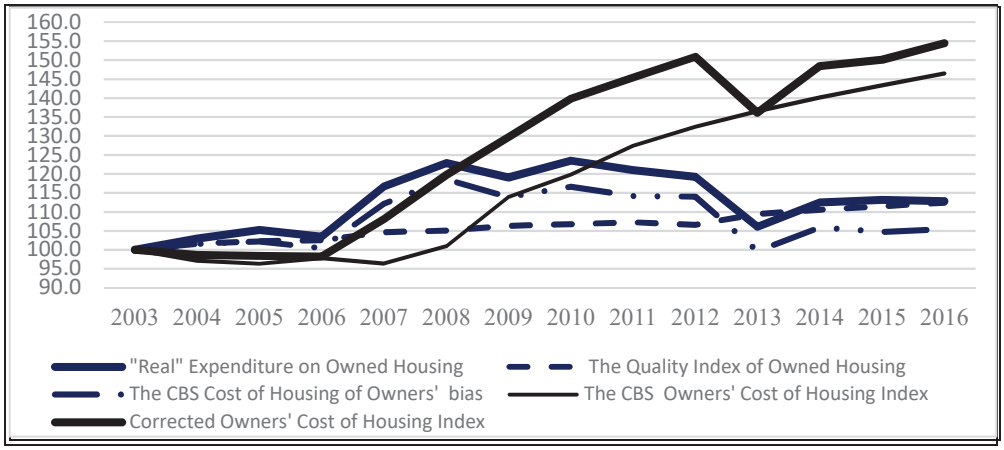
Over the period, homeowners' imputed rent expenditures (in current prices) and those of renters increased at an identical pace —65 percent. However, given the faster rate of increase of the CBS housing costs of home-owners, described in Figure 1, "real" housing expenditure of home owners increased by only 13 percent. To isolate the effect of the improvement in quality, I repeated the previous exercise, this time weighting the annual quality characteristics

[11] In 2007, rent prices constituted 4 percent of the CPI. The bias in the CPI due to the incorrect measurement of the change in rents was, therefore, 0.292% (=0.04*0.073), compared with the reported CPI of 0.5%.

of owner-occupied dwellings by their average shadow prices derived from the rent regressions. To calculate the (imputed) cost of housing index of owners we used the annual shadow prices, given the average characteristics (over the period) of an owner-occupied apartment.

The results of these calculations are described in Figure 8. The calculated change over the period in the index of owned-dwelling quality (12 percent) is almost identical to the change in "real" expenditure on housing, indicating that the bias in the cost of housing of home-owners in the CPI over the period is negligible. However, there are, in the course of the period, considerable deviations between the CBS index of imputed housing costs and the "correct" index (according to our calculation), and the extent of the bias in the period 2007–2012 exceeded 10 percent.[12] Again, even though the total bias was small, given the large weight of imputed expenditure on housing in the index (on average 17.7 percent), even small biases can trigger a major bias in the total index, particularly in years of particularly low CPI inflation (2007 and 2014–2016).[13]

Figure 8
The CBS Imputed Rent Index, the Index of "Real" Expenditures on Housing of Owners, the Quality Index of Owned Housing, and the Bias, 2003–16 (2003 = 100)



The bias in the total CPI that originates in error in measuring the index of the imputed costs of housing depends, among other things, on the weight of this expenditure in total household expenditures. To determine the "correct" weight, we calculated, using the

[12] The Household Expenditure Survey sample data that I used in my calculations point to an "anomalous" decrease in average expenditure on housing costs in 2013, reflected in Figure 8 in a "break" in the "real" expenditure data, and, as a result, in the estimated bias in the "corrected" index that year. It seems that the source of this "break" is some outlying observations in that year.

[13] In this case, too, 2007 stands out since according to our calculations, the bias in the total CPI exceeded 1 percent that year.

"correct" index, the imputed expenditure on housing in current prices, and compared the result with that of CBS. The difference, again, seems small and, according to our calculations, in most years expenditure on housing was overweighted in the CPI.

At day's end, however, we continue to wonder: What "immunized" (albeit partly) the index of owned-housing costs from the biases that infected the rent index? The answer to this question lies in the different methods of calculation that were chosen for the two components of housing in the CPI. While the rent index is based on changes in rent on dwellings under long-term leases, the cost of housing of owner occupied dwellings is based on a calculation that seems to neutralize the bias. According to this calculation, all dwellings in the database of rental dwellings are divided into nine quality-value clusters, each supposedly homogeneous in terms of number of rooms, locality, and socioeconomic level.[14] The index of housing costs of home-owners is based on the change in average monthly rent in the nine clusters, with the weight of each cluster updated once every two years. As such, this method is essentially not different from the hedonic regression that has been used by us to calculate the biases in the housing indices.[15]

E. SUMMARY—SOME THOUGHTS

This article focused on a surprising difference between the two main parts of the cost of housing component in the Israeli Consumer Price Index, i.e., the rental prices of renters vs. those of homeowners. When the property market was down (2002–07), the two parts declined at the same rate. However, when the property market headed up, the imputed rent prices of owners rose at a pace 50 percent faster than those of renters, at annual rates of 4.8 and 3.2 percent, respectively. The large disparity seems particularly odd since both indices are calculated using the same database, the adjusted rent index (for differences in quality) serving as a measure of the cost of housing of homeowners.

One of the main sources of information used by the CBS to calculate the change in rents is the Household Expenditure Survey. The analysis of the annual surveys shows an ever-increasing disparity between the reported household rents reported by renters and the respective CBS housing cost index, indicating a sizable downward bias in the latter. This finding in itself is not new (Raz-Dror, 2018, and in this issue of the Israel Economic Review). Raz-Dror, who observed a disparity between the CBS data on the change in average rent and the respective CBS housing cost index, attributed the bias to the deletion from the sample of rental dwellings of tenants who move homes. Confining the sample to long term leases results

[14] See Moshe Ben-Aharon, "Indicators from the Field of Property Prices—Description of the Current Situation," October 2017.

[15] There is a slight difference since the CBS method is applied on a monthly basis, whereas our regressions use annual data. The cluster reflects a combination of several characteristics, and the separate effect of each characteristic cannot be isolated in the CBS method.

in a significant downward bias in the cost of housing of renters (an average annual bias of 1.5 percent).

The cost of rented dwellings has a relatively small weight (around 5 percent) in the CPI. The downward bias, therefore, has no material effect on the estimate of the average inflation rate over the whole period. However, given the negative correlation between the bias and the annual inflation rate, the bias has a significant effect on the inflation estimate in years when the bias is exceptionally large and in years when the inflation rate is low.

In its drive to isolate changes in the "quality" of the apartment, the CBS used different methods for the calculation of the cost of housing of renters and homeowners. Whereas the estimate for renters was based on a sample that excluded "home-changers" (resulting in a significant bias), the effect of differences in quality on homeowners' cost of housing was eliminated analytically, using a "semi-hedonic" rent function. The use of the "semi-hedonic" method resulted in minimizing the bias where the cost of housing of homeowners is concerned.

The CPI is updated on a monthly basis and, unlike other data series which are revised as new information comes in, the CPI estimate is final. This requires, notwithstanding the tight deadline, extreme caution in the calculation of the index. The bias in the calculation of the CPI that Raz-Dror's study brought to light, and is discussed in this paper, has persisted for more than a decade, and the attempt to correct it has been undertaken only quite recently. Given the length of the period the bias escaped notice, it is only natural to ask whether there were on the way any warning signals that were disregarded by the CBS?

Two such signals were mentioned in this article: a. the widening gap over time between the two parts of the housing cost index (i.e., the cost to renters and that to owners), and b. the difference between the change of the housing cost index (i.e., the cost of rent) and that of the average rent. A third warning sign that should have called attention to the anomaly in the rental index was the development of the share of rent (in rental dwellings) in the CPI.

The shares of the different consumption items in the CPI index are adjusted biannually. Over the period 1999–2016 the share of the cost of housing of renters was changed four times, growing over the period almost by one-third (from 4.3 percent to 5.5 percent). Since according to the CBS the cost of housing of renters increased almost at the same rate as the CPI itself, the increased share can be explained only by a change in the quality of rented dwellings, or by an increase in the share of renters in the population. Given the modest increase in each of the latter (less than 10 pecent), the large increase in the CPI share should have raised some eyebrows.

Summing up, it seems that the CBS has attempted to escape the bias originating in changes in housing quality, a bias in the order of 10 percent, and was "trapped" in a bias in the estimated cost of housing of renters of up to 25 percent (over thirteen years). Fortunately for the CPI, the reputation of the CBS, and the policy driven by the CPI estimates (e.g., the Bank of Israel's monetary policy), the CBS calculated the cost of housing of homeowners in a different fashion, insulating this component from the malaise that plagued its smaller "brother".