SELF-REPORTED DWELLING VALUATIONS—HOW ACCURATE ARE THEY?

Dmitri Romanov,[1] Larisa Fleishman,[2] Aviad Tur-Sinai[3]

Abstract

Owners' valuations of dwelling prices are central in construction of price indices, empirical research of housing markets and households' economic behavior. Previous studies show that, on average, owners tend to overestimate the value of their dwellings by 5% relative to market valuation. We analyze the variation of the bias over the distribution of dwelling sale prices, using a unique dataset of more than 22,000 observations from Israel's Household Expenditure Survey, from 1997 to 2008, merged with the national sample of housing sale transactions by census tract. We find that self-reported estimates of dwelling values are, on average, 27% higher than the mean market prices of houses in the corresponding census tracts. Strikingly, the valuations of inexpensive and costly dwellings are biased in different directions: estimates reported by people who occupy dwellings in the lowest eight deciles of the price distribution are upward-biased, whereas those who live in the most expensive dwellings more typically understate the value of their homes. The self-reported valuation bias is systematically associated with owner's traits as well as with dwelling and neighborhood characteristics. The frequency of dwelling sales in the respondent's tract was found to have an effect on the self-reported valuation bias.

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[1] Central Bureau of Statistics.

[2] Central Bureau of Statistics and Hebrew University in Jerusalem

[3] Central Bureau of Statistics and Ben-Gurion University

1. INTRODUCTION

The value of a dwelling in the free market may be estimated in several ways: by a professional appraiser, by setting a price in a sale transaction, and also in the property's owner subjective judgment. Among these methods, sale price in the free market is considered the best estimate of a dwelling's value, according to the conventional definition of the American Institute of Real Estate Appraisers (1988). In economic research, however, the use of subjective valuations by property owners is more common, for two main reasons. First, information about sale prices usually originates in reportage to the tax authorities, which usually fails to provide researchers with data that offer sufficiently large samples at an appropriate spatial resolution to meet research needs. Second, many surveys report the subjective valuation of a dwelling together with characteristics of the property and its owner (an individual and/or a household)—information that is seldom available in the sale-transaction data that are reported to the tax authorities. Obviously, then, owner valuations elicited by surveys are very useful provided that they furnish an unbiased estimate of the prices of dwellings if the dwellings were sold that very day. Hence the immense importance of a study that tests the extent of accuracy of subjective dwelling valuations, the differences between these valuations and appraiser' estimates and sale prices, and the factors associated with these differences.

The accuracy of subjective dwelling valuations has been researched for nearly five decades, mainly on the basis of U.S. data. Although the estimates of the bias range from *minus* 2 percent to 16 percent, it would be fair to sum up by saying that in most scholars' opinion, dwelling owners tend to overvalue their properties by about 5 percent.

This study augments the research literature on this topic in several ways. First, we focus on investigating the accuracy of subjective valuations across a distribution of dwelling values. Research thus far has not addressed the issue of whether the valuations of inexpensive and expensive properties are biased in the same direction and whether the bias is homoscedastic. Second, the study is based on a unique database that covers more than a decade (1997–2008) and combines dwelling valuations culled from a large national survey (the Household Expenditure Survey, performed annually in Israel by the Central Bureau of Statistics) with data on sale transactions at the level of census tract. Third,

along with the dwelling and owner indicators that the survey provides, we augment the analysis with demographic and socioeconomic indicators of the population of the census tract (age, ethnic composition, average income) and the dwelling's spatial environment (proximity to main roads, sea shore, existence of schools in the neighborhood). Fourth, given information about the change in transaction prices in a census tract over time, we investigate the correlation between the dwelling valuations reported in the survey and dwelling prices in the tract within a one-year window before and after the date of participation in the survey, determining how long it takes for homeowner valuations to internalize "news" about housing prices in the neighborhood.

The main findings of our study are the following. On average, homeowners in Israel tend to overvalue their dwellings by 27 percent, while the average bias within the mid eight deciles of the price distribution (that is, without the lowest and the top deciles) stands at 22 percent. These estimates are much higher than the size of biases found in previous research. By investigating bias size across a distribution of dwelling prices, we find much variance in the accuracy of the subjective valuations as against transaction prices. The valuations of inexpensive and costly dwellings are biased in different directions: estimates reported by people who occupy dwellings placed in the first eight deciles of the price distribution are upward-biased, whereas those who occupy the most expensive dwellings (those in the top decile of dwelling prices) more typically understate the value of their homes.

Multivariate analysis confirms the existence of a significant and systematic relation between bias in homeowners' dwelling valuations and dwelling physical indicators, homeowner personal indicators, and census-tract population characteristics. It turns out that the interval of three months before the survey date has the highest correlation between valuations and average transaction prices in a given census tract for most of the dwelling-value distribution.

The rest of this paper is organized as follows: Section 2 presents theoretical background and a survey of literature on the accuracy of subjective dwelling valuations. Section 3 describes our sources of information and the construction of the database used in the study, defines the variables used in the analysis, and presents descriptive statistics of the variables. Section 4 presents the statistical models that we use for the empirical analysis. Section 5 gives the results; Section 6 discusses them and concludes.

2. SURVEY OF THE LITERATURE

The ramified research literature on various aspects of dwelling values bases its conclusions on the valuation of dwellings by their owners. The data for these studies originate in a large number of household surveys (e.g., in the U.S.: Decennial Census of Housing, American Housing Survey, Panel Study of Income Dynamics, Survey of Consumer Finances, and Health and Retirement Study; Dutch Socio-Economic Panel; World Bank Living Standards Measurement Study; and EU Survey on Income and Living Conditions) that ask, "What do you think your home is worth? That is, what do you think you could get for your home if you sold it now?"

Survey information about dwelling values is essential for calculating the housing-price index and the use value of an owner-occupied dwelling; it is a cornerstone of research on the real-estate market and households' economic behavior. Finally, since dwelling constitutes a major asset, economic studies use its value as a key indicator of households' economic status and wealth.

2.1 Accuracy of Subjective Valuations

The accuracy of subjective dwelling valuations, i.e., how well such valuations reflect the price level of properties in an actual housing market, has been examined in a number of studies that focus on the investigation of two main questions. The first is how to measure the extent of accuracy, i.e., setting a benchmark for comparison, against which the accuracy of subjective dwelling valuations should be checked. The second question asks why subjective dwelling valuations differ from the benchmark chosen for the comparison.

Earlier studies focused on validating homeowners' subjective valuations as an estimate of their dwellings' "true" value and compared owners' subjective valuations with those of appraisers (Kish and Lansing, 1954; Kain and Quigley, 1972); with valuations for the purpose of real-estate taxation (Robins and West, 1977); and with subjective valuations by owners of other properties (Follain and Malpezzi, 1981; Ihlanfeldt and Martinez-Vazquez, 1986). In particular, Kish and Lansing (1954), Robin and West (1977), and Ihlanfeldt and Martinez-Vazquez (1986) found that subjective dwelling valuations are upward-biased, whereas Kain and Quigley (1972), Follain and Malpezzi (1981), and Wolters and Woltman (1974) (in Follain and Malpezzi, 1981) found them to be downward-biased.

Other studies tackle the subject by comparing self-reported dwelling value with sale prices in transactions consummated, i.e., prices of the same dwellings if sold during the two years after the survey or in the year before the survey (Goodman and Ittner, 1992; Kiel and Zabel, 1999; Benitez-Silva, Eren, Heiland and Jimenez-Martin, 2009). The findings show that, on average, homeowners tend to valuate their properties above the market. DiPasquale and Somerville (1995) reach the same conclusion by comparing subjective dwelling values with prices of other dwellings sold nearby.

2.2 Sale Transactions vs. Subjective Valuation—Methodology Issues

One may argue that bias is intrinsic to the use of sale-transaction prices because such data reflect only the prices of dwellings in the research area that are sold instead of the price level of the entire inventory of dwellings. The very fact that the reported dwellings were sold while others were not indicates that the sellers were satisfied with the price at which their transactions took place, whereas the owners of unsold dwellings evidently considered the prices they were offered falling short of the "true" value of their properties.

Every seller in the housing market sets an asking price on the basis of information that she possesses about the value of her property relative to that of other properties. The asking price represents an opening position in bargaining with the potential buyer of the property (Arnold, 1999). Accordingly, it should exceed or at least be equal to the threshold price at which the seller is willing to sell the property; otherwise, the transaction will not be consummated (Quan and Quigley, 1991). Since the transaction price reflects the outcome of buyer–seller negotiations, it must be neither lower than the seller's threshold price nor higher than the buyer's reservation price. One may surmise that the difference between subjective evaluation and actual transaction price as found in the studies surveyed above—up to 16 percent—reflects the spread between the asking price of a property and the sales price concluded in negotiations.

Thus, a sample of actual transaction prices does not represent the asking price of owners of other dwellings in the area that were put up for sale but not sold, resulting in a sample-selection bias. Steele and Goy (2002), for example, documented a significant discrepancy between transaction prices and the overall price level in Canadian cities at a time of rapidly falling prices in the real-estate market.

Ihlanfeldt and Martinez-Vazquez (1986) also found this bias, although according to their conclusion, the use of sale transactions is in any event preferable to any other method of estimating dwelling value. Goodman and Ittner (1992) claim that sale-transaction data should be preferred over other alternatives.

As for subjective dwelling valuations, some researchers argue that they exhibit no sample-selection bias because they reflect the price level more accurately than other data due to the representative random nature of the properties sampled in the surveys (Zabel, 1999; Steele and Goy, 2002). In fact, many studies that use owner-valuation data base their inquiries and analyses on the American Housing Survey, which provides sufficiently large samples at the resolution of Standard Metropolitan Statistical Area. In certain surveys, however, the sample is too small to elicit estimates of dwelling values at the desired spatial resolution. National-level surveys may, however, yield biased dwelling-value estimates at the resolution of an individual locality or a census tract, since they are not generally designed to provide sufficient coverage at this area resolution.

Owners' subjective valuations in surveys are prone to problems related to cognitive complexity of the asset-valuation process (Hurd, 1999), and to biases related to survey and item non-response (e.g., Groves et al., 2002). There is much variation in the awareness of respondents who are asked to estimate the value of their dwellings relative to the housing market generally and the price level in the neighborhood of their dwellings specifically. As for response to the specific item of subjective dwelling valuation, Kain and Quigley (1972) found that homeowners who answered an item relating to property value (60 percent of their sample) typically had higher levels of schooling and income, younger age, and less longevity as homeowners. They also found that the response rate among owners of inexpensive properties exceeded that of owners of expensive dwellings. Gonzalez-Navarro and Quintana-Domeque (2009), in contrast, found no relation between item non-response, which occurred in 26 percent of their sample, and dwelling value and homeowner characteristics. Goodman and Ittner (1992), DiPasquale and Somerville (1995), and Gonzalez-Navarro and Quintana-Domeque (2009) found that the closer the purchase of the property is to the survey date, the more accurate the subjective valuation of the dwelling becomes. In contrast, Kiel and Zabel (1999) found a longer term

of ownership results in greater accuracy in dwelling valuation, whereas Agarwal (2007) claims that a shorter term of ownership increases the likelihood of an upward valuation bias.

Then, subjective dwelling valuations are based on different levels of importance that homeowners attribute to a wide range of dwelling indicators and aspects, including physical-structural characteristics, location characteristics, neighborhood quality, and environmental utilities and disutilities. The marginal contribution of these indicators to dwelling valuation is usually estimated in a hedonic price model pioneered by Rosen (1974). The factors related to subjective dwelling valuation may be sorted into several groups. The first group includes structural-physical characteristics of the property, e.g., lot size for low-rise dwellings, dwelling floorspace, number of bathrooms, heating and air-conditioning systems (e.g., Emrath, 2002), number of floors in the building (Zabel and Kiel, 2000), and fireplace, terrace, and parking (Arguea and Hsiao, 2000). The second group of factors relates to homeowner characteristics such as ethnic origin and characteristics, age, and income (Coate and Vanderhoff, 1993; Kiel and Zabel, 2008), schooling and gender (Kiel and Carson, 1990), and marital and employment status (Ihlanfeldt and Martinez-Vazquez, 1986). The third group is composed of environmental utility and disutility factors, such as proximity of dwelling to open spaces and bodies of water (Emrath, 2002), exposure of dwelling to road noise (Nijland and Wee, 2008) and proximity to an airport (Ihlanfeldt and Martinez-Vazquez, 1986). The fourth group includes location characteristics such as good access to public transport (Emrath, 2002) and location of dwelling relative to city center (Kiel and Carson, 1990). Arguea and Hsiao (2000) included in their hedonic price model the crime rate in the area and the level of cleanliness in the public domain as indicators of neighborhood "quality."

Most researchers who use subjective dwelling evaluations, base themselves on Goodman and Ittner (1992) and Kiel and Zabel (1999), who show that the difference between subjective valuation and transaction prices does not correlate with dwelling indicators, dwelling location, or homeowner indicators. Kain and Quigley (1972) found that homeowner's schooling is the only variable that correlates significantly with the difference between subjective dwelling valuation and appraiser's estimate. These findings provide an accepted justification for the use of subjective valuations for various research purposes (Engelhardt, 1996; Zabel, 1999).

Others claim, however, that the use of subjective-evaluation data is suitable for certain purposes only. (Steele and Goy, 2002; Rouwendal and Alessie, 2002), for example, use subjective housing valuations as an indicator of *change* in dwelling prices over time but are reluctant to use such valuations as an indicator of price *level*. DiPasquale and Somerville (1995) argue that despite the existence of biases in subjective dwelling valuations and certain misgivings about the use of these data, homeowners are usually aware of fluctuations in the market prices of their properties.

Ihlanfeldt and Martinez-Vazquez (1986), in contrast, express doubt about the propriety of using subjective dwelling valuations in research on the housing market. They adduce from the findings of their research that "[. . .] housing demand and hedonic price equations that rely upon owner estimates as the measure of housing value may yield bias coefficient estimates on many independent variables" (p. 365).

Arguea and Hsiao (2000), using two types of data—sale transactions and owners' valuations—conclude that there is a similarity between the latter and market value but add that transaction prices show smaller variance and, consequently, make it possible to obtain more precise model estimates.

Generally speaking, one may conclude that despite the problems and limitations of sale-transaction prices, it is the conventional wisdom that these data express more accurately the price level in a given area and elicit the best estimate of property value. This being the case, the difference between the sale-transaction prices and subjective valuations is perceived as a *bias* of the subjective valuations relative to "true" value of the property.

2.3 Reasons for the Bias in Subjective Valuation

The finding of most of the studies is that owners' valuation of their properties is upward biased by around 5 percent on average , although estimates of the bias size fall into a broad range from –2 to 16 percent (e.g., Kain and Quigley, 1972; Robins and West, 1977; Ihlanfeldt and Martinez-Vazquez, 1986; Goodman and Ittner 1992).

As for the reasons for the bias in subjective valuations, various studies yield clashing findings. For example, according to Agarwal (2007), a downward bias is typical of older homeowners and those of higher income. Ihlanfeldt and Martinez-Vazquez (1986) find a significant relation between

the bias in subjective valuation and homeowner characteristics (ethnicity, age, and income) and property indicators (number of bathrooms and bedrooms, age of building, heating fixtures, parking, and density of building in the residential area). Similarly, Benitez-Silva et al. (2009) find that accuracy in subjective housing valuation correlates with homeowner's schooling and income and fluctuates with economic conditions in the housing market at the time the dwelling is purchased.

Goodman and Ittner (1992) and Kiel and Zabel (1999), in contrast, find no relation between characteristics of the property or the residential area and bias in subjective dwelling valuation. Gonzalez-Navarro and Quintana-Domeque (2009) find that homogeneous building in a neighborhood considerably adds to the accuracy of the subjective valuation of a property situated in that neighborhood.

3. DATABASE AND DESCRIPTIVE STATISTICS

This study is based on data from Household Expenditure Surveys for the years 1997–2008. The survey is conducted annually by the Israel Central Bureau of Statistics on the basis of a national sample of more than 6,000 households, some living in owned dwellings and others occupying rented accommodations. Since our study focuses on examining the extent of accuracy of homeowners' subjective valuations, it includes only owner-occupier households, which account for 71 percent of the survey population. The survey data furnish much information about demographic, social, and economic indicators of the household and its head, who is determined by the members of the household, and also characteristics of the property. All of these are used in the analysis, as we specify below.

The survey data were matched with information about sale-transaction prices by census tracts. The sale-transaction file is obtained by the Central Bureau of Statistics from tax authorities on an ongoing basis. In 1997–2008, the file contained 612,000 transactions.

3.1 Database Construction

The consolidated file of twelve survey years includes 72,400 household records. In the first stage, the records were geo-referenced by a GIS system at the level of structure or census tract: 63,300

records were anchored, while 9,100 records—representing, largely, a population living in small and rural localities and collective communities (kibbutzim), in which there is no regular housing market—were deleted from the file. Next, 18,000 records of households that occupied housing not their own were dropped from the file.

The survey question that relates to dwelling valuation is, "What sum could you obtain if you sold the dwelling today?" The respondent is asked to give a point estimate, i.e., without choosing within a range of values pre-specified in the questionnaire. The valuations are usually expressed by respondents in dollar terms; they are translated into the local currency (NIS—New Israel Shekel) terms during data editing. Of 45,300 geo-referenced records of owner-occupier households, around 7,000 respondents provided no information about the value of their dwellings; these cases were deleted from the file. The item non-response rate for the subjective-valuation question was 15 percent on average in the research period but was found to have trended up over the years, from 5 percent in the late 1990s to 24 percent in 2007 and 30 percent in 2008. By comparison, in the European Survey of Health, Aging, Retirement and Expectations (SHARE), the non-response rate for the same item ranged from 6.5 percent in Sweden, Denmark, and the Netherlands to 25 percent in Spain, in 2004, whereas in 2006–2007 the item non-response rate climbed to 8 percent and 36 percent in the same countries, respectively (Christelis, 2008).

Then, 2 percent of the observations were excluded due to outlier subjective valuation (under NIS 150,000 and over NIS 3,200,000). Concurrently, 2 percent of outlier observations of transaction prices (under NIS 75,000 and over NIS 3 million) were also deleted from the national file of sale transactions from which an average dwelling price by census tract is calculated.

After removing the outlier observations, we linked each record in the survey to an average price of transactions carried out in the same census tract in the three months preceding the survey interview. (The reasons for choosing this period of time for comparison of transaction prices with the subjective valuations are presented below.) Of the 37,800 sound records in the survey, 26,700 were linked to an average transaction price in a given census tract with a three-month lag. The research population in the final file added up to 22,448 observations relating to the sixty largest cities in the country (in which 68 percent of the population of Israel lived in 2007).

3.2 Choice of Time Window for Comparison of Subjective Valuations and Transaction Prices

Previous studies that compared the accuracy of subjective valuations with transaction prices did so in different windows of time, paying no explicit attention to the question of the interval of time in which "news" about transaction prices in the survey respondents' residential environment "trickle down" to individuals' dwelling evaluations. This question is definitely a topic for a separate study. We have no specific information that can point to a mechanism of internalizing "news" about the state of the housing market in the individual's neighborhood in estimates of the value of her dwelling. We can, however, look into the variation of a correlation between subjective valuation by the survey participants and the sale-transaction prices over time and choose an optimum time lag for the analysis of the factors that affect the accuracy of the subjective evaluations.

In practice, we linked every observation in the survey to an average price of sale transactions in its census tract 3, 6, 9, and twelve months *before* the date of the survey interview, the month in which the survey is performed, and also 3, 6, 9, and twelve months *after* the reportage in the survey. The logic behind the linkage to sale transactions that took place after the survey interview lies in the fact that it takes several months to advertise a dwelling for sale and negotiate with potential buyers, during which time the survey participants may be exposed to information about the prices of dwellings for sale in their vicinity. This examination was done for various deciles of distribution of subjective valuations, because we assumed that there are differences in the pace of pass through from obtaining information about the value of dwellings in the residential surroundings and the individual's formulation of her subjective valuation, and these differences correlate with housing value. Table 1 shows the correlation between subjective valuation, expressed in the survey, and the average price of transactions in the census tract where the dwelling is located, at various periods of time around the survey reportage.

(Table 1 about here)

That table shows that for each time period, the correlation is greater at the extremes of the valuation distribution than in the middle of the distribution. The valuations of expensive dwellings

(deciles 9–10) correlate more strongly with prices of dwellings sold in their vicinity than the valuations of other dwellings do. At each point of the valuation distribution, the correlation coefficients for different time periods are dispersed in a range of roughly 0.05, with wider dispersion at the extremes of the distribution. The period of time in which the correlation between valuation and average transaction price in the census tract is greatest for most of the valuation distribution is three months before the reported of the valuation in the survey. This is the period of time for which the rest of the study will be performed.

3.3 Bias in Subjective Valuation

Figure 1 contrasts subjective dwelling valuations, reported in the survey, with the average price of transactions in a census tract across the distribution of dwelling prices (Panel A). This picture reflects a great deal of variance in the extent of (in)accuracy of the subjective valuations as against the prices of dwellings actually sold. In particular, one may see that an upward bias in valuation is typical of people who live in dwellings that are valuated in the lowest eighty percentiles of the distribution; it reaches more than 50 percent at the lowest decile of the distribution (Panel B). In contrast, the subjective valuation is downward biased in the uppermost decile of the dwelling-price distribution and comes to roughly 20 percent in the uppermost percentile. The average bias is 27 percent; the bias of the median-priced dwelling is 23 percent. Furthermore, Panel B shows that the bias is highly heteroscedastic at the low end of the distribution of dwelling prices, whereas variance declines slowly in the upper 70 percentiles of the distribution.

(Figure 1 about here)

Figure 2 completes the picture that was presented in Figure 1, showing the bias in subjective dwelling valuation (Y-axis, percent) for selected percentiles of the dwelling-price distribution over the years.

(Figure 2 about here)

The figure shows that the owners of inexpensive dwellings (second decile) typically overestimate the value of their dwellings, the size of the bias ranging across twelve years from 30 percent to 50 percent. In the second decile of dwelling value, the bias widened perceptibly in 2001–2003, which

were years of slump in Israel's housing market. In contrast, the bias in the valuations of owners of expensive dwellings (ninth decile) fell into the narrower range of 0–13 percent, with a clear trend of decline over time. The bias in the subjective dwelling valuations in the middle of the distribution was found within a 10–30 percent range, with a downward trend after 2005. One may adduce from the data in Figure 2 that the distribution of the bias in subjective valuation was relatively stable across the research years. Therefore, we may perform the analysis on a pooled sample of all years.

3.4 Descriptive Statistics

Before discussing the variables used in our analysis, it is instructive to learn about the dynamics of dwelling prices in Israel over the research period. Figure 3 depicts the indices of average dwelling price (nominal, NIS-valued) for the same percentiles that are presented in Figure 2.

(Figure 3 about here)

The prices of inexpensive dwellings (second decile) generally decreased since 1999, while the prices in the middle of the distribution rose moderately over the last decade. In contrast, the prices of expensive dwellings (ninth decile) soared by more than 50 percent during the research period. This rapid growth may serve an explanation for a downward bias in the subjective dwelling valuations of owners of expensive dwellings, who may not have kept up with the pace of increase in the prices of their properties.

Basing ourselves on the findings of the earlier studies discussed in Section 2, we selected and defined variables for analysis of the accuracy of subjective valuations. Some of the variables are self-evident; others require explanation. Table 2 defines the variables that we used in the study and presents their means and standard deviations.

(Table 2 about here)

In the group of variables that represent the characteristics of a dwelling, we defined the *Repairs* variable as denoting dwelling-renovation investment in the twelve months preceding the survey date, including interior modifications of dwelling structure, closing of terraces, construction of walls, and replacement of flooring, kitchen cabinets, etc.

The group of variables that reflect homeowner and residential-area indicators includes variables for ethnic affiliation and immigrant status. The Jewish population accommodates ethnic groups of Sephardi and Ashkenazi origin. The former, termed in the official statistics Jews of Asian-African origin, are immigrants from the Middle Eastern and North African countries. The Ashkenazi group originates mostly in the former Soviet Union (FSU), Europe, and North America. There are perceptible differences between these groups in respect of various socio-economic indicators.

Another group of variables relates to immigrants from the FSU who reached Israel after 1989. This population group is quite distinctive due to its size (round one-seventh of Israel's Jewish population in 2009), the celerity of their arrival (the main immigration wave lasted two years, 1990–1991), and their relatively short longevity in Israel in the research period. The mass arrival of immigrants of common origin, mostly of lower–middle socioeconomic class, strongly affected patterns of home purchase, concentration in specific geographic areas, residential environment, and property values countrywide.

Another group of immigrants, originating in Ethiopia, is of much lower socioeconomic status than FSU immigrants due to lack of schooling, difficulties in social integration, and severe reliance on welfare services and state subsidies. Accordingly, they have a perceptible effect on the residential environment even though they are much fewer in number than FSU immigrants.

4. ECONOMETRIC MODEL

Let us define X and Z1 as vectors of the explanatory variables that, together, reflect homeowner indicators, dwelling and residential-environment characteristics, and factors related to subjective valuation. (The partitioning of these variables between X and Z1 is unimportant for the moment.) We denote by *v* the white-noise error term, assuming that it is i.i.d. for every I and j. This allows us to formulate a model for the subjective valuation of dwelling *I* in census tract *j* as a hedonic price model in the following manner:

(1) $$\ln(\text{Valuation}_{ij}) = \beta X_{ij} + \gamma Z1_{ij} + v_{ij}$$

Similarly, we define the price model of the same dwelling, if it was sold:

(2) $$\ln(\mathrm{Price}_{ij}) = \kappa X_{ij} + \pi Z2_{ij} + w_{ij}$$

Some explanatory variables (vector X) in Model (2) are identical to the subjective valuation model; the others (Z2) represent factors that affect the dwelling price but not the subjective valuation of the dwelling by its owner, e.g., indicators relating to the other party to the sale transaction. Factor *w* is the white-noise error term, i.i.d. for every I and j.

Subtracting Equation (2) from Equation (1), we obtain a model of bias in subjective dwelling valuation relative to the price of the same dwelling in a sale transaction:

(3.1) $$\ln(\mathrm{Valuation}_{ij} / \mathrm{Price}_{ij}) = (\beta - \kappa)X_{ij} + \gamma Z1_{ij} - \pi Z2_{ij} + v_{ij} - w_{ij}$$

According to Model (3.1), the bias of the valuation relative to the price of the *same dwelling* is a function of factors X, Z1, and Z2. However, if the sale-transaction price of the dwelling for which the subjective valuation was reported is not known, information about the log-average price in a sample of sale transactions in the census tract of the dwelling may be used instead. We denote $\frac{1}{n}\sum_{i=1}^{n}\ln(\mathrm{Price}_{ij}) = \frac{\kappa}{n}\sum_{i=1}^{n}X_{ij} + \frac{\pi}{n}\sum_{i=1}^{n}Z2_{ij} + \frac{1}{n}\sum_{i=1}^{n}w_{ij}$, or $\overline{\ln(\mathrm{Price}_{j})} = \kappa\overline{X_{j}} + \pi\overline{Z2_{j}} + \overline{w_{j}}$:

(3.2) $$\ln(\mathrm{Valuation}_{ij}) - \overline{\ln(\mathrm{Price}_{j})} = \beta(X_{ij} - \frac{\kappa}{\beta}\overline{X}_{j}) + \gamma Z1_{ij} - \pi\overline{Z2}_{j} + v_{ij} - \overline{w}_{j}$$

Model (3.2) states that the relative bias in valuation as against the log-average transaction price in the census tract depends, among other things, on factor $(\beta X_{ij} - \kappa\overline{X}_{j})$, meaning that the variables that affect both the valuation and the price may appear in the regression in the form of deviations from the mean value in the census tract corrected by factor κ/β.

With the foregoing general model in mind, we begin by describing the empirical model of the subjective valuation that we will use in the estimation. This model is based on a hedonic price model, in which the explained variable is (the natural logarithm of) the subjective valuation of dwelling *I* in census tract *j* in year *t*. For the sake of convenience in presenting the model, we aggregate the explanatory variables in five groups as shown in Table 2:

(4) $$\begin{aligned}\ln(\mathrm{Valuation}_{ijt}) = {} & \mu_1\mathrm{Household}_i + \mu_2\mathrm{Personal}_i + \mu_3\,\mathrm{Asset}_i + \mu_4\mathrm{AvgTract}_{jt} + \mu_5\mathrm{Area}_i + \\ & \mu_6\ln(\mathrm{AvgPriceCT}_{jt}) + \mu_7\ln(\mathrm{dUSD}_t) + \mu_8\mathrm{NumTransactCT}_{jt} + \mu_9\mathrm{Year}_t + \varepsilon_{ijt}\end{aligned}$$

The first group of variables (*Household*) includes indicators of an owner-occupier household: number of persons, average income per capita in household, and size of the mortgage loan that the household took in order to buy the dwelling. The second group of variables (*Personal*) relates to homeowner characteristics: sex, age, marital status, years of schooling, and origin—Israel-born and, if not, whether or not immigrated in the 1990s, and Sephardi or Ashkenazi origin. The third group (*Asset*) includes dwelling indicators: whether it is a stand-alone house or an apartment in a condominium building, number of rooms, age of building, whether purchased by the household or obtained as a gift or an inheritance, whether acquired during the twelve months preceding the survey date, whether equipped with an air conditioner, a heating system, and a garden, and whether renovated in the past year. The fourth group (*AvgTract*) includes indicators of the census tract in which the dwelling is located: proportion of males, average age of residents of the tract, their distribution by origin, and their average income. The fifth group of variables (*Area*) includes environmental characteristics of the dwelling's nearest surroundings: number of roads of different types in the various ranges (5–50 meters) from the building, distance to the Mediterranean sea shore, and a number of schools within 500 meter from the building.

In addition to these variables, which are customarily included in a hedonic price model, we inserted four variables into the set of the explanatory variables. The first is (the natural logarithm of) the average price of sale transactions in the census tract in the three months preceding the subjective valuation offered in the survey (*AvgPriceCT*), which is meant to represent the information base via which the homeowner subjectively valuates her dwelling, net of dwelling quality and other factors for which we control. Since the relation between this variable and an explained variable is log-logarithmic, the parameter μ_6 denotes the elasticity of the subjective valuation relative to the average sale-transaction price in the census tract. It may be considered as the rate of pass-through from census-tract transaction prices to individual's subjective valuation. Accordingly, we would expect this parameter to be positive, within the range of 0–1.

The second variable, denoted as *dUSD*, is (the natural logarithm of) the change in the exchange rate (NIS/dollar) in the three months preceding the survey date. The reason for including this factor is

that both the dependent variable and the average price of sale transactions in the census tract are expressed in NIS (local currency) terms, while, until the late 2000s, dwelling prices have been cited usually in dollar terms. If subjective dwelling valuations are formulated in dollar terms and are "anchored" to the dollar prices of sale transactions with a three-month lag, one would expect local-currency valuations to fluctuate in tandem with exchange-rate fluctuations. That is, formation of valuations in dollar terms would imply a positive parameter μ_7; the stronger the dollar-terms rigidity of prices is, the closer to 1 its estimate would be.

The third variable is the number of sales transactions in the census tract in the three months preceding the individual's subjective valuation (*NumTransactCT*). This variable is meant to express the ability to sell dwellings in the census tract. The less salable the dwellings are, the higher their owners' valuation should be, for any given condition of demand. Thus, one should expect the estimate of parameter μ_6 to be negative.

Finally, the model includes a fixed effect for the year in which the subjective valuation of dwelling *I* was given (*Year*). This effect should represent all idiosyncratic effects that may influence the valuation of dwellings countrywide in a given year.

The white-noise error term, ε_{ijt}, represents random effects associated with subjective dwelling valuation that are not reflected in the foregoing explanatory variables. We posit that $\varepsilon_{ijt} \sim N(0,\sigma^2)$ for every t, j, and I, and sustains all assumptions of the OLS regression model.

The main equation in our study estimates the effect of the aforementioned explanatory factors on the percent of bias in subjective dwelling valuation relative to the average sale-transaction price of dwellings in the census tract in the three months preceding the survey. We define this relative bias as $\ln(\text{Valuation}/\text{AvgPriceCT})$. The model is the following:

$$\ln(\text{Valuation}_{ijt}/\text{AvgPriceCT}_{jt}) = \lambda_1\text{Household}_i + \lambda_2\text{Personal}_i + \lambda_3\text{Asset}_i + \lambda_4\text{AvgTract}_{jt} + \lambda_5\text{Area}_i + \lambda_6\ln(\text{dUSD}_t) + \lambda_7\text{NumTransactCT}_{jt} + \lambda_8\text{Year}_t + u_{ijt} \quad (5)$$

Notably, once the explanatory variable in Model (2) is defined as the log of the relation between subjective valuation and average sale-transaction price in the census tract, it follows that Model (5) is

a private case of Model (4), under assumption of $\mu_6 = 1$. In other words, once we assume unit elasticity of the subjective valuation relative to the average transaction price in the census tract, we derive the relative-bias model from the hedonic price model with a specification that includes average transaction price in census tract as an explanatory variable. Assumption $\mu_6 = 1$ may, of course, be tested empirically.

Comparing empirical Model (5) with general Model (3.2), we notice several differences. The first is the addition of a time dimension originating in the accumulation of survey years in the database of the study. The second difference is the omission of the Z2 group of variables, those that affect dwelling price but not subjective valuation. This omission may introduce a bias onto the estimates of the model if elements of the vector Z2 are correlated with elements of the vectors X and/or Z1. The third difference is that elements of the vector X appear in level and not in the form of a deviation from the mean in the census tract, for the model includes also a group of indicators of the population of the census tract (*AvgTract*) that reflects differences between characteristics relating to homeowner and those pertaining to neighborhood population.

We subject Model (5) to two sensitivity analyses. In one of them, we estimate the model for a subsample of 3.5 percent of observations—including only dwellings that, according to the survey reportage, were purchased during the twelve months preceding the survey. It should be noted that reportage of dwelling purchases in the survey is done via a retrospective questionnaire that does not note the date of the purchase. Thus, it may be flawed in its attribution of purchases to the twelve-month "window" before the survey date, as some transactions preceding the window are reported as having taken place within the window while others carried out during the window are forgotten (Kennickell and Starr-McCluer, 1997). It stands to reason that these homeowners, who as recent purchasers of their dwellings were exposed to conditions of the local housing market, were more aware than others of the value of their dwellings; therefore, we would expect their valuations to be more accurate.

The second sensitivity analysis concerns the possibility of small-sample bias at the level of census tract. As stated, the study was performed on the basis of a national survey that has the inherent

disadvantage of lacking uniform coverage at census-tract resolution. To determine how seriously this affects the estimates and the size of the subjective-valuation bias, we limited the sample to census tracts in which no fewer than ten, twenty, and thirty observations were found in a census tract in the research years.

5. ESTIMATION RESULTS

This part of the study presents the results of the empirical analysis on the basis of the models described above.

Table 3 shows the estimates of Model (4), which examines the factors that affect subjective dwelling valuation. The table presents estimates of the same model as derived from the full sample of 21,238 observations (Model A) and from a subsample of 738 observations of dwellings acquired in the year preceding the survey date (Model B). The estimation for the subsample of recently acquired dwellings—for which the price actually paid is known—allows us to perform a sensitivity analysis for the estimates of Model (4) and to learn whether the average price in a census tract serves as a close substitute for the actual dwelling price, which was reported by respondents among last year's expenditures and is therefore included in the estimation.

(Table 3 about here)

The full-sample model (Model A) explained 70 percent of the variance in subjective dwelling valuation in the survey. Most of the estimates are significant at the .01 level and the directions of their effect generally match those of hedonic price-model estimates in the literature (Arguea and Hsiao, 2000; Zabel, 2004; and Kiel and Zabel, 2008, among others).

The findings of the model show a significant relation between homeowner—household and individual—indicators and the subjective valuation of the dwellings that they own. Specifically, older people (as against younger ones), the Israel-born (as against immigrants), and those who have better schooling and higher income estimate higher values for their dwellings, *ceteris paribus*. Furthermore, household size correlates positively with subjective dwelling valuation.

The higher the mortgage payment is, the lower the subjective dwelling valuation. The estimates also indicate that homeowners who received their dwellings by gift or inheritance assign higher values to them than those who bought their dwellings with their own money.

Among the group of physical indicators relating to the dwelling, several variables, e.g., number of rooms, heating system, low-rise private house (as opposed to an apartment in a condominium), and private garden, stand out in their effect on subjective valuations.

As expected, the model reveals a strong and positive relation between average sale-transaction price in the census tract and subjective dwelling valuation (elasticity 0.3). Furthermore, we find that the subjective valuation is a negative function of the number of transactions performed in the census tract. That is to say, the scarcity of information about dwelling prices in the tract where the survey respondent lives induces the respondent to overvalue her dwelling.

The significant effects of the residential environment indicators confirm the importance of demographic and economic composition of the neighborhood population for dwelling valuation. In particular, a census tract with a more mature and affluent population elicits higher subjective dwelling valuations, whereas concentrations of the FSU and Ethiopian immigrants in the neighborhood induce owners to lower their valuations of their dwellings.

As expected, a significant positive relation was found between subjective dwelling evaluation and changes in the dollar exchange rate in the three months preceding the survey—the time at when interviewees in the survey were exposed to information about prices of transactions in their near vicinity. The elasticity found, 0.6, attests to powerful pass-through of exchange-rate volatility to the valuation of residential real estate in Israel.

The findings of the model also corroborate the importance of the characteristics that reflect environmental and dwelling-location effects on dwelling valuation. In particular, the results illuminate the dual effect of roads in the proximate vicinity of dwellings. Thus, the noise occasioned by main roads that are very close to dwellings (a distance of up to 5 meters) lowers the valuation, whereas the presence of roads at distances of 30–50 meters from the dwelling increases the valuation, evidently due to the good access that they allow. The proximity of an apartment building to a beach is also identified with environmental utilities that increase dwelling value. We also found a positive relation

between the existence and number of schools in the neighborhood and dwelling valuation. These findings are consistent with those of studies that explored the effect of dwelling location and environmental characteristics on property value (Bourassa, Hoesli, and Sun, 2005; Nijland and Wee, 2008).

Model B, estimated on the basis of a relatively small subsample, has a much higher goodness of fit than Model A (0.83 vs. 0.70, respectively) even though it includes fewer statistically significant explanatory variables. The reason for the better fit of Model B has to do with an explanatory variable that reflects the reported price of the survey respondent's dwelling (*Price*). Strikingly, this variable does not eclipse the average dwelling price in the census tract, (*AvgPriceCT*), as one might conjecture. Both variables enter the model at high levels of significance and with estimates of similar size: 0.31 for *Price* and 0.29 for *AvgPriceCT*. In other words, each of these variables—the price paid for the same dwelling and the average price of dwellings recently sold in the residential environment—has its own role to play in the subjective dwelling valuation and each provides relevant complementary information for the valuation.

As for the size of parameter μ_6 in Model (4) above, we note that the estimate of variable *AvgPriceCT* (0.31) (Table 3, Model A) is significantly smaller than 1, meaning that one cannot consider Bias Model (5) a private case of Subjective Valuation Model (4).

Model (5) examines the factors of bias in the subjective valuation relative to the average price of sales transactions in the same census tract (three months before the survey). The model was estimated using the OLS method. Table 4 shows the results of the estimation of the model for both the full sample (Column A) and a subsample of dwellings acquired in the year preceding the survey (Column C).

(Table 4 about here)

The purpose of the latter estimation is to analyze the sensitivity of the estimates to the timeliness of information about dwelling value that new homeowners possess relative to that in the possession of those who bought their dwellings long ago. Table 4 also presents a model with fixed effects for census tracts (Column B).

Model A explains almost 29 percent of variation in the subjective valuation bias. It was found that the subjective valuation bias is positively related with the number of rooms and the existence of air-conditioning and heating systems and private gardens. Furthermore, owners of low-rise private homes are inclined to overestimate the value of their dwellings to a larger degree than owners of apartments in condominium buildings, *ceteris paribus*.

As stated, the extent of the bias is affected by household and homeowner characteristics. In particular, we found that the Israel-born typically overvalue their dwellings while immigrants tend to undervalue them, and that older and higher-income homeowners tend to overvalue. These findings, while consistent with those of Ihlanfeldt and Martinez-Vazquez (1986), clash with those of Agarwal (2007). A possible explanation for the positive relation between income and size of subjective dwelling valuation bias may be found in the domain of economic psychology. Home ownership is one of the most important factors, along with current income, in measuring an individual's economic well-being. When a person's income and general well-being improve, her subjective standards for the estimation of her proprietary status also escalate, and these subjective standards usually go up long before her objective economic situation changes (Lewis, Webley, and Furnham, 1995). It follows that an increase in homeowner's income magnifies the bias in her dwelling valuation. Interestingly, no significant relation was found between homeowner's level of schooling and bias in dwelling valuation when household income is controlled for.

As for the effect of longevity of ownership—represented by the variable *Bought12months*—on the extent of the bias, we found that the valuations of new owners, i.e., those who reported having bought their dwellings in the twelve months preceding the survey data, were more upward-biased than those of the other participants in the sample, although the estimate was significant at a relatively low .10 percent level. This latter result corresponds to the findings of Kiel and Zabel (1999) and Agarwal (2007) but clashes with those of other studies, such as Kain and Quigley (1972) and Goodman and Itter (1992). Given the low significance level of this variable, the question of the reliability of reportage on purchases within the twelve-month window (as mentioned in Section 4) and uncertainty about what the respondent means when reporting the purchase of a dwelling (signing the contract, paying some or all of the purchase price, or moving in), this finding should be treated cautiously.

The larger the mortgage payments are, the smaller the bias. Similarly, the estimation shows that homeowners who acquired their dwellings by inheritance or gift tend to overvalue them relative to those bought their dwellings on their own. As expected, a negative relation was found between the number of sale transactions in the census tract and the size of the valuation bias. In other words, the lack of up-to-date information about housing prices in a survey respondent's area of residence causes a larger upward bias, *ceteris paribus*.

As for the effect of neighborhood indicators, the negative estimate of *IncomeCT* (in Column A) shows that owners of dwellings in low-income census tracts typically overestimate the value of their dwellings relative to the average price of dwellings recently sold in the same tract. Given the robust direct relation between household income and dwelling value, the price level of dwellings in these tracts is also probably relatively low. As has been shown in research of life- and income-satisfaction, while an increase in individual's income and proprietary status improves one's well-being—having magnified the bias in homeowner's dwelling valuation—the effect of income in the individual's reference group (e.g., neighbors) is mostly negative (Easterlin, 1995).

The effect of additional variables that characterize the demographic composition of the survey participants' residential environment reinforces this finding. In particular, an upward bias in valuation is typical of homeowners who live in tracts populated by concentrations of immigrants from the FSU and Ethiopia. This effect, combined with the fact that a higher share of these groups of immigrants in the tract has a negative impact on subjective dwelling valuation (as documented in Table 3), leads to the conclusion that the heavier presence of immigrant populations in a neighborhood depresses the average dwelling price more than it does the inhabitants' subjective valuations .

As for dwelling environment and location characteristics, it turns out that a stronger bias in dwelling valuation is typical of households in neighborhoods that are noted for the presence of schools and accessible road systems that are nearby but not too close to the building.

The estimate of 0.75 for exchange-rate changes during three months preceding the survey indicates a high degree of inelasticity of dwelling price valuations in dollar terms throughout the research period.

Column B of Table 4 presents a model with a fixed effect for census tracts. Most explanatory variables that are indicative of household, homeowner's personal traits, and physical properties of the dwelling are statistically significant; their effect on the valuation bias resembles the effect in Column A in terms of both the size of the estimates and the direction of their effect. In contrast, no significant impact was observed for the indicators of census-tract population; this seems to be a direct outcome of specifying the model with fixed effects for census tracts as opposed to a model accommodating only fixed effects for years, as shown in Column A.

Column C of Table 4 presents results for the subsample of respondents who acquired dwellings during the year preceding the survey date, with the same explanatory variables that were used in the estimation of Column A. This model also includes a variable reflecting the price actually paid for the dwelling reported in the survey (*Price*). The significance of the explanatory variables in this model is lower due to the very small sample size, but its explanatory power (0.33) surpasses that of the full sample, evidently due to the inclusion of the price actually paid for the dwelling. As for the statistically significant variables, no dramatic differences were found between the estimates for the subsample of new homeowners and the full sample, either in the estimates of the variables or in the direction of their effect. It turns out, however, that among all dwelling physical characteristics that were included in the model, only the number of rooms was found to be correlated positively with the bias of dwelling valuation. Furthermore, ownership of low-rise private dwellings induces a larger bias than apartments in condominium buildings.

Among the household traits, only income was found to be significant and it tends to increase the bias. As for the effect of indicators relating to the population of the respondent's residential area, the findings for the subsample resemble those described for the full sample. Notably, however, exchange-rate fluctuations (*dUSD*) had no statistically significant effect on the subjective valuation bias of new homeowners. This finding may follow from the fact that having recently reported their own transaction for tax purposes in local currency, new homeowners do not return to dollar terms when formulating their updated asset valuations.

The mean subjective-valuation bias that was found for the subsample of dwellings purchased in the twelve months preceding the survey (19.3 percent) is significantly smaller than the mean bias for

the full sample (26.8 percent). This stands to reason because new homebuyers are more familiar with the local housing market than others are.

Lastly, we examined the sensitivity of the estimates in Model (5) to a possible small-sample bias at the level of census tract, a spatial resolution that does not presume uniform coverage in the national survey on which the study is based. To examine how seriously this affects the quality of the estimates and the size of the dwelling-valuation bias, we "filtered" the full sample by imposing a minimum threshold of sample size in a census tract: no fewer than ten observations (Column A), twenty observations (Column B), and thirty observations (Column C) in all research years. Table 5 shows the results of the estimation for these downsized samples.

(Table 5 about here)

First, it should be noted that the mean bias in dwelling valuation is basically the same in all three models, although as the threshold size of the sample of observations in the census tract rises, the mean bias decreases and the fit of the model improves. At the same time, the number of statistically significant explanatory variables decreases steadily from Column A to Column C, evidently due to the drastic contraction of sample size from 19,200 to 12,960 to 5,240, respectively.

The major contribution of personal indicators to the level of the subjective dwelling-valuation bias weakens as the sample size in the census tract decreases. Among the personal indicators that affect dwelling-valuation bias, one may note the stability in the variables of per-capita household income as well as immigrant and marital status. (The contribution of two latter variables strengths as the sample size in the census tract decreases.)

In contrast to the homeowner personal indicators, the effect of most dwelling physical indicators actually gains strength as the threshold of sample size in the census tract goes down. In other words, the marginal effects on the dwelling-valuation bias of better housing conditions (number of rooms, air conditioning, heating system), and of ownership of private houses as opposed to apartments in condominium buildings, rise with an decrease in the sample size in the census tract. Notably, the impact on subjective-valuation bias of most census-tract population and environmental indicators, as well as the effect of the exchange rate, becomes stronger in the transition from Column A to Column C.

Consequently, despite certain differences in the estimates and significance levels of the explanatory variables, generally the difference in sample size in a census tract has no meaningful effect either on the size of the subjective-valuation bias or on the factors affecting it.

6. CONCLUSION AND DISCUSSION

The use of subjective valuations of dwellings by their owners as an estimate of dwelling value is very common in economic research. This study examined the reliability of subjective dwelling valuations on the basis of a multi-annual data (1997–2008) from Israel that integrate dwelling valuations culled from a national household-expenditure survey with sale-transaction data at the level of census tract.

The results of our study indicate that, on average, homeowners tend to overestimate the value of their dwellings by 27 percent and exhibit a median bias of 23 percent. These estimates are much higher than the size of biases found in previous research. This fact may be attributed to a wider spread between the asking price of a property and the sales price in the Israel's real-estate market than in the US market that was mostly analyzed in the literature.

This study elicited several new findings. First, by investigating bias size across a distribution of dwelling prices, we found wide variance in the accuracy of the subjective valuations as against transaction prices. The valuations of inexpensive and costly dwellings are biased in different directions: estimates reported by people who live in dwellings belonging to the first eight deciles of the price distribution are upward-biased and come to more than 50 percent in the lowest decile of the distribution, whereas people who occupy the most expensive dwellings (those in the top decile of dwelling prices) more typically understate the value of their homes by up to 20 percent.

A possible explanation for the downward bias at the upper end of the dwelling-value distribution may be proffered on the basis of Veblen's (2007) theory of conspicuous consumption. According to the "Veblen-goods" concept, the price that an individual is willing to pay for an expensive and prestigious property reflects both the utility that the property confers and the "prestige" value that its acquisition may signal to the individual's reference group. Econometric checks corroborate the Veblen-effect (Bagwell and Bernheim, 1996). Over time, however, the "prestige" aspect tends to

dissipate and makes no further contribution to the property owner's gratification (Ackerman, 1997). Thus, in the response to the survey question about the valuation of an owner-occupied dwelling, the weight of the "prestige" element is greatly reduced whereas the practical utility of property use internalizes stronger familiarity with the property specification in terms of its characteristics and immediate vicinity (region, neighbors, infrastructure, etc.) that were unfamiliar when the property was acquired. Accordingly, the explanation for the undervaluing of the costliest dwellings seems to lie, at least partly, in the difference between considerations of practical utility—that guide homeowners in their valuation of properties they live in, and a higher valuation of real estate in their vicinity among those who have just bought a dwelling in the neighborhood, ostensibly driven by the Veblen-good effect. Another possible explanation for the undervaluation of the most expensive properties is that prices increased more quickly in the prestige segment of Israel's real-estate market than in other market segments during the research years. For this reason, the valuations of owners of expensive properties may not have kept up with the pace of increase in the prices of their properties.

A difference in income level does much to dictate the difference in individuals' valuation of and attitude toward their economic and financial assets generally and dwellings particularly (Duflo, 2006). In particular, Roberts (2008) claims, there is a substantial difference between low-income persons and high-income persons in the manner of thinking and the considerations that figure in evaluating a dwelling and the size of a mortgage that one takes in order to acquire it. Due to the widespread belief that real-estate prices only increase over time, people usually are not worried about the fate of the bank loans that they have taken because, instead of intending to pay them back in full via installments from monthly income, they generally believe that they will settle their debts by applying the future capital gain that they will obtain by selling their dwellings. For owners of inexpensive dwellings, then, such considerations may serve as an incentive to overvalue their properties. When doing so, they tend to accept misleading information that supports their attitudes and beliefs (of inevitable increase of value of their properties) and disregard information about housing prices in the neighborhood that argues to the contrary—developing a bias, akin to a gap between economic and psychological forecasts as documented by Bovi (2009).

An upward bias at the lower end of the dwelling-valuation distribution may also take shape if liquidity constraints among owners of inexpensive dwellings bring about a price level for such dwellings that is under fair market value. Liquidity constraints have a strong effect on consumer behavior generally and housing purchase and selling behavior specifically (Maki, 1993; Genesove and Mayer, 1997). Studies focusing on the investigation of interrelations of liquidity constraints and changes in property prices indicate that low income homeowners, who usually also have a high loan-to-value ratio, are especially inclined to negative income shocks. These may be manifested in liquidity constraints and the "fire sale" disposal of dwellings at under-market prices in order to smooth consumption or pay debts (Brunnermeier, 2009). Indeed, Genesove and Mayer (1997, 2001) corroborated that homeowners with high loan-to-value ratios tend to set higher asking prices. This bias is observed even at times of downturns in the housing market, when sellers of inexpensive dwellings expect to take a financial loss when selling their properties (relative to the nominal price at which they bought the dwellings).

Another plausible explanation for the overvaluation of inexpensive dwellings by their owners is that certain utilities of home ownership (e.g., stability, local welfare services, community support etc.) are much more important for low-income persons that for high-income persons (Denton, 2001)—an importance that may be "translated" into the overvaluing of the least expensive dwellings by resource-poor persons.

In an attempt to determine the most relevant period of time during which subjective valuations internalized "news" about housing prices in the neighborhood, we tested the correlation between dwelling valuations reported in the survey and housing prices in the same area within a window of one year around the survey participation date. We found that the interval of three months before the survey date delivers the best correlation between valuations and average transaction prices in a given census tract for most of the dwelling-value distribution.

Our findings confirm the existence of a significant and systematic relation between bias in homeowners' dwelling valuations and dwelling physical indicators, homeowner personal indicators, and census-tract population characteristics. This finding clashes with the conventional wisdom in the estimation of hedonic price models and housing-demand models based on homeowners' subjective

valuations, which denies the existence of any correlation between dwelling-valuation bias and dwelling-owner indicators, dwelling characteristics, and residential-environment indicators. This conventional wisdom is based on the studies of Kain and Quigley (1972) and Goodman and Itter (1992), which found no statistical relation between bias and the aforementioned factors.

We found no dependency between the average valuation bias and sample size in the census tract for which the bias was examined. In other words, in a national survey that poorly reflects local spatial resolution (census tracts), sample size in small areas seems to have no dramatic effect on owners' valuations of their dwellings.

One must of course be cautious in any attempt to generalize the conclusions of this study to other periods of time and geographic locations. Clearly, however, the observation of a mean bias in subjective valuation relative to actual dwelling prices masks quite a bit of variation across the valuation distribution, and the bias may even change signs as it crosses the distribution. This finding entails further testing and efforts to understand why owners of expensive dwellings behave so differently from owners of lower-priced accommodations.

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Table 1: Correlation between subjective valuation and average price in sales transactions in census tract, by deciles of valuation and period of time between valuation and sales transactions, 1997-2008

Deciles of subjective valuation	Coefficient of correlation								
	After: months				Concurrently	Before: months			
	12	9	6	3		3	6	9	12
1	0.105	0.122	0.119	0.114	0.135	**0.152**	0.122	0.148	0.103
2	0.099	0.076	0.073	0.088	0.073	**0.088**	0.081	0.129	0.074
3	0.094	0.070	0.078	0.076	0.075	**0.108**	0.115	0.115	0.084
4	0.041	0.077	0.074	0.047	0.073	**0.083**	0.076	0.046	0.071
5	0.035	0.038	0.046	0.070	0.040	**0.024**	0.050	0.020	0.032
6	0.065	0.055	0.040	0.036	0.059	**0.074**	0.045	0.059	0.048
7	0.066	0.059	0.074	0.071	0.060	**0.048**	0.062	0.053	0.070
8	0.072	0.067	0.060	0.059	0.089	**0.070**	0.046	0.053	0.084
9	0.109	0.091	0.082	0.110	0.121	**0.096**	0.114	0.103	0.137
10	0.190	0.214	0.186	0.189	0.153	**0.225**	0.214	0.194	0.178

Table 2: Descriptive Statistics of Households and Their Dwellings, 1997–2008

Name of variable	Definition of variable	Avg. (S.D.)
*Characteristics of household**		
Persons	Number of persons in household	3.3 (1.7)
Income	(Ln of) Monthly monetary income per capita (NIS)	8.04 (0.69)
Mortgage	(Ln of) Mortgage loan repayment, or zero if none (NIS) [a]	3.52 (3.69)
*Characteristics of head of household**		
Male	Male (%)	55.7
Age	Age (years)	52.1 (15.6)
IsraelBorn	Israel-born (%)	44.3
Immigrant1990	Immigrated in or after 1990 (%)	14.0
ImmEuropeAmerica	European or American born, not incl. immigrants in or after 1990 (%)	24.0
ImmAsiaAfrica	Asian or African born, not incl. immigrants in or after 1990 (%)	17.7
Married	Married (%)	73.5
Education	Schooling (years)	13.1 (4.6)
*Characteristics of dwelling**		
Valuation	(Ln of) Subjective valuation of dwelling (NIS)	13.41 (0.54)
Purchased	Dwelling purchased (vs. inherited or received without pay) (%)	92.5
Bought12months	Dwelling purchased during twelve months preceding survey (%)	3.6
Price	(Ln of) Dwelling price, if purchased during twelve months preceding survey (NIS)	13.25 (0.57)
House	House (vs. dwelling in condominium building) (%)	27.4
Rooms	Total rooms in dwelling	3.8 (1.1)
BuildingAge	Age of building (years)	24.5 (14.8)
AirConditioner	Air conditioner in dwelling (%)	75.6
Heating	Heating system (%)	9.7
Garden	Garden (%)	2.2
Repairs	(Ln of) Expense on major repairs in dwelling in 12 months preceding survey, or zero if none (NIS) [b]	1.08 (2.327)
*Characteristics of census tract***		
AvgPriceCT	(Ln of) Average price in sale transactions three months before survey in census tract (NIS)***	13.29 (0.50)
NumTransactCT	Number of sale transactions three months before survey in census tract (%)	3.4 (3.1)
MaleCT	Men in census tract (%)	48.8
AgeCT	Average age in census tract (years)	38.3 (8.5)
IsraelbornCT	Israel-born in census tract (%)	57.2
Immigrant1990CT	Immigrated in or after 1990 in census tract (%)	15.0
ImmEuropeAmericaCT	European-American born, not incl. immigrants in or after 1990, in census tract (%)	16.0
ImmAsiaAfricaCT	Asian-African born, not incl. immigrants in or after 1990, in census tract (%)	10.8
EthiopiaCT	Ethiopian-born, not incl. immigrants in or after 1990, in census tract (%)	1.0
IncomeCT	(Ln of) Avg. income from wages and business per capita in census tract (NIS)***	10.32 (0.63)

Table 2: Descriptive Statistics of Households and Their Dwellings, 1997–2008 (continue)

Name of variable	Definition of variable	Avg. (S.D.)
*Environmental characteristics of surroundings*****		
RoadArea	Number of roads within 50 meters from the building	8.1 (10.7)
Road5mArea	Existence of a motorway within 5 meters from the building (%)	1.8
SchoolArea	Number of schools within 500 meters from the building	4.8 (4.8)
SeaArea	Distance to the Mediterranean sea shore (km) [c]	13.5 (22.7)
dUSD	(Ln of) Rate of change of the US dollar exchange rate in three months preceding the survey date	0.003 (0.04)

NOTE: ***Source:** Household Expenditure Survey, authors' calculations. ****Source:** Population Register, authors' calculations. *****Source:** Israel Tax Authority, authors' calculations. ******Source: GIS data,** authors' calculations.
a. 48.4 percent of households in the sample reported paying mortgage.
b. 18.5 percent of households in the sample reported some repairs in their dwellings in 12 months preceding survey.
c. Aerial distance from the building if it is located within 1 km from the shore, otherwise aerial distance from the city center.

Table 3: Estimates of Subjective Valuation Model

	Full sample	Sample of dwellings purchased in 12 months preceding survey		Full sample	Sample of dwellings purchased in 12 months preceding survey
	(A)	(B)		(A)	(B)
Variables	Estimate (Standard error)	Estimate (Standard error)	Variables	Estimate (Standard error)	Estimate (Standard error)
Intercept	6.918[a]	4.627[a]	**Price**	-	0.310[a]
	(0.116)	(0.490)			(0.020)
Persons	0.015[a]	0.011	**AvrPriceCT**	0.308[a]	0.289[a]
	(0.002)	(0.007)		(0.006)	(0.024)
Income	0.080[a]	0.056[a]	**dUSD**	0.597[a]	0.309
	(0.004)	(0.018)		(0.058)	(0.220)
Mortgage	-0.006[a]	-0.008[a]	**NumTransactCT**	-0.002[b]	-0.001
	(0.001)	(0.003)		(0.0007)	(0.002)
Male	-0.014[a]	-0.027[c]	**MaleCT**	-0.966[a]	-1.615[a]
	(0.004)	(0.016)		(0.135)	(0.572)
Age	0.001[a]	0.0006	**AgeCT**	0.007[a]	0.006[b]
	(0.0002)	(0.0007)		(0.0006)	(0.003)
IsraelBorn	0.027[a]	-0.031	**Immigrant1990CT**	-0.693[a]	-0.486[a]
	(0.006)	(0.032)		(0.024)	(0.095)
Immigrant1990	-0.073[a]	-0.050	**ImmEurope**	0.109[b]	-0.190
	(0.008)	0.033	**AmericaCT**	(0.049)	(0.205)
ImmEurope	-0.031[a]	-0.051	**ImmAsiaAfricaCT**	-0.193[a]	-0.108
America	(0.007)	(0.036)		(0.054)	(0.214)
Married	0.040[a]	0.024	**EthiopiaCT**	-0.599[a]	0.152
	(0.006)	(0.022)		(0.079)	(0.291)
Education	0.004[a]	-0.0003	**IncomeCT**	0.128[a]	0.080[a]
	(0.0005)	(0.002)		(0.006)	(0.023)
Purchased	-0.107[a]	-0.122[b]	**SeaArea**	-0.002[a]	-0.002[a]
	(0.008)	(0.053)		(0.0001)	(0.0005)
House	0.085[a]	0.070[a]	**SchoolArea**	0.011[a]	0.007[a]
	(0.005)	(0.020)		(0.001)	(0.002)
Rooms	0.176[a]	0.110[a]	**RoadArea**	0.005[a]	0.005[b]
	(0.002)	(0.011)		(0.0006)	(0.002)
BuildingAge	-0.013[a]	-0.007[a]	**Road5mArea**	-0.021[a]	-0.021[b]
	(0.0005)	(0.002)		(0.003)	(0.012)
BuildingAgeSq	0.0002[a]	0.0001[a]	**Fixed effect, years**	Yes	Yes
	(0.000008)	(0.00003)			
AirConditioner	0.030[a]	-0.008	**Number of observations**	21,238	738
	(0.005)	(0.019)			
Heating	0.155[a]	0.122[a]	**Adjusted R^2**	0.70	0.83
	(0.008)	(0.037)			
Garden	0.098[a]	0.076[c]			
	(0.015)	(0.042)			
Repairs	-0.0004	-0.001			
	(0.0009)	(0.002)			

NOTE: Dependent variable is the natural logarithm of the subjective valuation. Standard errors are in parentheses. Significant at: (a) 1%. (b) 5%. (c) 10%

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Table 4: Estimates of Subjective Valuation Bias Model

Variables	Full sample		Sample of dwellings purchased in 12 months preceding survey
	Estimate (Standard error)	Estimate (Standard error)	Estimate (Standard error)
	(A)	(B)	(C)
Intercept	-0.245[c]	-1.076[a]	-1.502[b]
	(0.133)	(0.352)	(0.680)
Persons	0.010[a]	0.009[a]	0.023[c]
	(0.002)	(0.002)	(0.012)
Income	0.066[a]	0.067[a]	0.102[a]
	(0.005)	(0.005)	(0.027)
Mortgage	-0.004[a]	-0.003[a]	-0.008[c]
	(0.0009)	(0.001)	(0.004)
Male	-0.004	-0.003	-0.025
	(0.006)	(0.006)	(0.025)
Age	0.003[a]	0.003[b]	0.002
	(0.001)	(0.0011)	(0.005)
AgeSq	-0.00003[b]	-0.00002[c]	-0.00002
	(0.00001)	(0.000010)	(0.00006)
IsraelBorn	0.024[a]	0.020[b]	-0.021
	(0.009)	(0.008)	(0.049)
Immigrant1990	-0.075[a]	-0.052[a]	-0.051
	(0.011)	(0.010)	(0.050)
ImmEurope	-0.015[c]	-0.010	-0.046
America	(0.009)	(0.008)	(0.055)
Married	0.0407[a]	0.045[a]	0.044
	(0.008)	(0.007)	(0.034)
Education	0.0001	0.0009	-0.004
	(0.0007)	(0.0007)	(0.004)
Purchased	-0.089[a]	-0.105[a]	-0.098
	(0.011)	(0.010)	(0.080)
House	0.109 [a]	0.143[a]	0.122[a]
	(0.007)	(0.007)	(0.030)
Rooms	0.172[a]	0.196[a]	0.131[a]
	(0.003)	(0.003)	(0.017)
BuildingAge	-0.007[a]	-0.014[a]	-0.004
	(0.0007)	(0.0007)	(0.003)
BuildingAgeSq	0.0001[a]	0.0001[a]	0.00009[c]
	(0.00001)	(0.00001)	(0.00005)
AirConditioner	0.046[a]	0.050[a]	-0.001
	(0.007)	(0.007)	(0.029)
Heating	0.056[a]	0.064[a]	-0.002
	(0.010)	(0.011)	(0.056)
Garden	0.072[a]	0.114[a]	-0.030
	(0.019)	(0.018)	(0.064)

Table 4: Estimates of Subjective Valuation Bias Model (continue)

Variables	Full sample		Sample of dwellings purchased in 12 months preceding survey
	Estimate (Standard error)	Estimate (Standard error)	Estimate (Standard error)
	(A)	(B)	(C)
Repairs	-0.001	-0.001	-0.004
	(0.001)	(0.001)	(0.004)
Bought12months	0.027[c]	0.002	-
	(0.015)	(0.014)	
Price	-	-	0.163[a]
			(0.030)
dUSD	0.751[a]	0.712[a]	0.133
	(0.076)	(0.073)	(0.335)
NumTransactCT	-0.007[a]	-0.006[a]	-0.005[b]
	(0.001)	(0.001)	(0.002)
MaleCT	-0.761[a]	0.189	-1.288
	(0.177)	(0.249)	(0.873)
AgeCT	0.008[a]	0.002	0.003
	(0.001)	(0.001)	(0.004)
Immigrant1990CT	0.285[a]	0.217[b]	0.299[b]
	(0.029)	(0.088)	(0.139)
ImmEuropeAmericaCT	-0.338[a]	-0.126	-0.080
	(0.064)	(0.137)	(0.313)
ImmAsiaAfricaCT	-0.292[a]	-0.024	-0.158
	(0.071)	(0.149)	(0.326)
EthiopiaCT	0.738[a]	0.169	1.320[a]
	(0.103)	(0.210)	(0.442)
IncomeCT	-0.083[a]	0.002	-0.131[a]
	(0.007)	(0.015)	(0.033)
SeaArea	-0.0001	-0.018	-0.001
	(0.0001)	(0.021)	(0.001)
SchoolArea	0.003[a]	0.0001	0.002
	(0.001)	(0.002)	(0.003)
RoadArea	0.002[b]	-0.001	0.006
	(0.001)	(0.001)	(0.004)
Road5mArea	-0.009[b]	0.003	-0.026
	(0.004)	(0.004)	(0.017)
Fixed effect , years	Yes	Yes	Yes
Fixed effect, census tracts	No	Yes	No
Number of observations	21,238	21,955	738
Mean dependent variable	0.112	0.112	0.108
Mean bias (pct.)	26.8	26.8	19.3
Adjusted R^2	0.29	0.10	0.33

NOTE: Dependent variable is the natural logarithm of the ratio of subjective dwelling value to average sale-transaction price in census tract. Standard errors are in parentheses.
Significant at: (a) 1%. (b) 5%. (c) 10%

Table 5: Estimates of Subjective Valuation Bias Model for Different Thresholds of Sample Size in Census Tract

Variables	Threshold: 10 obs. Estimate (Standard error)	Threshold: 20 obs. Estimate (Standard error)	Threshold: 30 obs. Estimate (Standard error)
	(A)	(B)	(C)
Intercept	-0.350[b]	-0.416[b]	-0.447[c]
	(0.141)	(0.162)	(0.251)
Persons	0.011[a]	0.010[a]	0.008[c]
	(0.002)	(0.003)	(0.005)
Income	0.067[a]	0.060[a]	0.047[a]
	(0.005)	(0.006)	(0.009)
Mortgage	-0.003[a]	-0.003[a]	-0.002
	(0.001)	(0.001)	(0.002)
Male	0.003	0.005	0.015
	(0.006)	(0.007)	(0.002)
Age	0.004[a]	0.005[a]	0.002
	(0.001)	(0.001)	(0.002)
AgeSq	-0.00003[a]	-0.00004[a]	-0.00001
	(0.00001)	(0.00001)	(0.00002)
IsraelBorn	0.022[b]	0.020[b]	0.023
	(0.009)	(0.010)	(0.015)
Immigrant1990	-0.065[a]	-0.067[a]	-0.074[a]
	(0.011)	(0.013)	(0.018)
ImmEuropeAmerica	-0.017[c]	-0.013	0.002
	(0.009)	(0.010)	(0.015)
Married	0.029[a]	0.029[a]	0.035[a]
	(0.008)	(0.009)	(0.013)
Education	-0.0005	-0.0001	0.001
	(0.0007)	(0.0009)	(0.001)
Bought12months	0.030[c]	0.020	0.006
	(0.016)	(0.018)	(0.027)
Purchased	-0.102[a]	-0.104[a]	-0.144[a]
	(0.011)	(0.014)	(0.021)
House	0.116[a]	0.138[a]	0.134[a]
	(0.007)	(0.009)	(0.013)
Rooms	0.170[a]	0.173[a]	0.195[a]
	(0.003)	(0.004)	(0.006)
BuildingAge	-0.008[a]	-0.008[a]	-0.009[a]
	(0.001)	(0.001)	(0.001)
BuildingAgeSq	0.0001[a]	0.0001[a]	0.0001[a]
	(0.00001)	(0.00001)	(0.00002)
AirConditioner	0.047[a]	0.048[a]	0.049[a]
	(0.007)	(0.008)	(0.012)
Heating	0.065[a]	0.089[a]	0.076[a]
	(0.010)	(0.013)	(0.020)
Garden	0.082[a]	0.064[b]	0.034
	(0.020)	(0.025)	(0.041)
Repairs	-0.001	0.0003	0.002
	(0.001)	(0.001)	(0.002)
dUSD	0.775[a]	0.772[a]	0.909[a]
	(0.078)	(0.090)	(0.131)

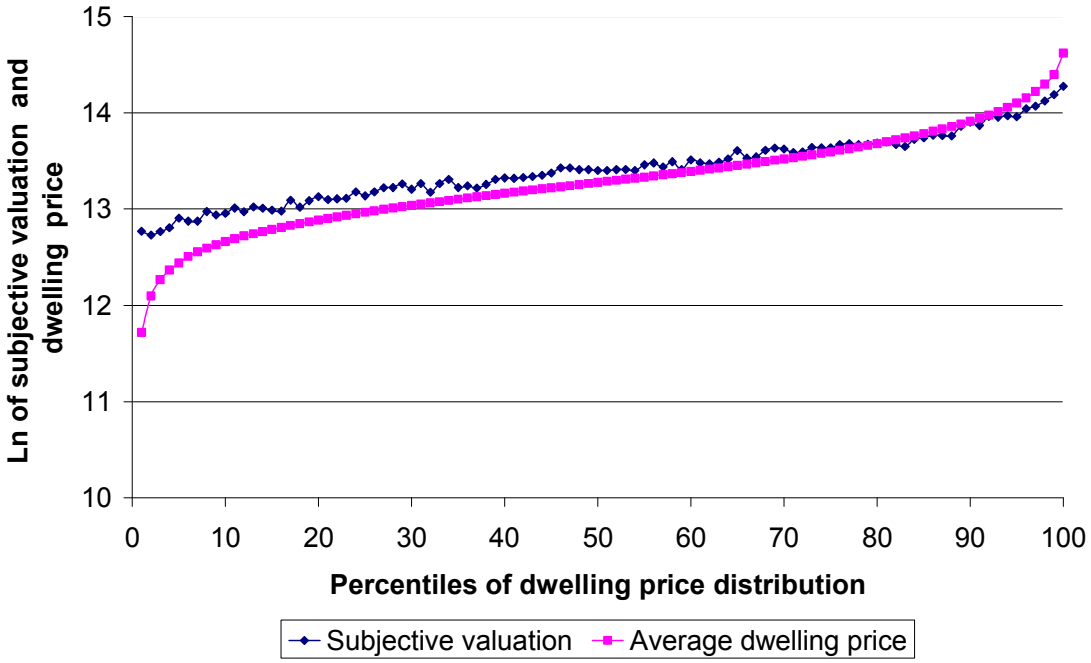
Table 5: Estimates of Subjective Valuation Bias Model for Different Thresholds of Sample Size in Census Tract (continue)

Variables	**Threshold: 10 obs.** Estimate (Standard error)	**Threshold: 20 obs.** Estimate (Standard error)	**Threshold: 30 obs.** Estimate (Standard error)
	(A)	(B)	(C)
NumTransactCT	-0.006[a]	-0.006[a]	-0.006[a]
	(0.001)	(0.001)	(0.001)
MaleCT	-0.677[a]	-0.496[b]	-0.452
	(0.189)	(0.212)	(0.292)
AgeCT	0.007[a]	0.006[a]	0.011[a]
	(0.001)	(0.001)	(0.002)
Immigrant1990CT	0.284[a]	0.307[a]	0.350[a]
	(0.030)	(0.036)	(0.058)
ImmEuropeAmericaCT	-0.268[a]	-0.229[a]	-0.505[a]
	(0.067)	(0.0798)	(0.123)
ImmAsiaAfricaCT	-0.274[a]	-0.274[a]	-0.567[a]
	(0.075)	(0.090)	(0.140)
EthiopiaCT	0.653[a]	0.318[a]	-0.329
	(0.108)	(0.125)	(0.221)
IncomeCT	-0.077[a]	-0.074[a]	-0.071[a]
	(0.007)	(0.009)	(0.014)
SeaArea	-0.0002	-0.0004[b]	-0.001[a]
	(0.0001)	(0.0002)	(0.0003)
SchoolArea	0.004[a]	0.008[a]	0.011[a]
	(0.001)	(0.001)	(0.002)
RoadArea	0.002[b]	0.002[c]	-0.001
	(0.001)	(0.001)	(0.001)
Road5mArea	-0.009[b]	-0.008[c]	-0.061[c]
	(0.004)	(0.004)	(0.034)
Fixed effect, years	Yes	Yes	Yes
No. of observations	19,218	12.959	5,235
Mean dependent variable	0.110	0.104	0.099
Mean bias (%)	25.9	23.6	22.6
Adjusted R^2	0.29	0.31	0.37

NOTE: Dependent variable is the natural logarithm of the ratio of subjective dwelling value to average sale-transaction price in census tract. Standard errors are in parentheses.
Significant at: (a) 1%. (b) 5%. (c) 10%

Figure 1: Subjective valuation vs. average dwelling price in census tracts, by percentiles of dwelling-price distribution, 1997–2008

A. Logarithm of subjective valuation and average dwelling price



B. Average bias of subjective valuation and its standard deviation

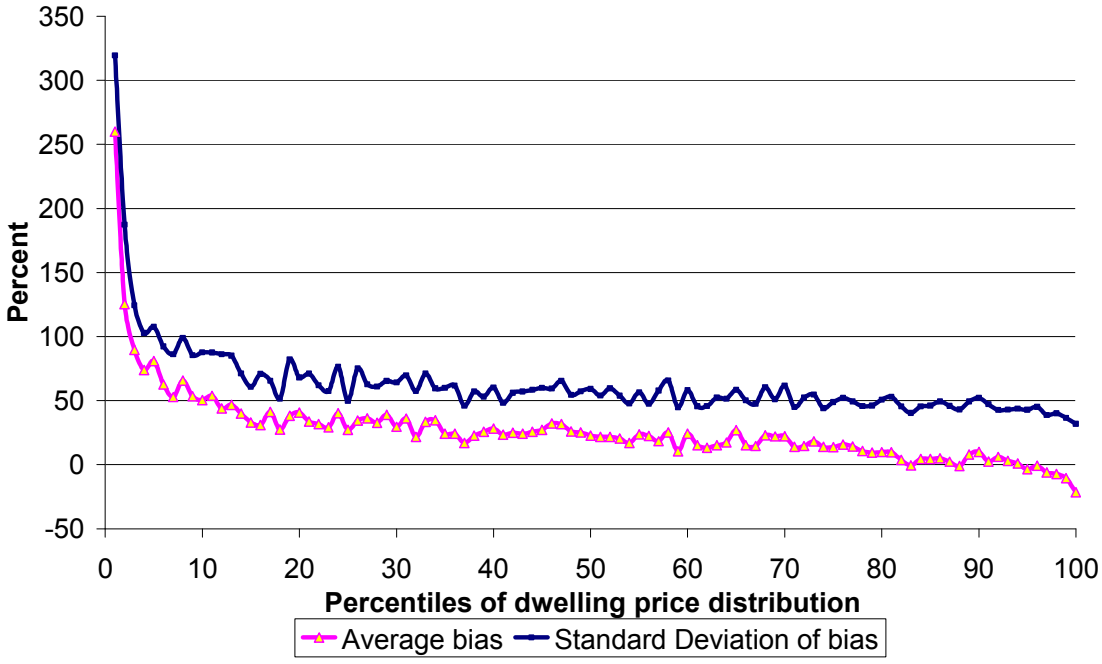


Figure 2: Average bias in subjective valuation, by selected percentiles of annual dwelling-price distribution, 1997–2008

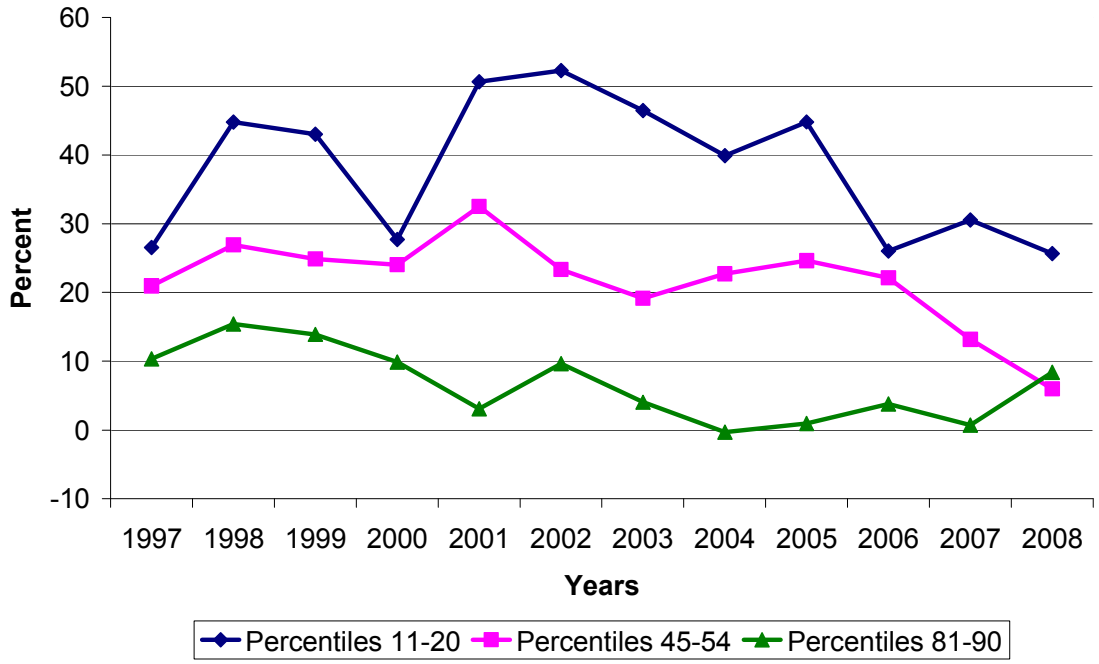


Figure 3: Average price of dwelling, by selected percentiles of annual dwelling-price distribution, 1997–2008 (in current prices, index 1997=100)