HOUSING AFFORDABILITY AND INEQUALITY:

A CONSUMPTION-BASED APPROACH

(PRELIMINARY DRAFT)

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ABSTRACT

Assessments of the state of housing affordability generated under the traditional housing price-to-income approach may not be informative due to varying individual preferences for housing and the commonly positive correlation between individual housing price and income. We thus propose to implement an alternative approach—including *standardized* and *normative* housing price-to-income measures—that resolves the shortcomings of the traditional method. We employ an extensive representative dataset of Israeli households over the period 1998–2013. Results indicate a continuous under-assessment of the state of inequality in housing affordability under the traditional approach. Further, the association between housing affordability and household socio-demographic characteristics is under-evaluated. Our evidence may serve policymakers in designing programs aimed at mitigating housing distress.

Key Words: Housing affordability, housing consumption, inequality, price-to-income

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1. INTRODUCTION

Although concern about housing affordability has long been on the agendas of governments and policymakers around the world, it became particularly acute following the social protests that flooded many Western cities in recent years and that were largely provoked by requests to make available a supply of housing at affordable prices.[1]

Studies consider housing affordability to be the relationship between housing costs and some capacity-to-pay criterion (e.g., Robinson *et al.*, 2006). One of the most prevalent methods for assessing the extent of housing affordability is the housing price-to-income ratio (see next section for a literature review on the various methods used for evaluating housing affordability). This ratio, however, may not be informative due to the generally varying individual preference for the consumption of housing services, as well as the likely positive correlation between housing consumption and income. These two factors might lead to two major shortcomings in studying the state of housing affordability using the housing price-to-income ratio. The first arises from classifying households as exhibiting no affordability distress simply because of their below-standard housing consumption. The second arises from categorizing households as carrying unreasonable housing costs relative to their financial capacity when, in fact, their cost burden is a result of their choice to consume above-standard housing services (see also Thalmann [1999]).

This study proposes an approach to correcting the above-described bias in the assessment of housing affordability. Specifically, we propose two alternative measures of housing affordability: "standardized" and "normative." Essentially, under our approach, each household is matched with a bundle of housing based upon fundamental individual demographic and locational attributes. Given this bundle of housing, the individual housing price-to-net income ratio is derived.

Based on an extensive, representative micro-level sample of Israeli households over the period 1998–2013, we then empirically estimate and compare the traditional, standardized, and normative housing affordability measures. We find that failing to correct for household below- and above-standard consumption of housing leads to a continuous under-assessment of the inequality in housing affordability and of the state housing unaffordability. Evidence further

[1] See, for example, *The New York Times*, Foreclosure Protesters in Spain's Cities Now Go Door to Door (by Suzanne Daley, July 15, 2011); *The Economist*, Income Inequality in America (April 23, 2012); *The Guardian*, Social Unrest on the Rise in Europe, Says ILO Report (by Phillip Inman, April 30, 2012); and *The Economist*, Why Homes Even in the Unfashionable Parts of LA Cost So Much (August 23, 2014).

indicates that the association between housing affordability and household characteristics is strongly contingent on the method by which affordability is measured. Specifically, our results show that, *ceteris paribus*, the association between housing affordability and both household heads' years of education and nationality is considerably more substantial under the proposed method compared with the traditional approach.

The main contribution of the research is twofold. First, our proposed method eliminates the potential bias in the assessment of the state of housing affordability by correcting for household below- and above-standard housing consumption. As shown below, this modification leads to important revisions in the assessment of the state of housing affordability inequality and the extent of its relationship to socio-demographic and locational characteristics. Further, by estimating household socio-demographic and locational attributes that associate with standardized and normative housing unaffordability, our evidence may serve policymakers in designing programs aimed at mitigating housing distress.

The paper is organized as follows. The next section provides background and reviews the relevant literature, while Section 3 presents the sample, including variable definitions and related summary statistics. Section 4 describes our approach to estimating and assessing housing affordability, and Section 5 presents related statistical results. Section 6 estimates and compares the correlation between the various housing affordability measures and household characteristics. Finally, Section 7 provides a summary and concluding remarks.

2. BACKGROUND AND LITERATURE REVIEW

A key element of this study is the derivation of the household *standardized* and *normative* housing consumption used in the computation of the corresponding individual housing affordability. Our standardized and normative consumption concept—which resolves the bias that follows from below- and above-standard consumption of housing—relates to the socio-economic discourse on the discrepancy between *required* and *desired* housing services.[2] While the literature often considers "required" housing as objective and structured in reference to a universal standard, "desired" housing is regarded as subjective and conditional upon human perceptions and preferences (see, for example, Seek, 1983; Miron, 1985; Lerman and Reeder, 1987;

[2] This normative discourse of housing affordability relies on, among others, modern need theory (e.g., Fraser, 1998).

Goodman, 1990; Hulchanski, 1995; Robert, 1997; Stone, 2006; and Whitehead, 1991). In that regard, our proposed standardized consumption principle combines both objective and subjective aspects. A subjective view as the derived standard may vary over time and space and an objective view as the standard is endogenously derived and thus represents current housing consumption across all households (see details in Section 4 below).

Methods for assessing housing affordability commonly include a financial capacity indicator on the one hand and, on the other, a purchase-related variable such as house price, down payment on the mortgage loan, loan installments, and ongoing housing cost (e.g., Gan and Hill, 2009). In practice, housing affordability is thus computed by indicators such as housing price-to-income (see, for example, Weicher, 1977; Bogdon and Can, 1997; Thalmann, 1999; Quigley and Raphael, 2004; Belsky *et al*., 2005; Stone, 2006; and Kim and Cho, 2010); mortgage debt-to-housing price (see, for example, Hendershott, 1980; Jones, 1989; Gyourko and Linneman, 1993; Mayer and Engelhardt, 1996; Gyourko and Tracy, 1999; and Norris and Shiels, 2007); mortgage loan repayment-to-income (see, for example, Jones, 1989 and Brounen *et al*., 2006); and ongoing housing cost-to-income (see, for example, Smets, 1999; Ong, 2000; Brounen *et al*., 2006; and Haffner and Heylen, 2011).[3] Further, some studies adopt the residual income approach, where the cost of basic goods net of housing is examined in association with income (e.g., Whitehead, 1991; Stone, 2006; Kutty, 2005; and Chen *et al*., 2010).

Only a handful of studies, however, directly examine the correlation between housing affordability and individual and market characteristics. Based on individual household data, Skaburskis (1997, 2004), Charlier *et al.* (2001), and Lin *et al.* (2014) examine the association between housing affordability and certain household attributes in Canada, Taiwan, and The Netherlands, respectively. Malpezzi (1999) and Ben-Shahar and Warszawski (2011) estimate the association between macro measures of housing affordability and market indicators in the United States and Israel, respectively. In line with these studies, our empirical test not only proposes a method for correcting possible bias in below- and above-consumption of housing in the assessment of housing affordability, but also explores the correlation of the proposed housing

[3] Notably, unlike most studies in this area that assess the state of housing affordability based on macro-data (such as *average* and/or *median* price and income figures), we employ a micro-level approach that allows us, among other things, to standardize and explore individual housing consumption and affordability.

affordability measures with a series of socio-demographic variables based on an extended sequence of independent cross-sectional samples.[4]

3. THE SAMPLE

Data for this study include a raw sample of about 218,000 observations on individual household socio-economic, demographic, locational, and dwelling unit characteristics provided by the Household Income and Expenditure Surveys conducted by the Israel Central Bureau of Statistics for the years 1998–2013. These annual, independent cross-sectional samples consist of 8,742 to 15,171 observations and are representative of all households in Israel (see Central Bureau of Statistics, 1998–2013). Table 1 shows the number of cross-sectional annual observations for the 1998–2013 period. Table 2 provides a description and summary statistics of household socio-economic, demographic, locational, and dwelling unit characteristics.

As indicated in Table 2, the typical household is home-owned (67%) and consists of 2.05 adults and 0.77 children. Also, 27% of household heads have 16 years or more of education; 25% have 13–15 years; 28% have 11–12 years; 8% have 9–10 years; 8% have 5–8 years; and 4% have 4 years of education or less. The share of household heads of Arab nationality is 3%, while 97% are Jewish or other nationalities.[5] Female-headed households constitute 41% of the sample, where the majority of household heads (60%) are married; 16% are single, 10% are divorced, 12% are widowed, and 2% are living separately from their spouses.[6] In addition, 23% of household heads are 65 or older, followed by age groups 55–64 (15%), 45–54 (18%), 35–44 (19%), 25–34 (20%), and 15–24 (5%). Household heads' country/continent of origin is Israel (45%), Europe or

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[4] Studies also explore the correlation between housing consumption and socio-demographic variables in various markets around the world. These include, for example, Mayo (1981), Awan *et al.* (1982), Mankiw and Weil (1989), Goodman (1990), Engelhardt and Poterba (1991), Pitkin and Myers (1994), Green and Hendershott (1996), Ohtake and Shintani (1996), Myers and Vidaurri (1996), Fortin and Leclerc (2000), Reed (2002), and Li (2014).

[5] Non-Jewish nationalities are under-represented in the Household Income and Expenditure Surveys conducted by the Israel Central Bureau of Statistics. In particular, the surveys only include Arabs living in mixed-population areas (i.e., where Jews and Arabs coexist) and thus exclude the majority of the Arab population in Israel, who live in segregated municipalities. Hence, our outcomes below regarding the below-standard housing affordability of Arab households is likely to be under-assessed, since the socio-economic status of Arab households who live in segregated communities is generally worse than those living in integrated cities.

[6] Household head gender is generally identified as the gender of the person who is the main income provider in the household. See Israel Central Bureau of Statistics (2013) for further details.

America (37%), or Asia or Africa (16%), while the continent/country of origin of the fathers of native Israeli household heads is Europe or America (30%), Asia or Africa (43%), or Israel (27%).[7] Finally, the average score on the periphery index is 4.32, where the index ranges from 1 (most peripheral level) to 6 (most central level).[8]

Our study further employs the universe of all housing transactions in Israel for the period 1998–2013—a total of over 776,000 observations—recorded by the Israel Tax Authority. We use this dataset to compute the house price for each household in the Household Income and Expenditure Surveys. As explained in the next section, based on all housing transaction observations, we estimate a hedonic price equation by which we project and match a housing unit price to each household in the Income and Expenditure surveys based on its housing asset attributes. Table 3 provides a description and summary statistics of the dwelling unit characteristics in the housing transaction dataset.[9]

As indicated in Table 3, the typical dwelling unit is a 3.6-room condominium apartment located on the second or third floor of a 21-year-old structure. The average unit price is about 224,000 dollars, with a standard deviation of about 164,000 dollars.

4. DEVELOPING THE STANDARDIZED, NORMATIVE, AND TRADITIONAL HOUSING AFFORDABILITY MEASURES

We propose standardized and normative housing affordability measures that resolve the shortcomings in the traditional assessment of housing affordability caused by an individual below- and above-standard consumption of housing. In what follows we describe the method by which we derive each of these measures.

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[7] It should be noted that during the 1990s Israel absorbed a total of about 1 million immigrants (almost 20% of the 1990 population), the majority of whom arrived from states of the former USSR.

[8] The periphery index calculated by the Israel Central Bureau of Statistics is based on a combination of two equally weighted components: an accessibility index (a population-weighted average of distances between a given municipality and all other municipalities in Israel) and a measure of proximity to the Tel Aviv district (see Central Bureau of Statistics, 2008). We supplemented the original index (ranging from 1 to 5) with a level 6 for households within the city of Tel Aviv.

[9] In fact, the Income and Expenditure Survey does not indicate the type of dwelling unit (whether it is a condominium, detached unit, etc.). However, as more than 90% of the housing transactions in Israel involve condominiums, we assume that housing units in the survey are condominiums and thus restrict the Tax Authority transaction dataset (from which a price is matched to the household dwelling in the survey) to include condominium transactions only (of the total of about 850,000 transactions we omit about 8.5% non-condominium observations, leaving over 776,000 condominium transaction observations).

Standardized Housing Affordability Measure

Step one: We stratify the sample of households from the Income and Expenditure Surveys over the period 1998–2013 (available from the Israel Central Bureau of Statistics) by demographic, locational, and time characteristics. Specifically, we generate mutually exclusive clusters of households, each denoted by *A, C, L,* and *Y* (henceforth *ACLY*), where *A* is the number of adults in a household, *A*=(1,2,…,5 and over); *C* is the number of children in a household, *C*=(1,2,…,8 and over); *L* is the score on the periphery index of the city in which the household resides, *L*=(1,2,…,6, where 1 is the most peripheral and 6 is the least peripheral); and *Y* is the year in which the household was observed, *Y*=(1998,1999,…,2013). Thus, for example, $i \in (A = 2, C = 3, L = 3, Y = 2010)$ implies that household i in the sample is included in the cluster whose characteristics include two adults with three children, living in a city whose score on the periphery index is 3, and where the household was observed in 2010.[10]

We require that each cluster include no less than 30 observations per year-city couplet; otherwise the cluster (with its observations) is removed from the sample. Table 4 shows the matrix of clusters according to the number of children (*C*) and the number of adults (*A*) and the share of each cluster in the sample. It follows that the number of different clusters (by number of children and adults) for which we observe no less than 30 observations per year and per city is equal to 18, where clusters with 2 adults occupy altogether the greatest share (55% of total households in the sample), followed by 1 adult (24%) and 3 adults (14%). Also, 62% of the households are classified in clusters with no children, followed by clusters with 1 child (15%) and 2 children (13%). Over time and space, the cluster of 2 adults with no children occupies the largest share (27.5%), while the second- and third-largest clusters include 1 adult with no children (22%) and 2 adults with 2 children (10%), respectively.

Step two: For each cluster *ACLY*, we compute

(1)

$$NR_{i\in ACLY}^{Standard} = \sum_i NR_{i\in ACLY}^{Actual} / N_{ACLY} ,$$

[10] Household clustering by number of adults and number of children is consistent with, among others, previous studies on the correlation between household housing consumption and both the number of adults and number of children. See, for example, Mayo (1981), Bratt *et al.* (2006), Li (2014), Awan *et al.* (1982), Goodman (1990), Swan (1995), and Reed (2002).

where $NR_{i\in ACLY}^{Actual}$ denotes the number of rooms consumed by household i in cluster $ACLY$, and N_{ACLY} denotes the total number of households in cluster $ACLY$. Hence, $NR_{i\in ACLY}^{Standard}$ is the average number of rooms consumed across all households in cluster $ACLY$. We refer to $NR_{i\in ACLY}^{Standard}$ as the (endogenously derived) standardized housing consumption of households in $ACLY$.[11]

Step three: Employing all housing transactions in Israel for the period 1998–2013 (based on the Israel Tax Authority dataset), we estimate a hedonic price equation of the form

(2)

$$\ln(P_{jl}) = \gamma_{1,l} + \gamma_{2,l}\, ln(NR_{jl}) + \gamma_{3,l}\, ln(Story_{jl}) + \gamma_{4,l}\, ln(Age_{jl}) + \gamma_{5,l} DumNew_{jl} + \vec{\gamma}_{6,l} DumYear_{jl} + \varepsilon_{1,jl}$$

for all l,

where the indices j and l represent transactions and cities, respectively; P denotes the housing transaction price; NR is the number of rooms in the unit; Age is the age of the structure in which the unit is located; $DumNew$ is a dummy variable that equals one for units whose age is up to 1 year and zero otherwise; and $DumYear$ is a time (year) fixed-effect. Also, $ln(\cdot)$ is the log operator, $\gamma_1 - \gamma_5$ are estimated parameters, $\vec{\gamma}_6$ is a vector of estimated parameters, and ε_1 is a random disturbance term. Equation (2) is separately estimated for every city l (altogether 52 equations—one for each city).[12]

Step four: Following the estimation of equation (2), we compute

(3a)

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[11] In an attempt to produce a standardized housing affordability measure along the lines of our suggested procedure, one could have alternatively proposed an estimation equation of the type $NR_{it} = \beta_1 + \beta_2 \times A_{it} + \beta_3 \times C_{it} + \beta_4 \times L_{it} + \varepsilon_{it}$, where i and t refer to households and time periods (years), respectively; $\beta_1 - \beta_4$ are estimated parameters; ε is a disturbance term; and all other variables are as described above. Note, however, that this equation potentially suffers from endogeneity, as the causality between a household's choice of C and L and the choice of NR may be bi-directional. Our clustering procedure thus avoids this potential endogeneity problem in the regression estimation.

[12] The number of observations per city ranges from 218 to 71,790. Also, the average R^2 of the 52 estimations of equation (2) is equal to 0.76, with a maximum of 0.89 and a minimum of 0.54. Finally, note that out of the total of 76 cities in Israel, we include the 52 cities represented in the clusters generated in step one above.

$P_{il}^{Standard} =$

$EXP\left[\hat{\gamma}_{1,l} + \hat{\gamma}_{2,l}\, ln\left(NR_{i\in ACLY}^{Standard}\right) + \hat{\gamma}_{3,l}\, ln(\overline{Story}_{il}) + \hat{\gamma}_{4,l}\, ln(\overline{Age}_{il}) + \hat{\gamma}_{6,l} DumYear_{il}\right]$ for all i and l,

where $NR_{i\in ACLY}^{Standard}$ on the right-hand side of (3a) is the standardized number of room consumption of household i, $i \in ACLY$ (from equation [1]); $\overline{Story}$ and $\overline{Age}$ are the average number of stories and average structure's age across all assets in city l, where i is located; and $\hat{\gamma}_1 - \hat{\gamma}_4$ and $\hat{\vec{\gamma}}_6$ are the estimated coefficients and vector of coefficients, respectively, from equation (2). That is, based on the estimated coefficients from equation (2) and a household's standardized room-consumption in the respective cluster, in equation (3a) we match each household in every *ACLY* (from steps one and two above) with a hedonic price that corresponds to its standardized housing consumption, $P^{Standard}$.[13]

Finally, given household i's net income, $Income_i$, we compute the ratio $P_i^{Standard} / Income_i$, which we refer to as the standardized housing affordability measure (i.e., standardized housing price-to-net income ratio).

Normative Housing Affordability Measure

In the spirit of the UK's Housing (Overcrowding) Bill,[14] we further propose a *normative* housing affordability measure. Accordingly, for each person age 18 or over (under 18) in a household we match a housing consumption that is equal to 1 room (0.5 rooms). We denote the total number of rooms per household i under this normative rule by NR_i^{Norm}.

Following the estimation of equation (2) and in the spirit of (3a), we then compute

(3b)

$P_{il}^{Norm} = EXP\left[\hat{\gamma}_{1,l} + \hat{\gamma}_{2,l}\, ln\left(NR_{il}^{Norm}\right) + \hat{\gamma}_{3,l}\, ln(\overline{Story}_{il}) + \hat{\gamma}_{4,l}\, ln(\overline{Age}_{il}) + \hat{\gamma}_{6,l} DumYear_{il}\right]$ for all i and l.

Hence, P_i^{Norm} in (3b) is the projected housing price of household i under the normative housing consumption rule. Finally, given household i's net income, $Income_i$, we compute the ratio

[13] Note that, while *DumNew* in (2) refines the estimation of the correlation between the structure's age and the housing unit price, it does not appear in (3a), since the average structure's age across all assets in city l, $\overline{Age}_{il}$, is greater than 1 year for all l; thus *DumNew*=0.

[14] See House of Commons, Housing (Overcrowding) Bill (Bill 46).

$P_i^{Norm}/Income_i$, which we refer to as the normative housing affordability measure (i.e., the normative housing price-to-net income ratio).

Traditional Housing Affordability Measure

The traditional housing affordability measure is based on a household's actual housing consumption. Following the estimation of equation (2), we compute

(3c)

$$P_{il}^{Traditional} = EXP\left[\hat{\gamma}_{1,l} + \hat{\gamma}_{2,l}\, ln\left(NR_{il}^{Actual}\right) + \hat{\gamma}_{3,l}\, ln(\overline{Story}_{il}) + \hat{\gamma}_{4,l}\, ln(\overline{Age}_{il}) + \hat{\gamma}_{6,l} DumYear_{il}\right] \text{ for all } i \text{ and } l,$$

where NR_{il}^{Actual} is the actual number of rooms consumed by household *i* and $P_i^{Traditional}$ is thus the price of *i*'s actual housing consumption. Given household *i*'s net income, $Income_i$, we then compute the ratio $P_i^{Traditional}/Income_i$ to which we refer as the traditional housing affordability measure (i.e., the traditional housing price-to-net income ratio).

5. HOUSING AFFORDABILITY AND INEQUALITY UNDER THE TRADITIONAL, STANDARDIZED, AND NORMATIVE MEASURES

In this section we examine the evidence pertaining to housing affordability as it is derived under the traditional, standardized, and normative approaches.[15] Figure 1 plots the annual average housing consumption per household (measured in total number of rooms) and the traditional affordability measure across all households over the period 1998–2013. It follows that from 1998 to 2013, average housing consumption has gradually increased from about 3.34 to about 3.56 rooms per household. Concurrently, the average traditional housing affordability measure increased from the 100–120 (months) regime to the 120–135 regime.[16]

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[15] The outcomes from the estimation of equation (2)—used in deriving the results that follow—are not reported and can be obtained from the authors on request.

[16] One should also note the steep increase in the traditional housing price-to-net income ratio over the 2007–2011 period. Notably, this trend was accompanied by a steep rise (of about 80%) in the local housing price index during the period (Israel Central Bureau of Statistics, 2014).

In order to gauge the differences among the traditional, standardized, and normative affordability measures, we divide the sample of households into those whose actual housing consumption is above and below their respective standardized consumption level (i.e., households exhibiting $NR_{it}^{Actual} \geq NR_{it}^{Standard}$ and those exhibiting $NR_{it}^{Actual} < NR_{it}^{Standard}$, respectively). For each of these two sub-samples, we then compute the average traditional and standardized housing affordability measure (i.e., the housing price-to-net income ratio under these approaches) over the period 1998–2013. Figure 2A illustrates the average traditional and standardized housing affordability of households categorized by individual actual housing consumption being below and above the corresponding standardized consumption.

It follows from Figure 2A that the discrepancy in housing affordability between the below- and above-standard consumption sub-samples is considerably larger when assessed by the standardized housing affordability measure rather than the traditional measure. Specifically, two major points should be noted. First, while average housing price-to-net income ratio of the above-standard consumption group is *greater* than that of the below-standard group under the *traditional* measure, average housing price-to-net income of the above-standard group is *smaller* than that of the below-standard group when assessed under the *standardized* approach. Moreover, inequality between the above- and below-standard consumption groups is considerably more pointed under the standardized affordability measure. In particular, while the average between-group difference is equal to about 12 months of net income under the traditional approach, the difference increases to about 41 months of net income under the standardized approach.

Correspondingly, we also classify the sample of households by those whose actual housing consumption is below and above their respective normative consumption level (i.e., households exhibiting $NR_{it}^{Actual} \geq NR_{it}^{Norm}$ and those exhibiting $NR_{it}^{Actual} < NR_{it}^{Norm}$, respectively). Figure 2B depicts the average traditional and normative housing affordability of households stratified by actual housing consumption being below and above their corresponding normative consumption over the period 1998–2013. As in the case of the standardized measure shown in Figure 4A, not only does the price-to-net income ratio of the below-normative group become greater than that of the above-normative group when measured by the normative rather than the traditional approach, but inequality between the groups assessed under the normative approach also considerably exceeds the inequality assessed under the traditional approach (corresponding average difference between the groups rises from 18 months to 68 months of net income).

Figure 3A (3B) further presents a snapshot of the standardized (normative) and traditional housing affordability measures for the sample stratified once again by room consumption being below- and above-standard (normative) level in the three largest cities in Israel—Jerusalem, Tel Aviv, and Haifa—in 2013. It follows from Figures 3A and 3B that while average housing price-to-net income ratio of the above-standard consumption group somewhat exceeds that of the below-standard group under the traditional measure, this pattern sharply reverses in all three cities when shifting to the standardized and normative measures. In particular, while under the traditional measure average housing price-to-net income ratio of the above-standard (normative) group exceeds that of the below-standard (normative) group by 2 to 71 months of net income (with the exception of Jerusalem, in Figure 3B, whose average housing price-to-net income ratio of the above-normative group is smaller than that of the below-normative group by 13 months of net income), under the standardized (normative) measure, average housing price-to-net income of the below-standard group exceeds that of the above-standard group by 51 to 89 (51 to 167) months of net income. Hence, the traditional affordability measure both under-assesses and, in fact, reverses the direction of inequality in housing affordability that persisted in the three largest cities in Israel in 2013 as it is derived under the standardized and normative approaches.

In Figures 4A and 4B, we stratify the sample by tenure mode. Specifically, Figure 4A (4B) presents the average housing price-to-net income ratio of homeowners and renters under the traditional and standardized (normative) approaches.[17] It follows from Figure 4A that while the traditional and standardized housing affordability measures are effectively identical for homeowners, renters' average housing price-to-net income ratio is considerably greater under the standardized measure compared to the traditional measure. Specifically, while housing price-to-net income ratio of homeowners ranges between 90 and 130 over the 1998–2013 period under both the traditional and the standardized measures, these figure increase to 110–140 and 133–178 for renters under the traditional and standardized measures, respectively. (The average difference between standardized and traditional affordability ratio of renters is equal to about 32 months of net income over this period.) It further follows from Figure 4B that while renters' price-to-net income ratio is greater than that of homeowners under both the traditional and normative approaches, both renters and homeowners exhibit a smaller average price-to-net income ratio

[17] Data on tenure choice of households are available only from 2001. Also, while our dataset does not distinguish between private and public rentals, one should note that only about 2% of the dwelling units in Israel include public housing (Israeli Central Bureau of Statistics, 2011).

under the normative measure compared to the traditional measure. In particular, the average ratio decreases for renters (homeowners) by an average of 40 (30) months of net income when shifting from the traditional affordability measure to the normative one.

Figures 5A and 5B (6A and 6B) repeat the stratification exercise, this time by household head gender (household head nationality—Jews versus Arabs). It follows from Figures 5A (5B) that the traditional measure under- (over-) assesses the price-to-net income ratio attained under the standardized (normative) measure for both male- and female-headed households. Also, the price-to-net income ratio for female-headed households exceeds that for males under both the traditional and standardized measures. It further follows from Figure 6A that while the levels of the traditional and standardized affordability measures are similar for the Jewish household group, for Arab households the average standardized measure considerably exceeds the traditional measure by about 60 months of net income. Moreover, it follows from Figures 6A and 6B that the difference in the traditional measure for Arab and Jewish households is 46 months of net income, while the equivalent figure for the difference in the standardized and normative measure rises to 101 and 97 months of net income, respectively. Notably, the normative measure exceeds the standardized measure for the Arab sub-sample.

Finally, Ben-Shahar and Warszawski (forthcoming) propose a housing affordability Gini coefficient based on the net income-to-housing price ratio to assess the level of inequality in housing affordability. Essentially, the net income-to-housing price ratio (i.e., the inverse of the housing price-to-net income ratio) measures the share (portion) of the housing unit that a household's periodic net income could purchase.[18] In Figure 7 we present the net income Gini coefficient and the housing affordability Gini coefficients (along the lines of Ben-Shahar and Warszawski, forthcoming) under the traditional, standardized, and normative approaches over the period 1998–2013. It follows that inequality in housing affordability is continuously under-assessed under the traditional approach compared to the standardized and normative approaches. Moreover, while the volatility in net income Gini coefficient is relatively low, housing affordability (under all approaches) exhibits greater volatility over time. Finally, while all three affordability inequality measures fall below net income inequality during the 1998–2005 period, the Gini coefficient of the standardized and normative affordability has tended to exceed that of

[18] As noted by Ben-Shahar and Warszawski (forthcoming), implementation of the Gini coefficient method requires a focus on net income-to-housing price ratio rather than the housing price-to-net income ratio.

net income since 2006 (the period in which the housing price index increased by about 80%; see Israel Central Bureau of Statistics, 2014).

6. COMPARING THE TRADITIONAL, STANDARDIZED, AND NORMATIVE MEASURES: HOUSING AFFORDABILITY AND HOUSEHOLD CHARACTERISTICS

Consider the following estimated equation:

(4)

$$Ratio_i = \alpha_1 + \alpha_2 Female_i + \alpha_3 Arab_i + \alpha_4 Adults_i + \vec{\alpha}_1 AGE_i + \vec{\alpha}_2 EDUCATION_i + \vec{\alpha}_3 STATUS_i + \vec{\alpha}_4 CONTINENT_i + \vec{\alpha}_5 DumYear_i + \varepsilon_{2i},$$

where $Ratio_i$=$\{P_i^{Traditional}/Income$, $P_i^{Standard}/Income$ and $P_i^{Norm}/Income\}$ denotes the traditional, standardized, and normative measures of household *i*'s housing affordability, respectively. Also, the independent variables in equation (4) include a series of household characteristics that associate with housing affordability (see once again the description of all variables in Table 2). Among those, *Female* is a dummy variable indicating the gender of the household head (equals 1 for female and 0 for male); *Arab* is a dummy variable indicating the head-of-household nationality (equals 1 for Arab and 0 for Jewish or other); *Adults* is the number of adults in the household; *AGE* is a matrix of categorical variables representing the head-of-household age group (18–24, 25–34, 35–44, 45–54, 55–64, and 65 and over—see *Age*1–*Age*6, respectively, in Table 2, where the base category is 15–17); *EDUCATION* is a matrix of categorical variables indicating the head-of-household years of education (1–4 years, 5–8, 9–10, 11–12, 13–15, 16+, and unknown—*Education*1–*Education*7, respectively, where 0 years is the base category); *STATUS* is a matrix of categorical variables indicating the head-of-household personal status (divorced, widowed, single, and living separately—*Status*1–*Status*4, respectively, where married is the base category); *CONTINENT* is a matrix of categorical variables indicating the head-of-household's and his/her father's continent of origin (including *Continent*1–*Continent*6, where the base category is born in Israel and father born in Israel); and *DumYear* is a control time (year) fixed-effect matrix. Finally, $\alpha_1 - \alpha_4$ and $\vec{\alpha}_1 - \vec{\alpha}_5$ are the estimated

coefficients and vectors of coefficients, respectively, associated with equation (4), and ε_2 is a random disturbance term.[19]

Columns 1–2 in Table 5 present results of WLS regression analysis of equation (4) that estimates the correlation between household characteristics and housing affordability under the traditional and standardized approaches, respectively. Outcomes provide solid evidence not only of the correlation between affordability and household characteristics but also on the different assessment of the correlations under the traditional (as compared to the standardized) measure. Most notably, years of education for household heads (relative to the base category of no education) monotonically decreases the price-to-net-income ratio by 9 (3), 21 (9), 45 (27), 59 (36), 63 (41), and 75 (46) months of net income for the 1–4, 5–8, 9–10, 11–12, 13–15, and 16 or more years of education categories, respectively, under the standardized (traditional) approach (all significant at the 1% level); compared to the base category of Jewish or others, Arab head-of-households associate with an increase in the housing price-to-net income ratio of 70 (30) months of net income under the standardized (traditional) approach (both significant at the 1% level); and female-headed households (compared to the male category) associate with an increased housing price-to-net income ratio of 18 (16) months of net income under the standardized (traditional) approach (both significant at the 1% level).[20]

Column 3 in Table 5 presents the results of WLS regression analysis of equation (4) for the normative housing affordability measure. These results once again strengthen the conclusion that the correlation between housing affordability and household characteristics is highly dependent on the approach by which affordability is measured.

7. SUMMARY AND CONCLUSIONS

[19] We also estimated equation (4), replacing the time fixed-effect matrix *DumYear* with macroeconomic control variables. Those included the annual change in the mortgage rate, change in the number of housing construction starts, change in the number of housing construction ends, change in the unemployment rate, rate of change in the construction index, and change in the sheqel-to-dollar exchange rate. Outcomes regarding these variables—not reported for ease of presentation and available upon request—are generally in line with common economic intuition.

[20] Our outcome on the gender effect in housing affordability relates to evidence on the association between gender and housing consumption (e.g., Mayo, 1981; Birch, 1985; Laux and Cook, 1994; and Saegert and Clark, 2006).

The concern over housing affordability has become particularly acute in recent years, as demonstrated by the social protests that have occurred in many Western cities around the world. While the literature has developed tools for assessing the state of housing affordability, these tools potentially lead to a biased evaluation of housing affordability that result from household below- or above-standard consumption of housing.

In the present study we propose an approach for correcting this bias by estimating per-household standardized and normative housing consumption based upon fundamental individual demographic and locational attributes. We implement the proposed method on an extensive sample of Israeli households. Findings show that failing to correct for household below- and above-standard and normative housing consumption leads to continuous under-assessment of both the state of housing affordability inequality and the degree of unaffordability. Evidence further shows that the association between housing affordability and household socio-demographic characteristics greatly depends on the way in which affordability is measured and, in particular, that the association between affordability and both education and nationality is more substantial under the standardized versus the traditional approach.

Our proposed method for estimating housing affordability and the evidence that follows on the state of housing affordability inequality and household characteristics that associate with housing affordability may serve policymakers in designing specific programs aimed at mitigating housing distress.

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Table 1: Number of Cross-Sectional Annual Observations for the 1998–2013 Period

Year	Number of Observations (households in survey)	
	Raw sample	Sample used for estimation
1998	13,499	10,305
1999	13,515	10,177
2000	13,485	10,027
2001	13,689	10,285
2002	14,201	10,509
2003	14,418	10,013
2004	14,636	10,234
2005	14,545	9,643
2006	14,582	9,748
2007	14,147	9,424
2008	14,167	9,933
2009	15,114	10,695
2010	15,171	10,659
2011	14,996	10,470
2012	8,742	4,306
2013	9,507	4,796
Total	218,414	151,224

Notes: Observations indicated in Table 1 come from the Household Income and Expenditure Surveys conducted by the Israel Central Bureau of Statistics. Original total number of households in the sample is 218,414. Missing observations and observations of households living in cities with insufficient number of housing transactions led to a final sample of 151,224 households.

Table 2: List of Variables from Income and Expenditure Surveys, Definitions, and Summary Statistics

Variable	Definition	Mean	Std. Dev.	Min	Max
Adults	Number of adults in household	2.05	0.87	1	9
Children	Number of children (under 18) in household	0.77	1.23	0	7
Peripheral	Score on the peripheral index (ranges from 1 [most peripheral] to 6 [most central])	4.33	1.15	1	6
Income	Household monthly net income (in dollars)	2,424	1,941	21	38,407
NR^{Actual}	Actual number of rooms consumed by a household	3.47	1.15	0.5	14
$NR^{Standard}$	Standardized number of rooms consumed by a household	3.47	0.55	2.31	4.89
NR^{Norm}	Normative number of rooms consumed by a household	2.44	1.10	1	9
P^{Actual}	Estimated price of the actual dwelling unit consumed by a household (in dollars)	188,172	117,682	8,187	1,608,551
$P^{Standard}$	Estimated price of the standardized dwelling unit of a household (in dollars)	188,703	102,750	6,700	732,609
P^{Norm}	Estimated price of the normative dwelling unit of a household (in dollars)	135,760	91,820	4,308	889,724
Tenure	Dummy variable that equals 1 if household is a homeowner and 0 otherwise	0.67	0.47	0	1
Continent Base (base category)	Household head born in Israel and father is born in Israel	0.13	0.34	0.00	1.00
Continent1	Household head continent of origin is Asia or Africa	0.16	0.36	0.16	0.36
Continent2	Household head continent of origin is Europe or America	0.37	0.48	0.37	0.48
Continent3	Household head born in Israel and father's continent of origin is unknown	0.003	0.05	0.003	0.05
Continent4	Household head is born in Israel and father's continent of origin is Asia or Africa	0.18	0.38	0.18	0.38
Continent5	Household head born in Israel and father's continent of origin is Europe or America	0.14	0.34	0.14	0.34
Continent6	Household head continent of origin is unknown	0.02	0.14	0.02	0.14

Table 2: List of Variables from Income and Expenditure Surveys, Definitions, and Summary Statistics (continued)

Variable	Definition	Mean	Std. Dev.	Min	Max
EducationBase (base category)	Household head years of education: 0	0.02	0.14	0	1
Education1	Household head years of education: 1–4	0.01	0.12	0	1
Education2	Household head years of education: 5–8	0.08	0.28	0	1
Education3	Household head years of education: 9–10	0.08	0.28	0	1
Education4	Household head years of education: 11–12	0.28	0.45	0	1
Education5	Household head years of education: 13–15	0.25	0.43	0	1
Education6	Household head years of education: Education:16+	0.27	0.44	0	1
Jewish or other (base category)	Household head with a Jewish or other nationality (excluding Arab)	0.97	0.16	0	1
Arabs	Household head with an Arab nationality	0.03	0.16	0	1
Male (base category)	Household head is male	0.59	0.49	0	1
Female	Household head is female	0.41	0.49	0	1
AgeBase (base category)	Household head age: 18–24	0.05	0.22	0	1
Age1	Household head age: 15–17	0.00	0.02	0	1
Age2	Household head age: 25–34	0.20	0.40	0	1
Age3	Household head age: 35–44	0.19	0.39	0	1
Age4	Household head age: 45–54	0.18	0.39	0	1
Age5	Household head age: 55–64	0.15	0.36	0	1
Age6	Household head age: 65+	0.23	0.42	0	1
StatusBase (base category)	Household family status: Married	0.60	0.49	0	1
Status1	Household family status: Single	0.16	0.37	0	1
Status2	Household family status: Divorced	0.10	0.30	0	1
Status3	Household family status: Widowed	0.12	0.32	0	1
Status4	Household family status: Living separately	0.02	0.13	0	1

Table 3: List of Variables in the Housing Transactions Recorded by the Israel Tax Authority, Description, and Summary Statistics

Variable	Description	Avg.	Std.	Min	Max
P	Transaction closing price (in dollars)	223,856	163,594	4,983	3,055,000
Room	Total number of rooms	3.59	0.957	1.5	10
Age	The age of the structure (in years) at the time of the transaction	20.76	18.58	0	90
Story	The story on which the asset is located in the structure	2.78	3.10	0	40
DumNew	Dummy variable that equals 1 if *Age* is no more than 1 year; 0 otherwise	0.20	0.40	0	1

Table 4: Household Clusters According to Number of Children and Number of Adults and Their Share in the Sample

	1 Adult	2 Adults	3 Adults	4 Adults	5 Adults	Total
No Children	22.0%	27.5%	8.5%	3.3%	0.9%	62.1%
1 Child	1.4%	7.9%	3.1%	2.0%	0.4%	14.7%
2 Children	0.9%	10.1%	1.8%	0.6%		13.2%
3 Children		5.9%	0.3%			6.2%
4 Children		2.0%				1.9%
5 Children or more		1.7%				1.7%
Total	24.2%	54.9%	13.6%	5.8%	1.3%	100.0%

Notes: Cells representing clusters of households with insufficient number of observations are left blank (as we condition the inclusion of a cluster in a given year by including no less than 30 households in the sample). Households in these clusters are omitted from the sample. As a result, the attained cluster distribution, while resembling that of the general population, exhibits a slight bias toward the larger clusters. The maximum bias is attained for the 2-person households whose share in the population (sample) equals 25% (28.9%).

Table 5: Outcomes Obtained from the Estimation of Equations (4)

Model	(1)	(2)	(3)
Dependent Variable	$P_i^{traditional}/Income$	$P_i^{Standard}/Income$	$P_i^{normative}/Income$
Constant	189.963***	227.684***	156.162***
	(12.292)	(14.173)	(9.724)
Female	16.295***	17.649***	13.063***
	(0.475)	(0.548)	(0.376)
Arabs	30.258***	69.942***	61.354***
	(1.804)	(2.080)	(1.427)
Adults	-19.235***	-22.995***	3.192***
	(0.285)	(0.329)	(0.226)
Age1	20.264*	40.402***	-9.941
	(12.159)	(14.019)	(9.619)
Age2	-10.410	-8.544	-37.899***
	(12.138)	(13.995)	(9.602)
Age3	-15.762	-20.164	-43.438***
	(12.145)	(14.003)	(9.608)
Age4	-3.948	-9.016	-48.360***
	(12.149)	(14.008)	(9.611)
Age5	3.204	-5.316	-51.548***
	(12.153)	(14.013)	(9.614)
Age6	18.083	13.397	-41.225***
	(12.154)	(14.014)	(9.615)
Education1	-2.674	-8.508***	-1.063
	(2.359)	(2.720)	(1.866)
Education2	-9.224***	-20.651***	-7.367***
	(1.683)	(1.940)	(1.331)
Education3	-27.308***	-44.818***	-22.260***
	(1.715)	(1.978)	(1.357)
Education4	-35.653***	-59.495***	-31.908***
	(1.627)	(1.875)	(1.287)
Education5	-41.080***	-63.014***	-35.731***
	(1.651)	(1.904)	(1.306)
Education6	-46.363***	-74.661***	-42.676***
	(1.658)	(1.911)	(1.311)
Status2	16.215***	24.823***	-8.576***
	(0.644)	(0.742)	(0.509)
Status3	16.142***	18.422***	-2.291***
	(0.782)	(0.901)	(0.618)
Status4	21.339***	11.977***	-10.520***
	(0.886)	(1.022)	(0.701)
Status5	18.502***	17.454***	-2.262*
	(1.609)	(1.855)	(1.273)
Continent1	-0.643	-4.865***	-5.398***
	(0.887)	(1.023)	(0.702)
Continent2	-18.317***	-12.559***	-12.162***
	(0.724)	(0.834)	(0.573)
Continent3	4.908	5.639	3.669
	(3.856)	(4.446)	(3.050)
Continent4	-8.056***	-9.904***	-8.196***

	(0.770)	(0.888)	(0.609)
Continent5	-9.313***	-15.546***	-11.441***
	(0.830)	(0.957)	(0.657)
Continent6	29.227***	44.443***	46.721***
	(2.137)	(2.464)	(1.691)
Time Fixed Effect	Included	Included	Included
N	145,088	145,088	145,088
R-squared	0.199	0.216	0.154

Notes: Estimators of the categorical time-indicator matrix *DumYear* are not reported in Table 4 and are available by request.

Figure 1: Average Per-Household Housing Consumption (in Total Number of Rooms) Computed under the Traditional, Standardized, and Normative Approaches, 1998–2013

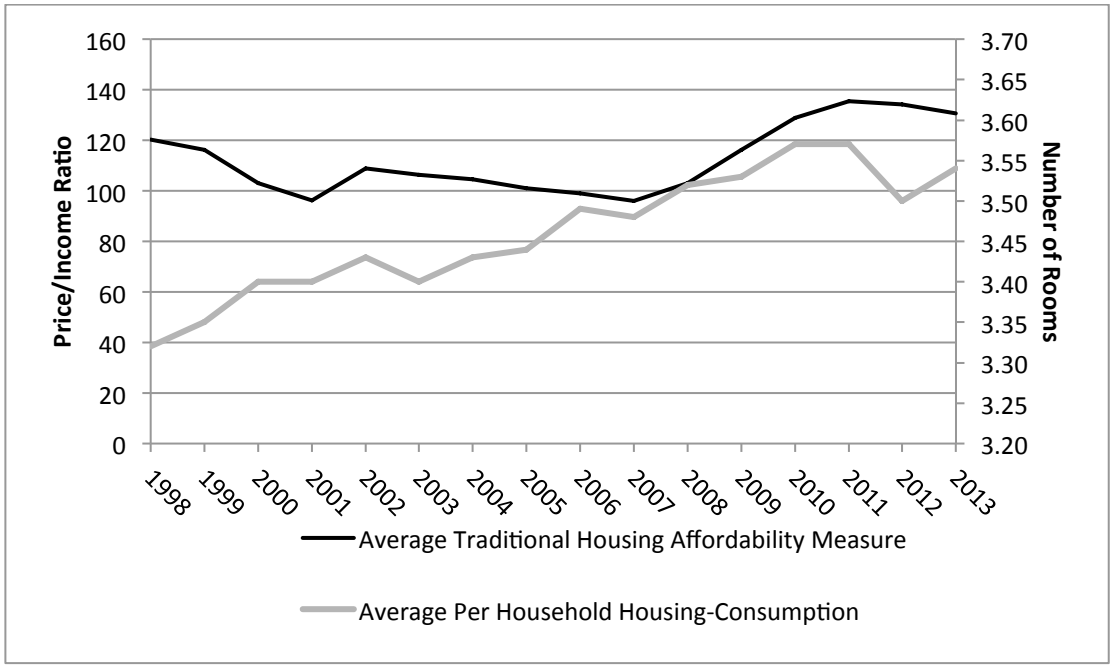

Figure 2A: Annual Average *Standardized* and *Traditional* Affordability Measures Stratified by Below- and Above-*Standard* Consumption of Housing, 1998–2013

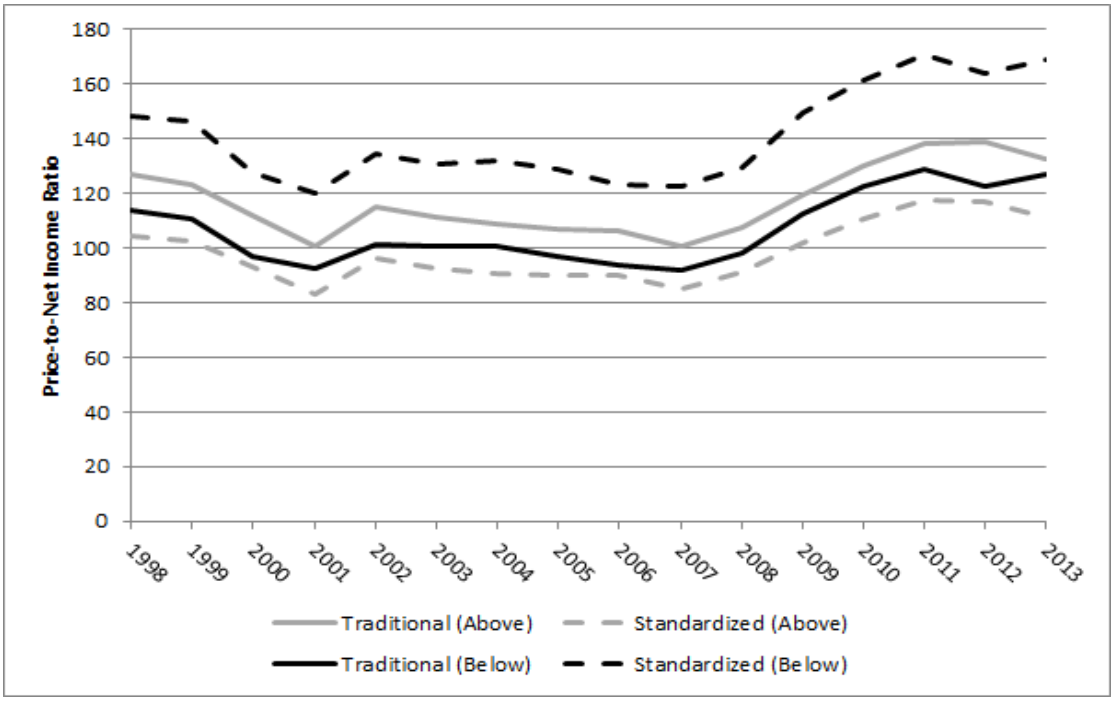

Figure 2B: Annual Average *Normative* and *Traditional* Affordability Measures Stratified by Below- and Above-*Normative* Consumption of Housing, 1998–2013

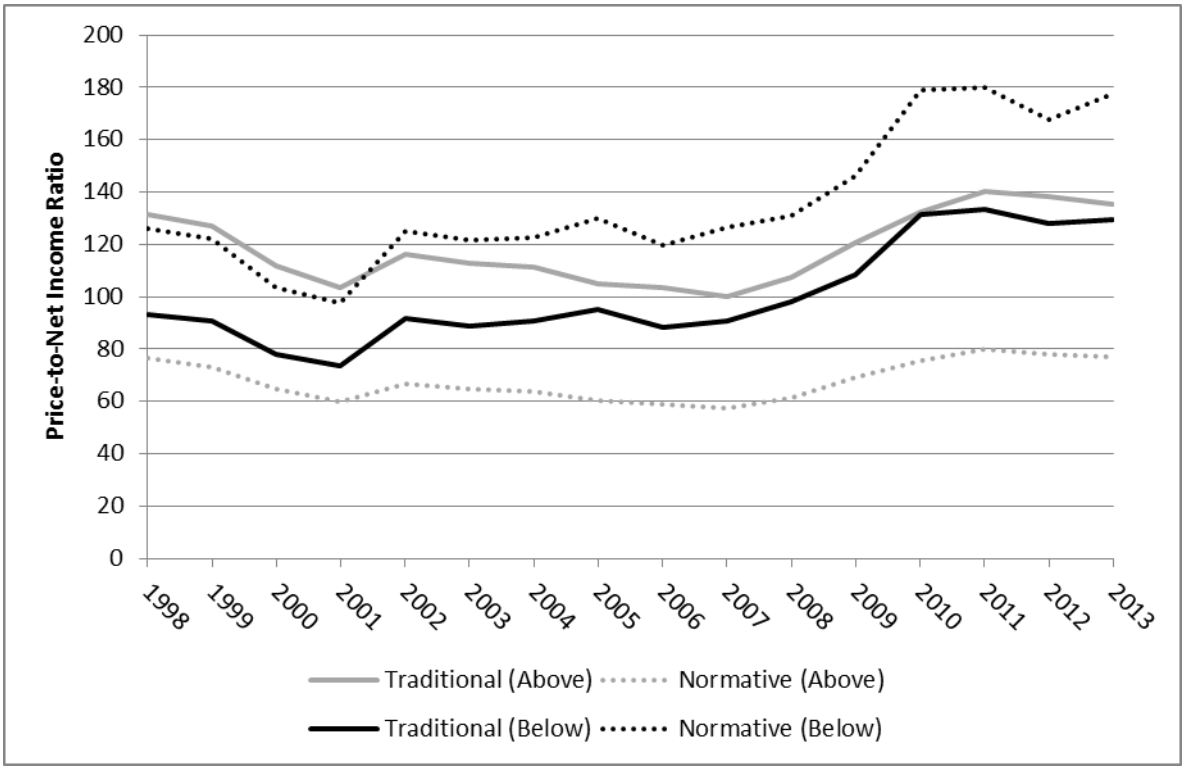

Figure 3A: Average Standardized and Traditional Affordability Measures Stratified by Below- and Above-Standard Consumption of Housing in Three Largest Cities, 2013

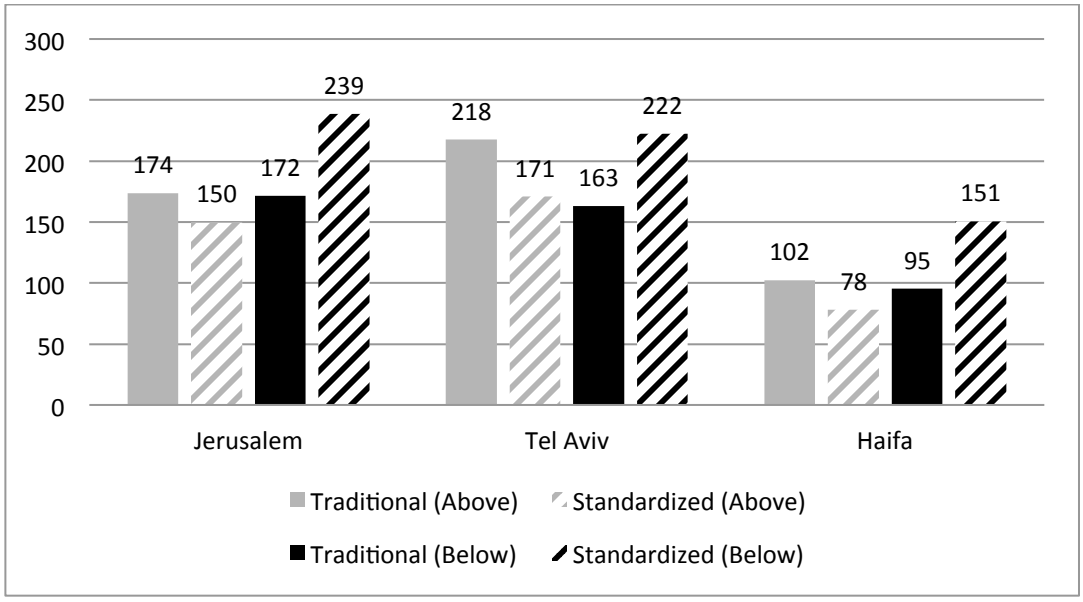

Figure 3B: Average Normative and Traditional Affordability Measures Stratified by Below- and Above-Normative Consumption of Housing in Three Largest Cities, 2013

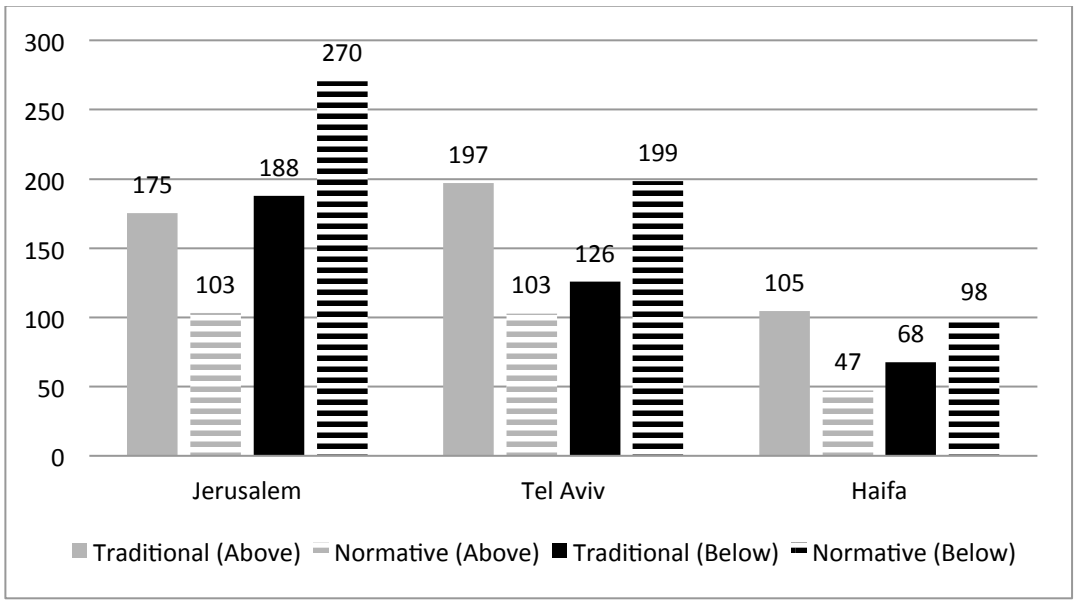

Figure 4A: Average Standardized and Traditional Affordability Measures Stratified by Tenure Mode, 1998–2013

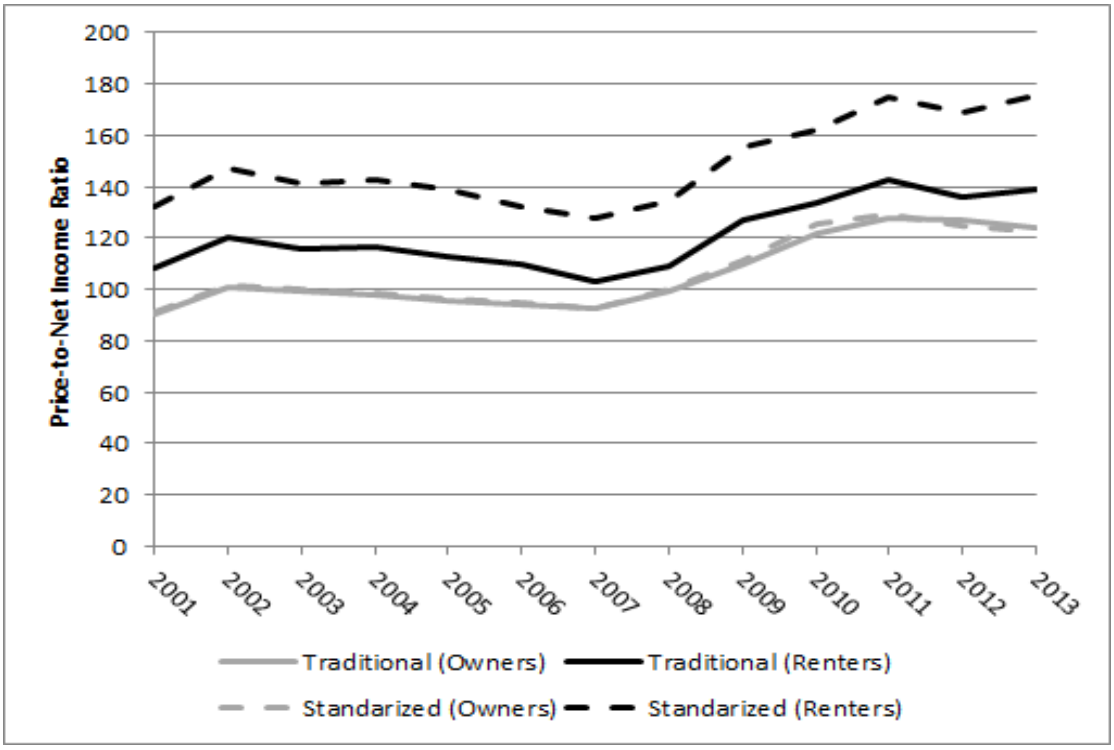

Figure 4B: Average Normative and Traditional Affordability Measures Stratified by Tenure Mode, 1998–2013

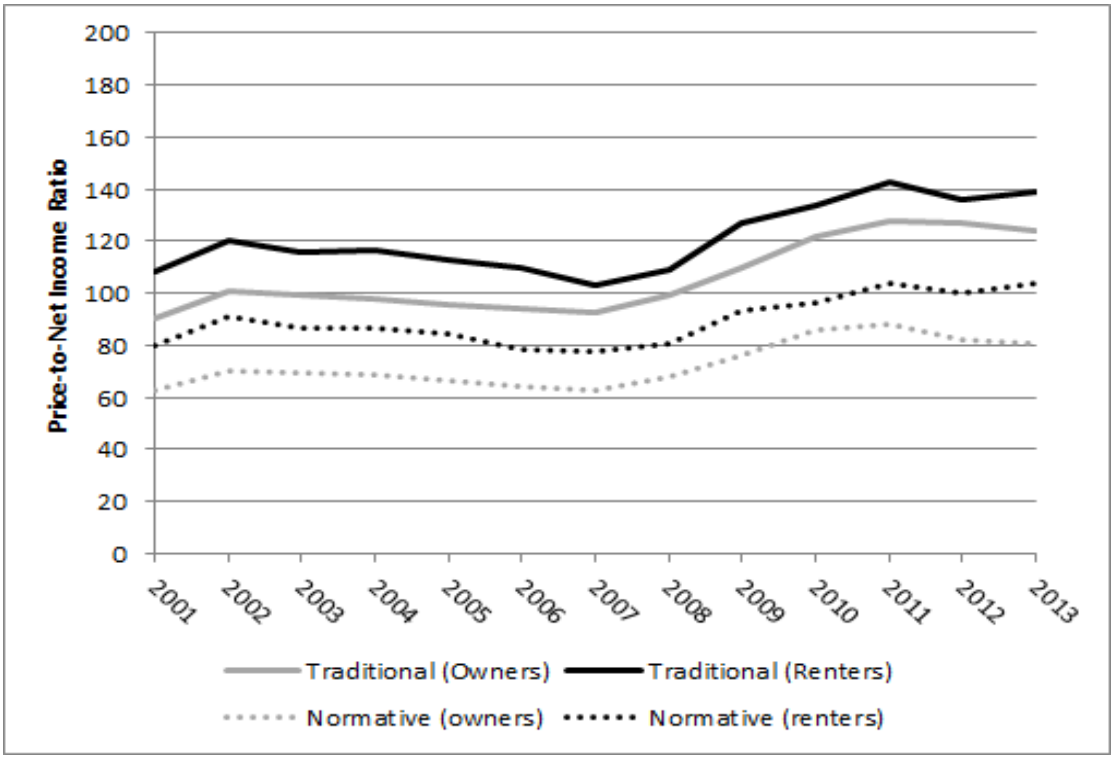

Figure 5A: Average Standardized and Traditional Affordability Measures Stratified by Household Head Gender, 1998–2013

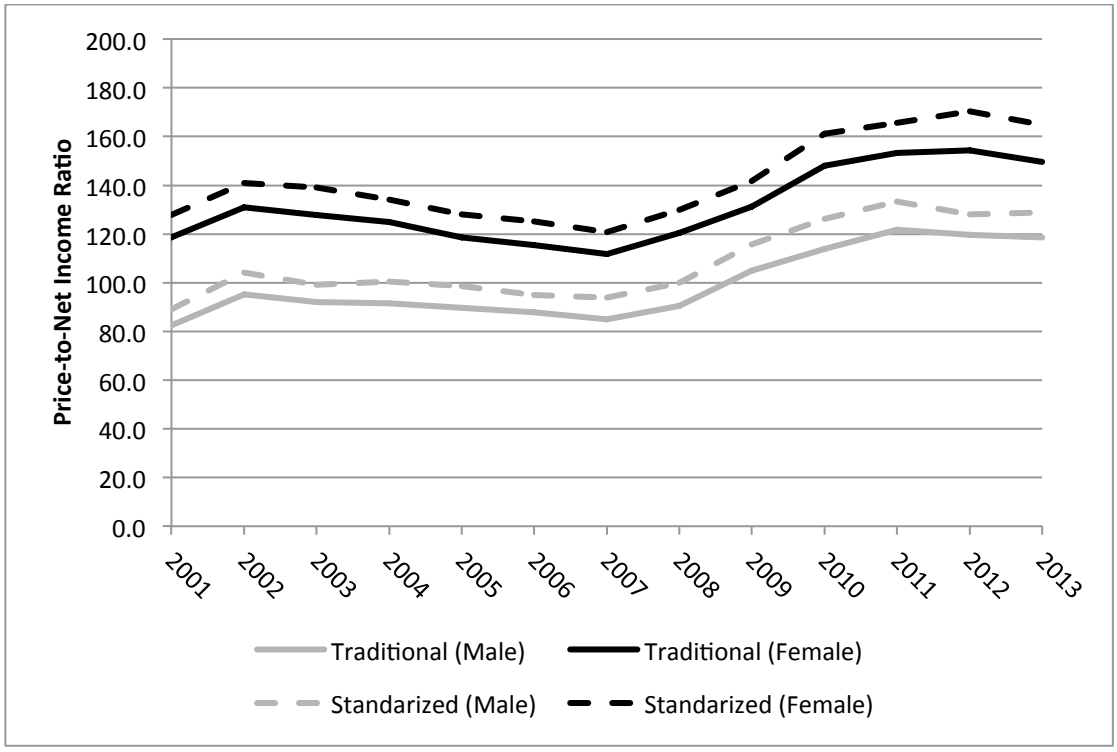

Figure 5B: Average Normative and Traditional Affordability Measures Stratified by Household Head Gender, 1998–2013

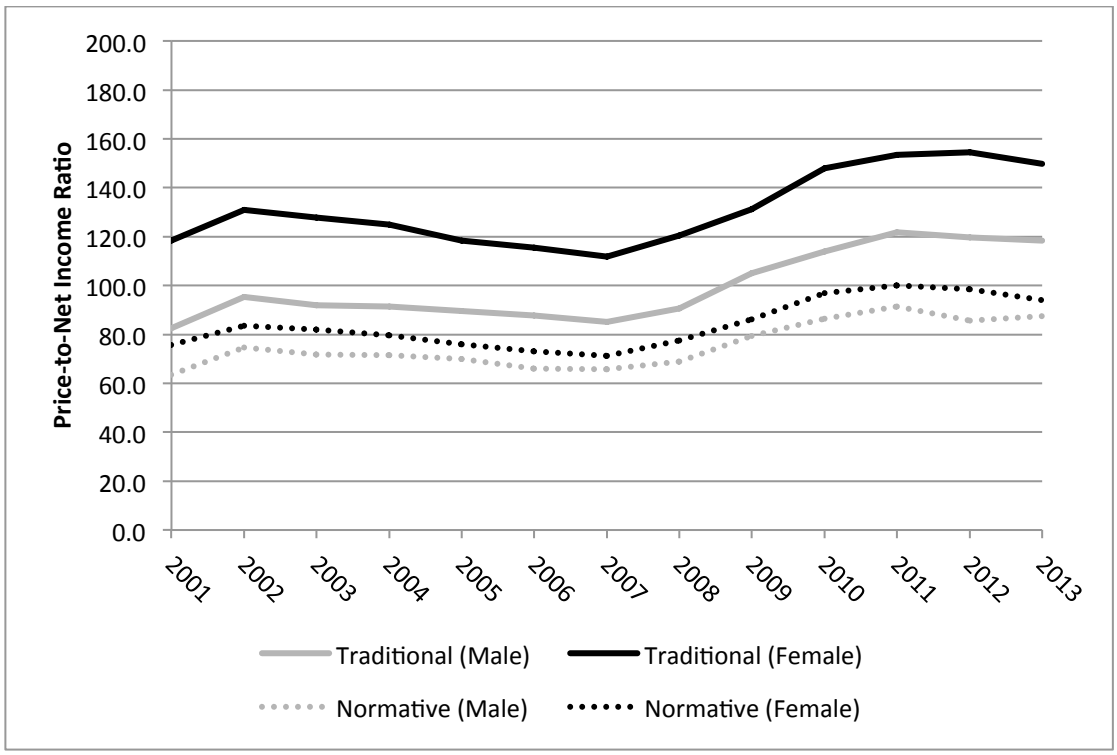

Figure 6A: Average Standardized and Traditional Affordability Measures Stratified by Nationality, 1998–2013

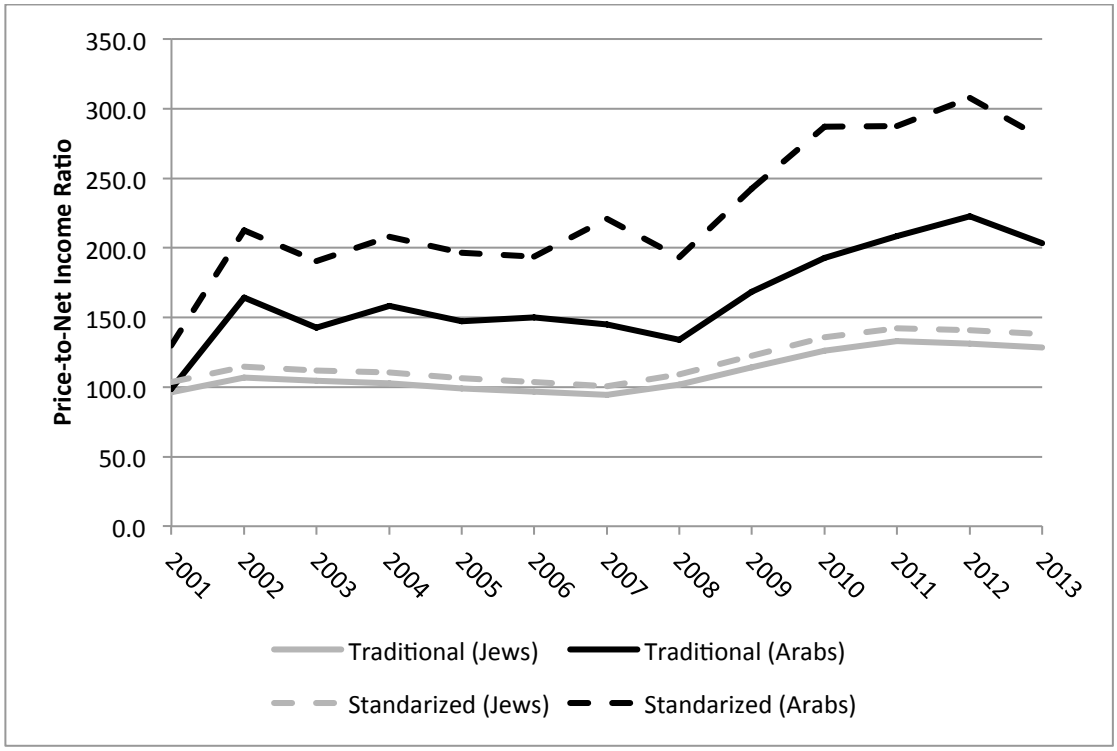

Figure 6B: Average Normative and Traditional Affordability Measures Stratified by Nationality, 1998–2013

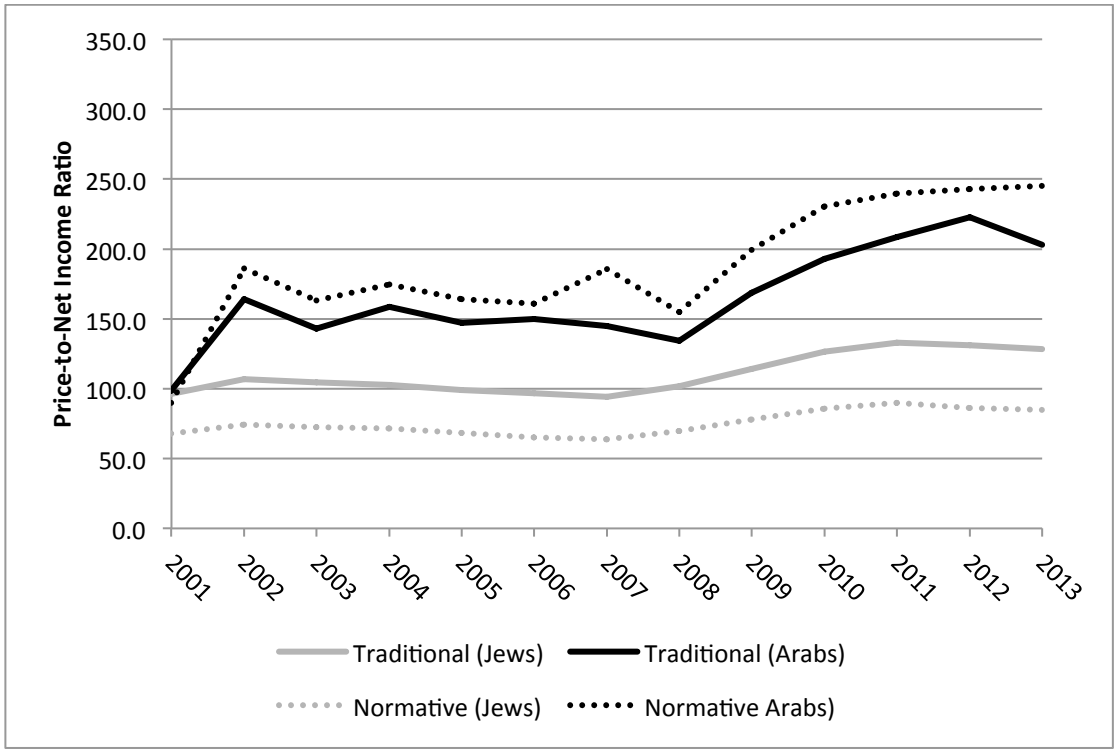

Figure 7: Income and Housing Affordability Gini Coefficients of Inequality, 1998–2013