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Accounting for owner-occupied dwelling services: Aggregates and distributions

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ABSTRACT

Research linking macro and micro statistics of dwelling services is in its infancy in the U.S. including work by the Bureau of Economic Analysis, Bureau of Labor Statistics, and the Census Bureau. Comparisons of aggregated estimates generated from micro-level data to estimates at the macro-level can inform both levels on the accuracy and precision of methods and data sources. In this study, the treatments of housing in the macro statistics of the National Accounts and in the micro statistics of household expenditure and income surveys are examined. Three approaches to value dwelling services using household survey data are compared: capitalization rate, hedonic, and rental equivalence. Estimates are produced using data from the U.S. Consumer Expenditure Survey and American Housing Survey. Estimated aggregates of implicit net rental income from owner-occupied housing are compared to the aggregate value in the National Accounts. Possible sources of differences in the macro- and micro-based aggregates are discussed. The effects of adding net implicit rental income on income distributions are examined, particularly on inferences about the relative well-being by the age of householder. Overall, only marginal reductions in income equality result when net rental incomes are added to before tax money income; this only occurs when reported rental equivalence and return to home equity are used as methods of rent estimation.

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1. Introduction

Dwelling services are produced from the stock of housing for consumption. Market rents are a good approximation of the value of dwelling services for most rental housing. However, some households do not pay a market price for the accommodation that is consumed. These include households living in subsidized rental or rent-controlled units,

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and households living in owner-occupied dwellings. In the past few years, there has been increased research on valuing these services with a particular focus on owner-occupied housing. Implicit rent and net rental income from housing services are important in the official economic statistics for the United States (U.S.) and for other countries. For example, at the macro level, reported rental equivalence from the U.S. Consumer Expenditure Survey are used in conjunction with market rents in the creation of the owners' shelter component of the Consumer Price Index (CPI), see Ptacek and Baskin (1996) and Verbrugge (2008a,b).[2] Imputed rent and net rental income enter the National Income and Product Accounts (NIPAs), specifically in Personal Consumption Expenditures (PCE) and personal income. At the micro level, implicit owners' rent and net rental income are important in assessments of economic well-being. For example, the U.S. Census Bureau adds net implicit rental income to the household income series to assess distributional differences between owners and renters, and to compare poverty rates among population subgroups taking account of the flow of services from owner-occupied housing (U.S. Census Bureau, 1992; see also Short et al., 2007). Garner (2006) and Garner and Short (2001) have examined the impact of using rental equivalence in the production of National Academy of Sciences-based poverty thresholds for the U.S.

The 1977 United Nations (UN) Provisional Guidelines on Statistics of Distribution of Income, Consumption and Accumulations of Households provided guidelines on defining household income for statistical purposes. Their recommendations for household income followed the structure of the System of National Accounts. The United Nations System of National Accounts (UN, 1993) provides a uniform basis for reporting national income statistics at the macro-level across countries.

The Expert Group on Household Income Statistics (Canberra Group, 2001) further developed standards on the production of income distribution statistics internationally to improve national income statistics and facilitate international comparability on household income distributions. Using the structure of the National Accounts to develop a micro-level income definition, the report encouraged comparing "grossed-up" micro data with national accounts aggregates to assess the accuracy of estimates.

In 2003, the International Labor Organization (ILO) issued the *Report II: Household Income and Expenditures Statistics* on micro-level economic statistics. This report provided the international guidelines on household expenditures and income statistics including guidelines for valuing dwelling services. The ILO Report emphasized consistency with the System of National Accounts (SNA) and across countries to improve international comparisons of distributions of economic well-being. The valuation approaches outlined in the ILO Report include rental equivalence, current market value approaches, repayment methods and user costs. The report noted that rental equivalence can be based on imputations derived from rents for rental units or from responses provided by the interviewees and or interviewers. The report provided guidance regarding how to obtain a consumption value for dwelling services and how to derive the implicit rental income from these services.

Within countries[3] and cross-nationally there has been an increasing demand for better coherence between and within macro and micro statistics, and to examine the distributional impact of imputed rent for dwelling services for which households do not pay full rent. Macro–micro research focused on the U.S., for example, has attempted to reconcile differences in household survey and macro national accounts estimates.[4] The most coordinated work at the micro level on imputed rents has been conducted in Europe under the auspices of AIM-AP (Accurate Income Measurement for the Assessment of Public Policies) in which Household Budget Survey (HBS) and European Union (EU)-Survey of Income and Living Conditions (SILC) data have been used. Studies focused on the distributional impact of dwelling services under the auspices of this project have been conducted for the following countries: Belgium (Verbist and Lefebure, 2007), Germany (Frick et al., 2007), Greece (Koutsambelas and Tsakloglou, 2007), and Ireland (Callan, 2007), Italy (D'Ambrosio and Gigliarano, 2007), The Netherlands (De Vos, 2007), and the United Kingdom (Mullan et al., 2007).

In most of the research to date, little attention has been given to reconciling micro and macro estimates of owner-occupied housing. In the U.S. developing such linkages is in its infancy. Of particular interest in this paper are the value of owner-occupied housing services and estimates of the implicit rent and net rental income from these services, and their impact on income distributions.

In general, the valuations of owner's imputed rents and net rental income have been made independently across economic series and research studies using different data sources and varied methodologies, making it difficult to assess conflicting findings. This paper describes, implements, and evaluates a number of approaches that have been used to produce these estimates. In particular, the purpose of this paper is twofold: first, to scrutinize and compare U.S. macro and micro estimates of owner-occupied dwelling services and implicit net rental income from these services; and second, to use the various micro data estimates to examine the respective implied distributions of net implicit rental incomes across U.S. households, in order to compare the implied well-being effects of the various approaches. Using 2005 data, micro estimates are derived from two national household surveys — American Housing Survey (AHS) and the Consumer Expenditure Interview Survey (CE) — and then compared to estimates from the U.S. NIPAs. We briefly review the methods used[5] by the

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[2] For examinations of the difference between rental equivalence and user costs, see Garner and Verbrugge (2009a).

[3] See papers by Braakmann et al. (2008), Coli and Tartamella (2008), Fesseau et al. (2008), Garner and Short (2008a), and Ho Han (2008).

[4] For expenditure comparisons, see, for example, Attanasio et al. (2006), Garner et al. (2006, 2009a), Houthakker and Taylor (1970), Meyer and Sullivan (2009), and Slesnick (1992, 1998). For income comparisons, see Ruser et al. (2004).

[5] The BEA method reviewed is the one in effect as of June 2009. The BEA introduced a new classification system for Personal Consumption Expenditures (PCE) in July 2009 (McCully and Payson, 2009), along with changes in definitions and statistical improvements. As discussed below, among the changes is the use of annual data from the CE to estimate the imputed space rental value of owner-occupied permanent-site non-farm housing.

Bureau of Economic Analysis (BEA) to produce the NIPA aggregates for owner-occupied housing as background for a comparison of aggregate rents, expenses, and implicit net rental incomes that are entirely micro-based. We find that the values of imputed rents are quite sensitive to the methods chosen and to the data used. However, a robust distributional finding is that elderly households would appear better off if account were taken of home ownership.

In the first section of the paper, a brief description of the treatment of owner-dwelling services in the NIPAs is provided. Next the AHS and CE, the sources of the micro data for this study, are described along with the methods used to produce the imputed rent for owner-occupants, expenses, and implicit net rental income. Aggregate rents, expenses and net implicit rental incomes resulting from summations of the micro data are compared to the U.S. NIPA aggregates. After the macro–micro comparison, a distributional examination of net implicit rental income is presented. The final section concludes the paper and offers suggestions for future research.

2. U.S. National Income and Product Accounts[6]

According to the U.S. Bureau of Economic Analysis, which produces the U.S. national accounts, the output of housing represents about 10 percent of total U.S. Gross Domestic Product (GDP) final expenditures and about 5 percent of total U.S. gross output. The term "housing" is used to represent the provision of shelter services by residential housing units and captures both tenant and owner-occupied residential units. As reported by Mayerhauser and McBride (2008), owner-occupied housing output is an abstract concept because there is no actual market transaction between two parties. In the National Accounts, owners are treated as both renters and as enterprises that produce services in the form of shelter. In their capacity as renters they pay a market rent for shelter services, but as enterprises, they may earn a profit as income or experience a loss due to housing expenses. This profit is measured as the difference between imputed rental income and expenditures incurred in operating the rental unit, excluding capital gains as discussed below. This is referred to as *rental income of persons living in owner-occupied housing* by the BEA. In this study we refer to this profit (or loss) as the net implicit rental income, or net rental income, of owner-occupants or homeowners.

Measuring owner-occupied housing services requires a measure of rental income. Since this is not an actual transaction, it must be imputed. Imputed rents for owner-occupied housing are the only imputation for household services included in the NIPA's production boundary. BEA makes this imputation so that economic growth is invariant to whether shelter is owned or rented. This imputation allows international comparability because home ownership rates differ significantly across countries.

The BEA produces estimates of the space or gross rent, expenses, and imputed rental income for non-farm owner-occupied permanent-site housing, owner-occupied non-farm manufactured homes, and farm dwellings owned by farm operators. In addition to owner-occupied permanent-site housing that is occupied, it also includes dwellings that have been sold and are awaiting occupancy and dwellings held off the market for occasional use by the owner, termed "vacant reserves"; these are treated as if they have been occupied for the full year. Each year, BEA produces annual estimates for owner-occupied housing.

The BEA imputes the gross rental value of owner-occupied units using a rent-to-value ratio approach. Rent-to-value ratios are computed from rental housing data collected in the decennial Residential Finance Survey (RFS). The rent-to-value ratios are applied to the mid-point market value of the owner-occupied units within corresponding value classes as reported in the AHS. In this calculation it is not possible to exclude the amount paid for utilities or furnishings that might be embedded in rents reported in the RFS data. In between survey estimates, BEA uses the BLS CPI for owners' equivalent rent. For owner-occupied manufactured homes, the value is based on applying rents from renters to owners. For this type of housing, the ratio of rooms-per-unit of tenant housing to rooms-per-unit of owner housing from the Census of Housing is applied to the average rent of tenant-occupied manufactured homes. For farm owner-occupied housing owned by farm operators, the BEA uses U.S. Department of Agriculture's (USDA's) estimates of the gross rental value of farm dwellings, which is a combination of tenant- and owner-occupied housing. BEA splits the rental value of operator dwellings between owner-occupied and tenant-occupied (which reflect dwellings for hired labor, etc.) using tenure splits of farm dwellings from BEA's fixed assets accounts. These calculations and estimates are used to produce an overall estimate of the market value of the flow of services from owner-occupied housing. The gross rental value of this space represents implicit spending for the consumption of owner-occupied housing; it also represents the implicit owner-occupied housing output.

The implicit rental income of persons living in owner-occupied housing is measured as output less expenses plus subsidies. Expenses include intermediate consumption, taxes on production, mortgage interest, current transfer payments and the consumption of fixed capital. Intermediate consumption includes expenditures on maintenance and repairs, property insurance, mortgage origination fees, other closing costs (such as title insurance, escrow fees, attorney fees), broker commissions on land, condo and co-op fees, and imputed banking services. Taxes on production paid by the housing sector are chiefly property taxes paid to local governments. During benchmark years, many of these expenses are based on survey or census data.

Residential housing subsidies are another element of housing services (McBride, 2008). These are grants made by governmental units and include two types: (1) disaster relief to owners of residential property affected by natural calamities such as hurricanes and floods (FEMA disaster assistance); and (2) housing assistance that involves Federal programs benefiting owner-occupants and tenant-occupants of residences. Housing subsidies, in a

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[6] This section draws extensively on Mayerhauser and McBride (2008); see also Mayerhauser and Reinsdorf (2005).

national accounting framework, are equivalent to negative taxes on production because they act to offset some or all of the effects on gross operating surplus of the below-market rents charged by landlords for public housing or the operating expenses of property owners.

The aggregate rental income of persons is calculated as revenue from gross implicit rents and residential housing subsidies less current operating expenses for the stock of housing that is owner-occupied. Capital gains (losses) due to the change in property values are not included in the NIPA concept of saving because they represent changes in prices of assets and are not a source of funding for new investment.

3. Going from macro to micro

Goals of this study are to start with the concepts of owner-occupied rent and net rental income as outlined for the NIPA, produce values for these using micro data, and then distribute the values across households. By distributing the implicit costs and benefits of home ownership across the population, it is possible to examine their impact on income-based measures of economic well-being. Incorporating measures of housing into distributional measures of household economic well-being allows for more reasonable inter-household comparisons, as well as international comparisons, of economic well-being.

Regarding the distributional analysis of income, we attempt to reconcile estimates of owned housing net rental income from the NIPA to a similar concept assigned at the household level. The Census Bureau currently implements an approximation of net rental income in its household income measures. This calculation is based on a return to equity approach following Smeeding et al. (1993). In that study, homeowners were assumed to have sold their homes and captured equity from the sales. They invest the equity and earn from this an income based on some rate of return. This return represents the flow from the financial asset, one's home, and results in shifting the relative standing of homeowners upward in an income distribution compared with renters.

According to Short et al. (2007), this method has weaknesses. The selection of return rates is arbitrary and the result has been that the value of net implicit rental income from owner-occupied housing generally exceeds the comparable NIPA estimates (Ruser et al., 2004). The Census Bureau reduces the overestimate by subtracting property taxes from the return to home equity. But the main expense that homeowners face is not property taxes, but rather, mortgage interest; this is an expense with a large life-cycle relationship that is not captured by property taxes.[7] The current Census method, then, overestimates the net implicit rental income of young families relative to

older homeowners. The return to equity approach is also weak in capturing changes in housing markets. The NIPA net implicit rental income from owner-occupied housing was −$5318 million for 2005 (McBride, 2008); this suggests that expenses incurred by households or on behalf of households for owner-occupied dwellings exceeded the market rent assumed by the BEA for this housing. Further, this reflects the very low rent-to-value ratios inherent in the housing markets during the mid-2000s in the U.S. and the large interest expenses that households were assuming in anticipation of future appreciation of home values. These variations are not captured in the return to equity approach.

For this study, we produce gross rents, expenses and implicit net rental income from owner-occupied dwellings living in the U.S. We apply different methods to value owner-dwelling services and compare the results to U.S. NIPA estimates. In the NIPAs, owner housing is divided into three groups: non-farm permanent site, owner-occupied and vacant reserves; manufactured, owner-occupied non-farm; and farm properties, owner-occupied. In the analysis, the household survey data are restricted to owner-occupied housing, on and off farms; there is no distinction between manufactured homes and permanent-site dwellings. Also not accounted for in the study are the values for vacant reserves. Based on BEA estimates (McBride, 2008), vacant reserves accounted for approximately 3 percent of all non-farm permanent site owner housing in 2005.

Net implicit rental incomes across the various methods are compared. The distributional impact of accounting for owner-occupied housing on economic well-being is examined in terms of income deciles. The decile analysis focuses separately on older and younger homeowners. We focus on these two groups as there is a general understanding that the benefits of homeownership change over time and in conjunction with stage in the life-cycle.

3.1. Valuation methods

There are several approaches presented in the literature to value imputed rents.[8] The approaches that we use in this study are a capitalization rate approach, a hedonic model with sample selection correction, and reported rental equivalence. Once we have estimated imputed rents, we subtract operating expenses that are based on the same household survey data, to derive implicit net rental income for each owner-occupied dwelling. The micro-level estimates are aggregated over all households to represent the gross rent and implicit net rental income concepts in the NIPAs. Also presented for the income distributional analysis are results based on the return to equity approach that the Census Bureau currently uses in its income calculations to value implicit net rental income from owner-occupied dwellings in household income statistics.

In the following, we review the valuation methods followed by descriptions of the data used. The results of the valuation methods are presented and contrasted to each

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[7] Distributional effects across age groups will differ for many reasons that reflect market conditions and consumer choices. For example, Asberg (1999) and Boehm (1993) have examined the tenure choice decisions of young adults. VanderHart (1998) studied housing choices for the older households (50 years and older). Recent dynamic general equilibrium studies of the tenure decision include Díaz and Luengo-Prado (2008), Chambers et al. (2009), and Sommers et al. (2009).

[8] See also Diewert and Nakamura (2009) for additional methods used to account for owner-occupied housing in the CPI.

other and to the NIPA values. Data and estimates for the year 2005 are used.

3.1.1. Capitalization rate approach

Several authors have suggested estimating $a = R_g/V$, the capitalization rate (Yates, 1994; Phillips, 1988a,b; Crone et al., 2004; Frick and Grabka, 2003) to represent the trade-off between investing in one's own home or placing the capital in other investments that would yield a return in income flow over time. The variable a represents the rate of return, R_g is the implicit gross rent and V is the market value of the home. This method is used to calculate a rent-to-value ratio (or rate of return) to transform the value of an owned home into a market rent. The capitalization rate approach for this study uses the average rent-to-value ratio implicit in the national product accounts to derive imputed rent and employed micro data to compute and subtract associated costs. Using U.S. NIPA data published by BEA for assets and space rents, this rate would be 5.4 percent in 2005. The rate of 5.4 percent is applied to each owner-occupied housing unit in the AHS and CE. One shortcoming of this approach is that it assumes a common capitalization rate for the entire U. S. In practice, the BEA uses multiple capitalization rates. Applying the single rate to each property value of owner-occupied dwellings, as reported in the AHS and the CE, should result in correct aggregates; however, the distributional impact of net imputed rents based on the single rate approach will mask important differences in property values along the income distribution.

3.1.2. Selection/hedonic approach

Another way of directly calculating net implicit rental income is by estimating gross rent with a hedonic regression model. The basic hedonic equation follows:

$$Y = X\beta + u_1 \tag{1}$$

where Y is the natural log of gross monthly rent, and X is a vector of housing unit characteristics. This model is estimated using data from a sample of renters[9]; estimated model coefficients are then used to predict market rents for homeowners in similar types of homes. We control for selectivity bias in the renter regression model using the Heckman two-step approach; thus we add an explicit selection equation to the model. The selection model is specified as follows:

$$s = 1, \text{if renter}, \tag{2}$$

or

$$s = 0, \text{if owner}$$

probability of being a renter $= Z\delta + u_2$

$\text{corr}(u_1, u_2) = \rho$

In the selection model, Z is the vector that contains variables relevant to the selection process. Some variables

are common to both the rent determination equation and the selection equation.

Imputed rents for owners are estimated by applying the renter coefficients to owner characteristics. The predicted log rent value for each owner is transformed into a level variable by multiplying each predicted value by an adjustment factor. Algebraically the rent is:

$$\widehat{Y} = \exp(\widehat{\sigma}^2/2) * \exp(\ln \widehat{y}) \tag{3}$$

Hedonic models with selection are developed using both the AHS and the CE data. The goal is to include variables deemed relevant to housing status selection and rent levels, drawing from the details about housing available in the separate surveys; some variables overlapped while others did not. Table 1 includes a list of the explanatory variables used and the weighted means for both surveys and for the selection and rent models. One advantage of this method over the first one is that one can control for rent differences by geographic area. We do this by including variables that capture housing price variation. In both the AHS and CE specifications, Fair Market Rents (FMRs) were sorted into deciles and each household was assigned the appropriate rent category.[10] The CE specification included, in addition, the median value of homes in the area where the household lived. Region and metro status were also included in the model.

Various housing amenities and household income variables were included in both models. The AHS specifications included neighborhood characteristics not available in the CE. The CE models included percentage of renters and percent poor in the Census tract where the housing unit was located based on 2000 decennial census data matched to the CE using census tract. The selection models included characteristics of the households, such as education and marital status that may affect the decision to own or rent. Estimated coefficients for these models are presented in Table 2.

3.1.3. Reported rental equivalence

Reported rental equivalence is only available from the CE Interview. During each of four quarterly interviews, owner-occupants are asked the following question:

> If someone were to rent your home today, how much do you think it would rent for monthly, unfurnished and without utilities?

If owned housing and rental housing are the same in terms of characteristics and quality, this approach should yield estimates of imputed rents that are similar to those from the hedonic model since both approaches are used to produce imputed rents at the individual housing unit

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[9] Renters living in subsidized housing or in rent-controlled units are not included in the AHS calculations. Renters in subsidized housing are not included in the CE calculations; renters living in rent-controlled units could not be identified so they are by default included in the CE sample.

[10] The Department of Housing and Urban Developments (HUD) calculates FMRs to administer housing programs. Housing assistance payments are limited by FMRs established by HUD for different areas. In the Housing Choice Voucher program, the FMR is the basis for determining the "payment standard amount" used to calculate the maximum monthly subsidy for an assisted family. In general, the FMR for an area is the amount that would be needed to pay the gross rent (shelter rent plus utilities) of privately owned, decent, and safe rental housing of a modest (non-luxury) nature with suitable amenities.

Table 1
Weighted means of characteristics of owners and renters living in the U.S.: 2005.

	American Housing Survey		Consumer Expenditure Survey	
	Renter (*n* = 10,005)	Owner (*n* = 29,507)	Renter (*n* = 7672)	Owner (*n* = 20,610)
Monthly rent	$725		$638	
Monthly rental equivalence				$1243
Monthly capitalization rate-based rent		$1070		$1088
Property value		$237,845		$241,827
Rooms including bedrooms			4.381	6.581
Rooms not including bedrooms	2.452	3.433		
Bedrooms	2.006	3.096		
Bathrooms	1.226	1.733	1.253	1.765
Halfbaths	0.148	0.398	0.153	0.382
Dwelling age (in years)	45	38	43	36
Dwelling age imputed			0.504	0.107
Rent includes fuel	0.276		0.302	
Rent includes water/trash	0.750		0.731	
Tenure duration	3.759	13.780		
Off street parking	0.874	0.969	0.769	0.835
Central air-conditioning	0.487	0.687	0.453	0.664
Housing includes major appliances[a]	0.340	0.474	0.333	0.459
Housing includes porch, balcony, patio			0.593	0.829
Not detached housing	0.696	0.100	0.672	0.100
Mobile home	0.046	0.074	0.039	0.068
In MSA	0.842	0.752	0.880	0.845
South	0.354	0.374	0.347	0.369
Midwest	0.199	0.245	0.199	0.242
West	0.254	0.205	0.262	0.205
Public transport good	0.541	0.342		
Police good	0.882	0.893		
Schools good	0.221	0.223		
At least one housing problem	0.095	0.049		
Crime bothers	0.205	0.123		
Traffic bothers	0.334	0.226		
Fair Market Rent deciles				
Decile 2	0.082	0.107	0.077	0.110
Decile 3	0.097	0.104	0.102	0.100
Decile 4	0.098	0.100	0.097	0.101
Decile 5	0.098	0.103	0.092	0.104
Decile 6	0.102	0.095	0.100	0.098
Decile 7	0.104	0.105	0.096	0.104
Decile 8	0.098	0.095	0.099	0.102
Decile 9	0.119	0.076	0.128	0.087
Decile 10	0.137	0.101	0.130	0.090
Median value of owned homes within the primary sampling unit			$237,237	$206,802
Crowd (number of people per room)			0.563	0.413
Percentage of renters in Census tract (2000 decennial census)			0.443	0.279
Poverty rate of people in Census tract (2000 decennial census)			0.150	0.107
Worked	0.611	0.551	0.783	0.690
Black	0.191	0.089	0.169	0.086
Hispanic	0.177	0.077	0.177	0.078
Household income	$38,167	$70,591	$38,509	$71,023
Received property income	0.149	0.316	0.143	0.362
Received transfer income	0.039	0.008	0.095	0.024
Age of householder (years)	41	52	40	52
High school graduate to AA degree			0.586	0.566
Bachelors college degree	0.159	0.197	0.218	0.311
Not married	0.318	0.262		
Never married			0.390	0.112
Widowed			0.068	0.115
Divorced or separated			0.223	0.136
Children present	0.362	0.352	0.342	0.344
Number of adults 18+	1.683	1.981	1.682	1.967
Time dummies for CE interview quarters				
yr20053			0.251	0.249
yr20054			0.243	0.251
yr20061			0.254	0.250
Mills	0.627	2.065	0.562	2.107

[a] Major appliances include stove, refrigerator, dishwasher, and garbage disposal. For the CE, the appliances refer to those that were included in the owned home or rental unit at the first interview.

Table 2
Results from selection and rent regression models: 2005.

	American Housing Survey		Consumer Expenditure Survey	
	Selection model (probability of being a renter)	Rent model	Selection model (probability of being a renter)	Rent model
Intercept	2.250**	5.421**	1.878**	5.033**
Rooms including bedrooms			−0.504**	0.086**
Rooms squared including bedrooms			0.026**	−0.006**
Rooms not including bedrooms	−0.356**	0.010		
Rooms squared not including bedrooms	0.027**	−0.001		
Bedrooms	−0.826**	0.096**		
Bedrooms squared	0.098**	−0.006		
Bathrooms	−0.300**	0.235**	−0.182*	0.247**
Bathrooms squared	0.015	−0.040**	0.017	−0.055*
Half-baths	−0.360**	0.057**	−0.296**	0.064*
Half-baths squared	0.051**	−0.014**	0.081**	−0.013
Dwelling age (in years/10)	0.052**	−0.038**	0.113**	−0.021**
Dwelling age (/10) squared	−0.002	0.002**	−0.005**	0.001*
Dwelling age imputed			0.718**	−0.038**
Rent includes fuel		0.076**		−0.025
Rent includes water/trash		0.037**		0.028
Tenure duration		−0.014**		
Off street parking	−0.066	−0.021	−0.004	−0.010
Central air-conditioning	−0.133**	0.076**	−0.107**	0.073**
Housing includes major appliances[a]	−0.057*	0.082**	−0.085**	0.071**
Housing includes porch, balcony, patio				0.049**
Not detached housing	1.458**	0.095**	1.281**	0.061**
Mobile home	−0.073	−0.278**	−0.234**	−0.246**
In MSA	0.003	−0.024	−0.027	0.057*
South	0.370**	−0.156**	0.372**	−0.164**
Midwest	0.147**	−0.092**	0.126**	−0.114**
West	0.509**	−0.041*	0.623**	−0.175**
Public transport good	0.062**	0.046**		
Police good	0.071*	0.036*		
Schools good	−0.040	0.009		
At least one housing problem	0.147**	−0.022		
Crime bothers	−0.044	−0.044**		
Traffic bothers	0.052*	0.015		
Fair Market Rent deciles				
Decile 2	0.083*	0.174**	−0.102	0.034
Decile 3	0.172**	0.310**	−0.072	0.100**
Decile 4	0.111*	0.304**	−0.137*	0.181**
Decile 5	0.116**	0.413**	−0.091	0.220**
Decile 6	0.123*	0.442**	−0.253**	0.242**
Decile 7	0.090	0.469**	−0.405**	0.269**
Decile 8	−0.230**	0.544**	−0.392**	0.346**
Decile 9	−0.112*	0.738**	−0.416**	0.372**
Decile 10	−0.040	0.833**	−0.386**	0.336**
Median value (/100,000) of owned homes within the primary sampling unit			0.004	0.103**
Crowd (number of people per room)			−0.060	0.188**
Percentage of renters in Census tract (2000 decennial census)			1.033**	0.165**
Poverty rate of people in Census tract (2000 decennial census)			−1.665**	−0.630**
Worked	−0.028		−0.005	
Black	0.207**		0.067	
Hispanic	0.001		−0.078*	
Household before tax income (/100,000)	−0.646**	0.346**	−0.397**	0.487**
Household before tax income (/100,000) squared	0.073**	−0.045**	0.009**	−0.013**
Received property income	−0.180**		−0.253**	
Received transfer income	0.380**		0.442**	
Age of householder (years)	−0.026**		−0.025**	
High school graduate to AA degree			−0.147**	
Bachelors college degree	−0.056*		−0.225**	
Not married	0.254**			
Never married			0.228**	
Widowed			0.197**	
Divorced or separated			0.359**	

Table 2 (*continued*)

	American Housing Survey		Consumer Expenditure Survey	
	Selection model (probability of being a renter)	Rent model	Selection model (probability of being a renter)	Rent model
Children present	0.175**		0.103**	
Number of adults 18+	0.151**		0.057**	
Interview period				
2005Q3			0.009	0.034*
2005Q4			−0.030	0.051**
2006Q1			0.018	0.076**
Mills		0.107**		0.087**
Likelihood ratio/adjusted *R* square	21,698.96	0.387	17,379.11	0.411

^a Major appliances include stove, refrigerator, dishwasher, and garbage disposal. For the CE, the appliances refer to those that were included in the owned home or rental unit at the first interview.

[*] Statistically significant at the 0.05 level.
[**] Statistically significant at the 0.01 level.

level. The CE is the only U.S. federal survey used for statistical purposes in which a rental equivalence question is asked.

3.1.4. Subtractions

Operating costs, based on the survey data, are subtracted from each of the owner rents to arrive at the net imputed rent that we require for the macro–micro comparison and for the distributional analysis. Property taxes, maintenance costs, and other expenses are subtracted from the gross rent at the housing unit or household level to arrive at an estimate of net implicit rental income.

3.2. Data

The two household survey data sets used for this study are the American Housing Survey (AHS) and the Consumer Expenditure Interview Survey (CE). These two surveys provide the most comprehensive data on renter and owner-occupied housing in the U.S. and thus were natural candidates for the micro-level analysis.[11] Since the surveys have different purposes, samples, and data collected, differences in estimated net rental income could result. For the micro-analysis, AHS data are from interviews conducted in 2005 while the CE data are from interviews conducted in 2005 calendar quarter two through 2006 calendar quarter one. For the CE, an interview refers to the previous three-months. For example, an interview conducted in January 2006 refers to the October through December 2005 period.

3.2.1. American Housing Survey

The 2005 AHS is a housing unit survey designed to collect data on the quality of housing in the United States.

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[11] The new American Community Survey (ACS) contains most of the same housing unit data traditionally collected as part of the Census of Population and Housing. The ACS contains information on acreage, number of bedrooms, condominium status and fees, contract rent, gross rent, heating fuel, insurance for fire, hazard, and flood, kitchen facilities, meals included in rent, mobile home costs, monthly housing costs, mortgage payment, mortgage status, occupants per room, plumbing facilities, real estate taxes, number of rooms, second or junior mortgage payment or home equity loan, tenure, units in structure, utilities, value, year householder moved into unit, and year structure was built.

This cross-section of the housing inventory provides a picture of houses and households as they change over long periods of time. The AHS actually consists of two surveys, a national survey and a metropolitan area survey. Both surveys are conducted during a 3 to 7 month period. This study only uses the national survey.

The national survey is conducted once every 2 years, in odd-numbered years. Samples of housing units in all survey areas were selected from the 1980 decennial census. These were updated by a sample of addresses obtained from building permits (for new construction) to include housing units added since the sample was selected. The survey goes back to the same housing units on a regular basis, recording changes in characteristics, adding and deleting units when applicable. The current sample of housing units has been interviewed since 1985.

The population weights applied to the AHS result in the total number of housing units in the United States based on the 2000 Census. A demographic adjustment ensures comparability among the surveys for people in occupied units. Adjustments include those for Hispanic groups, region, race, housing tenure (rent versus own), husband-wife, other male householder or other female householder, age of householder, and central city, suburb, or non-metropolitan area.

The national survey, conducted in 2005, collected data on about 59,581 housing units. For the sample analysis, unoccupied units and units occupied without payment of cash rent were dropped resulting in a sample size of 42,457 housing units. Of these, about 69 percent were owner-occupied dwellings. The rental hedonic model in this study was estimated with housing units rented for cash; rental units that are subsidized or rent-controlled were not included in the analysis sample. All owners were included in the selection model and received imputed rents. Outliers were excluded in estimating the hedonic part of the selection/hedonic model. In order to control for variations in housing prices by geographic area, the 2-bedroom Fair Market Rents (FMRs) for counties were attached to each housing unit record in the AHS; these rents were categorized by decile across all housing units in the original weighted selection sample of owners and renters. The weighted mean characteristics of owners receiving imputed rents and renters for whom the rent regression

estimates were produced are presented in Table 1. The table shows means separately for owners and renters.

3.2.2. U.S. Consumer Expenditure Survey

CE-based estimates use data collected in 2005 quarter two through 2006 quarter one (2005Q2–2006Q1). The CE is composed of two components, the Interview and Diary. Detailed housing unit information and associated expenditures are only collected in the Interview; thus this study is restricted to the Interview sample.

The CE collects information from households and families living in the United States on their buying habits (expenditures), income, and household characteristics. The samples for the CE are national probability samples of households designed to be representative of the total U.S. civilian population. The population eligible for the sample includes all civilian non-institutional persons. The CE Interview is a panel rotation survey. Each panel is interviewed for five consecutive quarters. Through the use of population weights and information from the most recent Current Population Survey (CPS) and the Census Bureau's official population estimates, CE data are made to represent the U.S. non-institutional population. CE's non-response adjustments are done using region, race, housing tenure (own versus rent), family size; CE calibration adjustments are made considering region, race, housing tenure, age of the reference person, and urban versus rural location.

The CE Interview is designed to collect data from a consumer unit in five different time periods. Approximately 7500 consumer units are interviewed each quarter of the calendar year. The first interview is a bounding interview and includes the collection of housing unit characteristics, property values,[12] and a list of the major appliances in a housing unit when the consumer unit moved in. These questions are not asked again. The second interview is the first time consumer units are asked to report rental equivalence values and rents. Homeowners are asked to report rental equivalences as of the day of the interview. Renters are asked to report the rents paid in each of the last 3 months. The property value, rental equivalence, and monthly rent questions all refer to different time periods, thus differences in imputed rents based on monthly rents and property values can differ from reported rental equivalence in volatile markets.

The original number of interviews conducted over the time period is 30,544. Of these, 67 percent were for owners living in the sampled units with rental equivalence and home property values. Vacation homes are not included in the analysis. Vacation homes are part of vacant reserves as defined by the BEA. The renter sample was restricted to consumer units who were paying rent but not receiving rent as pay and not living in subsidized housing. The number of renter consumer units was 7793; this number was further reduced when outliers were dropped from the rent regression. In the 2005 CE, rent-controlled housing units could not be identified in the CE and are thus included in the analysis sample.[13] The selection model for the first stage

of the hedonic modeling was estimated using the owner and full renter sample. See Table 1 for a comparison of AHS and CE sample statistics.

For this study, all interviews meeting the requirements of the study and occurring over the 2005Q2–2006Q1 time period were included in the study sample; in the earlier studies (Garner and Short, 2008a,b), only the fifth interviews were used. The reason to restrict the earlier samples to fifth interviews was to include information about assets and liabilities in the selection model; these data are only collected in the fifth interviews. Assets and liabilities are expected to influence whether someone can afford to purchase a dwelling or not. Unpublished results suggest that assets and liabilities are important; however, since data on these variables were not available in the AHS, they were dropped from the model specification. In addition, restricting the same to fifth interviews only resulted in a sample size that was 18 percent of the sample size of the AHS. By including all interviews during the time period, the sample size of the CE increased to 72 percent of that of the AHS. Mullan et al. (2007), in their selection/hedonic model of U.K. imputed rents, noted that the differences they found from using two different household survey samples were due to sample size.[14] We suspected that this might be the case in the earlier studies, leading us to include all interviews conduction during the study time period.

3.3. Selection model results

Results from the selection model are presented in Table 2 for the AHS and CE.[15] Both the selection and rent models fit the data well. The coefficients of the Mills ratio are positive and statistically significant, suggesting that factors related to being an owner or a renter differ. This selection should be accounted for in the estimation of the model to reduce bias in the estimates.

Unlike in the AHS, rent-controlled housing units could not be identified in the CE data for the study time period. Thus, it was expected that the selection/hedonic approach would result in lower imputed rents for owner-occupants in the CE as compared to the AHS. Also, another statistically significant variable in the AHS model is tenure duration, or the amount of time that the renter has lived in the dwelling. The AHS results, as well as the results of Verbrugge et al. (2009),[16] reveal that tenure duration is related to lower average rents. Not controlling for tenure duration in the CE estimation was expected to result in lower imputed rents for owners using renter hedonic results.

3.4. Comparison of imputation and aggregations

Average annual rents, housing expenses, and net rental income for owner-occupied housing are presented in Table

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[12] Property values of owned properties are collected quarterly beginning with the 2007Q2 Interview.

[13] A question about rent-controlled units was added to the Interview Survey in 2007 quarter two.

[14] However, when they applied a stratification model to the U.K. data sets, the imputed rents were nearly the same for the two survey samples.

[15] One might wonder about the extent to which model specification differences impact the results. Garner and Short (2008a) applied a common specification to the AHS and CE samples; however, they found that this specification fit the data poorly. For this reason, we chose in this study to use models that were statistically adequate representations of the data.

[16] See also Crone et al. (in press), who review earlier studies.

Table 3
Comparison of 2005 imputed rents and implicit rental income for owners using the U.S. Income and Product Accounts, American Housing Survey, and the Consumer Expenditure Interview Survey.

	BEA[a]	American Housing Survey			CE (2005 with data from 2005Q2–2006Q1)			
		Population	Capitalization rate	Selection/ hedonic	Population	Capitalization rate	Selection/ hedonic	Reported rental equivalence
Non-farm owner-occupied permanent-site housing								
Owner-occupied (including vacant reserves)								
Non-farm manufactured homes, owner-occupied								
Farm dwellings owned by farm operators								
Total number of owner-occupied housing units (thousands)	74,690				79,085			
Average rent for all owner-occupied housing units (millions of dollars)			**$12,862**	**$12,164**		**$13,059**	**$12,389**	**$14,916**
Non-farm owner-occupied permanent-site housing								
Owner-occupied (including vacant reserves)								
Non-farm manufactured homes, owner-occupied								
Farm dwellings owned by farm operators								
Total owner-occupied housing units multiplied by average "rent"			$960,663	$908,529		$1,032,746	$979,780	$1,179,634
Aggregate annual rent for all owner-occupied housing units			$960,696	$908,595		$1,032,746	$979,780	$1,179,631
Less: rental of durables			$0	$0		$0	$0	$0
Space rent for all farm and non-farm owner-occupied housing units (including vacant reserves) exclusive of utilities	**$959,454**							
Space rent for all farm and non-farm owner-occupied housing units (does not include vacant reserves) exclusive of utilities			**$960,696**	**$908,595**		**$1,032,746**	**$979,780**	**$1,179,631**
Less expenses			Running subtotals			Running subtotals		
Intermediate inputs (maintenance and repairs (includes ground rent))	$202,138	$69,682	$891,014	$838,913	$100,378	$932,368	$879,402	$1,079,252
Taxes on production and imports (property taxes)	$139,213	$175,152	$715,862	$663,761	$181,541	$750,827	$697,861	$897,711
Net Interest (mortgage interest)	$408,732	$330,722	$385,140	$333,039	$393,293	$357,533	$304,568	$504,418
Property insurance		$71,072[c]	$314,068	$261,967	$38,043	$319,490	$266,525	$466,375
Current transfer payments	−$10,980							
Consumption of fixed capital	$229,710	$177,647[d]	$136,421	$84,320	$191,249[d]	$128,241	$75,275	$275,126
Closing costs, total		$13,550	$122,871	$70,770	$23,181	$105,060	$52,095	$251,945
Origination fees	$32,992[b]	$4263[e]			$415	$127,826	$74,860	$274,710
Other closing costs	$22,374[b]	$9287[f]			$22,766	$105,060	$52,095	$251,945
Title insurance								
Title abstract and escrow fees								
Attorney fees								
Credit report								
Surveys								
Adjustment and collection services								
Engineering services								
Real Estate Brokers' commissions		$34,124	$88,747	$36,646	$48,973	$56,087	$3121	$202,971
Condominiums and co-operative fees		Included			Included			
Mortgage guaranty insurance (private administration)		Included			na			
Swimming pool maintenance					Included			
State and local documentary stamp tax					Included			

Others					
Total expenses	$968,813	$871,949	$976,659	$88,747	$56,087
					$202,971
Plus: subsidies	$4041			$36,646	$3121
Equals: rental income of persons with capital consumption adjustment (net rental income from all owner-occupied housing)	−$5318				
Counter factual using BEA expenses and subsidies	−$4076	−$56,177		$67,974	$15,009
					$214,859

a Space rent, expenses, and rental income are from the National Income and Produce Accounts (NIPA) Table 7.12. Imputations in National Income and Product Accounts. The rental income of persons with capital consumption adjustment is equal to the rental income in NIPA Table 7.9. Rental income of persons by legal form of organization and by type of income.
b Unpublished aggregates supplied by Denise McBride from the BEA, August 12, 2008.
c Includes property insurance, homeowners association fees, condominium fees, and other miscellaneous expenses.
d Estimated to be 1.0 percent of market value of owned home.
e Estimated to be 1.0 percent of the value of the original mortgage or home equity loan.
f Estimated to be 3.0 percent of the value of the original mortgage or home equity loan.

3. Annual average rent estimates vary widely. Using AHS data, the capitalization rate method yielded an annual rent of $12,862 as compared to a slightly lower estimate from the selection/hedonic model ($12,164). The selection/hedonic method also yielded the lowest annual rent for the CE, $12,389, followed by a higher rent of $13,059 using the capitalization method. For both surveys, the capitalization method resulted in rents that are about 5 percent higher than those based on the selection/hedonic models. In contrast, annual rental equivalence is 14 percent higher than the capitalization rents for the CE. As noted by Garner and Verbrugge (2009b), higher rental equivalence values can be expected in the U.S. housing market due to differences in owner and renter user costs and housing conditions.[17]

The relative average rents based on the capitalization approach for the AHS and CE are consistent with relative average property values in the two surveys; AHS average property values are slightly higher than those from the CE (see Table 1). Differences in the estimates for the AHS and CE resulting from using the selection/hedonic model are related to differences in the underlying samples and model specifications (see Table 2 again).

Table 3 includes the aggregations of imputed rents, expenses, and implicit net rental incomes using the survey data with a comparison to the NIPAs. The gross aggregate space or implicit rent for owner-occupied dwellings most similar to NIPAs is the AHS capitalization rate estimate: $959,345 million versus $960,696 million. This is expected since the rent-to-value ratios applied to total housing wealth from the AHS are from the NIPA figures. However, given that vacant reserves are not included in the AHS figures, it is surprising that the AHS aggregate is higher. The CE capitalization rate estimates exceed those of the AHS and NIPA by less than 8 percent and the CE selection/hedonic estimate was higher by only 2 percent. Gross rent using the rental equivalence data from the CE was the highest, at $1,179,631 million, exceeding the AHS and NIPA capitalization rate estimates by 23 percent, and the CE capitalization rate estimate by 14 percent.[18]

In order to derive implicit net rental income from owner-occupied housing, operating and other expenses were subtracted from gross rent. For the AHS and CE, some of these expenses were reported while others were derived using various assumptions. These costs include those for maintenance and repairs (referred to in the NIPA as "intermediate inputs"), mortgage interest ("net interest" in the NIPA), property insurance, the consumption of fixed capital, and closing costs. For the AHS and CE, expenses reported by survey respondents for maintenance and repairs, property taxes, and mortgage interest were aggregated. Property insurance premiums reported in the CE were also aggregated. The entry for the AHS for property insurance includes property insurance, homeowner association fees, condominium fees, and other miscellaneous expenses. The NIPA separates condominium and co-operative fees, swimming pool maintenance, and state and local documentary stamp

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[17] See also Iwata and Yamaga (2008) for Japanese evidence.
[18] While it is tempting to conclude that CE rental equivalence estimates are upward-biased, Garner and Verbrugge (2009b) argue that these estimates are in line with a homeowner user cost measure.

tax, and other expenses. Expenses for these are included in the previously noted categories for the CE.

We estimated values for the consumption of fixed capital (depreciation) and real estate brokers' commissions for the AHS and CE. Origination fees are also estimated for the AHS; for the CE, the entry reflects loan origination fees. Other closing costs, not including origination fees, are also collected in the CE and are presented in Table 2. For the AHS and CE, the consumption of fixed capital was assumed to be one percent of the current market values of owner-occupied dwellings for the year. The origination fees for new mortgages and home equity loans were assumed to be one percent of the original value of the mortgage or home equity loan. Loan values were reported in the AHS and CE. Brokers' commissions were estimated to be 4 percent of the value of new home sales; new homes were defined to be not older than 2 years. Brokers' commissions for older homes were estimated to be 6 percent of home sales. These percentages underlie the estimates of brokers' commissions in non-benchmark years (Meyerhauser and McBride, 2008).[19] Included in NIPA estimates, but not the survey estimates, are current transfer payments as a negative expense and subsidies as additional rent. Although premiums for mortgage guaranty insurance are collected in the CE, they are grouped with other types of insurance and thus are not included among the CE expenses.

Table 3 shows the aggregate rents and expenses from the NIPA accounts compared to those based on the AHS and CE data. These differ significantly. The aggregate expenses reported for the AHS are lower than those in the NIPA and in the CE. Property taxes are highest from the AHS. The only aggregate expenses that are close to those in the NIPA are those for mortgage interest and other closing costs as reported in the CE.

The gross rent figures from the capitalization rate method applied to the AHS closely replicate the NIPA figures; however, the resulting aggregate value of net rental income from the NIPA using the BEA calculations is −$5318 million, below the aggregate value from the estimates using survey data. Since operating costs computed at the household level are well below the NIPA figures, the end results of net rental income are much higher. Results from a counterfactual using survey gross rents but NIPA expenses are presented on the first page, last row, of Table 3. Not surprisingly, this exercise results in the AHS-based estimates being negative, but more positive when the CE-based imputed gross rents are assumed.

3.5. Distributional outcomes

A recent study of the Organization for Economic Co-operation and Development (OECD, 2008) ranked the income distribution of the U.S. as fourth most unequal among 30 OECD countries. The OECD comparison, along with most other international comparisons of income inequality, is based on comparisons of disposable cash income. However, many authors have stressed the importance of taking account of non-cash income and in-kind transfers for comparing income distributions (see, e.g., Smeeding et al., 1993) and one of the most important sources of non-cash income is housing.

Several studies have incorporated a measure of housing benefits in just such comparisons. Ritakallio (2003) compared Australia and Finland income distributions and concluded that there is an important redistributive effect from taking account of housing in countries such as the U.S., where ownership is common and 'imputed income' from housing is greatest for the elderly who also have the lowest disposable incomes, on average. Other studies have shown similar results. Smeeding et al. (1993) found more equal incomes for Germany, Sweden, Canada, and the Netherlands. Frick and Grabka (2003) showed lower inequality for Germany, the U.S., and the U.K., with the inclusion of imputed rents as income.[20]

For the AIM-AP project in Europe, Frick et al. (2009) reported that almost all seven European countries examined had lower measured income inequality as a result of accounting for housing benefits. They noted, however, the variation in results due to the use of different methodologies and data sources, suggesting that it was an open question whether any cross-country differences identified actually reflected true variations among the countries studied. Italy was an exception to the general findings; D'Ambrosio and Gagliarano (2007) reported increases in inequality for Italy when imputed rents were added to income.

This section describes the empirical results of accounting for implicit net rental income when measuring household well-being, something that can only be done with micro data. The analysis is restricted to owners and does not account for total household disposable income across all owners and renters in the U.S. population. The analysis is conducted for older and younger households separately as it is often assumed that that older households benefit more as owners who have paid off their mortgage obligations have lower expenses than those who have not. Examining mean net rental income for age and income groups suggests that the method employed to estimate implicit rents for owner-occupied dwellings can affect resulting comparisons of distributions of implicit net rental income.[21]

Tables 4 and 5 show mean amounts of net rental income for households by income decile (the means are those of all owner households within ranges of before tax money income) and age of householder using data from the AHS and CE, respectively.[22] For the AHS, Table 4 includes mean net rental income using the capitalization rate

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[19] Our choice of 2 years as the break point between younger and older dwellings was based on our own judgment.

[20] See also Onrubia et al. (2009) for a recent study focused upon Spain.

[21] Examinations of distributions for other population subgroups are also important. Gyourko et al. (1999) analyzed housing tenure differences by race and found these reflected differences in wealth holdings. Hendershott et al. (2009) examined differences in home ownership by marital status and marital history.

[22] When examining the results in Tables 4 and 5 it is important to note that the rankings of income were calculated for each survey sample independently (see mean values of before tax money income for the AHS and CE in the last columns of the tables). Thus the level implicit net rental incomes across methods within a survey can be compared but levels across surveys cannot, as the cutoffs for the income groups vary by survey. For comparisons across surveys, trends are reported.

Table 4
Annual weighted means of rental income and subtractions by deciles of before tax money income for all owner households in the American Housing Survey.

Decile	Imputed net rental income			Imputed rental income		Subtractions	Property value	Before tax money income
	Capitalization rate	Selection/ hedonic	Return to equity minus property tax	Capitalization rate	Selection/ hedonic			
Reference person age 65 or over (n = 7209)								
1	$2968	$2757	$4567	$8292	$8081	$5324	$153,332	$3477
2	$3196	$2831	$4520	$8431	$8067	$5236	$155,909	$10,146
3	$3063	$3530	$4361	$8013	$8480	$4950	$148,177	$14,119
4	$3494	$3570	$4923	$8938	$9013	$5443	$165,269	$18,610
5	$3514	$3083	$5276	$9836	$9405	$6322	$181,880	$23,719
6	$3946	$3672	$5578	$10,267	$9994	$6322	$189,854	$29,884
7	$4989	$3914	$6664	$12,002	$10,927	$7013	$221,930	$38,028
8	$4212	$3405	$6255	$12,347	$11,540	$8135	$228,310	$49,595
9	$5492	$3712	$7699	$14,818	$13,039	$9327	$274,013	$67,104
10	$9903	$3386	$13,425	$25,021	$18,503	$15,118	$462,671	$150,200
Reference person age 65 years of age or younger (n = 22,298)								
1	$664	$733	$2958	$7686	$7754	$7021	$142,117	$10,083
2	$92	$786	$2602	$7789	$8483	$7697	$144,028	$26,953
3	−$541	$44	$2377	$8743	$9328	$9284	$161,671	$38,255
4	−$345	$175	$2775	$9695	$10,215	$10,040	$179,273	$48,447
5	−$681	−$256	$2890	$10,424	$10,849	$11,104	$192,750	$58,571
6	−$364	−$189	$3208	$11,768	$11,943	$12,132	$217,608	$69,444
7	−$517	−$1040	$3708	$13,603	$13,080	$14,120	$251,542	$82,343
8	$96	−$530	$4145	$15,197	$14,572	$15,101	$281,024	$98,630
9	$256	−$1603	$5460	$18,885	$17,026	$18,629	$349,211	$123,949
10	$2957	−$2247	$9033	$28152	$22,948	$25,195	$520,567	$243,081

approach in the first column, followed by the rent selection/hedonic model in the second. The third distribution is based on a return to home equity minus property taxes, the method currently employed by the Census Bureau in household income series. It is clear that there are different outcomes across these methods. Imputed rental income, subtractions, property values, and before tax money income are shown as these underlie the imputed net rents shown in the first three columns. Table 5 includes results for the CE. Instead of return to equity as in the AHS, the CE results include estimates based on reported rental equivalence.

Unlike the situation for the capitalization rate and selection/hedonic approaches, the AHS results using the return to home equity results are based on subtracting only property taxes (Table 4). Property taxes are generally proportional to income, reflecting the correlation between

Table 5
Annual weighted means of rental income and subtractions by deciles of before tax money income for all owners consumer units: Consumer Expenditure Survey Interview 2005Q2–2006Q1.

Decile	Imputed net rental income			Imputed rental income			Subtractions	Property value	Before tax money income
	Capitalization rate	Selection/ hedonic	Reported rental equivalence	Capitalization rate	Selection/ hedonic	Reported rental equivalence			
Reference person age 65 or over (n = 4898)									
1	$3389	$1629	$6010	$8105	$6345	$10,726	$4716	$150,090	$10,045
2	$2907	$1794	$5708	$8611	$7497	$11,411	$5704	$159,464	$19,957
3	$3014	$1706	$5989	$9588	$8280	$12,563	$6574	$177,559	$29,468
4	$4165	$1487	$6942	$11,524	$8845	$14,300	$7358	$213,399	$38,706
5	$4475	$1870	$6104	$12,494	$9889	$14,122	$8019	$231,373	$48,763
6	$5685	$1711	$7361	$14,978	$11,003	$16,653	$9293	$277,372	$59,962
7	$5098	$1225	$6500	$15,059	$11,185	$16,461	$9961	$278,872	$73,490
8	$3084	$749	$4902	$15,193	$12,858	$17,011	$12,109	$281,353	$90,391
9	$6530	$2803	$6318	$18617	$14,889	$18,405	$12,087	$344,754	$114,357
10	$8183	$17,576	$7166	$29,946	$39,340	$28,929	$21,763	$554,558	$250,455
Reference person less than 65 years of age (n = 15,712)									
1	$1435	−$477	$3910	$7865	$5953	$10,340	$6430	$145,656	$6510
2	$782	−$342	$2976	$7430	$6306	$9624	$6648	$137,598	$20,475
3	$395	−$372	$2837	$7877	$7111	$10,320	$7482	$145,873	$29,805
4	−$804	−$1685	$1699	$8744	$7862	$11,247	$9547	$161,919	$38,783
5	−$1210	−$2258	$1578	$9796	$8748	$12,583	$11,006	$181,408	$48,959
6	−$881	−$2228	$1821	$11,303	$9957	$14,006	$12,185	$209,322	$60,594
7	−$803	−$2454	$1640	$12,879	$11,228	$15,322	$13,682	$238,503	$73,881
8	−$1276	−$2224	$1742	$13,720	$12,772	$16,738	$14,996	$254,074	$90,216
9	−$133	−$2881	$1122	$18,361	$15,613	$19,616	$18,494	$340,015	$115,058
10	$1366	$8558	−$2008	$29,168	$36,360	$25,793	$27,802	$540,139	$222,983

incomes and property values by geographic area. This subtraction has the effect of lowering values for higher income households relative to lower income households but do not reflect any age differences in householders that typically arise from mortgage payments.

The main difference between the elderly and non-elderly net rental incomes is that those for the elderly are higher. One observation from this comparison is that the return to home equity method results in values that are similar to, although higher than, values based on the other two methods for older households. The return to equity method appears to overestimate net imputed rent for younger households; this reflects the fact that younger households are expected to have very large mortgage interest costs compared with older households. Also only property taxes are subtracted from rent for the return to home equity approach.

For the AHS-based results (Table 4), the distribution of net imputed rent using the selection/hedonic method is different from the return to home equity approach in the same way as the capitalization approach for younger householders, but there are other differences too. For older households there is a fairly uniform distribution of net implicit rental incomes above the second income deciles, suggesting that rents may be under-predicted for higher value homes by this method. However, for younger households, net implicit rental income based on the selection/hedonic model becomes negative around the fifth income decile for younger households. A similar pattern results for net implicit rental incomes when using the capitalization approach, with net losses beginning with the third decile.

The CE-based distribution results are reported in Table 5, which displays average imputed net rents resulting from the simple capitalization rate approach, the selection/hedonic model, and reported rental equivalence. As with the AHS, for most of the distribution for older households, the capitalization method results in a fairly uniform distribution with positive incomes. Both survey samples imply higher net rents using the capitalization method for the higher income groups. In contrast, for younger households, net implicit rental incomes based on the capitalization rate method are negative from the fourth to the ninth deciles, similar to the pattern from the AHS. Comparing selection/hedonic based net rents of older households with net rents of younger ones, we see again that older households gain more, from owner-occupied dwelling services being valued, than do younger households. For older households, net rents are fairly uniform through the 7th decile, fall, and then climb at the 9th with income climbing. For younger households, net rents are negative through the 9th decile, with negative net rents fairly uniform from the 5th through the 8th deciles. Only for the 10th decile are rents positive. This pattern is the opposite of that found using the AHS selection/hedonic model and data, with net rents through the 4th decile being positive and those thereafter being negative.

Reported rental equivalence, from the CE, leads to the highest net rents for older owners for most of the income percentiles (through the 8th decile) when compared to results from the other methods and to results from the AHS. Net rental equivalence incomes for households between

the 9th and 10th deciles are lower than those from the capitalization rate method for older households. Net rents based on rental equivalence follow approximately the same pattern as net rents based on the capitalization method over much of the income distribution for older households. For younger households, net rents based on reported rental equivalence are highest for owners in the lower three income deciles. These rents fall, flatten, and then drop again over the income distribution. Net rents from rental equivalence are higher on average than those based on the selection/hedonic method.

While there are considerable differences across data sources and methods, all methods from both sources imply much larger flows from owned homes for older households than for younger households, resulting from the lower operating costs elderly householders face due to having paid off mortgages. This implies that comparisons of economic well-being will underestimate the relative position of elderly households if the benefits of home ownership are not accounted for.[23]

The impact of net rental income of owner-occupied housing on income inequality was examined using the Gini index.[24] For this analysis, net rental income using each of the three approaches was added to before tax money income. Only owners as a subgroup of the population were considered. Incomes were equivalized across all people living in owner-occupied housing by dividing income by the square root of family size and then weighting this income by the number of people living in each owner-occupied dwelling. Income inequality falls 1.3 percent when net rents based on reported rental equivalence are included for CE owners. For the AHS, income inequality also falls when the return to equity method is used, but the fall is less than one percent. Net rents added to income leads to increases in inequality when the capitalization rate and selection/hedonic approaches are used. As noted earlier, most of the AIM-AP researchers reported decreases in income inequality when rents were imputed for owners. Yet, increases in inequality were reported for Italy (D'Ambrosio and Gagliarano, 2007). The U.S. results, like those for Italy, are not surprising given the different structure of the population with the majority of U.S. (and Italian versus those in other European countries studied) households being owner-occupants and the fact that owner and renter housing appears to differ more in the U.S. and Italy than in the other European counties.

4. Conclusions

This paper has examined different methods for valuing net rental income for owner-occupiers at the household level. These methods were compared to aggregate estimates included in the NIPAs for the purpose of understanding differences in concepts and measurement. In general, it appears that imputed rent methodologies can replicate the

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[23] This result supports the arguments of Buckley et al. (2003) who discussed the relative well-being of Russian elderly households in Moscow.
[24] The Theil index and mean log deviation were also produced; however, samples were reduced for the estimation of these indexes due to zero and negative income and thus are not reported here.

national account estimates, but that reported expenses for homeowners differ considerably across methods and data sources.

In the future, we expect some of the differences uncovered here to be reduced. Differences in rents and net rental income for the CE and NIPA are expected to be reduced due to changes in the NIPA resulting from a comprehensive revision of the accounts, to be published in July 2009. CE rental equivalence data will henceforth be used in the NIPA estimation of the imputed space rental value of owner-occupied permanent-site non-farm housing. Estimates affected by the change are the PCE, rental income of persons with capital consumption adjustment, and gross housing value added (see McCully and Payson, 2009). Improvements in the CE are expected to reduce differences as well. For example, beginning with 2007 quarter two, data on rent-controlled housing is collected; including this variable in the selection/hedonic model is expected to produce better estimates of imputed rents.

Differences in methods and the data used to estimate implicit net rental income for dwelling services of owner-occupied housing are important for distributional analyses and their interpretation. It was shown that some measures have a more equalizing effect on extended income distributions that include net rental income than others. For all methods it was shown that elderly households, in general, benefit more than younger households from net implicit rental income. In comparisons of economic well-being, elderly households would appear better off if account were taken of home ownership. However, overall, income inequality either increases or decreases only marginally when net rents are added to before tax money income.

Overall, we have shown that care must be used in the application of methods to estimate imputed rents and in income distribution measures for populations and comparisons of economic well-being. We find that values of imputed rents are quite sensitive to the methods chosen and to the data used; however, the trends for younger versus older households seem to hold across surveys.

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