Comparing Approaches to Value Owner-Occupied Housing Using U.S. Consumer Expenditure Survey Data

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Introduction

Owner-occupied housing represents about two-thirds of the housing units in the U.S. In other countries such ownership is even more prevalent. This fact alone implies that the treatment of housing is important in assessments of economic well-being. In these assessments many agree that a household or family occupying a mortgage-free home has a higher level of living than another who rents. However, this difference is often not well captured in measures of consumption expenditures; thus, distributions of economic well-being based on consumption and interpretations of who is poor based on such a measure can be distorted.

The primary purpose is to explore how owner-occupied housing can be valued so that the flow of services from such housing can be captured in consumption expenditures and income. Two are based on hedonic regression models. The third is reported rental equivalence for owner-occupied housing as asked in the U.S. Consumer Expenditure Survey (CE). Reported rental equivalence is also modeled using a hedonic approach. Housing unit and geographic characteristics are the regressors in each model. A secondary purpose is to explore what interviewees could be considering as they respond to the rental equivalence question as posed in the CE. Data from 2003 quarter two through 2004 quarter one are analyzed. Predicted values based on the three regression-based valuation approaches are compared to out-of-pocket spending. In addition, net implicit rental income is estimated using the predicted implicit rents from the three approaches and the reported expenditures for shelter as reported in the CE. Net implicit rental income is that income that could be added to money income to represent the additional resources available to households to meet their economic needs. Analyses are

conducted at the region-MSA or region level. Imputed rents and net implicit rental income are produced for twelve geographic areas (three Metropolitan Statistical Areas designations and the four Census regions). This study is exploratory and represents the first work in the literature (that I could find) on rental equivalence, imputed rents, out-of-pocket spending, and net implicit rental income based on these using CE data.

Preliminary results reveal that residential capitalization rates are not constant across place, as shown by other researchers who have produced geographic-specific capitalization rates (e.g., Phillips 1988), and thus the implicit rents for owners are location specific. Imputed rents based on the relationship between rents and housing unit characteristics result in values that are lower than those from the capitalization rate model and from the reported rental equivalence model. In part this difference is expected if, as many have suggested, the quality of owner-occupied housing is higher than that of renter housing.

An additional rental equivalence regression model is run to explore the role that other variables, such as mortgage status, spending, and respondent's education and age, might play in influencing responses and to proxy omitted variables such as housing and neighborhood quality that are not available in the CE data. The percent of renters within the primary sampling unit is also included in the model and represents the mix of renter and owner housing units. It is expected that with a balanced mix of renters and owners within a geographic are, reported rental equivalence will be closer to the implicit rents based on the renter hedonic and capitalization rate models.   These results suggest that out-of-pocket spending for shelter and higher education are positively related to higher

reports of reported rental equivalence. Age, whether the owner had a mortgage, and percent of renters were not.

The paper proceeds as follows. First a brief description of work done in the federal statistical arena is presented. This is followed by a description of the approaches used in this study to value the flow of services from owner-occupied housing. These are the capitalization rate hedonic and renter hedonic approaches, and rental equivalence. Net implicit rental income for owners is defined next, followed by a description of the data and more details regarding the methods. The final two sections include the results and conclusion.

Background

Federal statistical agencies[1] have been involved in the production of values for the flow of services from owner-occupied housing for some time. Since the mid-1980's, the Bureau of Labor Statistics for the Consumer Price Index has been using rental equivalence, as reported by consumers participating in the Consumer Expenditure Survey who own their housing, to represent this value. Since 1951, the Bureau of Economic Analysis, for the production of the National Income and Product Accounts (specifically Personal Consumption Expenditures and National Income), has been creating an aggregate estimate of the value for all owner-occupied housing in the U.S. For the past 20 years at least, the BEA has used rental property rents and property values from the Residential Finance Survey and owner-occupant property values from the American Housing Survey (AHS) for these estimates. For many years, the CE has been used for

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[1] Yates (1994) used unit record survey data for Australia to implement 1997 United Nations recommendations that imputed rent from owner-occupied housing be included in household income statistics collected for income distribution purposes.

economic well-being measurement with consumption the underlying construct. For these measures, reported rental equivalence is used to value the flow of owner-occupied housing services.

Recently there has been an increasing interest in including a value for the flow of services from owner-occupied housing in measures of income for economic well-being measurement with the Current Population Survey as the basic survey for income data (e.g., National Academy of Sciences Workshop on Poverty Measurement, June 2004). However, the Current Population Survey only includes whether a housing unit is rented or owned. Thus data from another source would be needed to imputed "rents" for owners. Two likely sources of data for such imputations are the CE and American Housing Survey (AHS). In earlier work, Garner, Short, and Kogan (2006) produced implicit rents for owners using capitalization rate and renter hedonic regression models as well as regression models of CE rental equivalence. This earlier work revealed that the samples underlying the CE and AHS are sufficiently different to caution the use of one survey over the other for imputing implicit rents to the CPS for economic well-being measurement. This earlier research also suggested that the valuation methods considered resulted in sufficiently different implicit rents for owners within the survey that more analysis is needed. The focus in the current research is the CE. Short, O'Hara, and Susin (2007) focus on the AHS as they examine ways to account for owner-occupied housing in household income.

Methods and Procedures

This section includes the methods and procedures used to conduct this study. The

approaches used to estimate the value of owner-occupied housing are first presented

followed by a descriptions of out-of-pocket expenditures and the procedure to estimate

net rental income. A description of the data completes this section.

Valuing the Flow of Services from Owner-Occupied Housing

Three approaches to value the flow of services from owner-occupied housing are

used in this study. The first is to obtain estimates of residential housing capitalization

rates (rent to value ratios) and then apply these to the reported market value of owned

homes. The second is to use the coefficients from a hedonic regression of rents on

housing or dwelling unit characteristics and apply these to owners. The third is to model

reported rental equivalence reported from the CE.

Approach 1. Obtain estimate of residential housing capitalization rates (rent to value ratios) and apply these to reported values of owned homes.

The use of capitalization rates to derive flows of the value of owner-occupied

housing is not new and is related to the user cost of capital approach to transform the

asset value of housing into the flows of annual cost to the owner of the housing.

Basically the user costs of capital or asset price of housing is based on the present

discounted value of expected future net rental income. Green and Malpezzi (2003) define

user cost as the cost to use a unit of housing capital each period. For a renter, the user

cost is the rent he or she pays. For owners the estimation of the user cost is more

complicated. Basically, the user cost expression can be interpreted in terms of the

capitalization rate; that is the rate at which rents, R, are discounted into asset prices, V. In

the simplest form, the capitalization rate can be presented as C below:

$$C = \frac{R}{V},$$

(1)

where

     C = capitalization rate

     R = rent

     V = property value.

Phillips (1988) and Crone et al. (2004) used basically the same approach to estimate implicit annual capitalization rates. The technique used by Crone et al. was developed in Linneman (1980), Linneman and Voith (1991), and Crone, Nakamura and Voith (2000).

     The capitalization rates in the Phillips (1988) and Crone et al. (2004) research were obtained by using a pooled-tenure hedonic model of the form

$$\ln Hprice = BX + \gamma Tenure + \varepsilon,$$

(2)

where

     $\ln Hprice$ = log of the market value for owner-occupied units

          or the log of rent[2] of rental units

     X is a vector of dwelling attributes (e.g., structure type)

     $Tenure$ = 1 if the unit is owner-occupied

          =0 if the unit is renter-occupied.

     The focus on this analysis is the coefficient on $Tenure$, γ. This coefficient is the average percentage difference in $Hprice$ between owner- and renter-occupied units, controlling for differences in specified dwelling characteristics. Capitalization rates are calculated as 1.0 over the antilog of the $Tenure$ coefficient γ for each equation estimated

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[2] Phillips used the annual rent of renters while Crone et al. made the adjustment to annual in the calculation of the capitalization rate.

(for example, for each year).[3] (The characteristics of the dwelling are the same ones that are used for Approaches Two and Three. However, these characteristics are not the focus of the capitalization rate hedonic model; thus, I have chosen to present the regressors in the next section where I describe Approach Two, the hedonic rent model.)

Equation (2) was estimated for twelve geographic areas noted by the four Census regions (Northeast, Midwest, South, and West) and MSA status (MSA central city, MSA not central city, not in an MSA). The tenure coefficient was used to produce the capitalization rate based on annual rents and market values. The annual capitalization rate, C, in percentage terms is equal to (12 x 100 x $\exp(-\gamma)$). The capitalization rate for each geographic area was applied to each property within that area to impute rents for owner housing.

Two caveats of the capitalization rate hedonic approach were highlighted by Phillips (1988). First, this method of imputing average residential capitalization rates restricts implicit prices for various dwelling characteristics to be the same for owners and renters within each area or time period for which the equation is estimated except for the intercept. Thus, the capitalization rate is restricted to be constant for all structure types and locations within a geographic are, with the *Tenure* coefficient interpreted as a measure of average capitalization rate over all housing types. Second, "unspecified differences in average quality between owner-occupied and rental units are captured by

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[3] From Phillips (1988, p. 282): Note that if a unit is owner-occupied, then $\ln Value = \sum BX + \gamma + \varepsilon$ and if a renter-occupied $Ln \operatorname{Re} nt = \sum BX + \varepsilon$. Subtracting the two equations yields the following: $\ln \operatorname{Re} nt - \ln Value = -\gamma$, which can be written as $Ln\left(\dfrac{\operatorname{Re} nt}{Value}\right) = -\gamma$. Taking the antilog yields the capitalization rate specified as $\left(\dfrac{\operatorname{Re} nt}{Value}\right) = e^{-\gamma}$.

the *Tenure* term, thereby biasing the capitalization rate estimates. Such omitted variable bias may account for some variation in measured capitalization rates between metropolitan areas but should not obscure trends over time within individual cities given the durability of the housing stock" (p. 283).

Phillips (1988) imputed average housing capitalization rates for 12 metropolitan areas for the years 1974-1979 using the AHS. Capitalization rates ranged from 5.94 percent in 1974 to 8.19 percent in 1979 for Atlanta, for example, and 6.52 to 4.83 for Washington, DC during the same time period. Crone et al. (2004) produced capitalization rates for the U.S. as a whole using 1985, 1993, and 1999 AHS data. These researchers reported estimated capitalization rates of 8.1 percent to 9.0 percent for the AHS sample years.

For the purposes of this study, I would like to point out that Phillips presented evidence of considerable inter-metropolitan variation in the rate at which rents are capitalized into residential asset values using housing data on contract rent and homeowners' estimates of the market value of their homes. In the second part of Phillips' study, she examined the variation in housing capitalization rates across time and place by regressing the estimated capitalization rates from the first part of her study on heat and utility costs, property tax rates, real after-tax mortgage rates, inflation rates, rental vacancies, and recent trends in housing resale values and residential rents for areas. Phillips reported that during 1974-1979, for her geographic areas "… house values and market rents were not in a fixed relationship with one another. Rather their relationship reflects a complex interaction between inflation, the cost of capital, the tax treatment of

residential property, future expectations, and local rent control, among other factors" (p. 288).

Crone et al. (2004) reported that implied capitalization rates may reflect changes in the user cost of capital and hence affect the inflation rates of owner-occupied. housing services. Higher capitalization rates imply higher nominal valuations of owner-occupied housing services and determine the size of the service flow of owner-occupied housing relative to that of renter-occupied housing and other goods.

Approach 2. Estimate coefficients from an hedonic models of rents and apply these to owners with the same housing unit characteristics.

The second option uses the same characteristics as those used for the capitalization rate hedonic model with the exception of not including the owner variable.[4] In this case the contract rents paid by renters are regressed on the characteristics of their rental dwellings. The estimated coefficients are then applied to the characteristics of owner-occupied dwellings to produce a predicted value of imputed rents of like owner housing units. The regression coefficients are estimates relating the implicit marginal prices of the dwelling characteristics. Applying this approach results in an estimate of owners' rental equivalence in an average community using the characteristics and rent paid by renters with like housing and location. For this model, imputed owner rents are based on a semi-log regression of renters' rents on selected housing characteristics. Malpezzi et al. (1998) and others (see Gillingham 1975; Moulton 1995; Ozanne and

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[4] Another statistical approach that could be used is to impute rents to owners by matching the characteristics of owned dwellings with those of rented dwellings and applying the rents from renters to owners. Thus, imputed rents are estimated through stratification of the data (favored by EUROSTAT).

Malpezzi 1985; Thibodeau 1995) have found that a semi-log regression fits the hedonic price-characteristics relationship for housing fairly well.

Malpezzi (2000) notes that hedonic approaches to estimating rent for owner occupants have good theoretical and intuitive foundations. These are discussed in detail in Malpezzi, Ozanne, and Thibodeau (1980) but he notes that these approaches involve substantial data requirements and analytical work. Diewert (2003) has noted several problems with the hedonic approach. First, he notes that that characteristics of the owner-occupied housing market could be quite different from the characteristics of the rental housing market. In particular, he warns, that if the rental market for housing is subject to rent controls, this approach is not recommended. He also notes that hedonic regression models suffer from a lack of reproducibility in that different researchers will have different characteristics in the model and will use different functional forms. This concern was addressed by Garner, Short and Kogan (2006) in their earlier study by using the same housing unit characteristics and same functional form for both the CE and AHS models. The same models are used in this study.

The housing unit characteristics selected for the model are drawn primarily from those presented in the literature (see e.g., Follain and Malpezzi 1981; Garner and Rozaklis 1999, 2001; Malpezzi et al. 1998; Ozanne and Malpezzi 1985; Moulton 1995; and Thibodeau 1995). General hedonic regression specifications include variables representing structural characteristics of the dwelling, location characteristics, and contract characteristics. In this study, structural characteristics include the following: number of rooms not including baths, the number of full baths, the number of half baths, the dwelling age, whether the unit is a single-family detached unit or a mobile home, or

other type of dwelling, if the unit has off-street parking, central air-conditioning, and window air-conditioning. Variation by geography is represented by the median owned home property value within the primary sampling unit (PSU) in which the housing unit is located. Contract characteristics include whether the rent covers energy utilities and whether the rent covers water and or trash removal. Often rental contracts (and neighborhood ordinances for owners) are written such that a limited number of people can occupy the housing unit. We represent this with a variable we call "crowd." Crowd is defined as the number of people who live in the housing unit divided by the number of rooms.

In many other hedonic models of housing, particularly those estimated using the AHS (e.g., Crone et al., 2004; Short et al., 2007), housing quality and neighborhood characteristics are included. However, these data are not available in the CE.

Due to sample size limitations in the CE, the renter regression was run at the region level only. However, results are produced in the tables at the region-MSAstat level for comparison to the capitalization rate based imputed rents. Due to the functional form of the model (semi-logarithmic) and Jensen's inequality, both the estimated coefficients and the estimated model variance are used to produce the estimated imputed rents for owners.

Approach 3. Reported rental equivalence

The third approach is based on reports by interviewees to a question about the values of the flow of services from their owned housing units. The question is to be answered with regard to the current rental value of a comparable rental unit. If owned housing and rental housing are the same in terms of characteristics. quality, and

neighborhood, this approach should yield estimates of imputed rents that are similar to those from the renter hedonic model since both approaches are used to produce imputed values at the individual housing unit level.

Reported rental equivalence could be based on the owner providing an estimate of how much he or she thinks the rent would be for the housing services provided by the owned unit. An advantage of this approach is its simplicity. An owner occupant would be asked a question something like the following:

> *What would you say your dwelling would rent for without furnishings and*
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> *without utilities for a month?*

An interviewer, a housing expert such as a real estate agent, or community leader could also be asked the same question about particular housing units. An examination of reported rental equivalences by owners and by Consumer Price Index (CPI) interviewers showed similar implicit rental equivalence values by region, on average, in the U.S. (see Johnson, Shipp, and Garner 1997).

For this study, rather than use the actual reported rental equivalence from the CE, reported rental equivalence is regressed on most of the same characteristics as in the two previously presented approaches. Two additional variables, property value and property value squared, are also included. The variables referring to whether utilities are included in the contract rent are not in the rental equivalence equation. The predicted rental equivalence-based owner rents are derived by applying the CE rental equivalence model coefficients to the owner housing unit characteristics. A linear functional form is used for the model specification as it proved to be a better fit for the rental equivalence data

than did the semi-log. This is also the functional form that will be used by the BLS beginning in 2007 to impute rental equivalence when it is missing.

The CE is the only Federal survey that is used for statistical purposes in which a rental equivalence question is asked of owner-occupiers.[5] Responses to this question are used in the creation of the owners' shelter component of the CPI. Two other Federally funded studies of which I am aware in which a rental equivalence question has been asked is the General Population Rental Equivalence Survey contracted to WESTAT by the Office of Personel Management (Heston 2005) and the Federal Employees Survey of 1998 (Joel Popkin and Company 1998). The studies were slightly different. The one that is most relevant to this study is the one by Heston who examine the relationship between rents and rental equivalence, with a particular focus on Federal employees, using a hedonic approach and controlling for housing unit characteristics. Heston found that the base (before taking into account the value of baths, size, etc.) rental equivalence was only marginally higher than that of rents. The analysis was conducted at the city level.

Out-of-Pocket Expenditures for Owner-Occupied Housing

Selected out-of-pocket (OOP) expenditures for shelter are examined in terms of their relationship to owners' implicit rental income. Shelter expenditures are also used to produce estimated values of net rental income for owner-occupants of housing.   The net rental income calculation is presented in the next section.

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[5] Since the year 2000, the recommended World Bank Living Standards Measurement Study questionnaire includes questions for respondents to report rental equivalence values for owned housing. Several countries have used the recommended questions and produced estimates of consumption that account for owner-occupied housing. The Residential Finance Survey includes a rent question for owners of rental property.

For comparison to the predicted implicit rents for owners, two more restrictive definitions of expenditures are employed: one that includes mortgage repayments and one that does not. Home equity loans and lines of credit are not considered. Other expenditures that are included are mortgage interest, property taxes, property insurance, and maintenance and repairs.

It is likely that interviewees consider their current shelter spending when answering the rental equivalence question. To try to understand this, the second rental equivalence model described earlier includes CE-defined OOP shelter spending as a regressor. CE-defined OOP expenditures include mortgage repayments, mortgage interest, property taxes, property insurance, maintenance and repairs (see Appendix A for definition), and other related expenses. Repayments and interest associated with home equity loans and lines of credit are included.

Net Implicit Rental Income from Owner-Occupied Housing

The owner occupant is both a consumer and producer of housing services. By living in the house, the owner-producer of housing services generates an implicit net rental income. Implicit net rental income is defined as:

$$R_n = (R_g - C) + \rho V \qquad (3)$$

where

R_n =   after tax net implicit rental income

R_g =   implicit gross rent

C =   operating costs net of tax preferences

ρ =   expected appreciation of owner-occupied housing

V = house market value.

Operating costs include the costs that a landlord has to pay to maintain the property, the cost of financing, and depreciation. Other than depreciation, the operating costs specifically include expenses for maintenance and repairs, mortgage interest, property taxes and other related expenses such as property insurance. Owner occupied housing has preferential treatment through the U.S. income tax code resulting in an even higher implicit rental income than would be possible without the tax treatment. Thus, before a net implicit income form owner occupied housing is estimated and if the homeowner itemizes when filing income taxes, adjustments should be made so that after-tax mortgage interest and after-tax property taxes are used in the estimation.[6] This adjustment will reduce C and R_n will be higher.

For the purposes of this study, a simplified definition of net rental income is used. Not accounted for are depreciation, appreciation, and the preferential tax treatment of mortgage interest and property taxes. Also, only half of the expenditure for homeowners' insurance is included in operating costs for the estimation of net implicit rental income. This adjustment is made since only the structure would be insured by an owner producer, not the contents. The BLS, in the production of the CPI, includes 50.5 percent of homeowners insurance expenditures as to reflect renter-like expenses.

Data

Data from the U.S. Consumer Expenditure (CE) Interview Survey are used to conduct this study. The CE Interview is sponsored by the Bureau of Labor Statistics with

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[6] Specifically, property taxes and mortgage interest would be included in C net of tax savings due to their deductibility. So, if the marginal income tax rate is τ_F, mortgage interest payments are I and property tax payments are T, then C would include $(I + T)(1 - \tau_F)$, i.e. the after-tax cost of mortgage interest and property taxes.

data collected by the Census Bureau. Data are collected using personal interviews or by telephone. Through the use of population weights the CE is made to represent the number of consumer units in the U.S. including urban and rural areas. Data have been collected on a continuing basis (data are collected each month in each calendar year) using the current design since the last quarter of 1979. Data are collected each month. For this study, data collected during the second calendar quarter of 2003 through the first calendar quarter of 2004 are analyzed.

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 first step in sampling is the selection of primary sampling units (PSUs) that consist of counties or parts thereof or groups of counties. The set of sample PSUs used for the 2003 samples is composed of 105 areas. The sampling frame (that is, the list from which housing units were chosen) for the 2003 survey was generated using the following:

- the 1990 Population Census Bureau 100-percent-detail file

- the detail file was augmented with new construction permits and techniques used to eliminate recognized deficiencies in census coverage.

The CE Interview is a panel rotation survey. Each panel is interview for five consecutive quarters and then dropped form the survey. As one panel leaves the survey, a new panel is introduced.

In the second calendar quarter of 2003, the BLS introduced the use of computer assisted personal interviewing (CAPI). The use of CAPI has affected responses to the rental equivalence question in the CE. With the introduction of CAPI, the response rates

to the rental equivalence question from previous quarters increased by about 20

percentage points (to over 80 percent). For consumer units who did not report rental

equivalence and should have, imputed values are assigned by the BLS using a hot deck

procedure based on primary sampling unit, building type, number of rooms in the living

quarters, size of rooms, number of complete baths, number of half baths, year built, and

whether the unit has central air conditioning or a window unit (Keil 2004).   Given the

change in rental equivalence data collection and the improvement in reporting, the

analysis is limited to CE data collected in the first twelve months of CAPI data

collection: 2003 calendar quarter two through 2004 calendar quarter one (2003Q2-

2004Q1). This time period was selected in order to compare results from Garner and

Short (2006) to those produced for in this study.

CE data are from the Interview component alone. The Interview is designed to

collect data from a consumer unit at five different time periods. Approximately 7,500

consumer units are interviewed each quarter of the calendar year. The first interview is a

bounding interview with housing unit characteristics and property values collected.

These are not asked again. The second interview takes place about one month later. This

is the first time consumer units are asked to report rental equivalence values and rents.

The consumer unit is asked the rental equivalence or and monthly rent question in three

following quarterly interviews, spaced three months apart. 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 three 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 those based on reported

rental equivalence in volatile markets. However, since the data are from a 12-month period, it is hoped that the impact of this difference in timing is not great.

Another restriction to the data is that the last interview in which the consumer unit participated is considered. This was to maximize the number of consumer units who would have gained experience in answering the rental equivalence question. Examining the data from the 2003Q2-2004Q1 time period reveals that consumer were fairly equally distributed as to whether they were participating in their second, third, fourth, or fifth interview.

To be included in the CE sample, renters are identified as consumer units living in a sampled unit with positive rent payments in the previous three months, do not receive rent as pay, do not live in government subsidized or public housing, and do not live in student housing. The CE does not currently ask whether the rental unit is rent-controlled so we were not able to eliminate these units from our analysis. Owner-occupants are identified as owners living in a sampled unit and have a positive value for reported rental equivalence and property value.

Unlike the sample data used for the Garner, Short and Kogan (2006) study, the owner sample was further restricted to include only those consumer units who lived in the same owned property in the last three months. This was done in order to more easily match maintenance and repair expenditures to the currently occupied housing unit. Only 1.3 percent of the owner sample had lived in another owned housing unit in the past three months.

An additional restriction was to limit the analysis to consumer units who reported paying monthly rent in the past three months, or those with reported rental equivalence

and reported current market values of their homes. Thus, no cases with imputations or other data adjustments were included in the study sample. After the earlier restrictions, approximately 96 percent of the renter sample reported monthly rents. Seventy-five percent of consumer units reported rental equivalence and 83 percent reported market values. Sixty-six percent of owners reported both rental equivalence and market value. Without the imputation restrictions, 31 percent of the sample was composed of renters and 69 percent of owners. With the additional restrictions, the analysis sample is composed of 42 percent renters and 58 percent owners.

All of the regressors and shelter expenditure variables had values (reported or imputed by the BLS) with the exception of dwelling age and the number of rooms, bathrooms, and half-baths. The room variables were quite infrequently missing (for less than 1.0 percent of the renters and less than 1 percent of the owners). In contrast, dwelling age was missing for about 12 percent of the owners but 38 percent for renters. Missing values were imputed for rooms and dwelling age using building type and PSU or at the region level if sample sizes were small at the PSU level. Due to the large percentage of cases with missing dwelling age, a dummy variable entered the model to control for the imputation.

Results

The results from the implicit rent models are presented first followed by a comparison of the predicted implicit rents for owners and net implicit rental income. Weighted sample means are presented for each regression model along with the estimated

regression coefficients. Each regression model was estimated using population weights.[7] Regression outlier detection was used. In this process observations were omitted from the regression sample when standardized residuals were greater than 2.5. As a result of applying this procedure, the sample sizes for the renter and owner samples combined may not equal the sample sizes of the two rent regression and owner regression samples.

Descriptive statistics for the capitalization rate hedonic regression model are presented in Table 1. Both renters and owners are included in the sample. Means are presented for each of the region-MSA groups. The means reveal that there are differences across the geographic areas regarding the housing unit characteristics and median property values. Homeownership is more prevalent outside central cities and the number of rooms in the dwelling units larger outside central cities as compared to other areas. Within central cities, properties tend to be older and more crowded. Contract rents are more likely to cover utilities in central cities than in other areas. Central cities in the Northeast and MSA not central city areas in the West boast the highest average monthly rents. Owned home property values are highest in MSA not central city areas, again with the West and Northeast with the highest averages.

Table 2 includes the regression coefficients and model statistics for the capitalization rate hedonic regression model. The shaded numbers represent variables with coefficients that are statistically significant at the 0.05 level. The primary focus of these results is the owner coefficient which will be used to produce the capitalization rate for each geographic area.   The capitalization rates are presented in Table 3. Before

[7] Caution should be applied in interpreting the regression coefficients as the sample design elements of the CE survey were not used. For this, each regression model would need to be run using CE replicate weights.

moving to Table 3, I make some observations about the regression model. First the following variables have statistically significantly coefficients in all the geographic models: owner, number of bathroom and mobile home. The number of bathrooms is positively related with higher rents and market values. If the dwelling is a mobile home, the relationship is negative. Positive rents and market values are associated with the number of rooms in the dwelling, number of half-baths, off-street parking, central air-conditioning, more persons per room, and higher median property values within primary sampling units (PSUs).

The implicit capitalization rates from the pooled rent and market value hedonic regression with Tenure are presented in Table 3. The rates from this study are presented in column one and are referred to as those for the "restricted sample." The rates from the earlier Garner, Short and Kogan (2006) study which are based on reported and imputed rents and property values are presented in the next two columns. For most geographic areas, the capitalization rates are higher for the restricted sample than for the unrestricted sample, and also higher than those produced using the AHS. The capitalization rates are the lowest for the West, follow by the Midwest. They are the highest in the South. This pattern is reflected in the rates for the unrestricted sample and in the AHS results as well. These results reveal that capitalization rates vary by geography, as others have shown (e.g., Phillips 1988) However, they also vary by sample and survey, which is rather disturbing unless we can identify the underlying reasons for the differences. Additional research is needed to understand the differences across the CE samples and the AHS sample.

Weighted sample means and regression coefficients from the regression of log monthly rents are presented in Table 4. Due to the relatively small sample sizes at the region-MSA level, these models were run at the region level only. The log model fits the data fairly well as the Adjusted R^2 values are in the range of 0.3 for all regions except the Midwest for which the model does not perform as well. These results support the importance of geography in modeling rents as there are differences across the regions regarding the regressors. Only three variables have statistically significant coefficients in all of the models: MSA not central city, central air-conditioning, and crowd. As in the capitalization rate model, the number of rooms and bathrooms, off-street parking, central air-conditioning, crowding, and higher median property values are associated with higher rents. Not contributing to the explanatory power in any of the models are whether the unit has a porch, balcony, or patio and window air-conditioning.

The sample means and summary regression statistics for the rental equivalence model using CE data are presented in Table 5. The linear regression models fit the rental equivalence data quite well with adjusted R^2s in the neighborhood of 0.70. Property value and property value squared are additional regressors in this model. The results presented in Table 5 reveal that all of the following variables have statistically significant coefficients: property value and value squared, MSA central city, the number of rooms, bathrooms, and half-baths, and the median value of owner-occupied housing in the PSU. The following variables do not contribute significantly to the explanatory power of the region-based models: single detached home, off-street parking, whether the housing unit has a porch, balcony, or patio, window air-conditioning, and crowding.

The median monthly imputed rents for owner-occupied housing using the different approaches are presented in Table 6 along with the out-of-pocket (OOP) expenditures for shelter for comparison. The first column includes median reported rental equivalence, the second column are those based on modeling, the third are derived by applying the renter hedonic coefficients to the owner sample, and the fourth are derived by applying the geographically based capitalization rates to each owned property. Owner shelter expenditures are presented for the OLS rental equivalence sample and for the capitalization rate model sample since net implicit rental income is derived for each sample separately. Shelter owner expenditures in columns five and seven, ownerexp1, include repayments of mortgage principals, mortgage interest payments, property taxes, homeowners' insurance, and maintenance and repair expenses. Ownerexp2, presented in columns six and eight, does not include mortgage principal repayments.

In all but one instance, West-not MSA, median reported rental equivalence is higher than modeled rental equivalence, and in all cases the reported and modeled rental equivalence values are higher than the renter hedonic and capitalization rate model values. The renter hedonic model produces the lowest implicit owner rents. This result could be related to the fact that rent-control units could not be identified in the sample, but also because renter units and owner units are not equal in terms of housing unit quality or neighborhood quality. Also, renter and owner units are likely to be in different neighborhoods. The capitalization rate hedonic model is based on property value, not just rents within a geographic area, thus higher estimated implicit rents result.

OOP expenditures are lower than reported and modeled rental equivalence. For all but one geographic area, West MSA not central city, ownerexp1 expenditures are also

lower than the implicit rents from the capitalization rate model. Owerexp1 expenditures are higher than the implicit rents from the hedonic renter model for the following geographic areas: Midwest MSA not central city, South, MSA not central city and Not MSA, and all of the West.

Table 7 includes median implicit net rental income based on the three approaches and OOP spending with the health insurance adjustment for the twelve geographic areas. Since the preferential tax treatment of mortgage interest and property taxes are not considered in the estimation, the incomes presented in Table 7 would be lower estimates of the "true" implicit rental income that owners receive producing and living in their own dwellings. As would be expected based on the results presented in Table 6, the highest Net implicit rental income is based on the modeled rental equivalence, followed by those based on the capitalization model. If depreciation were considered in the derivation of the incomes, the values would be expected to vary based on the age of the unit and weather conditions. If appreciate were considered, net implicit rental incomes would be higher or lower depending on the local economy regarding the market value of housing.

A final regression was conducted to see if demographic variables added any explanatory power to the rental equivalence model. Shelter spending on owner-occupied dwellings was also considered. Results from this regression are presented in Table 8. Quarterly spending on shelter is positively associated with reported rental equivalence as is higher education. It is not clear what role education is playing here. It could be that higher educated consumer units are more aware of the rental value of their owned properties, that they live in higher quality housing and or neighborhoods, or that they think their properties would rent for more than they actually would. Whether the

consumer unit had a mortgage or not did not contribute to the explanatory of the model, nor did the age of the respondent.

Conclusions

The primary purpose of this research was to explore three different approaches to value owner-occupied housing and to estimate the implicit rent for owner occupants using these approaches. Net implicit rental income was derived based on the implicit rents obtained and a simplified definition of operating expenditures. A secondary purpose was to explore what interviewees might be considering when answering the CE rental equivalence question.

The results presented in this study reveal that different approaches result in different implicit rents and net implicit incomes. The regression models underlying the rental equivalence model, and the property value component of the capitalization rate model fit the CE fairly well. The renter hedonic does not. More research is needed to better model the rent equation before it can be used to derive implicit rents for owner-occupants.

The rental equivalence regression model that accounts for respondent unit characteristics and shelter spending suggests that such variables can contribute to our understanding of reported rental equivalence in the CE. Additional research is needed to further understand the cognitive processed used by interviewees in answering the question. Underlying the reported rental equivalence question is the expectation that owners can estimate rental equivalences even when there is no comparable rental dwelling in the area if they know of rents in other areas (for example if there is no rental

housing in rural areas but there are rental units in nearby urban areas). The estimate might

not be of lower quality compared to a rental equivalence from a rental market that is

exactly like the one where owners live. In these cases, owners, with the help of

interviewers, could be walked through the steps needed to help them determine what they

would be willing to pay to rent the own dwelling or alternatively what they might charge

someone else to live there. Reporting what they would pay to live in their own dwelling

could be a very good estimate of the true rent.

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Appendix A. Definition of Maintenance and Repairs Using CE Interview Data

UCC   Definition

230112 Painting and papering labor and materials, owned dwelling
230113 Plumbing and water heater labor and materials, owned dwelling
230114 Heating, AC, and electricity labor and materials, owned dwelling
230115 Roofing and gutters labor and materials, owned dwelling
230122 Hard surface flooring labor and materials, owned dwelling
230142 Repair of disposal, dishwasher, or range hood, owned dwelling
230151 Other repair and maintenance labor and material, owned dwelling
230901 Property management, owned dwelling
240112 Paint, wallpaper, and supplies, owned dwelling
240122 Equipment for paint and wallpaper, owned dwelling
240212 Materials for panel, siding, etc., owned dwelling
240213 Materials and equipment for roof and gutter, owned dwelling
240222 Materials for patio, masonry, etc., owned dwelling
240312 Plumbing supplies and equipment, owned dwelling
240322 Electric supplies, and heating and cooling equipment, owned dwelling
320612 Construction materials, owned dwelling
320622 Floor repair or replacement materials, owned dwelling
340911 Management, special services, or security, owned dwelling

For this study, there were $0 for the following UCCs:
320632 (Landscaping materials, owned dwelling)
990930 (Materials for remodeling, etc. and for maintenance and repair,
         owned dwelling)

Table 1. Weighted Means by Region and MSA for Log Linear Model of Monthly Rent or Current Market Value of Owned Home: CE Interview 2003Q2-2004Q1
(restricted to cases with no data adjustment for rental equivalence, property value, or rent paid)

	Northeast			Midwest			South			West		
	MSA Central City	MSA not Central City	Not MSA	MSA Central City	MSA not Central City	Not MSA	MSA Central City	MSA not Central City	Not MSA	MSA Central City	MSA not Central City	Not MSA
sample size	470	1063	105	781	1300	418	1073	1612	594	1137	1383	315
Regressors												
Owner	0.336	0.684	0.644	0.477	0.731	0.694	0.461	0.647	0.620	0.457	0.626	0.497
Number of rooms not including baths	4.632	6.112	6.032	5.512	6.263	6.082	5.153	5.949	5.476	5.222	5.742	5.421
Number of bathrooms	1.124	1.437	1.294	1.278	1.569	1.464	1.509	1.750	1.577	1.563	1.715	1.533
Number of half-baths	0.202	0.409	0.309	0.254	0.440	0.223	0.209	0.321	0.180	0.185	0.281	0.224
Dwelling age	62.791	50.416	67.432	50.797	36.454	44.277	32.179	25.082	29.150	33.547	29.140	27.052
Dwelling age imputed indicator	0.505	0.239	0.293	0.431	0.213	0.257	0.464	0.290	0.359	0.371	0.262	0.394
Single detached home	0.190	0.640	0.646	0.568	0.697	0.759	0.538	0.633	0.672	0.523	0.663	0.574
Mobile home	0.003	0.030	0.081	0.010	0.024	0.096	0.020	0.070	0.145	0.019	0.057	0.094
Off-street parking	0.370	0.835	0.865	0.807	0.886	0.932	0.847	0.860	0.863	0.805	0.891	0.791
Porch	0.327	0.696	0.778	0.720	0.793	0.782	0.734	0.808	0.821	0.696	0.791	0.770
Central AC	0.119	0.351	0.037	0.551	0.709	0.568	0.761	0.867	0.639	0.480	0.508	0.275
Window AC	0.453	0.398	0.236	0.261	0.184	0.324	0.186	0.112	0.209	0.117	0.128	0.111
Crowd (persons per room)	0.541	0.446	0.388	0.448	0.449	0.428	0.491	0.476	0.481	0.539	0.542	0.429
Energy utilities included in rent	0.497	0.154	0.178	0.171	0.097	0.075	0.155	0.061	0.050	0.133	0.083	0.052
Water and/or trash utilities in rent	0.630	0.285	0.294	0.436	0.218	0.168	0.361	0.239	0.193	0.450	0.275	0.379
Median property value/1000 within PSU	$252.037	$199.829	$62.872	$133.908	$147.038	$91.894	$113.158	$133.029	$97.374	$237.308	$250.906	$139.068
Dependent variable												
ln of monthly rent or ln property property value	$8.315	$10.280	$9.129	$8.638	$10.395	$9.536	$8.503	$9.789	$9.168	$9.042	$10.092	$8.796
monthly rent	$789	$725	$442	$512	$604	$362	$494	$610	$389	$723	$809	$453
property value	$200,741	$234,023	$72,256	$116,134	$183,672	$105,633	$116,406	$161,074	$100,805	$257,305	$268,688	$169,369

Table 2. Regression Coefficients for Log Linear Model of Monthly Rent or Current Market Value of Owned Home: CE Interview 2003Q2-2004Q1

(restricted to cases with no data adjustment for rental equivalence, property value, or rent paid)

	Northeast			Midwest			South			West		
	MSA Central City	MSA not Central City	Not MSA	MSA Central City	MSA not Central City	Not MSA	MSA Central City	MSA not Central City	Not MSA	MSA Central City	MSA not Central City	Not MSA
sample size	470	1063	105	781	1300	418	1073	1612	594	1137	1383	315
Regressors												
Intercept	4.655	4.833	5.471	5.261	4.752	4.327	4.586	4.854	4.574	5.054	5.004	4.743
Owner	5.107	5.199	4.525	5.122	5.274	4.979	4.988	5.056	4.985	5.630	5.327	5.277
Number of rooms not including baths	0.023	0.064	0.080	0.007	0.063	0.028	0.066	0.068	0.085	0.046	0.073	0.057
Number of bathrooms	0.351	0.317	0.346	0.274	0.329	0.349	0.324	0.264	0.284	0.175	0.217	0.404
Number of half-baths	0.083	0.144	0.233	0.150	0.211	0.138	0.137	0.162	0.175	0.101	0.105	-0.015
Dwelling age	0.001	-0.002	-0.002	-0.004	-0.001	-0.001	0.000	-0.004	-0.006	-0.003	-0.001	-0.007
Dwelling age imputed indicator	-0.121	-0.012	-0.329	-0.176	-0.025	-0.412	-0.099	-0.085	-0.073	-0.016	-0.062	0.115
Single detached home	0.166	0.037	-0.624	-0.034	0.107	0.272	0.096	0.125	0.371	0.181	0.060	0.239
Mobile home	-2.800	-0.872	-1.590	-2.198	-1.422	-0.899	-1.112	-0.967	-0.483	-1.104	-1.119	-0.873
Off-street parking	0.221	0.192	0.178	-0.013	-0.024	0.262	0.022	-0.017	-0.062	-0.053	0.022	-0.049
Porch	0.027	-0.005	0.231	-0.032	0.048	0.203	-0.032	0.087	0.164	0.000	0.138	0.202
Central AC	0.190	0.141	0.065	0.202	0.005	-0.202	0.215	0.108	0.166	-0.009	0.008	-0.050
Window AC	0.080	0.021	0.277	-0.009	-0.092	-0.161	-0.060	-0.160	-0.166	-0.225	-0.126	-0.367
Crowd (persons per room)	0.159	0.152	0.391	0.247	0.140	0.177	0.122	0.115	0.041	0.093	0.039	0.230
Energy utilities included in rent	0.026	-0.025	0.480	0.178	-0.027	-0.021	-0.139	0.033	0.133	-0.200	0.083	-0.052
Water and/or trash utilities in rent	0.010	0.061	-0.957	-0.153	0.181	0.379	0.177	0.113	0.269	0.214	-0.010	0.009
Median property value/1000 within PSU	0.005	0.004	0.002	0.005	0.005	0.008	0.005	0.005	0.004	0.004	0.003	0.003
Model Adjusted R2	0.947	0.946	0.949	0.965	0.968	0.915	0.947	0.958	0.954	0.946	0.949	0.932
Model RMSE	0.603	0.637	0.572	0.514	0.464	0.779	0.628	0.555	0.582	0.691	0.645	0.776

A shaded number indicates the variable coefficient in the regression model is statistically significant at the 0.05 level.

Table 3. Capitalization Rates Based on Regression Model of Log Monthly Rent or Log Property Value

	Consumer Expenditure Survey 2003		American Housing Survey 2003[a]
	Restricted Sample	**Unrestricted Sample**[a]	
region/msastat regressions			
Northeast			
MSA Central City	7.267	5.644	5.511
MSA not Central City	6.628	6.242	6.372
Not MSA	13.005	12.446	7.606
		14.913	
Midwest			
MSA Central City	7.156	6.746	7.910
MSA not Central City	6.145	6.047	8.262
Not MSA	8.255	6.811	8.219
South			
MSA Central City	8.180	8.117	8.182
MSA not Central City	7.645	7.944	9.477
Not MSA	8.204	7.776	9.212
West			
MSA Central City	4.308	4.324	5.279
MSA not Central City	5.830	5.429	6.085
Not MSA	6.130	6.567	8.738
region regressions			
Northeast	7.698	6.796	
Midwest	6.886	6.447	
South	7.731	7.835	
West	5.352	5.218	
national regression			
National	6.703	6.565	7.326

[a] Garner and Short 2006 (Southern Economics Association Annual Conference, November 2006).

Table 4. Weighted Means and Regression Coefficients for Log Linear Model of Monthly Rent:

CE Interview 2003Q2-2004Q1 (restricted to cases with no data adjustment for rent paid)

	Northeast		Midwest		South		West	
sample size	691		907		1373		1330	
	mean	**coefficient**	**mean**	**coefficient**	**mean**	**coefficient**	**mean**	**coefficient**
Regressors								
Intercept	1.000	4.983	1.000	5.150	1.000	4.671	1.000	5.389
MSA Central City	0.449	0.201	0.452	0.111	0.411	0.094	0.431	0.084
MSA not Central City	0.474	0.182	0.346	0.206	0.382	0.131	0.413	0.143
Number of rooms not including baths	4.238	0.023	4.596	0.015	4.383	0.073	4.300	0.013
Number of bathrooms	1.065	0.386	1.158	0.062	1.377	0.107	1.336	0.092
Number of half-baths	0.137	0.096	0.146	-0.031	0.142	0.080	0.134	0.116
Dwelling age	63.86	0.00	46.967	-0.002	30.938	-0.002	33.436	-0.002
Dwelling age imputed indicator	0.618	-0.080	0.635	-0.019	0.685	-0.045	0.561	0.011
Single detached home	0.111	-0.110	0.267	0.037	0.289	-0.047	0.296	0.082
Mobile home	0.017	-0.572	0.041	-0.111	0.062	-0.229	0.038	-0.274
Off-street parking	0.506	0.168	0.832	0.035	0.829	0.040	0.813	-0.014
Porch	0.366	-0.059	0.620	-0.001	0.682	0.034	0.620	0.018
Central AC	0.119	0.270	0.420	0.168	0.689	0.249	0.341	0.077
Window AC	0.403	0.066	0.362	0.058	0.196	0.045	0.147	-0.052
Crowd (persons per room)	0.537	0.257	0.500	0.201	0.551	0.278	0.605	0.120
Energy utilities included in rent	0.604	0.001	0.321	0.083	0.210	-0.079	0.209	-0.158
Water and/or trash utilities in rent	0.919	-0.015	0.766	-0.006	0.638	0.105	0.777	-0.031
Median property value/1000 within PSU	$219.605	0.003	$132.513	0.004	$119.578	0.004	$235.674	0.003
Dependent variable								
ln of monthly rent	$6.426		$6.098		$6.091		$6.404	
monthly rent	$721		$515		$512		$706	
Model Adjusted R2		0.336		0.197		0.317		0.327
Model RMSE		0.478		0.527		0.470		0.484

A shaded number indicates the variable coefficient in the regression model is statistically significant at the 0.05 level.

4

Table 5. Weighted Means and Regression Coefficients for Linear Regression Model of Reported Rental Equivalence: CE Interview 2003Q2-2004Q1
(restricted to cases with no data adjustment for rental equivalence and property value)

	Northeast		Midwest		South		West	
sample size	940		1574		1877		1467	
	mean	**coefficient**	**mean**	**coefficient**	**mean**	**coefficient**	**mean**	**coefficient**
Regressors								
Intercept	1.000	-242.779	1.000	-154.976	1.000	-140.967	1.000	17.460
Property value/1000	$212.963	2.516	$143.906	2.969	$135.039	3.981	$249.389	3.320
Property value squared/1000	$80,711	0.000	$34,049	0.000	$32,207	-0.002	$97,948	-0.001
MSA Central City	0.166	-135.106	0.230	148.439	0.251	198.230	0.30054	68.753
MSA not Central City	0.728	3.192	0.511	162.226	0.502	199.251	0.57081	47.006
Number of rooms not including baths	6.684	46.873	6.712	11.242	6.415	28.023	6.49137	31.825
Number of bathrooms	1.518	74.421	1.597	93.093	1.811	96.410	1.86993	68.054
Number of half-baths	0.484	46.723	0.423	62.563	0.326	19.029	0.32153	45.125
Dwelling age	50.37	-0.495	40.43	-0.764	26.688	-1.703	27.99136	-2.070
Dwelling age imputed indicator	0.105	57.364	0.107	18.711	0.130	-12.132	0.11983	-88.891
Single detached home	0.795	15.969	0.892	47.139	0.839	-40.578	0.85036	50.277
Mobile home	0.036	-115.389	0.042	1.736	0.081	-121.795	0.06038	-0.612
Off-street parking	0.850	10.873	0.893	-9.556	0.875	37.873	0.87306	-5.858
Porch	0.758	6.250	0.848	20.872	0.860	-10.682	0.86576	6.845
Central AC	0.349	153.622	0.737	42.122	0.845	24.602	0.56613	54.150
Window AC	0.400	49.826	0.176	-9.035	0.133	-17.689	0.10096	-24.256
Crowd (persons per room)	0.419	100.802	0.413	14.819	0.435	36.328	0.46199	58.109
Median property value/1000 within PSU	$188.434	2.663	$127.951	2.220	$117.329	1.161	$224.034	0.900
Dependent variable								
reported monthly rental equivalence	$1,312		$967		$961		$1,346	
Model Adjusted R2		0.679		0.697		0.718		0.711
Model RMSE		443.576		293.253		961.023		335.339

A shaded number indicates the variable coefficient in the regression model is statistically significant at the 0.05 level.

Table 6. Median Monthly Implicit Rents and Expenditures for Owners: CE Interview 2003Q2-2004Q1

(restricted to cases with no data adjustment for rental equivalence and property value)

	Implicit Rents				Out-of-pocket Expenditures			
	Reported rental equivalence	Modeled rental equivalence	Renter hedonic model	Capitalization rate model	Shelter	Shelter minus mortgage principal	Shelter	Shelter minus mortgage principal
model specification		*linear*	*log linear*	*log linear*	*(ownerexp1)*	*(ownerexp2)*	*(ownerexp1)*	*(ownerexp2)*
Northeast								
MSA Central City	$1,200	$1,212	$908	$1,090	$683	$580	$664	$577
MSA not Central City	$1,200	$1,351	$933	$1,022	$853	$683	$858	$685
Not MSA	$500	$559	$377	$650	$288	$268	$288	$254
Midwest								
MSA Central City	$800	$839	$530	$572	$497	$391	$511	$401
MSA not Central City	$1,000	$1,104	$659	$794	$773	$574	$797	$595
Not MSA	$500	$573	$412	$585	$347	$252	$347	$250
South								
MSA Central City	$800	$834	$533	$614	$480	$386	$485	$387
MSA not Central City	$1,000	$1,071	$668	$860	$729	$580	$732	$589
Not MSA	$550	$605	$442	$581	$321	$221	$331	$229
West								
MSA Central City	$1,200	$1,304	$762	$754	$855	$677	$861	$686
MSA not Central City	$1,300	$1,353	$893	$1,069	$952	$763	$973	$779
Not MSA	$1,000	$951	$554	$727	$596	$531	$625	$535
produced at this level	*region*	*region*	*region*	*region/msastat*	*owner OLS sample*		*owner cap rate sample*	

Table 7. Median Monthly Implicit Net Rental Income for Owners: CE Interview 2003Q2-2004Q1

(restricted to cases with no data adjustment for rental equivalence and property value)

	Net Rental Income		
	Modeled rental equivalence	**Renter hedonic model**	**Capitalization rate model**
Northeast			
MSA Central City	$510	$347	$318
MSA not Central City	$571	$282	$330
Not MSA	$296	$215	$404
Midwest			
MSA Central City	$418	$130	$171
MSA not Central City	$483	$81	$194
Not MSA	$260	$173	$254
South			
MSA Central City	$412	$163	$209
MSA not Central City	$464	$143	$265
Not MSA	$298	$238	$288
West			
MSA Central City	$553	$110	$63
MSA not Central City	$473	$127	$263
Not MSA	$413	$78	$216
	OLS sample		*owner cap rate sample*

Table 8. Weighted Means and Regression Coefficients for Linear Regression Model of Reported Rental Equivalence with Demographic Variables: CE Interview 2003Q2-2004Q1 (restricted to cases with no data adjustment for rental equivalence and property value)

sample size	Northeast 938 mean	coefficient	Midwest 1573 mean	coefficient	South 1876 mean	coefficient	West 1466 mean	coefficient
Regressors								
Intercept	1.000	-201.523	1.000	-137.023	1.000	-130.017	1.000	30.165
Property value/1000	$214.606	1.265	$144.458	2.691	$134.932	3.641	$249.781	2.816
Property value squared/1000	$89,149	0.000	$34,780	0.000	$32,278	-0.001	$99,030	-0.001
MSA Central City	0.167	-118.829	0.231	143.708	0.252	182.181	0.300	72.513
MSA not Central City	0.727	0.833	0.510	153.858	0.501	181.035	0.572	56.580
Number of rooms not including baths	6.680	39.298	6.716	6.932	6.407	24.018	6.491	25.240
Number of bathrooms	1.519	65.045	1.597	75.777	1.807	66.677	1.870	60.217
Number of half-baths	0.484	46.084	0.424	59.871	0.326	5.976	0.322	51.918
Dwelling age	50.302	-0.650	40.405	-0.757	26.633	-1.598	28.031	-1.812
Dwelling age imputed indicator	0.105	42.975	0.105	8.395	0.130	-13.208	0.120	-86.064
Single detached home	0.793	43.215	0.891	32.365	0.839	-45.807	0.850	64.362
Mobile home	0.036	-135.265	0.042	14.614	0.082	-115.735	0.060	-3.989
Off-street parking	0.849	-6.873	0.892	-30.783	0.875	27.917	0.873	-8.503
Porch	0.757	17.606	0.849	26.763	0.860	-15.829	0.865	-15.801
Central AC	0.348	119.343	0.737	42.725	0.846	30.471	0.567	46.534
Window AC	0.399	41.369	0.176	6.808	0.133	-1.564	0.102	-18.945
Crowd (persons per room)	0.420	68.962	0.413	-14.824	0.435	27.292	0.462	51.936
Median property value/1000 within PSU	188.233	2.928	127.958	2.001	117.205	0.991	223.905	0.797
Percent of renters within PSU	0.384	-160.586	0.342	-19.846	0.401	82.303	0.456	31.450
Quarterly spending on shelter	$3,225	0.034	$2,390	0.019	$2,228	0.023	$3,333	0.040
Has mortgage	0.670	-26.270	0.693	32.790	0.663	-12.782	0.759	-45.932
High school graduate	0.299	92.418	0.297	19.469	0.265	33.396	0.195	55.316
College < BA/BS	0.281	121.666	0.314	56.618	0.307	63.898	0.331	50.845
College graduate	0.205	247.965	0.203	72.262	0.203	113.661	0.237	69.273
Greater than undergraduate	0.141	333.128	0.105	162.778	0.102	162.574	0.128	101.427
Age less than 65 years	0.822	9.875	0.842	30.151	0.820	16.937	0.827	5.548
Dependent variable								
reported monthly rental equivalence	$1,313		$968		$960		$1,349	
Model Adjusted R2		0.741		0.723		0.7291		0.7289
Model RMSE		426.730		385.983		296.272		330.10418

A shaded number indicates the variable coefficient in the regression model is statistically significant at the 0.05 level.