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Measuring the external benefits of homeownership

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ABSTRACT

The subsidization of homeownership is justified on efficiency grounds only to the extent that it provides benefits to people other than the homeowner. We use the clustered neighborhoods subsample in the American Housing Survey to measure that benefit in the form of higher housing prices in neighborhoods with higher ownership rates (and lower vacancies). We attempt to account for unobservable neighborhood and house attributes that may be correlated with occupancy and ownership through instrumental variables, switching regressions and panel methods. Estimates indicate that a housing transition from renting to owning creates approximately $1300 in measured benefits.

1. Introduction

Homeownership is heavily subsidized by the federal government through various tax expenditures and other programs that directly or indirectly provide substantial encouragement for households to become homeowners. Prominent among these is the exemption from tax of the implicit rental income generated by owner-occupation, and the deductibility of mortgage interest payments from income. Capital gains from the sale of owner-occupied housing are also subject to exclusions and there are other subsidies in the tax code that accrue to owner-occupiers. Using data from 1990, Gyourko and Sinai (2003) estimate that the treatment of implicit rent and mortgage deductibility alone reached almost 200 billion dollars in tax expenditures (see also Poterba and Sinai, 2008). Moreover there have been numerous state and local programs designed to foster ownership, including homestead exemptions from local property taxes and other programs particularly aimed at neighborhoods with below average incomes and environments. All recent US administrations have been seen as fostering homeownership; the presidential quotations cited in Gabriel and Rosenthal (2004) bear witness to the political popularity of promoting homeownership.

Considerable doubt has been cast on the desirability of these policies, especially in light of the recent economic downturn. While this paper is not the appropriate venue for a discussion of that downturn, it is appropriate to note that the usual recitation of its chronology lays some blame on the credit risk posed by households entering ownership without the financial means to do so, and that the public subsidization of homeownership did nothing to discourage such risk-taking. Quite the opposite. However, even before recent events focused US attention on the tax treatment of ownership, there were doubts about the interest deduction and similar subsidies. A prominent example of this is the President's Commission Advisory Panel on Tax Reform, which in its final report of November 2005 suggested that it be replaced with a 15% tax credit.[1]

Perhaps worse, at least from an efficiency perspective, is the deadweight loss associated with the special tax treatment of owner-occupied housing. Poterba (1992) calculates the deadweight loss associated with the income tax code's treatment of housing, and finds it to be substantial, especially so for those in higher tax brackets.

The justification for the tax treatment of housing, or any subsidization of ownership should not rest on its status as a merit good – that ownership is part of the "American Dream" and thus "should" be accessible to any household – but with the more compelling justification that ownership creates external benefits; that ownership not only creates private benefits, but also benefits for the neighborhood and broader community. Over the past two decades or so a research program has grown around the identification of external effects that are created by ownership. Three sets of

[1] It is worth noting that in light of the exclusion of implicit rent, the mortgage interest deduction merely puts debt and cash purchases of houses on the same footing. Even in the absence of the MID, there would still be substantial financial advantages to ownership.

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effects have been so identified and on that account debated in the literature, and all of them are the subject of mixed findings:

a. *Maintenance and appearance*: Rossi-Hansberg et al. (2010), among others, document the strong spillover effects of housing revitalization expenditures. However, in the absence of directed policy expenditures as described by these authors, the literature suggests that neighborhood maintenance is more likely to be undertaken by owner-occupiers than by renters. Renters have little incentive to perform maintenance directly, since the return on such investment accrues not to them but to the landlord, and the landlord cannot credibly commit to properly compensating tenants for proper maintenance, or what amounts to the same thing, punishing tenants for excessive wear and tear (Henderson and Ioannides, 1982). Landlords do have an incentive to maintain the property, but this comes at a higher cost when the landlord is an absentee one. Galster (1983) and Harding et al. (2000) both come to the conclusion that owner-occupied properties are better maintained than rental properties. DiPasquale and Glaeser (1999) report some similar findings. A cautionary note is presented by Gatzlaff et al. (1998), who find that there are basically no differences in the appreciation rates of rented and owner-occupied dwellings.
b. *Children*: Green and White (1997) and Haurin et al. (2002) both contain evidence to suggest that children growing up in owner-occupied dwellings have higher high school graduation rates and cognitive test scores, which potentially confer external benefits. Aaronson (2000) notes that this seems to be due to the longer spells that owners have in their place of residence. It also should be noted that recent papers by Barker and Miller (2009) and Holupka and Newman (2012) cast doubt on the link between childhood outcomes and ownership.
c. *Citizenship*: In a widely-cited paper, DiPasquale and Glaeser (1999) provide substantial evidence that homeowners are more involved with local organizations and community, have greater knowledge of their local elected officials, and vote with greater frequency. Not all of this is necessarily productive. Fischel (2001) notes that homeowners will be more active adherents of NIMBYism (i.e. not in my back yard) and that this may devolve to mere rent-seeking. Contrary evidence is obtained by Engelhardt et al. (2010) who use a randomized treatment to obtain exogenous shifting of households into ownership. They find little evidence of increased civic or neighborhood involvement by these new owners.

In sum, the literature has emphasized the possibility of specific actions by homeowners that potentially create positive spillovers, but there appears to be none for which there is unmixed empirical support. The lacuna in the above literature is that the monetary value of these behaviors, or other external benefits of homeowners, is not measured. Conceptually, it would be straightforward to calculate the externality value of homeownership, even if the behaviors are not directly observable. If ownership is valuable to the owner's neighbors then those neighbors should be willing to pay more to live near owner-occupiers. A hedonic regression, one that correlates housing prices (where this can be either the flow rent, or the asset price) to the numerous structural and locational characteristics embodied in them, could include some measure of the ownership propensity in the neighborhood, and that characteristic should, if the aforementioned externalities exist, have a positive coefficient in the regression. Indeed, Nelson (1979), Kohhase (1991), and likely dozens of other authors have found that the ownership rate within a census tract has a positive relationship with housing prices in that tract. However, the obvious problem is that there is unobserved heterogeneity across neighborhoods that can cause the correlation to be spurious. (Coulson et al., 2002) tried come to grips with the problem of consistently estimating the hedonic price of neighborhood homeownership in the presence of this heterogeneity. In that light, we are in the tradition of recent literature which tries to measure the impact of measures of local amenities and disamenities through housing prices, even when the quality dimension under examination is potentially endogenous. Methods that deal with this endogeneity include border models (e.g. Black, 1999) and other regression discontinuity designs (e.g. Greenstone and Gallagher (2008)); panel and difference-in-difference approaches (e.g. Voicu and Been, 2008); random treatment (e.g. Pope, 2008); structural modeling of endogenous treatments (e.g. Noonan and Krupka, 2011); spatial dependence (e.g. Ahlfeldt and Maennig, 2010) and so on. Numerous authors have used these methods in a wide variety of applications, but none of these are completely suitable for our purposes.

Like Hoyt and Rosenthal (1997), Coulson et al. (2002), Ioannides (2003) and Myers (2004) we use the "cluster samples" of the American Housing Survey (AHS) – about which more below – to identify neighborhoods. These data are uniquely qualified to answer our question; it is the only data we know of to contain information on both renters and owner who are contiguous, linked in a panel with only 4 years between samples, with detailed information on both the house and the demographic characteristics. In our baseline model we entertain a simpler identification scheme than Coulson et al. (2002), by simply exploiting the panel nature of this data to account for unobservable neighborhood and house heterogeneity. We assume that neighborhood unobservables are constant within neighborhoods and over time, and this allows us to use temporal variation in neighborhood homeownership rates to identify the neighborhood homeownership effect. Hedonic regressions are estimated for owner-occupied properties where the hedonic attributes include a number of structural and neighborhood attributes and we find in this baseline specification that a marginal increase in the ownership rate of about 9% points (i.e. one house in an 11-house cluster) increases the price of housing in the neighborhood by about 4.5%.

In the subsequent section we provide an important robustness check on this model. In this check we account for the possibility that the neighborhood fixed effects, while constant within neighborhoods at any particular point in time, may not be constant over time. This is potentially important because the reason that both neighborhood housing prices and neighborhood ownership rates have increased together over time is because the unobserved neighborhood quality may have also moved in the same direction. Even fixed effect estimation will produce inconsistent estimates of the key parameters in such a case. There are two effects to account for. The first is that instruments are now needed for the neighborhood ownership rate (and other neighborhood-level variables). We again exploit the panel nature of the data, using lagged variables to provide instruments. We present conditions under which this is acceptable and find the parameter estimate quite comparable to the baseline model. We then apply similar procedures to instrument other neighborhood-level variables that describe the demographics of the neighborhood. The key coefficient is, again, similar.

We then turn to the selection effect. When fixed effects do not completely account for the unobservables, we note that the selection of houses into owner and rental categories is not necessarily conditionally random. We employ a standard switching regression technique to take this selection into account. We note, however, that (a) there is a non-negligible number of vacant houses in the sample, so we also include the neighborhood occupancy rate in the specification and (b) we do not observe the value of these unoccupied properties, so that when the unobservables are not completely accounted for by fixed effects, we must account for the selection into occupancy (and observable price) even before accounting for selection into owner-occupation. We model this in the usual parametric fashion first described by Poirier (1980) and applied by, among others, Hotchkiss and Pitts (2005) and Lahiri and Song (2000). This is basically a Heckman correction with Mills ratios derived from a bivariate probit model. Implementing this procedure leads to homeownership externality estimates that are in fact much larger than those estimated previously. This may be due to the high degree of collinearity between the Mills ratios and the instrumented neighborhood characteristics.

We next use house-specific fixed effects instead of neighborhood fixed effects, to account for house-specific unobservables. The estimates are again very comparable to those in previous estimates, although the stability of the estimates is understandably compromised when both selection and the IV are taken into account. We then repeat the exercise for rental properties. Here we encounter data issues, since the number of rental properties in each neighborhood is small. The relevant coefficients are nevertheless usually positive, though their precision is not what would be hoped for.

Finally, we provide some evidence from the Panel Survey of Income Dynamics to investigate whether the results we get are from selection on the basis of unobservable personal characteristics (as opposed to unobserved neighborhood characteristics). We find there is no evidence of this.

The paper proceeds with a discussion of the American Housing Survey data that we use in the estimation. We then describe the model and the baseline estimates, along with the extensions discussed above. We conclude with a simple back of the envelope calculation that compares our externality estimates to the size of the deadweight loss of the mortgage interest tax deduction.

2. Data

Our data comes from the American Housing Survey (AHS). While the AHS takes a couple of different forms, our data are from the National Sample, which is a biennial survey of over 50,000 housing units from across the USA. It is important to note that this sample repeatedly surveys the same units, so it is a panel of the units, but not necessarily the same occupants. The AHS records data on the price and physical structure of the units (size, assortment of rooms and other characteristics) and the occupants (including income and some limited financial data along with numerous demographic characteristics) as well as the quality of the location and housing unit, as evaluated by the occupants.

There are both rental and owner-occupied units in the sample. The price given in each record corresponds to the tenure type: rental units report the monthly rent, while the owners provide an estimate of the current market value of the unit. This latter estimate is of course subject to error (as is perhaps the rent reportage), however Kiel and Zabel (1997) note that while the error has a positive bias, given owners' optimism about the value of their assets, this bias is uncorrelated with housing attributes, so that only the intercept term is affected.

Importantly for our purposes, in the 1985, 1989 and 1993 waves of the survey, for a limited number of respondents (called "kernel" respondents) the sample also included "neighborhood clusters". These clusters are the 5–10 housing units that are nearest to the respondent in question (Myers, 2004). These contiguous units are only sampled in the given years and in particular not surveyed in the 1987 or 1991 waves. We assemble a panel data set consisting of the kernels and the surrounding cluster for each of the three surveys. The units are classified as being in one of the three states: vacant, rented, or owner-occupied.

In the United States, owner-occupied housing is strongly associated with single family structures. The reasons for this are open to debate (Glaeser, 2011; Coulson and Fisher, 2012) but Glaeser and Sacerdote (2000) note that the types of social interactions that occur in the former type of housing can be different than those in the latter. For this combination of reasons, we limit our analysis to clusters which are entirely composed of single family households. To include multiple structure types would complicate our analysis immensely, and to use anything other than single family housing as our sample would unduly limit the size of our database.

Table 1 presents the transition matrices between each of the three states for the houses in the panel, for both of the transition periods 1985–1989 and 1989–1993. The table entries are sample counts for each of the transition possibilities. Since the data set is comprised of single-family houses only, the ownership rate is high, above 80%. Note that once a house enters the ownership state it tends to persist in that state; for example 93% of homes that were owned in 1985 remain in that state in 1989. However persistence in the rental and vacancy states is much less pronounced. Only half of 1985 rental units remained rentals in 1989. The proportion rises to about 60% in the 1989–1993 transition. The number of vacancies is small in both years (though perhaps larger than expected given that these are largely owner-occupied properties) and there is little persistence (around 15%) in that state in each of the 4 year transitions. All of these facts are congruent with evidence on the longer tenancy spells in owner-occupied housing (Rohe and Stewart, 1996) (see Table 2).

The persistence of the ownership state need not concern us to the extent that our need is for temporal variation in cluster ownership rates, rather than the state of the individual unit. Fig. 1 speaks to that point. For each of the transition periods, for both the neighborhood occupancy and ownership rates, we graph the number of relevant clusters at each pair of t and $t + 4$ rates. The numbers on the diagonal therefore represent counts of neighborhoods that had constant rates over the 4 year transition period. As can be seen,

Table 1
These tables represent the transitions to and from the three house states for the two 4-year periods 1985–1989 and 1989–1993.

	1989		
	Owner-occupied	Rental	Vacant
1985			
Owner-occupied	2639	113	84
Rental	110	240	31
Vacant	68	39	20
	1993		
1989			
Owner-occupied	2652	82	83
Rental	92	255	45
Vacant	71	44	20

Table 2
Distribution of cluster sizes.

Number of units in neighborhood	Number of neighborhoods
4	17
5	28
6	24
7	33
8	55
9	65
10	79
11	86

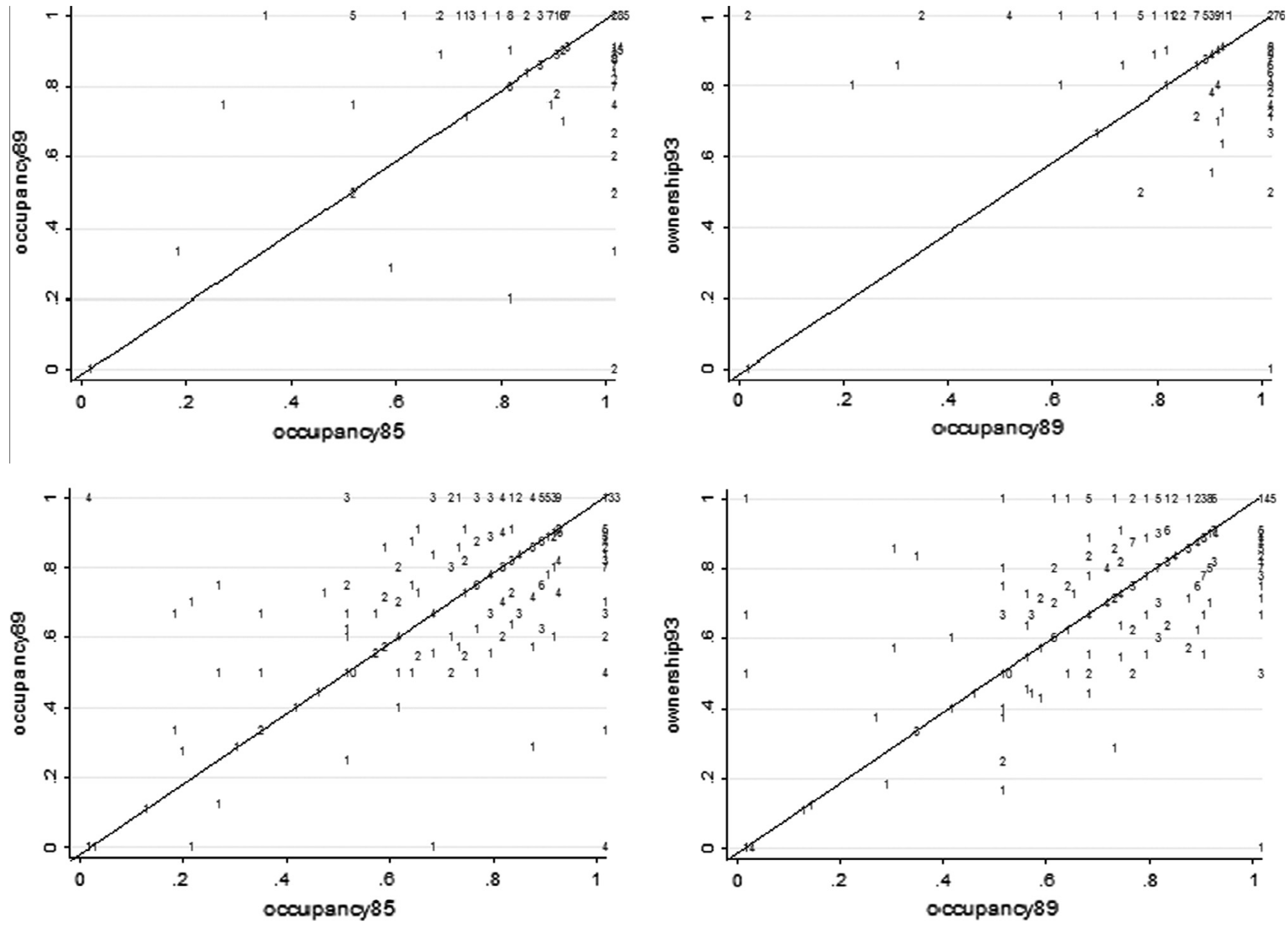

Fig. 1. The plot entries are the number of neighborhoods in the sample with the indicated occupancy or ownership rates in the indicated years.

there is rather a lot of persistence in occupancy rates, most notably visible in the fact that somewhere around 2/3 or more of the neighborhoods start and stay at 100% occupancy. This will hamper our ability to measure the effect of vacancies on cluster housing prices. The problem is much less acute, although still visible, with respect to ownership rates; about one-third of the clusters have 100% ownership in both time periods. But overall, there appears to be sufficient changes in neighborhood ownership to identify its effects, though this is not so clear with respect to occupancy rates. Reinforcing this notion is Table 3, which presents changes in ownership and occupancy rates between surveys. Note that about half of the clusters experience no change in ownership rates between surveys while the clusters that do experience changes usually do so within a 30% increase or decrease.

We turn now to the specification of the empirical model.

3. Specification and estimates of baseline models

The preceding considerations suggest an empirical model for housing price (P) and rent (R) based on the following semi-log approximation:

$$\ln P_{ijt} = X_{it}\varphi + \overline{Z}_{jt}\gamma + \overline{H}_{jt}\delta + \overline{O}_{jt}\theta + \alpha_{it} + \tau_{jt} + \varepsilon_{ijt} \quad (1)$$

$$\ln R_{ijt} = X_{it}\varphi' + \overline{Z}_{jt}\gamma' + \overline{H}_{jt}\delta' + \overline{O}_{jt}\theta' + \alpha'_{it} + \tau'_{j} + \varepsilon'_{ijt} \quad (2)$$

The log-linear form is a convenience in that it will allow us to compare the sizes of the coefficients in the rental and owner equations. Note that $i = 1,\ldots,n$ indexes housing units, $j = 1,\ldots,J$ indexes neighborhood clusters, and t indexes time periods. Also

P_{ijt} = price of housing unit i in neighborhood j at time period t.
R_{ijt} = rent of housing unit i in neighborhood j at time period t.
X_{it} = vector of physical characteristics of housing unit i in year t.
$\bar{z}_{jt}$ = vector of demographic characteristics of neighborhood j. This consists of averages of demographic characteristics of the cluster residents. That is, with n_j as the number of units in cluster j,

$$\overline{Z}_{jt} = \sum_{i=1}^{n_j} Z_{ijt}/n_j \quad (3)$$

O_{ijt} = 1 if house i in neighborhood j at time t is occupied by an owner or a renter (and = 0 if vacant).
H_{ijt} = 1 if house i in neighborhood j at time t is owner-occupied (and = 0 if occupied by a renter) and is only observed if the house is occupied.
$\overline{O}_{jt}$ = occupancy rate in neighborhood j at time t. This is calculated in the same way as $\overline{Z}_{jt}$.
$\overline{H}_{jt}$ = homeownership rate in neighborhood j at time t. This is calculated in the same way as $\overline{Z}_{jt}$. Note that for purposes of this calculation $\overline{H}$ is calculated as the percentage of units (and not just occupied units) that are inhabited by their owners.

These regressors have associated coefficients φ, γ, δ, and θ respectively in the hedonic equation describing the owner-occupied market, and φ', γ', δ', and θ' for the rental market. Also,

Table 3
The change in cluster occupancy and homeownership rates. Intervals are open on the lower end and closed on the higher end for positive changes, closed on the lower end and open on the higher end for negative changes.

	Between 1985 and 1989	Between 1989 and 1993
Occupancy rate changes		
No change	254	240
0–10%	14	21
10–20%	29	32
20–30%	8	7
30–40%	4	3
40–50%	6	4
−10% to 0%	29	19
−20% to −10%	31	42
−30% to −20%	6	13
−40% to −30%	4	4
−50% to −40%	2	2
Homeownership rate changes		
No change	201	212
0–10%	24	28
10–20%	39	41
20–30%	16	7
30–40%	6	8
40–50%	6	3
50–60%	0	1
−10% to 0%	25	18
−20% to −10%	49	43
−30% to −20%	9	19
−40% to −30%	7	3
−50% to −40%	4	4
−60% to −50%	1	0

α_{it} = unobserved characteristics of the housing unit that are possibly changing over time.
τ_{jt} = unobserved characteristics of the neighborhood that are possibly changing over time.
ε_{ijt} = random error term.

We concentrate here on the hedonic price model for owner-occupied homes. The model for rented homes will be discussed in the next section. As Clapp and Salavei (2010) and Clapp et al. (2012) and have noted, rental and owner hedonics will have distinct parameter values because owners not only enjoy the flow of housing services from housing attributes that renters do, but also enjoy the option value arising from various attributes as inputs to reconstructed units. Therefore it is appropriate to consider owners and renters separately. However, the paucity of rental observations in most of the neighborhoods means that controlling for unobservable neighborhood effects will be next to impossible. We will nevertheless present some evidence on rental units in the next section.

Also, we have noted that we only observe the owner's estimate of property value for those units that are owner-occupied, and neither rent nor value for vacant units. For the reasons noted below, we will also limit the estimation to the two latter years in our sample, 1989 and 1993.

The appropriate estimation procedure depends critically on the assumptions made about the behavior of α and τ. This is important because the occupancy and ownership status of individual dwellings likely depend on unobserved attributes of the house and neighborhood, and omitting them from the model would bias the coefficients of the ownership and occupancy rates. Under the usual fixed effects assumption, the α and τ components are constant over time, and therefore observable with panel data. The estimation of the above equations provides consistent estimates of the parameters. We could identify the price impact of neighborhood ownership and occupation by the usual method of observing changes in $\overline{O}$ and $\overline{H}$ in individual neighborhoods over time, controlling for the unchanging α and τ via fixed effects. (Note that controlling for an unchanging α *ipso facto* controls for unchanging τ.)[2]

Table 4 presents means and standard deviations for the variables used in hedonic regressions (1) and (later) (2), stratified by year and tenure status; for convenience we present this for occupied units only. The first pair of variables is rent and value means for the respective tenures. These are logarithms: the corresponding average value is around $90,000 and the average rent is approximately $400/month. The next set of variables includes the individual demographic variables which are aggregated to the neighborhood level to create measures of neighborhood attributes. (These are reported in the table at the individual level.) Household income is the self-reported measure of total household income. The variable white is equal to one if the head of household is white, and zero otherwise. The measures of school quality and shopping are equal to one if the locational attribute in question is "adequate".[3] By this measure shopping is largely seen as adequate, while schools not so much.

Structural characteristics include the number of bathrooms. In matching observations across time, we inspected the coded number of full baths and the number of half-baths in the unit. Somewhat surprisingly, we found that these two variables were often not the same from observation to observation of the same house, but that the *sum* of the two was (almost always) identical. We conclude that there is some confusion about the distinction between full and half baths in the minds of the survey respondents and we correspondingly just add up the two numbers for every observation and use the total as the measure of number of bathrooms. There is a very slight increase over time in this variable that can be accounted for by renovation. We also include the age of the unit. This is the year of the survey minus the year that the house was built. The latter is coded into the AHS as a categorical variable, so we take the middle year of the category as our measure of construction year. Garage, air conditioning, and the three heating indicators are all equal to 1 if the given attribute exists. Finally, two measures of size, square feet of the lot and interior square feet are included in the model. A time dummy (for 1993) is also included in some specifications, although this variable is perfectly collinear with age if fixed house effects are included in the specification.

Table 5 presents initial estimation results for owner-occupied units only. The first column merely provides a benchmark by presenting the results of a regression of value on the two key variables, the ownership rate and the occupancy rate. As can be seen, in both equations, both of the indicators are positive and statistically significant at the usual levels. The dependent variable is the log of the price, and the two rates are listed in decimal terms so the coefficients of these two variables can be read as approximately the percentage change in housing price when moving the

[2] Note that we are not identifying parameters via the tenure changes of individual units themselves. Since we stratify the equations by tenure type, a unit that switches from, say, rent in time t to own in time $t+4$, only becomes part of the owner equation in time $t+4$. The identification comes from the units who are part of the ownership sample in both periods who experience the change in the ownership rate. A by-product of this is that there does not exist any bias from new owners systematically valuing properties differently, certainly with house-specific fixed effects. As noted, we account for the potential self-selection into the samples below.

[3] Nonrespondents (including those who answered with "unable to state" or similar answers) were left out of the neighborhood level calculations. In particular, households without school age children did not answer to the question about school adequacy. (We thank a referee for alerting us to this.) These measures of neighborhood quality are, by design, not particularly finely measured, in the belief that more nuanced ratings (also available in the survey) might be contaminated by self-selection of people into neighborhoods based on unobservable person characteristics. These concerns are hopefully minimized if there is general agreement on what 'adequate' means. For similar reasons, we do not include measures of residents' satisfaction with the neighborhood, or their neighbors.

Table 4
Means and standard deviations, by year and tenure status (occupied units only).

Variable	Rent 1989		Rent 1993		Owner 1989		Owner 1993	
	Mean	sd	Mean	sd	Mean	sd	Mean	sd
Price variables								
Log value	–	–	–	–	11.34	0.80	11.41	0.73
Log rent	5.95	0.65	6.06	0.64	–	–	–	–
Variables used to construct observable neighborhood measures								
Household income	30871.72	22734.27	33985.39	27462.27	43090.19	31954.48	46968.33	34224.04
White	0.74	0.44	0.71	0.45	0.83	0.38	0.82	0.39
Adequacy of schools	0.33	0.47	0.41	0.49	0.27	0.44	0.25	0.43
Adequacy of shopping	0.85	0.36	0.90	0.30	0.89	0.31	0.91	0.28
Individual structural attributes								
Number of baths	1.44	0.67	1.51	0.66	1.93	0.87	1.98	0.91
Age of unit	35.19	23.50	37.90	23.52	33.26	21.07	35.25	21.21
Garage	0.59	0.49	0.60	0.49	0.80	0.40	0.81	0.39
Air conditioning	0.25	0.43	0.31	0.46	0.47	0.50	0.51	0.50
Gas heat	0.67	0.47	0.65	0.48	0.67	0.47	0.68	0.47
Oil heat	0.07	0.25	0.08	0.26	0.12	0.32	0.11	0.32
Electric heat	0.19	0.39	0.19	0.40	0.17	0.37	0.18	0.38
Lot size	14739.74	40330.27	13910.00	30059.29	16823.56	34800.86	18252.40	47824.71
Unit square feet	1437.56	698.40	1429.27	6.04	1948.54	847.07	1953.84	844.61
Number of units	392		382		2818		2863	

Table 5
Regression results for hedonic price model for home values (t-stats in parentheses).

Homeownership rate	0.95	−0.0407	0.021	0.447	0.480
	(16.03)	(−0.34)	(0.22)	(2.04)	(3.78)
Occupation rate	1.323	0.371	−0.187	−0.069	0.014
	(11.21)	(1.62)	(−0.97)	(−0.31)	(0.10)
Average income (000s)		0.0235	0.0147	0.0021	0.0023
		(14.44)	(11.35)	(1.38)	(1.85)
Percentage white		−0.086	0.305	0.180	0.119
		(−1.01)	(5.37)	(1.02)	(0.98)
Adequacy of schools		−0.13	−0.08	0.02	0.03
		(−2.26)	(−1.68)	(0.53)	(1.01)
Adequacy of shopping		0.211	0.030	0.131	0.131
		(1.97)	(0.29)	(1.45)	(2.11)
Age of unit		−0.001	−0.002	−0.001	−0.023
		(−1.47)	(−3.16)	(−1.14)	(−4.15)
Number of baths		0.132	0.127	0.098	0.031
		(6.44)	(8.36)	(7.03)	(1.42)
Unit square feet (000s)		0.055	0.094	0.066	−0.065
		(2.86)	(6.37)	(6.12)	(−0.62)
Lotsize (0000s)		0.0019	0.0054	0.0046	0.00093
		(1.07)	(2.59)	(2.16)	(0.31)
Garage		0.122	0.080	0.041	−0.017
		(3.77)	(3.33)	(2.21)	(−0.42)
Air conditioning		−0.078	0.019	0.068	0.035
		(−2.44)	(0.77)	(4.04)	(0.91)
Gas heat		−0.080	−0.035	−0.035	0.099
		(−0.80)	−(0.65)	(−0.73)	(1.82)
Oil heat		0.251	0.255	−0.029	−0.010
		(2.42)	(3.53)	(−0.53)	−0.12)
Electric heat		−0.074	0.040	−0.005	0.054
		(−0.72)	(0.66)	(−0.10)	(0.89)
Year of survey		−0.003	−0.005	−0.013	Omitted
		(−0.68)	(−1.30)	(−3.40)	
Intercept	9.118	9.93	10.69	11.82	11.22
	(80.87)	(21.85)	(26.44)	(27.64)	(33.48)
R-squared	0.0791	0.463	0.634	0.051 (within)	0.0204 (within)
Number of observations	5681	5681	5681	5681	5681
Location indicators	None	None	Metro area	Neighborhood	House

rate from 0% to 100%. That increase in homeownership raises the value of said owner-occupied property by about 95%. Increasing the occupancy rate by 10% points yields a 13% increase in housing values in the cluster.

The next two columns present the estimates from the OLS estimation of Eq. (1), including the above-mentioned housing and neighborhood characteristics, but without any location indicators. In all of the estimates going forward, the standard errors are clustered at the level of the neighborhood. Many of the estimated coefficients of the included characteristics are sensible: an additional 1000 square feet adds about 5% to the value of the house and an additional 10,000 square feet of land adds about .2%, although the standard error on this coefficient is large. An additional bathroom is valued at about 13% of house value and a garage about 12%. The year of the survey loads with a negative coefficient, but this is sensible, given the time period, which was not one of generally rising prices. The air conditioning and heating binaries are somewhat erratic. The former has a negative coefficient, while oil heat enters positively (compared to the omitted category of "other" heat source) and the other two with negative coefficients.

The neighborhood coefficients are particularly puzzling. Most importantly for this study, the neighborhood ownership rate is negative (though imprecisely estimated) as are adequacy of school and percentage white. Average income and shopping quality, as well as occupancy rate are all positively and precisely estimated, as expected. The reason for this seems clear: there are no controls for location in this specification. In particular, the collinearity of ownership with low land prices (i.e. in suburbs and rural areas) makes it imperative to provide for location controls. In the third column we therefore include MSA fixed effects (including one for non-MSA location) as well as a binary for central city location. In this specification the ownership rate now has the expected positive coefficient, though this is not precisely estimated, and the coefficient of the ethnic makeup of the cluster has switched signs as well. School adequacy and now the occupancy rate enter with significant negative coefficients, so there are still some anomalies.

In the fourth column we take the expected step of including even more precise location effects, which is to say, neighborhood fixed effects. This has the effect of controlling for all time-invariant neighborhood characteristics; the identification of neighborhood parameters in Eq. (1) comes only from changes in those characteristics between 1989 and 1993. Therefore any substantive and/or statistically significant effect will presumably only occur when there are a sufficient number of such changes occurring. The occupancy rate (as might have been apparent from Fig. 1 and Table 3) appears to suffer from this as the coefficient is negative with a large standard error. The coefficients of neighborhood income, ethnicity, schools and shopping are now positive as expected but only the last is precisely estimated. Importantly though, the neighborhood ownership rate now indicates that a 10% point rise in that rate increases property values by about 4.5%. This coefficient is quite precisely estimated, and shows both the importance of not only neighborhood ownership rates for housing prices, but also the importance of controlling for locational characteristics in trying to estimate this parameter.

In the final column of the table we use house fixed effects. Thus we are controlling for unobserved (time invariant) characteristics of both the house as well as the neighborhood. The key coefficient rises very slightly. It seems that whatever unobserved heterogeneity is correlated with neighborhood ownership, it is at the level of the neighborhood rather than the house. The other neighborhood coefficients are basically unchanged as well, although the occupancy rate coefficient does seem rather unstable. The impact of the physical characteristics of the house is now only identified through changes in those characteristics; the sample variation in these characteristics is not sufficiently large to allow precise estimation of these coefficients. Note that the year coefficient is not identified at all.

3.1. Extension to time-varying heterogeneity

The previous section demonstrates that in a standard fixed neighborhood effects estimation that neighborhood ownership rates exert a positive influence on neighborhood housing prices. However the very fact that units become occupied or vacant in a neighborhood, or switch their tenure status between owning and renting can be related to the fact that these unobservable features are changing as well. That is, a change in $\overline{H}$ is possibly correlated to a changing τ, or α. In this case, fixed effects estimation will not yield consistent parameter estimates. Therefore it is necessary to instrument for the ownership and occupancy rates. No contemporaneous variable would seem to be a suitable instrument—i.e. one that is correlated with homeownership and occupancy, yet uncorrelated with neighborhood unobservables. Therefore we opt to take advantage of the panel aspect of our data and use observations on data from the previous wave as instruments for contemporaneous endogenous regressors. Since current prices are based on current conditions, and not on past neighborhood quality this suggests that lagged variables will be uncorrelated with current neighborhood quality. This will be valid, however, only if the neighborhood effect τ_{jt} is uncorrelated over time. This too is implausible; there is likely to be some—though not universal—persistence in neighborhood quality. We resolve this by assuming that

$$\tau_{jt} = \tau_j + \tilde{\tau}_{jt} \tag{4}$$

where τ_j is a standard time-invariant fixed effect and

$$E(\tilde{\tau}_{jt}) = 0 \quad \text{for all } t; \quad E(\tilde{\tau}_{jt-4}\tilde{\tau}_{jt}) = 0 \tag{5}$$

Thus if unobservable neighborhood quality is a random shock around around a neighborhood specific mean, then lagged variables will be uncorrelated with contemporary values of the neighborhood unobservable as long as the neighborhood fixed effect is included in the specification.[4]

We now consider the *switching problem.* We note that P and R are only observed when the unit is occupied, and the respective prices are only observed when the corresponding tenure choice is made. Thus both the occupancy and tenure decision for a given property impacts whether a price is observed for that property and the nature of the price that we do observe. Thus we potentially face a two part selection issue. The first selection is into occupied status, and the second selects into the rental or owner market, with the resulting hedonic Eqs. (1) and (2) being relevant.

In order for a building to be occupied, the owner of the property and the (new) resident must meet and agree to make the appropriate transaction. In the case of a rental property, the landlord must meet and match with a renter, while in the ownership market the old owner must do the same with a new owner. We consider the propensity of a building to be occupied can be modeled by:

$$O^*_{ijt} = F_{ijt}\varphi + w_{ijt} \tag{6}$$

where w is a normally distributed error which is invariant with respect to the eventual tenure of the building once it is occupied. This is an explicit assumption about the decision tree that market participants make about housing transactions.[5] In order to not belabor the notation too much, we let w_{ijt} contain all the unobservable elements that are specific to the housing unit and the neighborhood. We will come to the specification of F shortly but it is worthwhile to recall that these data are from an era when the default rate was very low, "foreclosure contagion" (Harding et al., 2009) was not an issue, and housing vacancies were only rarely due to foreclosure, but rather due to the simple frictions that arise in a market with significant search costs.

As is usual in this kind of context, O^* is unobserved, but we do observe the indicator function for the unit being occupied (in which case $O = 1$):

$$\begin{aligned} O_{ijt} &= 1 \text{ if } O^*_{ijt} > 0 => F_{ijt}\varphi > -w_{ijt} \\ &= 0 \text{ if } O^*_{ijt} < 0 => F_{ijt}\varphi < -w_{ijt} \end{aligned} \tag{7}$$

[4] While we cannot test this assumption on the unobservables, a referee suggests checking the correlation of homeownership with plausibly exogenous measures of neighborhood quality. If these observables are uncorrelated with the ownership rate, it is more likely that the unobservables are similarly uncorrelated. Footnote 3 suggests the use of schools and shopping adequacy for this role. Regressing the ownership rate on neighborhood fixed effects and either or both of these two variables yields small coefficients and t-ratios less than one.

[5] Alternative decisions trees are of course plausible. Properties may be owner-occupied, and if not owner-occupied, then the owner must decide whether to leave them vacant or rent them out. This latter tree pre-supposes that all vacant houses are part of the owner-occupied market. The one we use does not make that assumption.

Similarly, we consider the propensity of an occupied building to be owner-occupied as a latent variable H^*:

$$H^*_{ijt} = K_{ijt}\omega + u_{ijt} \tag{8}$$

and if $H = 1$ if the unit is owner-occupied:

$$\begin{aligned} H_{ijt} &= 1 \text{ if } H^*_{ijt} > 0 => K_{ijt}\omega > -u_{ijt} \\ &= 0 \text{ if } H^*_{ijt} < 0 => K_{ijt}\omega < -u_{ijt} \end{aligned} \tag{9}$$

Again, there are unit and neighborhood specific elements to u. Now consider the mean functions that arise for (1) (with a similar construction for (2)):

$$\begin{aligned} \mathrm{E}(\ln P_{ijt}|P_{ijt} \text{ observed}) &= \mathrm{E}(\ln P_{ijt}|F_{ijt}\rho < -w_{ijt} \text{ and } K_{ijt}\omega > -u_{ijt}) \\ &= X_i\varphi + \overline{Z}_{jt}\gamma + \overline{H}_{jt}\delta + \overline{O}_{jt}\theta + E(\tau_{jt} + \alpha_{it}|F_{ijt}\rho \\ &< -w_{ijt} \text{ and } K_{ijt}\omega > -u_{ijt}) \end{aligned} \tag{10}$$

The two-step estimator would be constructed as follows:

1. A bivariate probit model of O and H is estimated. The log-likelihood for this is:

$$\begin{aligned} \log L = &\sum_{O=0} \log[1 - \Phi(-F_{ijt}\rho)] \\ &+ \sum_{O=1,H=0} \log[\Phi_2(-F_{ijt}\rho, K_{ijt}\omega, \sigma_{uw}) \\ &+ \sum_{O=1,H=1} \log[\Phi_2(-F_{ijt}\rho, -K_{ijt}\omega, \sigma_{uw})] \end{aligned} \tag{11}$$

where the first term is the contribution of the unoccupied units to the likelihood, the second term is that of renter homes, and the third is the contribution of owner units. From Poirier (1980) and followers (e.g. Hotchkiss and Pitts, 2005), the hedonic regression (1) becomes:

$$\ln P_{ijt} = X_i\varphi + \overline{Z}_{jt}\gamma + \overline{H}_{jt}\delta + \overline{O}_{jt}\theta + \sigma_{ug}\lambda_{P1} + \sigma_{wg}\lambda_{P2} + \epsilon_{ijt} \tag{12}$$

where $g = \tau + \alpha$ and the final terms are zero-mean noise encompassing both ε and the deviations of u and w from their respective expectations. The σ terms are the covariances between g and the residuals in the two selection equations. Since F and K come from the lagged wave of the sample, this is in effect the ability of potential occupants to forecast neighborhood quality at time t and make unit-specific decisions about occupancy and ownership. The selection terms are given as:

$$\lambda_{P1} = \frac{\varphi(-F_{ijt}\rho)\left[1 - \Phi\left[\frac{(K_{ijt}\omega - \sigma_{uw}F_{ijt}\rho)}{(1-\sigma^2_{uw})^{\frac{1}{2}}}\right]\right.}{\Phi_2(-F_{ijt}\rho, -K_{ijt}\omega, \sigma_{uw})} \tag{13}$$

$$\lambda_{P2} = \frac{\varphi(K_{ijt}\omega)\Phi\left[\frac{(F_{ijt}\rho - \sigma_{uw}K_{ijt}\omega)}{(1-\sigma^2_{uw})^{\frac{1}{2}}}\right]}{\Phi_2(-F_{ijt}\rho, K_{ijt}\omega, -\sigma_{uw})} \tag{14}$$

where each λ term is proportional to the conditional expectation of τ or α conditional on the observational status of O and H.

For each observation, Eqs. (7) and (9) give us an estimated probability that any given unit at time $t - 4$ will be occupied and owned at time t. We simply take the averages of those within each neighborhood and use them as instruments in the hedonic equation. Recall that under (5) lagged variables can serve as instruments for current ownership and occupancy rates. We include lagged values of the neighborhood occupancy rate in the probability of occupancy equation (F) and the lagged neighborhood ownership rate in the probability of ownership equation (K).

Table 6 presents the results of the estimation of the resulting bivariate probit model. As can be seen, the lagged neighborhood ownership and occupancy rates are highly significant.

Table 6
Probit models for selection into ownership and occupancy.

	Coef.	z-Ratio
Ownership		
Ownership rate	2.36	22.61
_cons	−0.638	−7.27
Occupancy		
Occupancy rate	1.73	8.22
_cons	−0.111	−0.85

Table 7 reports the results of specifications using a variety of different treatments. For space reasons we report only the coefficient of the neighborhood ownership rate and its t-ratio.[6] As can be seen in the fourth row we use neighborhood fixed effects and the instruments described above to estimate the hedonic price equation in a fixed effects two-stage least squares regression.[7] The first column presents the coefficient in a specification where only the ownership and occupancy ratios are instrumented. The coefficient is very similar to the previous fixed effects estimator of Table 5.

We then surmised that the variables describing the demographics of the neighborhood were also potentially endogenous. We constructed two additional instruments using methods similar to those described above—that is, we regressed the "white" binary on lagged values of the white percentage (using a probit), and income on the lagged average income (using OLS) to create predicted values of these two variables and averaged them for each neighborhood, as before.[8] Additionally instrumenting for ethnicity and average income in addition to ownership and occupancy rates results in almost no change in the coefficient. The coefficients are precisely estimated—and recall that we still employ cluster-correction—in the sense that we can still reject the null that there is no effect of neighborhood ownership rates on house prices. However, adding the Mills ratio for selection into occupancy and ownership increases the neighborhood ownership coefficient over 10-fold. While this coefficient still indicates that ownership has a positive influence on neighborhood property values, the large coefficients are somewhat implausible and would seem to be due to the instability in the data matrix due to the collinearity between the selection terms and the instruments for the occupancy and ownership rates.

In the second panel of Table 7 we estimate the same models as in the first panel, but use the house, rather than the neighborhood, as the source of the fixed effect (i.e. α rather than τ). We do not cluster correct the standard errors at the neighborhood level, as that would be somewhat superfluous in this case. The coefficients are (somewhat surprisingly) much the same as in the first panel, in fact they are slightly larger (with the exception of the specification that includes selection in ownership and occupancy where the coefficient is slightly less). The t-ratios indicate precision in these estimates. This is true for all the specifications, and again, correcting for selection into ownership and occupancy causes an untoward increase in the coefficient.

[6] The results are in an unpublished appendix. The remaining structural coefficients are relatively stable throughout these estimates, until we imposed house fixed effects. In this specification these coefficients are identified only by major changes in the physical structure of the unit—that is, by home improvement and the like. This being a relatively scarce event, the coefficients are sometimes imprecisely measured. The effect of occupancy rate is always difficult to measure. Shopping adequacy, on the other hand, almost always has a positive and precisely estimated coefficient. In the rent equations below, the use of neighborhood fixed effects renders many coefficients hard to measure.

[7] The Wu–Hausman test rejects the null of exogeneity both in the model where just ownership and occupancy are instrumented and where average income and ethnicity are also instrumented for. The prob-values are less than 1% in both cases.

[8] The coefficient on lagged white percentage had a t-statistic of 42 and in the income equation the lag had a t-stat of 51.

Table 7
The table presents coefficients of neighborhood ownership rate under a variety of specifications that vary the dependent variable (value or rent), the treatment of endogeneity, the nature of fixed effects (neighborhood cluster or house), and inclusion of inverse Mills ratios for selection into ownership and occupancy.

Dependent variable	Value	Value	Value
Endogenous neighborhood characteristics	Ownership, occupancy	Ownership, occupancy, white pct., avg income	Ownership, occupancy, white pct., avg income
Selection	None	None	Ownership and occupancy
Fixed effects	Neighborhood	Neighborhood	Neighborhood
Coefficient	0.583	0.592	7.84
	(2.50)	(2.43)	(2.26)
Dependent variable	Value	Value	Value
Endogenous neighborhood characteristics	Ownership, occupancy	Ownership, occupancy, white pct., avg income	Ownership, occupancy, white pct., avg income
Selection	None	None	Ownership and occupancy
Fixed effects	House	House	House
Coefficient	0.632	0.649	7.54
	(4.60)	(4.46)	(3.14)
Dependent variable	Rent	Rent	Rent
Endogenous neighborhood characteristics	None	Ownership, occupancy	Ownership, occupancy, white pct., avg income
Selection	None	None	None
Fixed effects	Neighborhood	Neighborhood	Neighborhood
Coefficient	0.177	0.220	0.431
	(0.67)	(0.91)	(1.33)

In the final panel, the sample is of rental units rather than owner-occupied units. As previously noted, the sample size is far smaller, and the number of units per neighborhood is quite small. This makes estimation with neighborhood fixed effects difficult and next to impossible with house fixed effects-thus we revert to neighborhood effects, again using neighborhood level cluster correction. The fixed effect coefficients in the first column (i.e. without any instruments) indicate that the effect on rental units is far smaller than for owner-occupied units. We instrument for ownership and occupation in the second column, and for all four neighborhood variables in the third. The coefficient increases in magnitude and significance, until in the ultimate specification the effect is close to that for owner-occupied units, although the precision is not quite at the desired level. While we do not present it in the table, adding the Mills ratios for ownership and occupancy once again cause the key coefficient to rise substantially.

Our summary judgment from Tables 5 and 7 is that an increase in the neighborhood homeownership rate does cause an increase in neighborhood housing prices, regardless of one's treatment of endogeneity and selection issues. The quantitative estimate of the effect is stable under a wide variety of specifications and indicates that a 10% point increase in the ownership rate causes approximately a 6% point increase in housing prices, depending on that treatment. If selection terms are added this causes the effect to increase dramatically, but this is presumably due to the multicollinearity of the selection terms and the instruments. There is not enough sample variation in these data to be definitive about the effect on rents, or about the effect of vacancies.

Given the robustness of our main result, it is worth performing a back of the envelope calculation. Note that the typical neighborhood in our sample has 11 houses. We ignore the effect of neighborhood ownership on rental units as being too imprecisely estimated. So assuming nine of these eleven are owner-occupied, the transition of the tenth unit from rental to owner would raise the ownership rate by 9.1% points. Taking the effect on house prices to be as above, the increase in the house price of the other nine owner-occupied houses is $.091 * .06 = 5.46\%$ points. Assuming a typical sample property value of \$90,000, this amounts to about \$4900 per housing unit. Thus the externality benefit of ownership in a neighborhood is therefore $9 * 4900 = \$44{,}200$. If a 3% annual capitalization rate is applied (assuming an infinite-lived asset), this yields an annuity of approximately \$1327 per year in externality value for an owner-occupied property.

To give some sense of this magnitude (though not to perform an explicit welfare calculation) Poterba (1992) calculates the deadweight loss that accompanies the use of the mortgage interest tax deduction for 1990 taxpayers (i.e. under the 1986 Tax Reform Act). This date is quite congruent with our use of data from 1989 and 1993. This loss varies considerably across income groups and Poterba gives an estimate for those with an annual income of 30, 50 and 250 thousand dollars. The annualized deadweight loss is \$53, \$326, and \$1631 respectively. Thus, the calculations above suggest (subject to considerable variation, obviously) that if the mortgage interest deduction happens to induce additional ownership, the benefits from that marginal owner outweigh the deadweight loss of the deduction for all but the highest income households.

One final objection to our results is that we cannot account for possible differences in unobservable personal characteristics, and these unobservable characteristics may be correlated with both tenure choice and neighborliness. If so, then the arrival of a new neighborly owner is just another neighborhood's loss. We have until now emphasized the possibility that neighborhood characteristics may induce homeownership and this in turn induces higher house prices. Another interpretation of our results would be that people with (unobservable) characteristics that make good neighbors (regardless of neighborhood quality) choose to be owners. A proper check on this possibility is not possible with our data, since we would need to observe the same households as both renters and owners (rather than the same *units* with both renters and owners). Instead we use the Panel Survey of Income Dynamics, which follows people instead of housing units. We first look at households that were renters in 2001 and observe how many hours they volunteered per year. We model this variable as a function of the usual demographic characteristics (age, household income, number of kids, individual race and education categories) but also indicator variable for homeownership in 2003. To the extent that volunteer hours are a good indicator for the personal qualities that we seek to identify, we should see a positive coefficient on this latter indicator if inherently good neighbors sort into homeownership. The results are displayed in Table 8.[9]

[9] The full results are in the unpublished appendix.

Table 8
Notes: The table entries are the coefficients and *t*-ratios of 2003 tenure status (owner = 1, Renter = 0) in a regression model estimating the determinants of 2001 volunteer hours for persons over 25. The model also includes family income, number of kids, individual age, and a full suite of individual education, marital status, and racial group binaries.

Variable	Heads	S.O. (if present)	Heads	S.O. (if present)
	2001 renters		2001 owners	
Coefficient	−7.07	−3.02	2.26	5.24
t-Ratio	(−2.31)	(−1.08)	(0.73)	(1.29)
N	6068	2831	13,852	11,039
*r*2	0.05	0.09	0.02	0.04

The first two columns display the results; the first column is household heads, and the second column is for the wife or other adult cohabitant. The coefficients are negative, the opposite of what this selection hypothesis describes. The effect is small (7 and 3 hour reductions, respectively) though in the case of heads it is statistically significant. While this evidence is by no means conclusive, there is absolutely no evidence in favor of owners being a sample self-selected on their "neighborliness". The last two columns of Table 8 refer to households that were owners in 2001. The coefficients on 2003 ownership were positive for both heads and spouses, which is congruent with a story that suggests that ownership is a causal factor for "neighborliness", but again, the coefficients are imprecisely estimated.

4. Conclusions

Previous research on the externality value of homeowners has emphasized the measurement of the different behavioral patterns of owners and renters. Such findings are not able to assess the total externality value of owners—including potential external costs—nor provide monetary valuation of these externalities. We contend that measuring changes in local housing prices as local homeownership rates change potentially overcomes these issues. We note that estimating this is fraught with difficulty, given the lack of "natural experiments" and have attempted instead to perform this estimation in the context of the small neighborhood clusters constructed by the American Housing Survey in 1989 and 1993. Our estimation strategy considers a wide variety of assumptions on the nature of the unobservable housing and neighborhood effects. The estimates are quite robust over a broad range of models (but not the universe of possible models) but a benchmark set of estimates about those effects suggest that transiting a home from rental to ownership in a typical neighborhood would create about $1327 per year in externality value.

There are, of course, caveats attached to this analysis. Our emphasis on small neighborhood clusters suggests that our measurement of externalities is a lower bound, since this need not include benefits obtained from participation in broader civic affairs, such as those emphasized in DiPasquale and Glaeser (1999) or Engelhardt et al. (2010) (though they were not found in the latter), nor does it include the potential costs of homeownership due to broader labor market immobility (Coulson and Fisher, 2009). We have also not accounted for dynamic behavior. We have assumed the reaction to changes in the neighborhood homeownership rate was realized in prices by the time of the survey. This need not be the case, as such external effects may only be realized over a longer span of time. Homeowners (as noted in the introduction) have longer spells in their units, and this contributes to their behavior. While these longer spells may be fully anticipated by incumbent neighbors, and be responsible for the price changes, a longer view of this process may yield further insight. Finally, recent events have brought attention to the ability of home purchasers to become homeowners with very little equity, or to experience negative equity through house price changes. It would be of substantial interest to find out whether those with zero or negative equity create the same kinds of external benefits as more invested owners. The time period of our sample is not the right one to investigate this, but if comparable data should become available for a more recent period this would prove a fruitful ground for future research.

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Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.jue.2013.03.005.

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