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# Maintenance and the Home Equity of the Elderly

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**Abstract**

Economists have puzzled over the apparent failure of older homeowners to cash out home equity. Casual observation, however, suggests that older homeowners undermaintain their homes. Estimated home equity reduction may thus be biased downward if self-reported home values do not incorporate the market's view of the state of repair. American Housing Survey data show that homeowners over 75 spend approximately $270 less per year on routine home maintenance than younger owners of similar homes and approximately $1,100 less on all home improvement. Older homeowners realize weaker price appreciation than younger owners of similar homes in the same markets over identical horizons by approximately three percent per year. Older homeowners do, thus, take money out of their homes. The large magnitude of depreciation relative to expenditure differences suggests the availability of maintenance projects with positive financial and consumption benefits to a large number of older homeowners. The results are difficult to explain within a standard life cycle model given the near absence of a market for reverse mortgages.

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# 1 Home Maintenance and the Life Cycle

Because of the central role of housing in most portfolios,[1] understanding the use of housing wealth in old age is important to understanding the adequacy, risk and intended use of portfolio wealth more generally. A canonically modeled household with no bequest motive, no direct utility over wealth and no tax or liquidity uses for housing wealth in particular should consume most home equity before death. Artle and Varaiya (1978) implicitly describe the utility costs related to failure to smooth consumption when these complications are not present yet home equity is not spent before death. Findings that the elderly rarely move out of their homes[2] and almost never take on reverse mortgages[3] suggest that one or more of these complicating factors are important.

Casual empiricism suggests a third way, in addition to resale or reverse mortgage, in which the elderly might convert home equity to consumption: substitution of other consumption for home maintenance expenditures. As Gyourko and Tracy (2003) observe, home maintenance and improvement represent a non-trivial fraction of all US expenditures and changes in these expenditures reflect changes in lifetime income.[4] These considerations suggest that we should find economically and statistically significant differences in both expenditures on maintenance and in changes in the quality and value of housing between older and younger homeowners.

It is not obvious on life cycle grounds, however, that expenditures on durable goods such as home maintenance will decline with age. While an older household with no bequest motive should dissave, it is a matter of empirical controversy whether older households do, in fact, dissave; see for example Hurd (1989). Even if we knew that older homeowners were interested in dissaving, home improvement is a form of both consumption and investment. And even if we knew that neglecting to repair one's home represented dissaving, home repairs are a function of both labor and expendi-

[1]See, for example, Kennickel, Starr-McCluer and Surette (2000).

[2]See, for example, Feinstein and McFadden (1989) and Venti and Wise (2000)

[3]E.g. Abt (1995). Based on HUD loan origination data and US Census counts, to date, takeup of the dominant reverse mortgage program (HECM) is less than one-half of one percent of eligible homeowners.

[4]They find home maintenance equal to 3.1% of income in the *American Housing Survey*. The 2001 *Consumer Expenditure Survey* shows home maintenance (inclusive of insurance) equal to 2.2 percent of all expenditures, but this figure includes renters. NIPA accounts suggest that home improvement is typically equal to half of the value of new residential construction.

tures. Older homeowners presumably have more expertise, time and tools than younger households, but less stamina. Hence, we would expect older households to mix capital and labor differently in producing home improvements, with no clear prediction on differences in expenditures for any level of home repair.

It is thus worthwhile asking two sets of questions empirically: first, do older households undertake less home maintenance than younger households? Second, to what extent do the homes of older households appear to suffer the effects of neglect? If the difference in expenditures is large but the economic consequences are small, then we can interpret a failure to perform maintenance as a rational reaction to a shorter horizon in the home, with larger expenditures by younger homeowners perhaps justified by idiosyncratic tastes for particular improvements. If the difference in expenditures between old and young homeowners is small relative to the difference in rates of depreciation, then we must wonder why older homeowners fail to make investments that both generate improved living conditions and earn high rates of return.

# 2 Data and Equations to be Estimated

Empirical exploration of the relationships between age and expenditures and between age and depreciation requires panel data on owners' characteristics and expenditures as well as the characteristics and prices of their homes. Such data is provided by the American Housing Survey (AHS), a biennial panel survey of American homes performed by the US Census Department in conjunction with the Department of Housing and Urban Development. The unit of observation is a home, rather than a household. Hence a house stays in the panel after its initial occupant moves out. Up to nine observations per home are available on the set of homes that were first observed in 1985 and last observed no later than 2001.

I confine the sample to houses that were owner occupied in 1985.[5] I delete rental units and homes headed by individuals who either do not identify their age or claim an age below 20 years. I also delete condominiums and cooperative apartments; in such units, maintenance expenditures are difficult to observe. The results presented here should be interpreted as relating to the changes in maintenance with age and the consequences among owners of detached homes. This is the large majority (93 percent

[5] I do not consciously exclude the relatively small number of owner occupied seasonal housing. The results presented are robust to their exclusion.

above age 75 and 97 percent below age 75) of homeowners in the AHS. Incomplete information concerning house values or maintenance costs lead to an annual sample size of 7,000 to 8,000. Table 1 provides summary statistics on the variables discussed below.

The first set of regressions I estimate ask whether home maintenance and improvement expenditures change with age. This question can be asked both within individuals and across individuals. Treating individuals in different years as different observations, the estimated equations take the form:

$$IMPROVEMENT_{it} = \alpha + X_{it}\beta_1 + H_{it}\beta_2 + f(AGE_{it})\gamma + \epsilon_{it}. \quad (1)$$

Here $IMPROVEMENT$ measures expenditures on home maintenance, repairs and additions or counts the number of improvements. $X$ represents household characteristics and $H$ home characteristics. $f(AGE)$ measures the concept of being old in two different ways. First, I divide the observations by tens of years, so that people between the ages of 25 and 34 receive a value of 1 for the variable $a25$ and zero for the indicators $a35 \ldots a75$, where $a75$ represents age 75 or older. Given the small number of homeowners (approximately one percent) aged under 25, the comparison group is almost entirely in their 40s and 50s (the median age group among homeowners in AHS) when only $a45$ is omitted. a75 indicates that the household head is 75 or over. Second, I formulate a continuous version of $f(AGE)$ as the household head's gender-nonspecific probability of death based on age and year of birth ($PROB$), taken from the Berkeley Mortality Database. Standard errors are clustered at the level of the home, which allows for correlations in unobserved contributors to home improvement, $\epsilon$, between observations not only within owners, but within subsequent owners of the same home.

$X$ in some specifications includes indicator variables for the metropolitan area (MSA) in which the homeowner lives; non-metropolitan homeowners are discarded from the sample. It is not clear whether owner characteristics beyond age $X_{it}$, such as family structure, wealth and length of tenure belong on the right hand side of equation (1). If our goal is to identify how old homeowners have behaved in recent years, then purging the effects of symptoms of aging from the estimated effect of age on maintenance is not appropriate. On the other hand, it may be interesting to know if any observable characteristics of older households seem to drive the results. In particular, one might think that the taste for home improvement increases or decreases with the length of stay in one's home. We might also suspect that elderly widows are outliers in terms of the extent of maintenance performed. Some specifications thus include a polynomial in the number of years the household head has lived in the home ($STAY1$ through $STAY7$) and some include indicators for single status ($SINGLE$) and an interaction of being single with being over 75 ($OLDSINGLE$). A problem is that since we have only imperfect measures of the concept of being old, measures of the consequences of old age are likely biased in the presence of length of stay variables because any true measure of age is likely to be correlated with the length of stay in the home to date.

I consider five measures of $IMPROVEMENT$: (i) routine maintenance costs ($CSTMNT$), (ii) major alterations and repairs ($RAC$), (iii) the sum of (i) and (ii) ($TSPEND$), (iv) the number of alteration or replacement projects undertaken ($RAN$) and (v) indicators for four particular types of repairs or replacements identified in the first six waves of the panel: $ROOF$, $KITCHEN$, additions to the home ($ADD$) and mechanical equipment ($MEQ$).[6]

$H_{it}$ includes the square footage of the home ($UNITSF$), a polynomial in the age of the home ($BUILDAGE1$ through $BUILDAGE7$) and a set of 141 dummy variables indicating in which metropolitan area (SMSA) the unit is located.

Home maintenance expenditures do not map trivially to changes to the quality of a home because quality has both vertical and horizontal components. For example, painting a room one's favorite color may add nothing to the resale value of one's home, but fixing a leaky pipe almost certainly enhances resale value.[7] Also, the marginal benefit of maintenance and repair expenditures presumably are decreasing, with small expenditures preventing large problems and large expenditures perhaps adding little benefit with lot size fixed and housing quality presumably concave in land and capital. Further, houses that require less maintenance are more desirable than those which require more, all else equal. Hence directly regressing housing quality measures on home maintenance expenditures would not give a good idea of the consequences of home maintenance for housing quality. Instead, I ask whether homes headed by older

[6] Following Gyourko and Tracy (2003), I halve $RAC$, which is a two-year sum so that figures are annual. $CSTMNT$ is defined in the early years as spending on routine maintenance last year and in later years as spending in a typical year - the latter definition elicits many fewer zeroes.

[7] To the extent that a house, or the affected walls near a leak are certainly going to be torn down by the next purchaser, even vital repairs may add zero to resale value.

individuals appear to depreciate relative to homes of younger households. The presence of controls points to a causal link between neglect and depreciation among the elderly.[8]

Sets of regressions similar to equation (1) replace improvements with measures of levels and changes in housing quality on the left hand side. Such measures include interviewer and interviewee assessments of home quality as well as market and owner-estimated prices. These regressions are of the form:

$$QUALITY_{it} = \alpha + X_{it}\beta_1 + H_{it}\beta_2 + f(AGE_{it})\gamma + \epsilon_{it} \tag{2}$$

in a pooled cross-sectional setting and

$$\Delta QUALITY_{it,t-s} = a + \tilde{X_{it,t-s}} b_1 + \tilde{H_{it,t-s}} b_2 + \tilde{f}(AGE_{it,t-s})\delta + u_{it,t-s} \tag{3}$$

in a panel setting taking $s$-year differences. Tildes above variables indicate that the set of characteristics in a difference setting will be different from those considered in a levels setting.

Two sets of dependent variables suggest themselves in assessing the effect of home maintenance (through age) on housing quality: the dollar value of the home and the perceived quality of the home. Home values are provided both by the respondents' estimate of the market value ($VALUE$) of the home and by the purchase price for homes when they are sold ($PRICE$), or at the time of a respondents' initial purchase. Housing quality is measured both by the respondent's answer to the question "On a scale of 1 to 10, how would you rate your unit as a place to live?" ($HOWH$) and by the interviewer's estimation of whether the home is in adequate repair, inadequate repair or severely inadequate repair. I denote a change from adequate repair to inadequate or severely inadequate repair between periods $t$ and $t-k$ by $FALL_k$. Only approximately three percent of the houses in the sample are deemed to be in disrepair.

[8]Using age as an instrument home maintenance expenditures in a two stage least squares setting is uninformative due to the weak explanatory power in the first stage regression. Determining the appropriate functional form for such an estimation strategy would be challenging given the likely nonlinear relationship between maintenance expenditures and appreciation.

# 3 Results

## 3.1 The Elderly Spend Less on Maintenance

Figure 1 illustrates the cross sectional relationship between age and home maintenance expenditures, plotting unconditional mean spending on maintenance against age. This graph pools the nine waves of AHS, so that the same individual forms part of mean expenditures for several increasing ages until the end of the sample or the end of their tenure owning a particular home. Values are recorded in 2001 CPI adjusted dollars. We see an obvious trend towards reduced spending on home maintenance with age, and households headed by an individual aged 75 or over spend approximately 1,100 less than other households on total home improvement expenditures at 1,267 as opposed to the mean spending among all homeowners of 2,331.

One might argue that older homeowners live in different regions, have stayed longer in their homes or have different types of homes such that there is no independent role for age to play. This is revealed not to be the case in Table 2, which estimates OLS and Tobit equations of the form (1) with total expenditures as the dependent variable. In column (1), we find that conditioning only on the age and size of one's home, homeowners over 75 spend 1,045 less than the population conditional mean. A Tobit, reported in column (2) shows that the effect is much larger conditional on positive expenditures. The results in (1) and (2) exclude MSA fixed effects, but their presence has no significant effect on the estimates in otherwise identical regressions; these effects are added in subsequent specifications. Column (3) is identical to column (1), but replaces the discrete measure of old age and the arbitrary boundary of age 75 with the continuous measure of one-year probability of death. Moving from a one percent chance of death to an eleven percent chance of death (e.g. moving from 60 years old to 85 years old) is associated with a reduction of approximately $1,900 in home improvement expenditures. Column (4) compares each age decade to the group of homeowners between the ages of 45 and 55. There is a general trend towards reduced expenditures with age (except for the youngest group). This pattern is likely indistinguishable from a combination of wealth and income effects, difficult to observe in the AHS. Column (5) reveals that single people spend significantly less on home improvement than other homeowners. There is no significant interaction, however, between elderly status and single status.

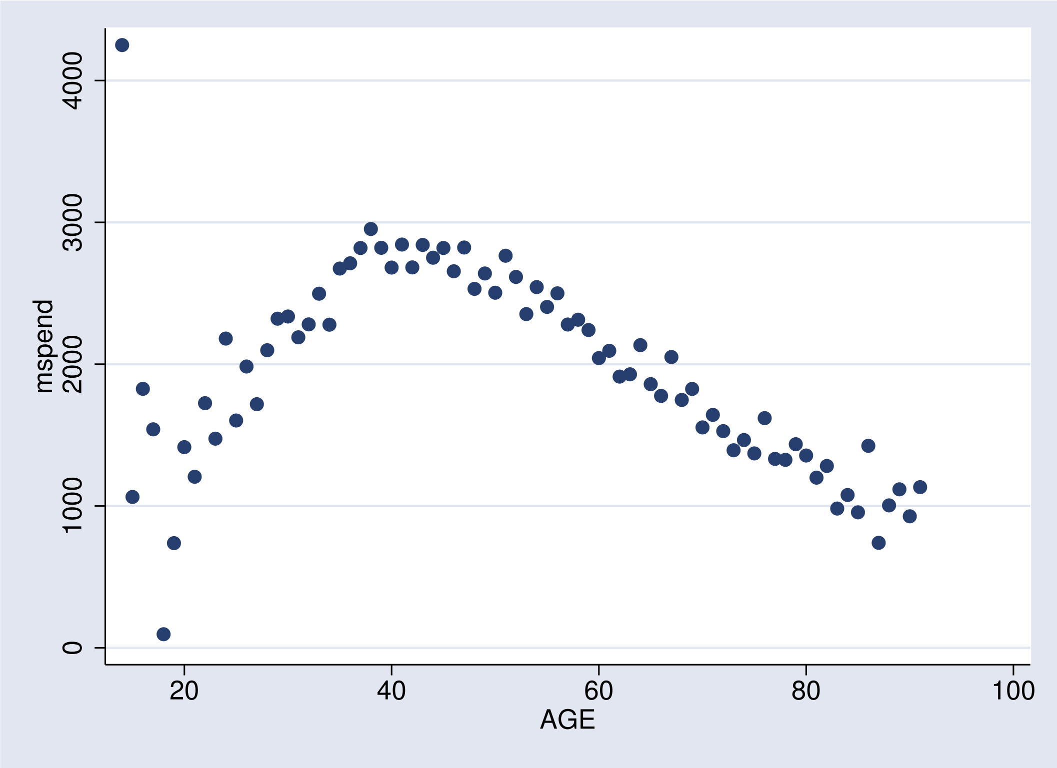
## 3.2 Expenditure Typology

Columns (6) and (7) of Table 2 show that controlling for the length of tenure in one's home reduces the magnitude but does not eliminate the strong significance of the pure aging effect. We find that in the presence of building covariates as well dummy variables indicating the number of years one has lived in one's home, older homeowners spend approximately $500 less per year than younger homeowners. The estimate is unchanged if the 82 dummies are replaced with a seventh order polynomial in the length of stay. More generally, we might think that expenditure differences between older and younger homeowners are driven by a taste among younger homeowners for customization that is either not present or moot among older homeowners. We might therefore suspect that the market value of such improvements is likely to be less than their cost.

Table 3 shows differences among homeowners across different types of home repair. Column (1) shows that controlling for a seventh degree polynomial in the length of stay in one's home as well as the size, location and age of the home, homeowners over 75 spend $100 less per year in 2001 dollars than other homeowners on routine maintenance, around a population mean of 622 and median of 266. Given the right skew, we might be concerned that the difference in means of routine maintenance expenditures is driven by outliers. The median expenditure among older homeowners, however is 92.31, compared to 300 among younger homeowners. At least part of the difference in expenditures between old and young homeowners is thus attributable to differences in the extent of routine maintenance, which does not fit a pure customization explanation.

Columns (2) and (3) show that older homeowners perform a smaller number of repairs or alterations than other homeowners. The interpretation of column (3) is that homeowners of this age are 8.8 less likely to do any repairs or alterations over the course of two years than other homeowners. The Tobit in column (2) reports that conditional on performing repairs, older homeowners perform almost one less repair. The population mean number of repairs is less than two and the median number is one. Columns (4) through (7) suggest that differences between older and younger homeowners does vary somewhat based on the type of repair. Older homeowners are less likely than others to replace or add major equipment such as a furnace, but the difference is not quite significant at a five percent level of confidence. There is no significant difference in roof repair rates conditional on all covariates. New additions

Figure 1: Mean unconditional home maintenance expenditures by age




and kitchen repair and replacement may be considered more elective types of repairs, and we see that older homeowners are significantly less likely to undertake such projects. Hence we can reason that the balance of repairs among younger homeowners is tipped towards customization relative to the repairs performed by older homeowners.

## 3.3 Consequences: Changes in Housing Quality and Age

### 3.3.1 Changes in Perceived Quality and Value

Given that older households spend less on home maintenance, we might expect that their homes suffer a loss in observable quality or value relative to younger homeowners. Table 4 asks whether homeowners or the AHS interviewers perceive such a difference. The first two columns measure changes in interviewer assessed home repair over a two year period among homes owned in consecutive years by the same owner. In the absence of covariates, we find in column (1) that older homeowners are 9 percent likelier than other homeowners to let their homes fall into disrepair. Column (2), however, reveals that conditional on building characteristics, location and length of ownership, there is no significant difference between older and younger homeowners. Conditional on covariates, we find in Column (3) that older homeowners believe that their homes are a higher quality place to live by .34 points on a scale from one to ten. Columns (4) through (6) regress changes in the owner-perceived quality of homes on age and other characteristics. Column (5) shows that among households that do not move between AHS waves, older homeowners perceive some decrease in the quality of their home as a place to live relative to other homeowners. In columns (4) and (6), I consider owner-perceived quality differences between buyers and sellers.

Naturally, the survey question "on a scale of 1 to 10, how would you rate your unit as a place to live?" can be expected to elicit different quality scales from different respondents. The fact that older homeowners tend to think more highly of similar homes than younger homeowners leads to an expectation that the difference between the buyer's view of the home and the seller's view will be more negative when the seller is older. This is confirmed in column (4) of Table 4, which shows that the gap between the seller's last estimate of quality and the buyer's first estimate is larger when the seller is 75 or older by .4 on the 10-point quality scale. One might interpret this result as weak evidence that older homeowners do not perceive the same reduction in quality as the market. Much of the difference in seller-buyer gaps is explained away by covariates, but the interpretation of heterogeneous views between buyers and sellers of the value of older homeowners' homes is confirmed below by comparing changes in market value perceived by older homeowners and those realized in market transactions.

### 3.3.2 Changes in Market values of homes

A natural way to measure the extent to which older homeowners are subject to greater rates of depreciation is to compare annual rates of appreciation among older and younger homeowners. Ideally, we would compare appreciation rates for homes that are identical but for the age of the owner. The AHS allows comparison of homes of similar size and age within the same metropolitan area, but little neighborhood information is available. For the exclusion of neighborhood effects to matter for the results, it would have to be the case that older homeowners live in neighborhoods that see less appreciation than those in which younger homeowners live for reasons having to with something other than building characteristics or the level of upkeep. Building age and square footage may proxy for neighborhood traits, so the generally insignificant effects of building age and square footage provide at lease some confidence that incorporating neighborhood information would not change the results. The assumption of a constant within-MSA appreciation rate, however unrealistic, is implicit in the construction of house price indices such as OFHEO's.

There are three plausible measures available in the American Housing survey of price appreciation among households selling their homes. The first two measures, the dependent variables in Table 5, are log changes in value from an owner's earlier estimated value. In column (1), confining the sample to homes with the same owner in consecutive panel waves (approximately 90% of AHS observations on owner occupied units), I ask whether homeowners over age 75 perceive a lesser rate of appreciation than other homeowners. Conditional on metropolitan area and the age and square footage of the home, there is a difference of two percent over a two year horizon, but this is indistinguishable from zero.

In columns (2) through (6) of Table 5, the dependent variable is the log nominal difference between the resale price that a home received and the owner's estimate of value in 1985. This difference can be expected to differ both by metropolitan area and by the length of time between 1985 and the year of sale. There could further be compositional differences in the set of sellers across years; older homeowners might be relatively more likely to sell after years of relatively high or low price growth relative to owners of similar homes in the same market. In unreported regressions, I find no such difference in the timing of resale, but to allow for the possibility, I demean each observation at the interacted level of metropolitan area and year of resale. Hence, for example, I compare the appreciation rate of homes sold in the Chicago MSA in 1990 only to the appreciation rate of other homes sold in Chicago in 1990.

The results of the regressions of log change from estimated value to resale price are that a year of occupancy by a household headed by an individual over age 75 yields depreciation of two to three percent relative to appreciation if the home were owned by a younger household. Column (2) is a simple comparison of deviations from the mean appreciation for an MSA-year sold cell. The right hand side variable counts the number of years between 1985 and the year of resale that a homeowner was 75 or over. For example, a home headed by a 68 year old in 1985 that was resold in 1996 would have a value of two for the variable $YEARSa75$. A home headed in 1985 by a 68 year old that was resold in 1989 would generate a value of zero for $YEARSa75$. With this specification, I find a significant difference of approximately 2.3 percent. This means that holding the length of the holding period constant, if the esimated value in 1985 is an unbiased estimate of market value, then switching one of the years of occupancy from ownership by a younger household to ownership by an older household would be associated with 2.3 percent less appreciation (or more depreciation). The standard error estimates are robust to heteroskedasticity, which must be present given different horizons. Column (4) divides the dependent variable by the length of time from 1985 to resale, so that the dependent variable is annual appreciation. I find an effect of ownership by a household head aged over 75 in 1985 indistinguishable from that found in column (2). Columns (5) and (6) restore the functional form of column (2), so that the dependent variable is total appreciation and the right hand side variable of interest is years of occupancy in which the household head is 75 or older. I find that the estimated effect is increased insignificantly by controlling for the size and age of the home.

Column (3) of Table 5 replaces the discrete measure of oldness by the continuous measure of survival probability. The variable $VALPROB$ measures the probability that someone of the age of the owner in 1985 would live until the year of sale, so a younger original owner has a larger value for $VALPROB$. The interpretation of the result here is that increasing the probability of death from one percent to 11 percent over the course of the period between 1985 and resale is associated with relative depreciation of 2.7 percent; this result is in accord with the estimated effect in the discrete case given the survival probabilities of older and younger homeowners.

One might be concerned that the reason that the homes of older owners appreciate less is simply that for a home of the same quality, older homeowners bargain less hard, so that there is no reason to associate the difference in maintenance levels with the difference in appreciation rates. To alleviate this concern, Column (6) of Table 5 includes not just the years of occupancy by a homeowner over 75 and building characteristics, but also a set of dummy variables indicating whether the seller was 75, 76... 92 at the time of resale.[9] While the presence of these indicator variables, not surprisingly, diminishes statistical significance, the effect of an incremental year of ownership by an older homeowner rises. This suggests that the mere fact of being an old seller is not associated with lower resale price. Rather, the effect comes with the time between value measures interacted with occupancy by an older owner. This enhances the plausibility of a causal role for under-provision of maintenance in the relative depreciation faced by older homeowners.

[9] 92 is the oldest observed age at resale.

While 1985 estimated value is highly correlated with resale price, one might worry that older homeowners systematically over- or underestimate their own home's value relative to the rest of the population. Anticipating such an objection to the results of Table 5, in Table 6, I replace the owner's 1985 estimate of value as a baseline with the owner's 1985 recollection of purchase price whenever the home was purchased (1985 or, typically, earlier). For 55 percent of homeowners, the recollection in two consecutive panel waves of purchase price is identical. The correlation between recollected purchase price in two consecutive waves is .94. For homeowners less than 75, the correlation between consecutive recollections is .9386, for those over 75, the correlation is .9463. There is thus no systematic difference in the quality of price recollection between older an younger homeowners and the quality of recollections appears to be quite high.

The dependent variable in Table 6 is the nominal log difference between resale price in the year the 1985 owner sold and purchase price in the year the 1985 owner purchased. Column (1) of Table 6 includes on the right hand side the number of years between purchase and resale that the seller was 75 or over. The variable $OLDYEARS$, for example, would receive a value of 20 for a homeowner who was 80 in 1985, purchased their home in any year prior to 1981 and sold their home in 1999. If the same homeowner had been 50 in 1985, $OLDYEARS$ would receive a value of zero. This variable differs from $YEARSa75$ in that years between purchase and 1985 are included in $OLDYEARS$ but not in $YEARSa75$. Also on the right hand side in specification (1) in Table 6 are the size and age of the building as well as dummy variables indicating the metropolitan area and the length of time between purchase and sale. We find that holding the number of years the property is held constant, but increasing the number of years during which the seller was 75 or over is associated with depreciation of approximately six percent. This effect is insignificantly different from zero when the standard errors are estimated robust to heteroskedasticity.

Allowing for differences in the timing of sales between older and younger households, columns (2) through (6) of Table 6 replace the fixed effect of MSA-horizon with explicit interactions between the year purchased and the year sold within each MSA. Hence, for example, in columns (2) through (6), a homeowner who purchased a home in the Detroit MSA in 1960 and sold in 1991 is compared only with homeowners with that exact profile. In column (1), that homeowner might be compared with a household that purchased their home in Detroit in 1965 and sold in 1996. An unfortunate side effect of this precision in comparisons is the loss of almost all observations. Out of almost 3,000 first observed sales of homes present in the 1985 AHS, only 60 are sales of homes with multiple observations for the same MSA-year bought - year sold cell. With 60 observations and 29 fixed effects, estimation of standard errors will be very poor, particularly given heteroskedasticity present when the log difference between purchase price and resale price is not normalized by length of tenure. Columns (2) and (3) find that with or without building size and age controls, a significant depreciation effect of three percent per year arises. Controlling for the age of old sellers, we find the same result in column (4) as we did in Table 6; the esimated effect of an incremental year of occupancy over 75 increases in magnitude. Not surprisingly, when standard errors are estimated in robust form in column (5), statistical significance disappears. Significance is restored in column (6), where the dependent variable is divided by the number of years of occupancy, as is the number of years of being old, so that the variable $\frac{OLDYEARS}{\text{yr. sold - yr. bought}}$ is the fraction of tenure during which the 1985 household head was over 75. In sum, the results of the purchase to resale estimates are similar to those of the 1985 to resale estimates. A year of occupancy by an older homeowner is associated with relative depreciation of approximately 3 percent.

# 4 Concluding Remarks

American Housing Survey data show that older homeowners spend significantly less money on both routine home maintenance and on alterations and repairs than younger households. Homeowners over 75 invest approximately 1,000 less per year in improving their homes' state of repair. Part, but not all of this difference is related to the fact that older homeowners have lived in their homes longer than younger homeowners, and people with longer tenures in their homes spend less on home maintenance and improvement.

Translating these difference in home improvement into a relative reduction in housing wealth is not a trivial exercise; heterogeneity among homeowners, depreciation, inflation and likely decreasing returns to capital investment in homes imply that an inframarginal dollar spent on home improvement will not in general add exactly one dollar to the resale value of the home. However, to the extent that differences in maintenance expenditures across age groups are related to neither home characteristics nor price changes, comparing realized appreciation among older and younger homeowners should provide an estimate of the consequences of the relative under-investment of the elderly.

In the years leading up to resale, older homeowners see approximately 3% less appreciation, or more depreciation, per year than younger homeowners in homes of similar size and age in the same metropolitan areas. Significant differences in appreciation arise whether the base price considered is estimated value prior to sale or the initial purchase price. This difference in annual appreciation rates cannot be attributed to differences in bargaining approaches between older and younger sellers, because the annualized difference arises even when controls are present for the age of the seller.

The magnitude of realized relative depreciation appears to be greater than the difference anticipated by older sellers. If the differences in expenditures and appreciation are roughly constant across wealth levels, then at a median home value among older homeowners in AHS of $100,000, there is an annual gap of $2,000 between the lesser home improvement expenditures relative to younger homeowners and the difference in annual appreciation for comparable homes. While equivalent expenditures by older and younger homeowners might not yield identical rates of depreciation, discussions with contractors suggest that on average, annual expenditures of less than $1,000 should equalize the opportunity sets of seniors completely unable to do work on their own and younger homewoners highly proficient at repairs.

While some of the difference in expenditures appears attributable to diminished customization, through expansion or kitchen remodeling, older homeowners spend significantly less on routine maintenance than younger homeowners and there is a nearly significant difference in the propensity to replace major equipment. Further, a general refusal to exercise any options to undertake a project, regardless of type, that generates more capital gains than costs violates utility maximization as long as the projects themselves do not reduce utility. In fact, anecdotal evidence suggests that disruption and fear associated with contracting out home improvement may be important factors in the relative under-provision of maintenance among the elderly. Given that older homeowners perceive their homes to have inflation rates only slightly and insignificantly smaller than younger homeowners, it also seems possible that older homeowners are not aware of the availability of profitable home improvement expenditures.

Venti and Wise (2000) cite an AARP report stating that most elderly homeowners strongly wish to remain in the same home. This appears to be a costly preference, in that older homeowners enjoy smaller capital gains on housing than younger households at the time of sale. The smaller rate of appreciation may be due not to a greater rate of depreciation among the elderly, but rather to a greater rate of upgrade to existing homes among younger households. It is difficult to distinguish between repairs required to keep a home in constant condition from alterations and repairs which enhance quality. To the extent that these results can be viewed as older households failing to make high return investments in home maintenance, and seeing large depreciation as a result, the puzzle of elderly homeownership has been extended.

One might argue that a wish to stay in place combined with absence of a bequest motive could rationalize the observed under-provision of maintenance. However, a homeowner wishing to remain in place for a long time and with no bequest motive should find reverse mortgages, loans of cash to be repaid when the homeowner moves out or dies, appealing. However, to date, there has been very little demand for reverse mortgages.[10] In any event, the results modify the conventional view that older households are over-invested in housing. For a given level of housing wealth, older households appear to enjoy a greater level of non-housing consumption, when non-housing consumption is considered net of investments in home maintenance and improvement.

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[10]It could be argued that the absence of a market for reverse mortgages is a result of a lack of supply, or of high interest rates (which only matter if there is a bequest motive or intent to move) which could arise from recognition of the deteriorating quality of older households' homes. Neither appears to be the case, as discussed in Abt (1995). Rather there appears to be widespread lack of appreciation for the benefits of reverse mortgages, in particular, cashing out home equity. If some of the proceeds from a reverse mortgage could be used for projects which generate lifetime wealth and a part less than the net change in lifetime wealth for consumption, then it is very difficult to explain an absence of demand.

Gyourko, Joseph, and Joseph Tracy (2003) 'Using home maintenance and repairs to smooth consumption.' Working Paper, Wharton

Hurd, Michael (1989) 'Mortality risk and bequests.' *Econometrica* 57(4), 779–813

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Table 1: Summary Statistics: Data From the American Housing Survey

| Variable | Description | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|---|
| CSTMNT | Routine Maintenance Expenditures | 68,366 | 622 | 1,144 | 0 | 16,592 |
| NumRepairs | Number of Home Improvement Projects | 21,400 | 1.91 | 2.88 | 0 | 45 |
| RAC | Alteration/Repair Expenditures | 68,956 | 1,599 | 4,525 | 0 | 288,899 |
| TSPEND | RAC + CSTMNT | 65,816 | 2,245 | 4,777 | 0 | 292,861 |
| ROOF | All/Part of Roof Replaced | 44,543 | .18 | .38 | 0 | 1 |
| ADD | Additions Built | 44,546 | .04 | .20 | 0 | 1 |
| KITCHEN | Kitchen Added or Remodeled | 44,538 | .09 | .29 | 0 | 1 |
| MEQ | Major Equipment Added or Replaced | 44,495 | 0.11 | 0.32 | 0 | 1 |
| UNITSF | Square feet | 68,532 | 1,964 | 931 | 100 | 5,001 |
| LPRICE | Purchase Price | 64,995 | 64,903 | 70,913 | 1 | 548,029 |
| VALUE | Owner's estimate of mk't value | 74,025 | 130,216 | 103,955 | 0 | 681,012 |
| MOVE | Year moved in | 74,022 | 75.37 | 14.35 | 1 | 101 |
| PROB | Age-birth year specific mortality rate | 74,025 | 0.015 | 0.023 | 0.0004 | 0.17 |
| STAY | Years lived in home | 74,022 | 17.03 | 13.71 | 0 | 87 |
| BUILDAGE | Age of structure | 74,025 | 41.57 | 19.98 | 0 | 86 |
| AGE | Age of respondant | 74,025 | 52.60 | 15.97 | 14 | 91 |
| a25 | Age between 25 and 35 | 74,025 | 0.127 | 0.333 | 0 | 1 |
| a35 | | 74,025 | 0.222 | 0.415 | 0 | 1 |
| a55 | | 74,025 | 0.176 | 0.381 | 0 | 1 |
| a65 | | 74,025 | 0.153 | 0.360 | 0 | 1 |
| a75 | Age 75+ | 74,025 | 0.107 | 0.309 | 0 | 1 |
| ADEQUATE | Home not in disrepair | 79,386 | .96 | .20 | 0 | 1 |
| FALL | Home not in disrepair 2 yrs. ago, is now | 53,182 | .03 | .17 | 0 | 1 |
| DHWOHSALE | Buyer's estimate of unit quality - seller's | 6,298 | -.08 | 2.13 | -9 | 9 |
| DHOWHSTAY | Change in owner's estimate of unit quality | 45,994 | -.017 | 1.603 | -9 | 9 |
| $\frac{\ln(\frac{\text{Resale}}{\text{Value}_{1985}})}{\text{yr. sold} - 1985}$ | $\frac{\text{Log Resale price - log 1985 value estimate}}{\text{Resale year - 1985}}$ | 2,757 | .024 | .216 | -3.689 | 2.547 |
| $\frac{\ln(\frac{\text{Resale}}{\text{Purchase}})}{\text{yr. sold - yr. purchased}}$ | $\frac{\text{Log Resale price - log purchase price}}{\text{Resale year - purchase year}}$ | 2,780 | .054 | .095 | -1.323 | 2.505 |
| YEAR | | 74,025 | 1992.39 | 5.17 | 1985 | 2001 |

Table 2: Regressions of total home improvement expenditures on age

| | (1) TSPEND | (2) TSPEND | (3) TSPEND | (4) TSPEND | (5) TSPEND | (6) TSPEND | (7) TSPEND |
|---|---|---|---|---|---|---|---|
| a75 | -1,045.316 | -1,742 | | -1,246.028 | -921.040 | -504.889 | -504.987 |
| | (52.87)** | (77.08)** | | (69.482)** | (70.438)** | (53.181)** | (52.962)** |
| PROB | | | -18,979.655 | | | | |
| | | | (829.099)** | | | | |
| BUILDAGE | 9.48 | 9.24 | 10.859 | 11.408 | 10.332 | 14.782 | 14.899 |
| | (1.49)** | (1.14)** | (1.503)** | (1.504)** | (1.499)** | (1.611)** | (1.607)** |
| UNITSF | 0.552 | 0.673 | 0.573 | 0.567 | 0.564 | 0.551 | 0.552 |
| | (0.033)** | (.024)** | (0.033)** | (0.033)** | (0.033)** | (0.033)** | (0.033)** |
| a25 | | | | -121.993 | | | |
| | | | | (68.518) | | | |
| a35 | | | | 237.346 | | | |
| | | | | (73.492)** | | | |
| a55 | | | | -395.854 | | | |
| | | | | (65.371)** | | | |
| a65 | | | | -854.281 | | | |
| | | | | (77.272)** | | | |
| SINGLE | | | | | -319.853 | | |
| | | | | | (63.247)** | | |
| OLDSINGLE | | | | | -106.104 | | |
| | | | | | (96.765) | | |
| MSA Fixed Effects? | No | No | Yes | Yes | Yes | Yes | Yes |
| Length of Stay | No | No | No | No | No | 87 dummies | Polynomial |
| Observations | 61174 | 61174 | 61174 | 61174 | 61174 | 61172 | 61172 |
| R-squared | 0.03 | | 0.03 | 0.03 | 0.03 | 0.04 | 0.04 |
| Functional Form | OLS | Tobit | OLS | OLS | OLS | OLS | OLS |

**Notes:** Robust standard errors in parentheses, clustered at the home level. * significant at 5%; ** significant at 1%. a25 indicates age between 25 and 35. a75 indicates age 75 or over for the household head. $BUILDAGE$ is the age in years of the home. Controls for length of tenure in home are either a 7th degree polynomial or inclusion of 87 indicators for the number of years in residence. $PROB$ measures age-birthyear mortality probability. OLDSINGLE is the product of a75 times an indicator for living with no one else.

Table 3: The Effects of Old Age on Different Expenditure Types

| | (1) CSTMNT | (2) Num Repairs | (3) Num Repairs | (4) MEQ | (5) ROOF | (6) ADD | (7) KITCHEN |
|---|---|---|---|---|---|---|---|
| a75 | -100.655 | -0.940 | -0.088 | -0.012 | 0.000 | -0.026 | -0.044 |
| | (16.188)** | (0.111)** | (0.012)** | (0.006) | (0.008) | (0.003)** | (0.005)** |
| BUILDAGE | 2.406 | 0.001 | -0.000 | 0.000 | 0.002 | -0.000 | 0.001 |
| | (0.374)** | (0.002) | (0.000) | (0.000)* | (0.000)** | (0.000) | (0.000)** |
| UNITSF | 0.145 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | (0.009)** | (0.000)** | (0.000)** | (0.000)** | (0.000)** | (0.000) | (0.000)* |
| MSA FE? | Yes | No | No | Yes | Yes | Yes | Yes |
| Length of Stay Polynomial? | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 63,501 | 19,910 | 19,910 | 41,096 | 41,179 | 40,929 | 41,139 |
| R-squared | 0.05 | | | | | | |
| Form | OLS | Probit | Tobit | Probit | Probit | Probit | Probit |

**Notes:** ROOF implies a roof replacement project. ADD is a new addition. MEQ implies replacement of major equipment. KITCHEN implies a kitchen rehabilitation or addition. a75 indicates age 75 or over for the household head. The polynomial in length of stay includes the seven terms $STAY^1 \ldots STAY^7$. * Denotes significance at five percent, ** at 1 percent. Standard errors are clustered at the home level.

Table 4: Regressions of Changes in Owner and Interviewer Assessment of Housing Quality

| | (1) FALL | (2) FALL | (3) HOWH | (4) ΔHOWH SALE | (5) ΔHOWH STAY | (6) ΔHOWH SALE |
|---|---|---|---|---|---|---|
| a75 | 0.091 | 0.005 | 0.339 | -0.407 | -0.103 | -0.134 |
| | (0.034)** | (0.003) | (0.022)** | (0.092)** | (0.026)** | (0.109) |
| UNITSF | | -0.000 | 0.000 | | | |
| | | (0.000)* | (0.000)** | | | |
| Constant | -1.856 | | 8.621 | -0.043 | -0.008 | 0.082 |
| | (0.011)** | | (0.125)** | (0.028) | (0.008) | (0.233) |
| MSA fixed effects | No | Yes | Yes | No | Yes | Yes |
| Polynomial in building age | No | Yes | Yes | No | No | Yes |
| Polynomial in years since moved in | No | Yes | Yes | No | No | Yes |
| Observations | 53,182 | 48,531 | 64,877 | 6,298 | 45,994 | 6,290 |
| R-squared | | | 0.07 | 0.00 | 0.00 | 0.04 |
| Functional Form | probit | probit | OLS | OLS | OLS | OLS |

**Notes:** Robust standard errors in parentheses. In columns (1) and (2), the coefficients are changes in probability of a home falling into interviewer assessed disrepair (FALL) over a two year period. HOWH refers to the owner's assessment of the unit's quality on a scale of one to ten. The dependent variable in columns (4) and (6) is the difference between the buyer's view of a sold home and the sellers view two years prior. Column (5) presents the case where the home is not sold. a75 indicates age 75 or over for the household head, and in the ΔHOWH|STAY regressions indicates that the seller is 75 or older. The polynomials in building age and length of stay have seven terms each.

Table 5: Changes in Home Prices and Old Age: Baseline price is 1985 owner estimated value

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | $\ln(\frac{Value_t}{Value_{t-2}})$ | $\ln(\frac{Resale}{Value_{1985}})$ | $\ln(\frac{Resale}{Value_{1985}})$ | $\frac{\ln(\frac{Resale}{Value_{1985}})}{yr.\ sold-1985}$ | $\ln(\frac{Resale}{Value_{1985}})$ | $\ln(\frac{Resale}{Value_{1985}})$ |
| YEARSa75 | | -0.023 | | | -0.028 | -0.031 |
| | | (0.009)* | | | (0.011)** | (0.017) |
| VALPROB | | | 0.270 | | | |
| | | | (0.122)* | | | |
| a75 | -0.002 | | | -0.022 | | |
| | (0.008) | | | (0.016) | | |
| UNITSF | 0.000 | | | | 0.000 | 0.000 |
| | (0.000) | | | | (0.000) | (0.000) |
| BUILDAGE | 0.001 | | | | 0.001 | 0.001 |
| | (0.000)** | | | | (0.001) | (0.001) |
| Constant | -0.024 | 0.167 | -0.089 | 0.026 | 0.106 | 0.108 |
| | (0.005)** | (0.013)** | (0.112) | (0.004)** | (0.044)* | (0.044)* |
| Fixed Effects: MSA × | 1 | yr. sold | yr. sold | yr. sold | yr. sold | yr. sold |
| Age Dummies? | No | No | No | No | No | Yes |
| Observations | 42985 | 2781 | 2757 | 2757 | 2629 | 2629 |
| R-squared | 0.00 | 0.36 | 0.35 | 0.30 | 0.37 | 0.38 |
| Observations | 2,278 | 2,278 | 2,278 | 42 | 42 | 42 |
| R-squared | .29 | .30 | 0.3 | 0.63 | 0.48 | 0.63 |

**Notes:** Standard errors in parentheses. * denotes significant at five percent, ** at one percent. a75 indicates age 75 or over for the household head. Value is owner-estimated value of a home, Resale is the actual sale price for homes sold after 1985. VALPROB is the probability that the seller would have survived to the year of resale as of 1985 given age in 1985. Fixed effects in columns (2) through (6) interact the year of sale and MSA in which the house is located.

Table 6: Changes in Home Prices and Old Age: Baseline price is pre-survey purchase price

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | $\ln(\frac{\text{Resale}}{\text{Purchase}})$ | $\ln(\frac{\text{Resale}}{\text{Purchase}})$ | $\ln(\frac{\text{Resale}}{\text{Purchase}})$ | $\ln(\frac{\text{Resale}}{\text{Purchase}})$ | $\ln(\frac{\text{Resale}}{\text{Purchase}})$ | $\frac{\ln(\frac{\text{Resale}}{\text{Purchase}})}{\text{yr. sold - yr. purchased}}$ |
| $\frac{\text{OLDYEARS}}{\text{yr.sold-yr.purchased}}$ | | | | | | -0.036 |
| | | | | | | (0.017)* |
| OLDYEARS | -0.061 | -0.043 | -0.046 | -0.098 | -0.098 | |
| | (0.041) | (0.021) | (0.022)* | (0.031)** | (0.075) | |
| UNITSF | -0.000 | | 0.000 | 0.000 | 0.000 | 0.000 |
| | (0.000) | | (0.000) | (0.000) | (0.000) | (0.000) |
| BUILDAGE | 0.005 | | -0.006 | 0.007 | 0.007 | -0.000 |
| | (0.002)** | | (0.009) | (0.012) | (0.012) | (0.000) |
| Constant | 0.837 | 1.296 | 1.403 | 0.810 | 0.810 | 0.060 |
| | (0.087)** | (0.110)** | (0.410)** | (0.500) | (0.362)* | (0.013)** |
| MSA× yr. sold | MSA× | Yes | Yes | Yes | Yes | Yes |
| × yr. purchased? | horizon | | | | | |
| Age Dummies? | Yes | No | No | Yes | Yes | No |
| Observations | 2629 | 60 | 59 | 59 | 59 | 59 |
| R-squared | 0.80 | 0.70 | 0.70 | 0.86 | 0.86 | 0.51 |

**Notes:** The unit of observation is a sales transaction witnessed in the American Housing Survey. Resale is the price at which a home transacted in yr. sold. Purchase is the price at which the reseller originally purchased the home in yr. purchased. OLDYEARS is the number of years between purchase and resale during which the reported head of the household was 75 or older. Fixed effects either interact each metropolitan area (MSA) with the number of years between purchase and sale, or more restrictively, both the year of purchase and the year of resale.