Home Maintenance and Housing Disinvestment among Older Americans

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Abstract

We investigate the role of endogenous depreciation of the housing stock through deferred maintenance in explaining the housing equity puzzle. To calculate the total value of disinvestment, we apply a household production model where households can either purchase professional services or combine market goods with own-time. We find that home production is a significant source of home investment; professional services, materials, and time are gross complements; and married households extract nearly 10 percent of home value through deferred maintenance. Further, households appear forward-looking, increasing maintenance just prior to retirement, potentially anticipating low moving probabilities and future housing disinvestment.

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1 Introduction

Becker (1964) formalized a resource allocation model that recognized the fundamental importance of time as both a scarce resource and necessary input to economic activity. While widely acknowledged (Aguiar, Hurst and Karabarbounis, 2013), the central role of time as a component of household production continues to remain absent from the majority of empirical analyses. As a result, studies of consumption and investment decisions that use expenditure in lieu of consumption can generate conclusions that are incomplete or even misleading. For example, the substantial decline in food expenditures upon retirement seems to conflict with the predictions of the Permanent Income Hypothesis, giving birth to the so-called retirement-consumption puzzle. Subsequent work that approached the issue from the household production framework, however, recognized that this puzzle was almost entirely illusory. As Becker's (1964) model predicts, because the opportunity cost of time decreases in retirement, households substitute away from goods-intensive production toward more time-intensive production methods. While expenditure falls, the increase in time allocated to shopping and meal preparation allows households to smooth consumption through retirement[1] (Aguiar and Hurst, 2005; Atalay, Barrett and Staneva, 2020; Been, Rohwedder and Hurd, 2020; Hurst, 2007; Schwerdt, 2005; Stancanelli and Van Soest, 2012; Velarde and Herrmann, 2014). In this article, we consider the potential for home production to at least partially explain another challenge to the predictions of the Permanent Income Hypothesis: the apparent failure of retirees to use their housing assets to increase consumption during retirement, i.e., the *housing-equity puzzle* (HEP).

Housing constitutes a significant share of the total assets held by retired Americans. Almost 80 percent of retirees own a home (US Census Bureau, 2018); in 2015, the mean net worth of those homes was approximately $200,000 (Li and Goodman, 2016); and housing accounted for nearly half of the total net worth of retirees (Moulton et al., 2016). Yet, there is little evidence that households use housing equity as a regular source of income in retirement to smooth consumption.

[1] For further reading on the retirement-consumption puzzle see Hamermesh (1984); Banks, Blundell and Tanner (1998); Bernheim, Skinner and Weinberg (2001); Hurd and Rohwedder (2008).

The take-up rate for reverse mortgages is exceptionally low (Davidoff, Gerhard and Post, 2017; Kaul and Goodman, 2017; Nakajima and Telyukova, 2017) and only a small percentage of retirees downsize to smaller residences as they age. On the contrary, most retirees continue to live in their pre-retirement residence throughout the majority of their retirement, exhibiting annual transition rates of 1.7 to 9.1 percent per year (Feinstein and McFadden, 1989; Munnell et al., 2020; Murray, 2019*a*; Venti and Wise, 1989, 1990, 2001, 2004). Further, when retirees do change residence, they are just as likely to upsize as downsize (Calvo, Haverstick and Zhivan, 2009; Clark, Deurloo and Dieleman, 2003; Venti and Wise, 1989). The majority of housing transitions associated with a decrease in housing stock follow idiosyncratic negative shocks, such as the death of a spouse or divorce, rather than as part of a long-term retirement asset management plan (Ai et al., 1990; Borsch-Supan, Hajivassiliou and Kotlikoff, 1992; Calvo, Haverstick and Zhivan, 2009; Fisher et al., 2007; Poterba, Venti and Wise, 2011; Venti and Wise, 1989, 1990, 2001, 2004).

Some view the HEP as an indication of the presence of market failures that prevent older adults from maximizing lifetime utility or an inability on the part of older households to successfully navigate real estate and home finance markets. A competing set of responses rejects the HEP as a failure of standard life-cycle models to correctly specify the utility function[2]. In this article, we instead consider the possibility that the HEP arises, at least partially, from a mis-specified housing production function, namely, a failure to incorporate endogenous depreciation of housing stock through deferred maintenance. Maintenance on the house in conducted through both market expenditure on professional services and home production where household members perform maintenance themselves by combining their time with good purchased in the market (so called, *do-it-yourself* or *DIY*).

Without proper maintenance, the physical housing asset depreciates as foundations crack, roofs leak, paint peels, pipes burst, and durable goods become obsolete. These processes will tend to

[2] Included in this family of rejoinders are a desire to include housing in a bequest to children (Begley, 2017; Suari-Andreu, Alessie and Angelini, 2019); housing equity as a form of precautionary savings (Murray, 2019*b*; Nakajima and Telyukova, 2017; Poterba, Venti and Wise, 2011); and non-pecuniary utility flows from staying or disutility flows from moving (Carstensen, 2006; Fisher et al., 2007).

reduce the value of the asset. Homeowners can counteract depreciation by allocating resources to maintenance and upkeep, but at the cost of reduced consumption. Of course, the converse also holds: households can reduce maintenance allocations and thereby increase consumption at the cost of reducing housing equity

Previous researchers have posited that reduced maintenance may be a potential method of extracting housing equity (Davidoff, 2006; Feinstein and McFadden, 1989) and there is empirical evidence consistent with such a mechanism. First, housing quality is negatively correlated with age and a significant number of retirees reside in buildings in need of basic repair (Mayer and Lee, 1981; Reschovsky and Newman, 1991). Second, retired households tend to spend around $900-$1,400 per year less than the average working-age household on home maintenance (Begley and Lambie-Hanson, 2015; Davidoff, 2006; Fisher and Williams, 2011; Gyourko and Tracy, 2006; Haughwout, Sutherland and Tracy, 2013). Third, homes owned by older households appreciate 1.0-3.6 percent slower relative to working-age households (Davidoff, 2006; Rodda and Patrabansh, 2007). While suggestive, these results are also consistent with cohort effects: older adults may simply tend to live in homes and neighborhoods that are systematically different than those of younger adults along dimensions that are unobserved by the econometrician and only imperfectly captured by geographic fixed-effects.

While the previous research has looked at maintenance expenditures by older adults, they have not done so in the context of the HEP and have not included home production of maintenance in their analysis. A decrease in maintenance expenditure in retirement may be offset by more time being spent maintaining and improving the home. If this is the case, then housing wealth is not being extracted due to lack of maintenance; and the slower rate of home appreciation is a product of other observed and unobserved differences between older and younger homeowners. However, if older households are allotting less time to housing maintenance while simultaneously reducing their expenditure, then the previous studies underreport the true value of disinvestment in the house, and thus the importance of housing disinvestment in explaining the HEP.

The contribution of this study addresses this gap in the literature by estimating the economic importance of housing disinvestment through deferred maintenance using a household production model and a longitudinal sample of older adults. This approach allows us to better control for unobserved heterogeneity across cohorts, while parsimoniously accounting for the myriad resource allocation decisions that homeowners make.

In a preview of our results, we find that total investment in home maintenance, i.e., the combined value of spending on professional services, the purchase of materials, and the time allocated to DIY projects, tends to decrease as households age during retirement. Comparing the realized value of home maintenance between age 65 and 84 with a pre-retirement age baseline, the mean cumulative reduction in the total value of home maintenance is $20,864 ($1,043 annually) for married households and $2,636 ($132 annually) for single households. Further, we find that failing to account for home production of housing maintenance leads to significant underestimates of the degree to which homeowners extract value from their home, which accounts for a quarter of the disinvestment for married households and most of the disinvestment for single households. Finally, we also show that, unlike other commodities that have been studied in the home production model, resource allocation in the housing maintenance decision exhibits a strong degree of complementarity between time spent on home maintenance, expenditure on DIY materials, and expenditure of professional services.

Interestingly, this decline appears to be anticipated by households before they retire. Specifically, households increase both the time and money they spend on home improvement between the ages of 60-65, particularly in married households. This pattern is consistent with forward-looking behavior as pre-retirees increase housing investment in preparation of living in their home through retirement. Whatever the causes of the HEP—sentimentality, transaction costs, capital market failures—our results are not consistent with naivety or lack of sophistication on the part of homeowners.

As would be expected, the decline in housing maintenance corresponds to slower appreciation rates for older homeowners. Specifically, we find that homes owned by those 75 and older have appreciation rates 2- to 5-percentage points lower than those under age 75, which is consistent with the findings of Rodda and Patrabansh (2007) and Davidoff (2006). Although the reallocation of resources from maintenance to consumption cannot explain the entirety of the HEP, they suggest that older households extract an economically meaningful share of total equity from their homes by reducing maintenance as part of a forward-looking asset management strategy.

This paper proceeds with a discussion of the data used in Section 2, a graphical analysis of time and money spent on maintenance and upkeep in Section 3, a regression analysis in Section 4, a discussion of the results in Section 5, how house values appreciate for retirees in Section 6, and concluding remarks in Section 7.

2 Data

To examine the home maintenance behavior of older Americans, we use restricted geocoded data from the 2004 to 2014 waves of the Health and Retirement Study (HRS). Relative to other data sources, e.g., the American Housing Survey (AHS), the HRS offers several unique advantages for the current investigation.

First, the HRS is a longitudinal survey administered every two years since 1992 with a large, nationally representative sample of approximately 20,000 older households defined by their birth cohort.[3] It is therefore possible to study household resource allocations within a given housing unit as the members of the household age. In contrast, the AHS is a repeated cross-section.

Second, to fully account for the role of housing maintenance as a vehicle for wealth management, it is necessary to have data on the allocation of both monetary and time resources within

[3] The original target population for the HRS when the study was initiated in 1992 is adults born between 1931-1941 (designated 'HRS Cohort') and those born before 1924 (AHEAD cohort). Every six years the survey adds a new cohort starting in 1998 with those born between 1924-1930 (Children of the Depression) and 1942-1947 (War Babies Cohort). In 2004 those born between 1948-1953 (Early Baby Boomers Cohort) were added; and the last group added was in 2010 with the addition of those born between 1954-1959 (Mid-Baby Boomers Cohort). For more information on the HRS and its sample selection, see https://hrs.isr.umich.edu/publications/biblio/9047 (HRS Staff, 2008).

the household. As noted in Dunn (2015), there are few data sources that include both expenditure and time use for all members of a household. The HRS is a notable exception as a subsample of HRS households are asked to complete the Consumption and Activities Mail Survey (CAMS) in off-years (the core HRS is administered in even-numbered years; the CAMS in odd-numbered years). From 2005-2015, CAMS respondents are asked to report annual household expenditure on 1) materials purchased for home repair and 2) expenditure on professional services for maintenance and repair. We sum these values to define the total annual household monetary expenditure on housing maintenance.[4] In addition, each member of the household (not just the responding member) is asked to provide the number of hours each month engaged in home improvements or home repair. We are therefore able to construct a measure of total household time allocation to home maintenance by summing over individual household members. This monthly value is scaled by twelve to calculate the total annual household time allocation on housing maintenance.

Third, the core HRS contains a rich set of demographic information about the household and its constituent members. Variables of particular importance include age, education, marital status, home ownership, house values, labor and non-labor income, assets, cognitive ability, and various measures of physical health. Based on these measures, we are able to restrict our sample to households that continuously reside in an owner-occupied single-family residence that either 1) only include an opposite sex married couple in which the husband is at least 55 years old or 2) only includes an unmarried single individuals at least 55 years old. Age for married household refers to the age of the husband in all analyses. These restrictions allow us to abstract from other intrahousehold decision processes to focus narrowly on housing maintenance allocations.

Descriptive statistics of all the variables used in this analysis can be found in Table 1, and a detailed breakdown of all the variables used in this analysis can be found in Appendix A. All monetary values in the HRS and CAMS are reported in nominal dollars and have been converted

[4] The RAND FAT file of the main HRS survey also includes a variable for household spending on major home improvements. This variable does not separate purchases of professional services from materials and does not include routine maintenance. Thus, our preferred results use the expenditure variables from CAMS. Nonetheless, the age-profile of expenditure using the HRS variable is quantitatively similar.

into 2009 real dollars using the PCE chain-type price index from the Federal Reserve Economic Database.[5] Further, depending on the question, expenditure and time allocations in HRS and CAMS are reported over varying time frames (e.g., monthly, yearly, biyearly, etc.) and have been converted to annual values.

3 Graphical Analysis

In this section, we examine the age-profile of housing maintenance allocations in a highly intuitive graphical approach, treating each biennial CAMS wave as a representative sample drawn from the population of older adults in the United States. While intended as a purely descriptive analysis, as will be seen subsequently, the most important stylized facts continue to hold when we adopt a more rigorous regression framework.

3.1 Annual Housing Maintenance Expenditure

Figure 1 plots the age-profile of mean household expenditure on professional services, do-it-yourself materials, and total maintenance expenditure (their sum). All three series exhibit a similar inverted U-shaped pattern: increasing steadily during late working years, followed by a steady decline after age 65. For example, the three-year moving average of total expenditure increases approximately 83 percent between age 55 and 60 where it peaks at around $2,750, and then falls approximately 63 percent from age 60 to 80 to just over $1,000. These results are consistent with those reported by Bogdon (1996) and Davidoff (2006).

Figure 2 repeats the analysis separately for married- and single-households, as well as by the gender of single-household member. Married households spend more than single households and single women spend slightly more than single men, but it is worth noting the sample size of single men is relatively low compared to single women. Expenditure in married households peaks around

5 Downloaded from the Federal Reserve Economic Database (https://fred.stlouisfed.org/series/PCEPI) on 5/13/2017 (Bureau of Economic Analysis, 2017).

age 60, plateaus from ages 65 to 75, and then follows a sharp decline. Single households have a more gradual increase in total expenditure and peak around age 65 followed by a steady decline. Breaking the analysis by expenditure type, married households spending on professional services follows as similar pattern to total expenditure whereas single households spending on professional services is relatively flat until age 75. All households, except single men, have an increase in spending on DIY materials though the peak is around age 60 for married households and 65 for single households. Single men have a slight increase on spending for DIY materials after age 75, which is most likely due to the small sample size and survivor bias.

Mayer and Lee (1981) and Reschovsky and Newman (1991) suggest that declines in maintenance and the quality of retiree homes is due to declining incomes with age. Figure 3 plots the age-profile of maintenance expenditure by income quintile (constructed from the 2009 CPS).[6] Although home maintenance is clearly normal, the inverted U-shaped pattern of expenditure is evident throughout most of the income distribution with the exception of the highest income quintile where spending on professional services is around $6,000 at age 55 and is declining until age 65, where there is an increase until age 75 followed by a decline. The large spending on professional services by the highest income quintile is also reflected in total maintenance expenditure. It is noteworthy that total expenditure peaks slightly later for higher income households. This may be because households that are in better health spend more on home maintenance, as seen in Figure 4 and that high-income workers tend to be in better health and thus fully retire at older ages (Bosworth, Burtless and Zhang, 2016; Gustman and Steinmeier, 2005, 2014).

The increase in maintenance expenditure prior to age 65, particularly for married households, suggests that homeowners are forward looking in their maintenance allocations. The inverted U-shape is consistent with an intention to remain in their home throughout retirement and making the necessary investments to do so.

[6] Figure B1 in the Appendix reports results by quintile of the house value distribution and reveals similar patterns as the age-profile by income quintile.

3.2 Time Allocated to Home Maintenance

Figure 5 plots the age-profile of annual time allocations to home maintenance by household type and gender. As with household expenditure, both single and married households exhibit an inverted U-shape relationship that peaks around age 65 and declines subsequently, offering additional evidence that households are forward looking. Married men spend more time on home maintenance than single men do, but the time spent by women is relatively similar for married and single women. The shared shape also suggests that time and money are complements, rather than substitutes in home maintenance production – recall that the inverted U-shape was evident within income bands and thus not entirely explained by normality.

3.3 Total Investment in the Home

To calculate the total value of home maintenance requires a dollar-equivalent valuation of home production. We approach this problem two ways. First, we use the analogy of a job quote that allocates cost into two categories: "parts" and "labor." For example, a homeowner may get a quote for a new fence in the form: "wood plank costs $x per linear foot and we charge $z per linear foot for installation." When purchased from a contractor, these costs are reported together as professional services. If instead the owner engages in home production, we observe the cost of wood as DIY materials and the time allocated to installation as hours on home maintenance. In the parts-and-labor approach, we require a dollar value of this time.

The shadow wage is one candidate, but identifying the value of time for older household members is difficult as the individuals who work in the formal labor market into their 70s and 80s are a highly selected sample. The median usual weekly earnings for a full-time worker reported from the CPS averaged over the four quarters of 2009 was $684, or approximately $19.54 per hour assuming a 35-hour full-time workweek ($22.51 for men and $17.28 for women). Yet, the median rate for hourly workers age 65 and above was significantly lower: $12.00 for men and $11.11 for females, generating a fairly wide range of values.

An alternative we consider is calculating the value of homeowner time relative to purchasing market labor. The *Home Advisor's True Cost Guide* reports that the average cost of a repairperson is \$77.[7] Bridgman (2016) estimates that labor in home production is approximately one-third as productive as market labor. Assuming this ratio holds for home maintenance implies a value of time of approximately \$25 per hour.

Finally, we attempt to estimate the value of home production directly. Assume that the value of housing stock evolves according to the following:

$$v_{hjy} = (1-\delta)v_{hjy-1} + \alpha p_y + f(d_y, t_y) \tag{1}$$

where h denotes the household, j denotes location, y denotes year, v denotes home value, p denotes expenditure on professional services, d denotes expenditure on do-it-yourself materials, and t denotes time to home maintenance. The physical stock of housing depreciates at rate δ.

We specify the home production function, f, as a linear interaction of time and DIY materials, generating the following:

$$v_{hjy} - v_{hjy-1} = \alpha p_y + \beta_1 d_{hy} + \beta_2 t_{hy} + \beta_3 d_{hy} t_{hy} - \delta v_{hjy-1} \tag{2}$$

For our preferred analysis, we specify this relationship with following estimating equation restricted to positive values of $p_h y$, $d_h y$, and $t_h y$:

$$v_{hjy} - v_{hjy-1} = \alpha p_y + \beta_1 d_{hy} + \beta_2 t_{hy} + \beta_3 d_{hy} t_{hy} + \tau_t + \delta_h + \varepsilon_{hy} \tag{3}$$

where δ_h is a household fixed-effect and τ_t is an annual trend. Because the auto-regressive component of the housing stock equation is not the primary concern of our study, we opt for a fixed-effects specification as a parsimonious but robust method to capture home-specific depreciation, while simultaneously controlling for time-invariant location, home, and homeowner attributes that

[7] See https://www.homeadvisor.com/cost/handyman/#closing-article (visited 6/23/2020).

are associated with changes in home values and the resource allocations of homeowners.[8] Using the estimated parameters reported in Table B1 of the appendix, we estimate the value of home production relative to market purchased maintenance as[9]:

$$H = \frac{\hat{\beta}_1 d_{hy} + \hat{\beta}_2 t_{hy} + \hat{\beta}_3 d_{hy} t_{hy}}{\hat{\alpha}} \tag{4}$$

Table 2 reports the values for home production and total investment resulting from equation 3 as well as using the dollar value of time from the CPS and Home Advisor's True Cost Guide. Our results are robust with similar results using all three methods with our estimated values of time being $23.33 for married households and $21.77 for single households.

Figure 6 plots the age profile of home production and the total value of maintenance by household type and gender. Failing to account for the value of time greatly understates the true value of housing maintenance, as the value of time nearly equals total expenditure for married and single households before age 65.

Table 3 summarizes the preceding results reporting annual household maintenance allocations by age-range and household type. Married households spend more time and money on home maintenance than single households do and the value of time is not a large factor in the total value of maintenance for single households but is for married households, notably prior to age 65.

The implications of the fall in housing maintenance is evident in as shown in Table 4[10], which compares mean cumulative total value of housing maintenance with the counterfactual of households maintaining the same level of spending as they did between ages 55-64. The total value of

[8] We did consider two alternative specifications: a linear lagged dependent variable without a household fixed-effect and an Arellano-Bond GMM estimator with a lagged dependent variable and a household fixed-effect. As expected, the former does not adequately capture time-invariant household attributes, resulting in unreasonably large values of household production. The latter estimator performs poorly.

[9] While we acknowledge that some home improvement projects end disastrously [Are you familiar with the economist who began his project with "Let's assume the wall is not load-bearing"?], we impose a floor of zero for H and record negative predicted values as such.

[10] Tables B2 and B3 in the appendix show the results for the alternative methods presented in Table 2.

maintenance for married households between the ages of 65-84 is $68,012, which is $20,864 less than they would have spent by maintaining the same level of investment they did between ages 55-64, an average of $1,043 per year. The mean house value for married households is $217,838, implying a mean disinvestment through forgone maintenance of 9.4 percent. For single households, the mean value of disinvestment is $2,636, or 1.5 percent. Breaking down single households by gender, for single men, the mean value of disinvestment is $13,064, or 6.3 percent. Single women spend a relatively similar amount on investment after age 65 as they do prior to age 65. On average, they spend $63 more per year after age 65, where they actually invest in the house instead of disinvest.

Although married and single households exhibit similar overall patterns, the magnitude of the increase in housing investment before retirement and subsequent disinvestment after retirement is substantial larger for married households. Pre-retirement differences partly reflect that married households tend to have higher incomes and wealth than single households. It also likely captures the ability of married individuals to allocate DIY activities across household members. These additional resources thereby allow married households to invest more heavily before retirement and thus draw down housing assets more aggressively after retirement.

It is important to recognize the significant role that time allocated by homeowners plays in housing maintenance over the life-cycle. Failing to account for the value of this time would lead to an underestimate of the true value of disinvestment. Married households disinvest an average of $15,491 on professional services, while households with single men and single women disinvest an average of $1,125. The reduction of time spent on home maintenance accounts for 25.8 percent of total disinvestment for married households and 91.4 percent for single men.

4 Regression Analysis

4.1 Value of Maintenance

Although the preceding graphical analysis is consistent with forward-looking planning by households who anticipate sustaining consumption through retirement by reallocating time and monetary resources away from home maintenance, alternative mechanisms may be driving the observed relationships. For example, the fall in expenditure may reflect reduced income or deteriorating health. Therefore, we estimate a series of nonparametric local-linear regressions using the Gaussian kernel that control for these household attributes while avoiding assumptions about the shape of the age-profile. The optimal bandwidth is selected using cross-validation as suggested by Li and Racine (2004). The regressions take the following form:

$$Y_{it} = g(Age_{it}, X_{it}, \phi_i, \lambda_t) + \varepsilon_{it} \tag{5}$$

where Y_{it} denotes the measure of home maintenance (expenditure on professional services; the value of time allocated to home maintenance; and the total value of household maintenance); X_{it} denotes household characteristics (home value, household income, non-housing wealth, urban location, and mobility); ϕ_i denotes a state fixed-effect; and λ_t) denotes a year fixed-effect. These regressions are estimated separately by marital status and gender for single households.

4.2 Appreciation of House Values

A second set of regressions estimate the relationship between age and home appreciation. Davidoff (2006) notes the difficulty in linking home maintenance directly to the value of housing as an investment vehicle because "painting a room... may add nothing to the resale value of one's home, but fixing a leaky pipe almost certainly enhances resale value." He suggests an alternative empirical approach that examines whether the homes of older owners appreciate more or less slowly than the homes of younger households. We therefore also estimate a second set of nonparametric regressions using the Gaussian kernel with optimal bandwidths selected using cross-validation that take the following form:

$$APPRECIATION_{it} = g(Age_{it}, X_{it}, \phi_i, \lambda_t) + \varepsilon_{it} \tag{6}$$

We use similar measures of appreciation as in Davidoff (2006) and Rodda and Patrabansh (2007): log differences and compounded annual growth rate (CAGR), which are defined as:

$$Log\ Differences = log\left(\frac{House\ Value_{t+1}}{House\ Value_t}\right) \tag{7}$$

$$CAGR = \left(\frac{House\ Value_{t+1}}{House\ Value_t}\right)^{\frac{1}{n}} - 1 \tag{8}$$

Since the HRS is administered biennially, $n = 2$ for this calculation.

Rodda and Patrabansh (2007) suggest that one possible explanation for older households reporting lower appreciation rates could be that older households simply lack the ability to process local housing market activity. We therefore include in the set of explanatory variables, X_{it}, a measure of cognition that is available in the HRS. We also estimate these regression separately by marital status and gender for single households.

5 Empirical Results

5.1 Value of Maintenance

Table 5 shows observed margins and the observed contrasts from the nonparametric regressions of home maintenance allocations for pre- and post-retirement age groups by household type, while the panels of Figure 7 and Figure 8 plot observed mean from nonparametric regressions over the age profile. The observed margins show the average of the mean function resulting from the nonparametric regressions, shown in Figures 7 and 8, over the specified age range and the observed contrasts show the change in the mean function over the specified age range.

For married households, the observed margin for the total value of maintenance from ages 55 to 64 is $4,342 and falls to $3,690 from ages 54 to 84. The observed contrast from age 55 to 64 is $1,529 and -$3,391 from age 65 to 84. This shows that the total value of maintenance for married households follows a U-shaped trajectory over the age profile and invest less into home maintenance in retirement than working ages. Married households show a similar U-shaped pattern for spending on professional services and home production over the age profile. This further suggests that married households are forward looking as they increase their investment in maintenance.

For single households, the observed margin for the total value of maintenance is $2,226 from ages 55 to 64 and $1,914 from ages 65-84. The observed contrast from age 55 to 64 is $1,716 and -$2,943 from age 65 to 84. This shows that the decline in maintenance over the age profile for single households also follow a U-shaped pattern and invest less in maintenance as they age. Home production also shows a U-shaped pattern over the age profile but spending on professional services has a slight linear decline.

The pattern for single women follows a similar pattern to that of all single households, showing a linear decrease in the total value of maintenance, home production, and professional services. Single men also show a U-shaped pattern for maintenance, however, there are few single men in the sample relative to single women, which make the results for professional services and home production not significant over large parts of the age profile.

5.2 Appreciation of House Values

Figure 9 shows annual home appreciation rates by household type and gender for single households. The trend in appreciation rates is similar for all household types. CAGR shows a positive growth rate in house values until around age 70 and log differences shows a positive growth rate until around age 63. Table 6 shows the observed margins and the observed contrasts for the non-parametric regressions on appreciation. We compare appreciation rates for households over age 75 to those under age 75 following Davidoff (2006) and Rodda and Patrabansh (2007). For married and single households, the observed contrasts for both log differences and CAGR show a generally downward trend throughout the age profile. The observed margins for both log differences and CAGR show that houses appreciate 1 to 2-percentage points less for married households and 2 to 4-percentage points less for single households after age 75-84 compared to households under age 75. The observed margins are not statistically significant, but the magnitude of our findings are similar to Davidoff (2006) and Rodda and Patrabansh (2007). While we are not able to draw a causal relationship of lower appreciation rates for older households to a decrease in home maintenance, it does appear that some households are extracting some housing equity by forgoing investment in maintenance.

6 Conclusion

The preceding analysis established important new stylized facts about the housing investment decisions of older Americans. First, we have demonstrated that the value of home production is nearly as important as the purchase of professional services. Further, failing to account for the value of time in home production will vastly understate the magnitude of housing investment through maintenance. Future work in this area must recognize the limitations of working with data that lacks information about both household monetary and time allocations to activities that increase the value of housing stock.

Second, resource allocation to housing maintenance demonstrates strong complementarity. Within the home production decision, time and the purchase of market goods are complements. Further, within the overall housing maintenance portfolio, home production and expenditure on professional services are also complements. In this respect, housing maintenance differs from other commodities that have been examined in the home production framework. For example, Aguiar and Hurst (2005) find that home production of meals are a substitute for restaurant meals and that grocery expenditure is a substitute for shopping and meal preparation.

Third, the age-profile of home maintenance exhibits a clear inverted U-shape. Households increase investment in maintenance and upkeep between ages 60 to 65 as they prepare to live in their home throughout retirement. After age 65, however, households decrease spending on professional services, spending on do-it-yourself materials, and time spent on maintenance each year. Indeed, the decline in home production accounts for 25.8 percent of the total disinvestment for married households and 91.4 percent for single households between ages 65 and 84.

Bring these results together, we demonstrate that married households disinvest an average of $20,864 from ages 65-84 (9.4 percent of the mean house value) and single households disinvest an average of $2,636 (1.5 percent of the mean house value). This difference is partially attributable to pre-retirement differences; married households tend to have higher incomes and wealth than single households and home investment is normal. It also likely captures the ability of married individuals to allocate DIY activities across household members. These additional resources thereby allow married households to invest more heavily before retirement and thus draw down housing assets more aggressively after retirement.

At the outset of this study, we posited that the HEP could be potentially explained by a failure to adequately account for housing disinvestment through deferred home maintenance. For older married households, we do find evidence that a reduction in home maintenance accounts for a small, but economically meaningful way of extracting housing wealth. Indeed, our results suggest households anticipate this disinvestment process. Nevertheless, there are good reasons to believe, as forward-looking as this behavior may be, it is not the first-best way to extract equity.

Butrica and Mudrazija (2016) show that older households could increase their median income by as much as 40 percent by selling their home and annuitizing the money from the sale, four times the value of disinvestment we report here. Even if one were to grant that the non-pecuniary value of physical structures were sufficiently high given the exhibited reticence to relocate during retirement, disinvesting via deferred home maintenance is unlikely to provide the equivalent income of a reverse mortgage in a well-functioning credit market.

Home Equity Conversion Mortgage's (HECMs) account for 90 percent of reverse mortgages in the United States (Nakajima and Telyukova, 2017). One of the more popular ways households extract equity through a HECM is through the *Tenure* plan. The *Tenure* plan allows the homeowner to receive equal monthly payments the remainder of time in their home (Johnson and Simkins, 2014; Shan, 2011). This HECM plan is comparable in terms of equity extraction by forgoing maintenance for a household that spends the majority of their retirement in the same house. Shan (2011) shows that for a $200,000 house (close to the average house value of the HRS sample used for this study), the annual payout for a *Tenure* plan is between $5,232-$7,320[11] per year for a household that takes out a HECM at age 65[12].

Given that older homeowners want to stay in their home and the amount of money available via a reverse mortgage is more than double what the average household is extracting by forgoing maintenance, new questions arise as to the reasons why older homeowners are not using reverse mortgages. One possible explanation is that older homeowners do not have the financial literacy to fully comprehend reverse mortgages and generally lack awareness of them (Davidoff, Gerhard and Post, 2017; Kaul and Goodman, 2017; Kutty, 1998; Venti and Wise, 1990, 2004). However, one of the primary reported reasons reverse mortgages are not popular is because homeowners say the costs are too high (Moulton et al., 2016; Redfoot, Scholen and Brown, 2007). Moulton et al. (2016) further report that small payouts and a desire to be debt-free as other reasons homeowners give for forgoing this option. These explanations are puzzling because by staying in their home and deferring maintenance they will be extracting a smaller amount of money from their home. This gives more plausibility to a lack of understanding of what a reverse mortgage is and how it works. Kaul and Goodman (2017) outline some possible changes that would increase the popularity and effectiveness of reverse mortgages; however, even in their current state they appear to be a better method of equity extraction than forgoing maintenance.

Despite more lucrative options available, households are extracting home equity by forgoing investment in home repair (in both money and time). Households appear to be forward looking and not naive to their investment decisions. We show that the value of disinvestment due to decreases

[11] This value varies depending on interest rates.

[12] Table 1 in Shan (2011) lays out the proceeds of a hypothetical borrower of a house worth $200,000.

in maintenance is higher than previously thought and including the value of time is an important consideration for future studies of this nature. We also show that spending on home maintenance is not offset by an increase in time spent on home maintenance and that households are indeed forgoing maintenance as they age which appears to lead to slower appreciation rates for older homeowners. This provides some evidence to suggest that older homeowners are extracting some equity from their home by forgoing maintenance as they live in their home throughout retirement.

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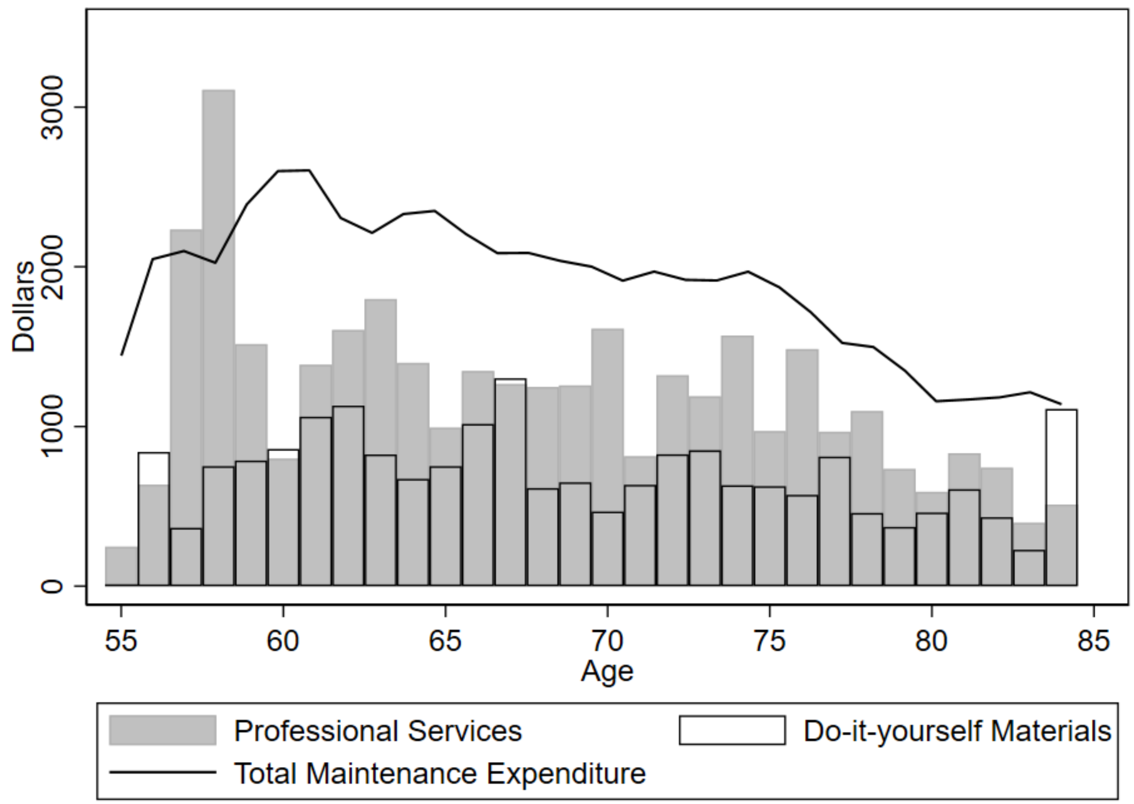
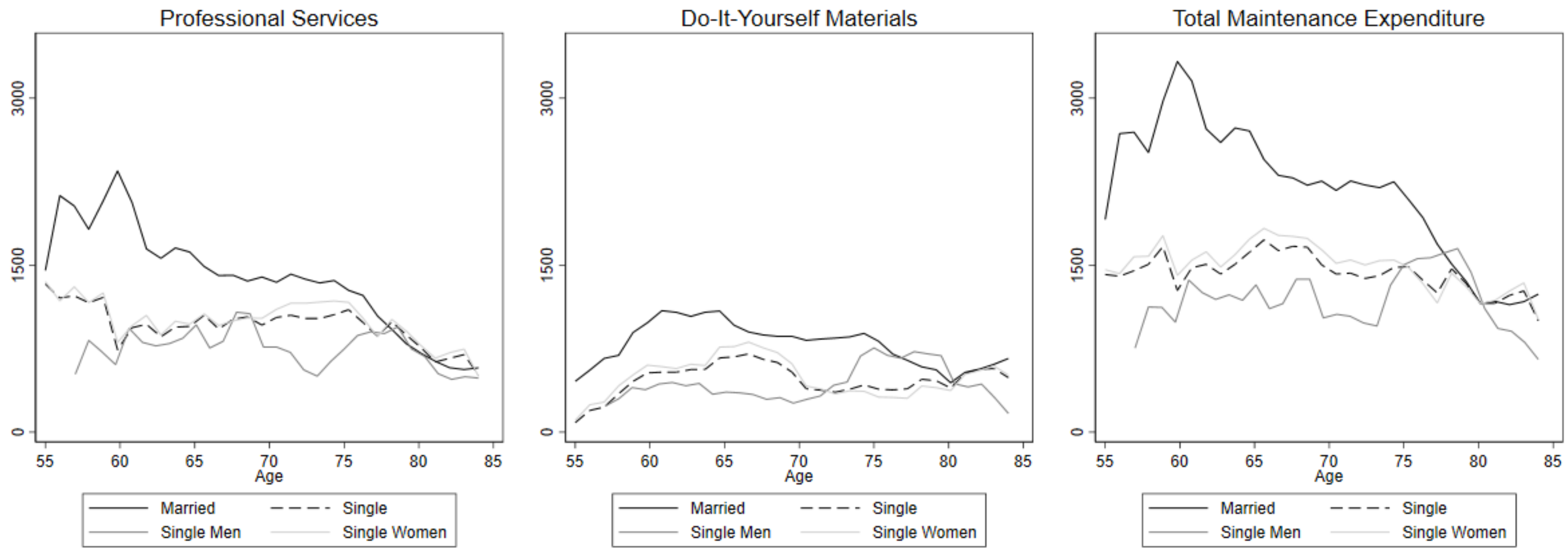
Tables and Figures

Figure 1: Age Profile of Maintenance Expenditure



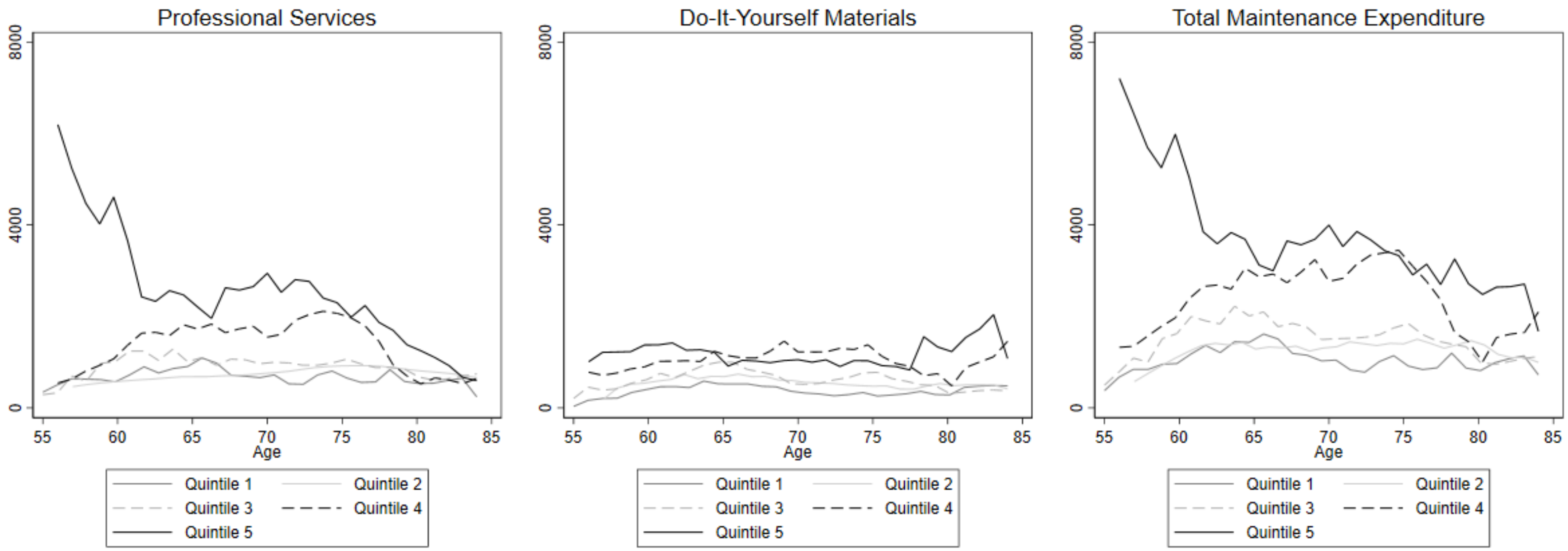
Notes: This figure shows the age-profile of average annual expenditure on professional services, do-it-yourself materials, and a three-period moving average for total maintenance expenditure. N = 3,048.

Figure 2: Age Profile of Maintenance Expenditure by Household Type



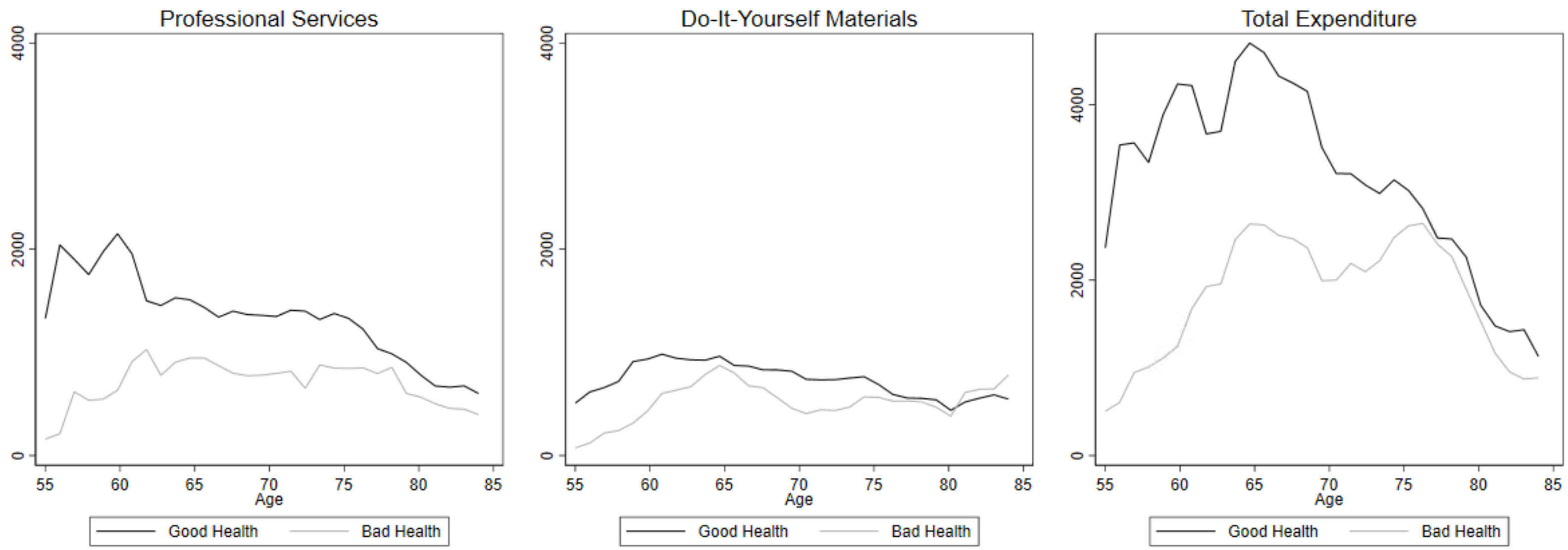
Notes: This figure shows the age profile of annual expenditure on professional services, do-it-yourself materials, and total maintenance using a three-period moving average separated by marital status and gender for single households. Age is the age of the man in a married household and the age of the individual in a single household. N = 1,943 (married); 1,105 (single); 244 (single men); 861 (single women).

Figure 3: Age Profile of Maintenance Expenditure by Income Quintile



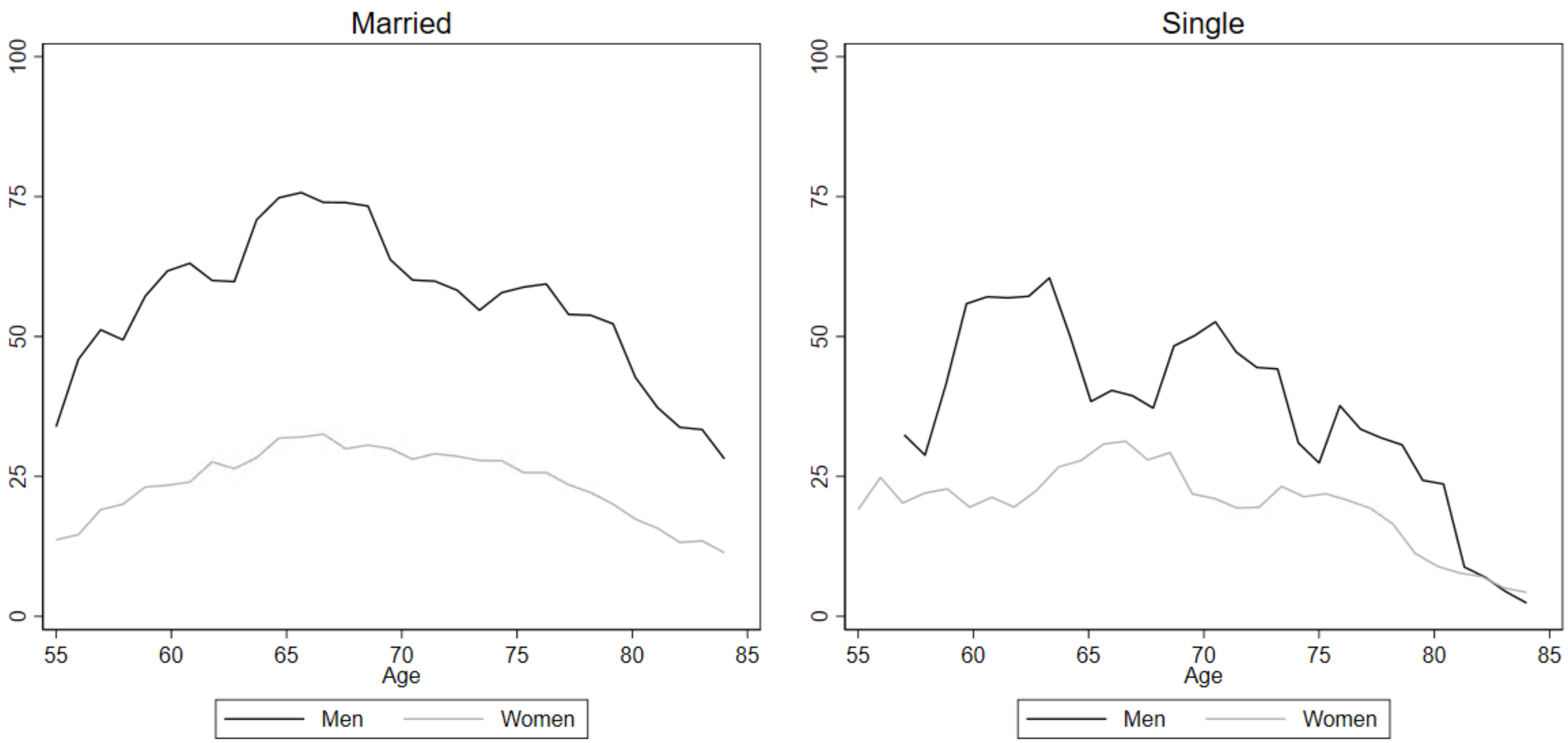
Notes: This figure shows the age profile of annual expenditure on professional services, do-it-yourself materials, and total maintenance using a three-period moving average separated by income quintile. Age is the age of the man in a married household and the age of the individual in a single household. N = 555 (qunitile 1); 879 (qunitile 2); 681 (qunitile 3); 508 (quiltile 4); 425 (qunitile 5).

Figure 4: Age Profile of Maintenance Expenditure by Health Status



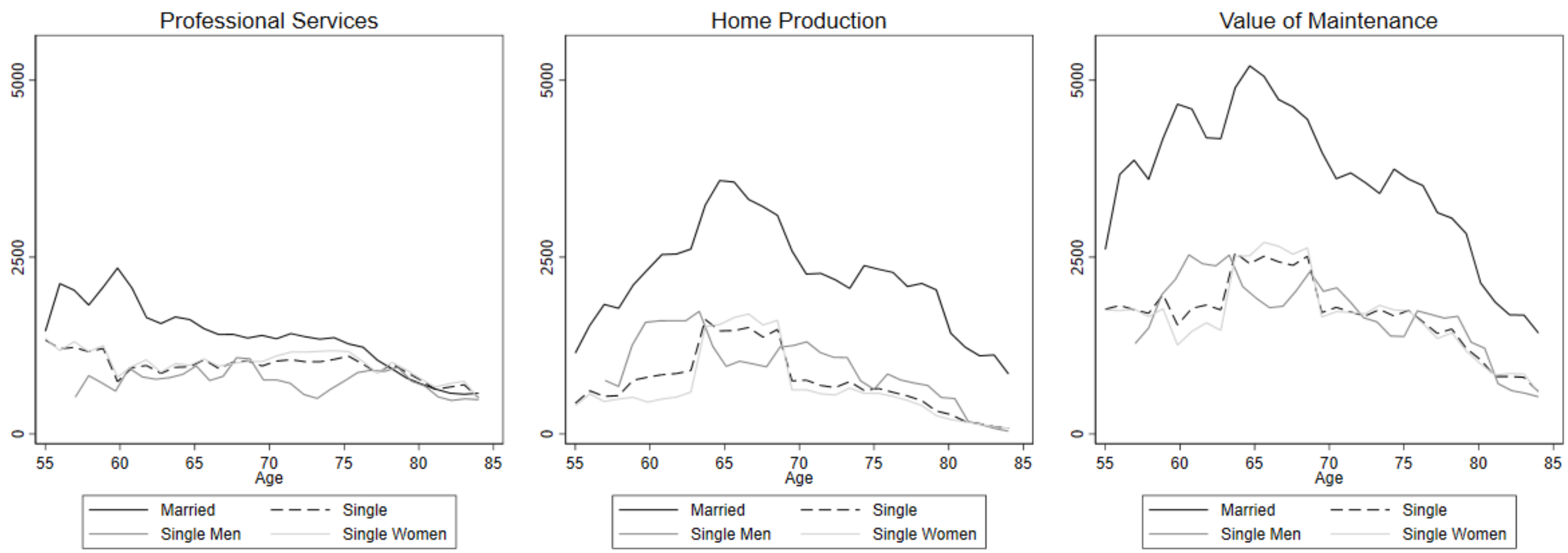
Notes:This figure shows the age profile of annual expenditure on professional services, do-it-yourself materials, and total maintenance using a three-period moving average separated by health status. Age is the age of the man in a married household and the age of the individual in a single household. N = 2,401 (good health); 647 (bad health).

Figure 5: Age Profile of Time Spent on Maintenance



Notes: This figure shows the age profile of annual time spent on home maintenance using a three-period moving average separated by marital status and gender. N = 1,309 (married men); 631 (married women); 242 (single men); 852 (single women).

Figure 6: Age Profile of Total Value of Maintenance

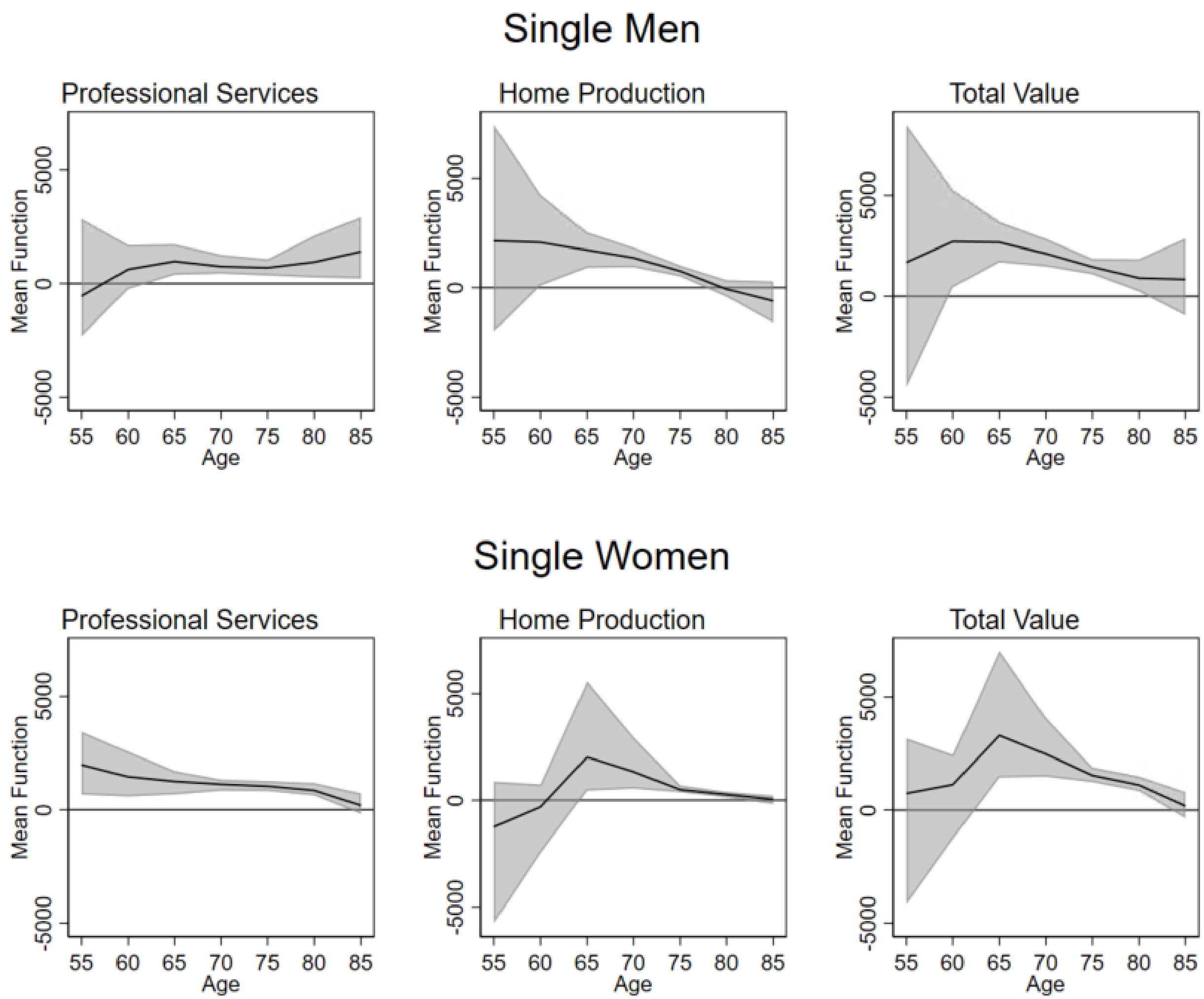


Notes: This figure shows the age profile of expenditure of professional services, home production, and the total value of maintenance (professional services + home production) using a three-period moving average separated by marital status and gender for single households. Age is the age of the man in a married household and the age of the individual in a single household. Home production is the estimated value, H, from equation 4. N = 1,940 (married); 1,094 (single); 242 (single men); 852 (single women).

Figure 7: Kernel Regression of Value of Maintenance by Household Type

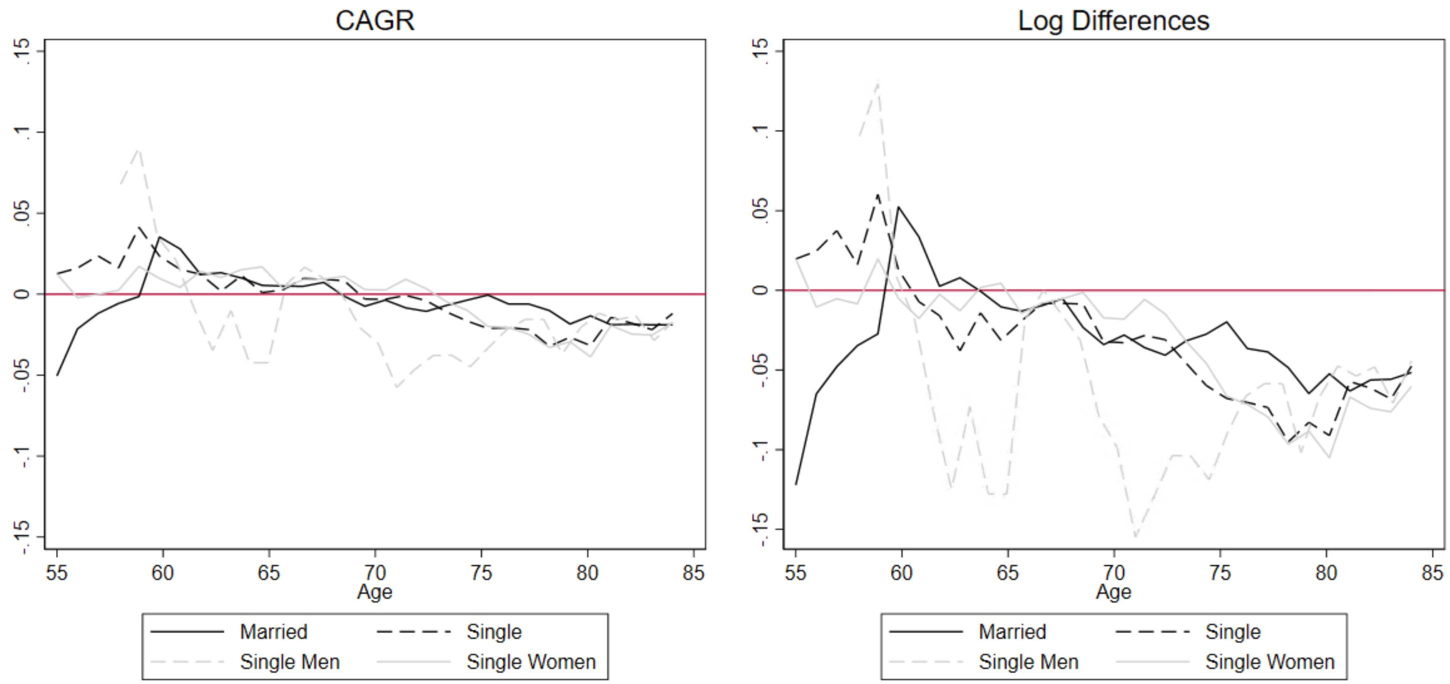
Notes: These graphs show the observed margins of the nonparametric kernel regressions on the given value of maintenance (spending on professional services, home production, and total value) shown with bootstrapped 95% confidence intervals calculated with 100 replications. Controls include age, house value, income, non-housing wealth, mobility index, an indicator for urban status, a year fixed-effect, and a state-fixed effect. *N*: 1,859 (married professional services); 1,854 (married home production); 1,854 (married total value of maintenance); 1,037 (single professional services); 1,031 (single home production); 1,031 (single total value of maintenance).

Figure 8: Kernel Regression of Value of Maintenance by Gender



Notes: These graphs show the observed margins of the nonparametric kernel regressions on the value of maintenance (spending on professional services, home production, and total value) shown with bootstrapped 95% confidence intervals calculated with 100 replications. Controls include age, house value, income, non-housing wealth, mobility index, an indicator for urban status, a year fixed-effect, and a state-fixed effect. *N*: 217 (single men professional services); 215 (single men home production); 215 (single men total value of maintenance); 819 (single women professional services); 809 (single women home production); 809 (single women total value of maintenance).

Figure 9: Annual Home Appreciation



Notes: This figure shows the age profile for the annual house appreciation of house values using log differences and compound annual growth rate with a three-period moving average separated by marital status and gender for single households. Log difference = $\log(FutureValue/PresentValue)$. *CAGR* = compound annual growth rate = $(\frac{Future\ Value}{Present\ Value})^{\frac{1}{n}}-1$. N is the number of years and is equal to 2 since the HRS is a biennial survey. Age is the age of the man in a married household and the age of the individual in a single household. N = 1,533 (married); 882 (single); 190 (single men); 692 (single women).

Table 1: Descriptive Statistics

	All		Married		Single		Single Men		Single Women	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Demographics										
Age	71.64	7.19	71.41	7.11	72.35	7.38	70.99	7.08	72.72	7.42
Male	0.43	0.49	0.49	.050	0.21	0.41	1.00	0.00		
Female	0.57	0.49	0.51	0.50	0.79	0.41			1.00	0.00
Married	0.76	0.42								
Urban	0.78	0.42	0.79	0.41	0.75	0.44	0.79	0.41	0.73	0.44
Good Mobility	0.90	0.31	0.91	0.29	0.85	0.36	0.90	0.30	0.83	0.37
Good Cognition	0.93	0.26	0.94	0.24	0.89	0.31	0.89	0.31	0.89	0.31
Good Health	0.80	.40	0.81	0.39	0.78	0.42	0.76	0.43	0.78	0.42
Wealth Measures										
House Value	206,864	178677	217,838	180645	170,232	166,877	211,467	230788	159,351	143619
Income	65,634	78325	75,019	84211	35,257	42813	46,492	59161	32,210	36612
Non-Housing Wealth	345,856	710927	390,212	783857	202,298	354705	304,029	473247	174,704	309575
Maintenance Expenditure										
Do-It-Yourself Materials	764	1757	847	1814	497	1525	451	995	509	1640
Professional Services	1,241	3154	1,326	3346	965	2410	852	2200	995	2464
Total (DIY + Prof Services)	2,005	3865	2,173	4063	1,462	3080	1,303	2491	1,505	3221
Time Spent on Maintenance										
Men	58.16	122.69	59.43	81.02	39.94	90.15	39.94	90.15		
Women	25.10	78.83	26.43	81.02	19.83	69.30			19.83	69.30
Total	67.87	151.64	81.26	166.03	24.13	74.66	39.94	90.15	19.83	69.30
House Value Appreciation										
Compound Annual Growth Rate	-0.005	0.15	-0.004	0.15	-0.007	0.17	-0.013	0.18	-0.005	0.17
Log Differences	-0.031	0.30	-0.028	0.29	-0.04	0.33	-0.060	0.36	-0.036	0.32
Observations	4,944		3,777		1,167		249		918	

Table 2: Valuation of Home Production

	(1)		(2)		(3)	
	Married	**Single**	**Married**	**Single**	**Married**	**Single**
Home Production	2,871	1,135	2,429	997	2,509	844
	(4695)	(2720)	(3878)	(2383)	(7363)	(7241)
Value of Time	25.00		19.54		23.22	21.77
					(11.05)	(11.18)
Total Investment	4,220	2,095	3,779	1,957	3,859	1,803
	(6019)	(3971)	(5394)	(3712)	(8228)	(8024)
Observations	1,943	1,105	1,943	1,105	1,940	1,094

Notes: This table shows the value of home production, value of time, and total investment calculated using the following three methods outlined in section 3.3. Numbers in parenthesis are the standard deviation.

a) According to *Home Advisor's True Cost Guide*, https://www.homeadvisor.com/cost/handyman/#closing-article (6/23/2020), they average cost of a handyman is \$77 per hour. In (1) we assume people are about $\frac{1}{3}$ as productive as a professional regardless of age or gender. Therefore, we assign the value of time to be \$25 per hour.

b) In (2) we use the CPS hourly average for full-time workers in 2009, which is \$19.54 per hour

c) In (3) we estimate the value of home production, H, from equation 4. We calculate Value of Time = home production / hours spent on maintenance for each household.

Table 3: Annual Households Maintenance Expenditure by Age and Household Type

	Married			**Single Men**			**Single Women**		
	55-64	**65-74**	**75-84**	**55-64**	**65-74**	**75-84**	**55-64**	**65-74**	**75-84**
Household Expenditure									
Professional	1,913	1,406	932	729	758	824	1,027	1,124	848
Services	(4716)	(3434)	(2103)	(1854)	(1953)	(1970)	(2442)	(2809)	(2014)
Do-It-Yourself	1,029	919	669	413	358	632	502	595	400
Materials	(1745)	(1992)	(1576)	(541)	(705)	(1506)	(1039)	(2032)	(1174)
Total Maintenance	2,942	2,325	1,601	1,142	1,116	1,456	1,530	1,718	1,247
Expenditure	(5424)	(4172)	(2877)	(1934)	(2160)	(2579)	(2751)	(3848)	(2423)
(Prof Services + DIY)									
Hours Spent on Home Maintenance									
Men	61	68	49	53	43	27			
	(108)	(143)	(102)	(98)	(78)	(103)			
Women	27	30	22				22	25	15
	(75)	(92)	(66)				(51)	(91)	(40)
Home Production									
Men	2,749	3,047	1,992	1,493	1,074	616			
	(6544)	(8671)	(6323)	(3706)	(2182)	(2289)			
Women	2,661	2,999	1,926				634	1,128	376
	(8491)	(9202)	(6574)				(1948)	(11294)	(1121)
Total Value of	4,562	4,359	2,864	2,222	1,832	1,463	1,662	2,242	1,229
Maintenance	(8491)	(9202)	(6574)	(4111)	(2984)	(3020)	(3202)	(12278)	(2383)
Observations	625	1,941	1,057	50	119	75	125	436	300

Notes: Age is the age of the man in a married household and the age of the individual in a single household. Home production is the estimated value, H, from equation 4.

Table 4: Cumulative Investment in Maintenance between Ages 65-84

	Married	Single	Single Men	Single Women
Cumulative Investment Ages 65-85	68,012	33,798	31,366	34,495
Cumulative Investment as if Ages 55-64	88,876	36,435	44,431	33,236
Difference	20,864	2,636	13,064	-1,259
Average per year	1,043	132	653	-63
Percent of House Value	9.4	1.5	6.3	-0.8

Notes: This table shows what the actual cumulative value of maintenance is from ages 65-84 and compares it to the counterfactual of what the cumulative value of maintenance would have been had households maintained the same level of investment as they did while in their late working years, ages 55-64. The difference between the two give the implied level of disinvestment. Percent of house value is calculated by dividing the difference by the house value for each household type from Table 1.

Table 5: Nonparametric Margins and Contrasts: Value of Maintenance

	Panel A: Married			**Panel B: Single**		
	Professional Services	**Home Production**	**Total Value of Maintenance**	**Professional Services**	**Home Production**	**Total Value of Maintenance**
Observed Margin						
Age 55-64	1,853.5***	2,469.7***	4,341.6***	1,023.3***	1,206.8***	2,227.5***
	(264.8)	(365.4)	(475.31)	(186.8)	(197.0)	(244.0)
Age 65-84	1,235.9***	2,443.3***	3,689.6***	1,024.8***	889.3***	1,913.8***
	(65.9)	(205.4)	(227.6)	(90.5)	(492.4)	(536.2)
Observed Contrast						
Age 55-64	541.1	905.6	1,529.2	-269.2	2,022.5	1,715.8
Age 65-74	-758.0	-2,633.1	-3,391.2	-964.6	-1,951.1	-2,942.6
Observations	1,859	1,857	1,854	1,037	1,031	1,031
$\mathbf{R^2}$	0.70	0.60	0.62	0.68	0.52	0.51

	Panel C: Single Men			**Panel D: Single Women**		
	Professional Services	**Home Production**	**Total Value of Maintenance**	**Professional Services**	**Home Production**	**Total Value of Maintenance**
Observed Margin						
Age 55-64	809.5*	1,579.1*	2,394.5**	1,075.9***	1,057.0***	2,131.1***
	(393.5)	(653.6)	(767.3)	(282.0)	(194.5)	(360.4)
Age 65-84	769.3***	804.8***	1,578.8***	1,074.9***	889.1***	1,959.9***
	(145.2)	(157.1)	(218.5)	(98.2)	(636.8)	(665.9)
Observed Contrast						
Age 55-64	1,483.9	-349.0	1,059.4	-681.7	2,980.5	2,313.8
Age 65-84	366.2	-2,252.6	-1,880.6	-866.7	-1,937.0	-2,884.7
Observations	217	215	215	819	809	809
$\mathbf{R^2}$	0.85	0.85	0.85	0.73	0.63	0.61

Notes: Results presented show the observed margin for the specified age ranges of the nonparametric regression and the observed contrasts for the specified age ranges of the nonparametric regression which show the change in the margin between the two ages. Standard errors are bootstrapped with 100 replications. Controls include age, house value, income, non-housing wealth, mobility index, an indicator for urban status, a year fixed-effect, and a state-fixed effect.. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 6: Nonparametric Margins and Contrasts: Housing Appreciation

	Panel A: Married		**Panel B: Single**	
	CAGR	**Log Differences**	**CAGR**	**Log Differences**
Observed Margin				
Age 55-64	0.00	-0.02	0.00	-0.02
	(0.01)	(0.01)	(0.01)	(0.01)
Age 65-84	-0.01	-0.04**	-0.02	-0.06**
	(0.01)	(0.01)	(0.01)	(0.02)
Observed Contrast				
Age 55-64	0.14	0.27	0.16	0.26
Age 65-74	-0.03	-0.04	0.01	0.03
Observations	1,365	1,365	789	789
R^2	0.17	0.17	0.26	0.24

	Panel C: Single Men		**Panel D: Single Women**	
	CAGR	**Log Differences**	**CAGR**	**Log Differences**
Observed Margin				
Age 55-64	-0.01	-0.05	0.01	-0.01
	(0.02)	(0.04)	(0.01)	(0.01)
Age 65-84	-0.02	-0.06	-0.01*	-0.01
	(0.02)	(0.04)	(0.01)	(0.01)
Observed Contrast				
Age 55-64	0.05	0.28	0.03	0.13
Age 65-84	-0.04	-0.07	0.00	0.01
Observations	164	164	625	625
R^2	0.45	0.43	0.29	0.29

Notes: Results presented show the observed margin for the specified age ranges of the nonparametric regression and the observed contrasts for the specified age ranges of the nonparametric regression which show the change in the margin between the two ages. Standard errors are bootstrapped with 100 replications. Controls include an indicator for cognitive ability, a year fixed-effect, and a state fixed-effect. *** p < 0.01, ** p < 0.05, * p < 0.10.

Appendices

A Description of the variables

Variables from the HRS are taken from two sources. The first is the Enhanced FAT files compiled by the RAND Center for the Study of Aging, which compiles the raw data from the survey into one file for each wave making it easier to merge with other waves. The second is from the RAND HRS data file. Developed at RAND with funding from the National Institute on Aging and the Social Security Administration, it is a cleaned file containing HRS data from all waves of the survey (RAND HRS Data, 2016). RAND takes the raw responses from the HRS — in some cases, questions vary across waves — and combine them into a variable that is consistent across waves.

House Value

House Value comes from the RAND HRS file. Several changes were made to this variable by the authors. There are many instances where there were incredibly large percent changes in house value between waves. Upon visual inspection, much of this was caused by what appears to be input error from the respondent where zeros were left off. One example would be, if a respondent reported in 2000 a house value of $350,000, then in 2002 a house value of $400, and in 2004 a house value of $450,000 – it is most likely the respondent meant $400,000 in 2002. A second example would be, if a respondent reported in 2000 a house value of $350,000, then in 2002 house value was missing, and in 2004 a house value of $450,000 but reported owning a home but not moving in 2002. To find and correct as many of these possible errors as possible, we searched for house values where the ratio of $\frac{HV_t}{HV_{t-1}} > 1$ and manually inspected these values for irregularities these year over year for households that did not move. In cases such as the first example, the house value was adjusted by adding the appropriate number of zeros. In cases such as the second example, the median value between the surrounding years was imputed, so in the second example the house value for 2002 would be $\frac{450{,}000+350{,}000}{2} = \$400,000$. In cases where a value was reported but did not appear to have an apparent fix, the household was dropped. In the case where a house value of zero was reported in any wave, the household was also dropped. The households identifying numbers that were adjusted are available upon request.

Household Income

Household income comes from the RAND HRS file and is a sum of all the self-reported income to the household, which includes: individual earnings, capital income, pension income, annuity income, social security, other government transfers, and other household income.

Non-Housing Wealth

Non-Housing Wealth come from the RAND HRS file and is the sum of the self-reported values of real estate excluding the primary residence, vehicles, businesses, IRA accounts, stock value, checking accounts, checkable deposits, bonds, and other savings minus household debt.

Spending on Do-It-Yourself Materials

Spending on Do-It-Yourself Materials is a CAMS variable. Households that reported values over $40,000 in a given year were dropped as many of these appeared to be errors in the survey response and were not reflective of the households typical spending patterns.

Spending on Professional Services

Spending on Professional Services is a CAMS variable. Households that reported values over $40,000 in a given year were dropped as many of these appeared to be errors in the survey response and were not reflective of the households typical spending patterns.

Time Spent on Home Improvement

Time Spent on Home Improvement is a CAMS variable.

Age

Age comes from the RAND HRS file. The household variable for age is determined by the age of the male in married households and the age of the individual in single households.

Marital Status

Marital Status comes from the RAND HRS file. This is a dummy variable takes a value of 1 if they report they are married and a value of 0 for any other marital status.

Gender

Gender comes from the RAND HRS file.

Good Mobility

Mobility comes from the RAND HRS file and is constructed from the variables RwMOBILA and SwMOBILA. The mobility index is a scale of 0-5. If the average for the household is less than 2 then the household is considered to have good mobility and this variable takes a value of 1, otherwise it takes a value of 0.

Good Cognition

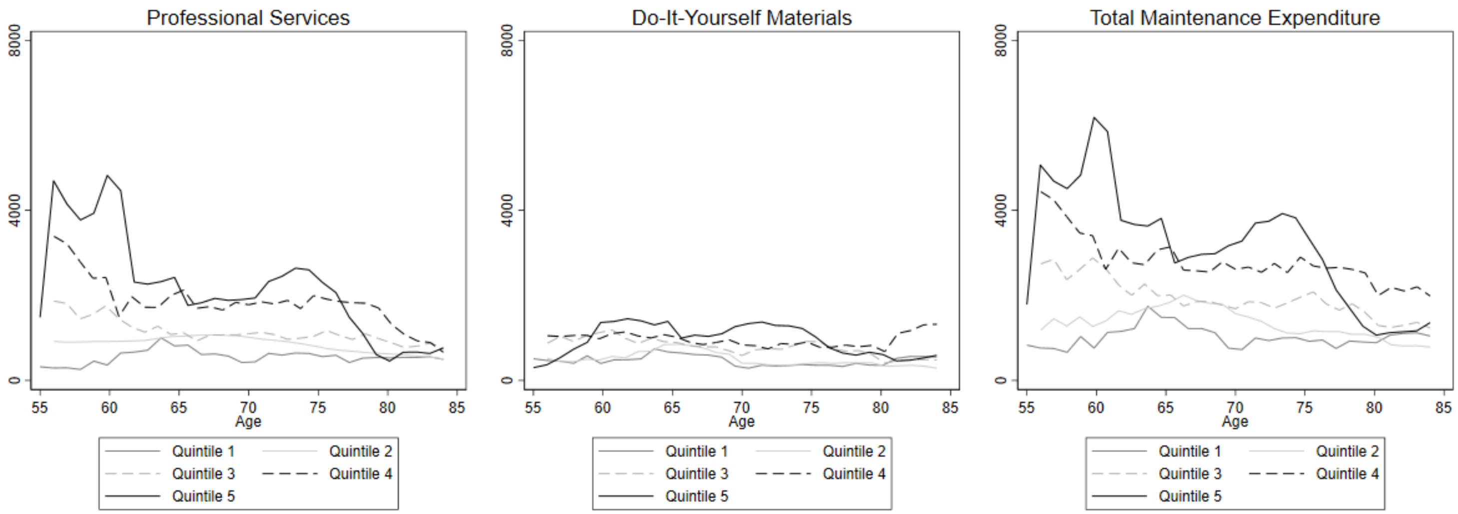
Cognition comes from the Rand HRS file and is constructed from the variables RwCOGTOT and SwCOGTOT. The cognition score is from 0-35. If the average for the household is greater than 17 then the household is considered to have good cognition and this variable take a value of 1, otherwise it takes a value of 0.

Good Health

Health comes from the Rand HRS file and is constructed from the variables RwSHLT and SwSHLT on self reported health. The health score is from 1-5. If the average for the household is greater than 3 then the household is considered to have good good health and this variable take a value of 1, otherwise it takes a value of 0.

B Additional tables and figures

Figure B1: Maintenance Spending by House Value Quintile



Notes: This figure shows the age profile of annual expenditure on professional services, do-it-yourself materials, and total maintenance using a three-period moving average separated by house value quintile. Age is the age of the man in a married household and the age of the individual in a single household. N = 648 (qunitile 1); 657 (quintile 2); 614 (quintile 3); 540 (quiltile 4); 510 (quintile 5).

Table B1: Regression Results for Estimating Home Production

Expenditure on Professional Services	1.146
	(1.57)
Expenditure on DIY Materials	-0.530
	(4.50)
Time Spent on Maintenance	24.93
	(48.99)
DIY x Time	0.01
	(0.01)
Trend	-1336.2
	(1405.40)
Observations	731
R^2	0.016

Notes: Regression output from equation 3 used to predict home production. Standard errors are clustered at the households level. Controls include a household fixed-effect.*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table B2: Cumulative Investment in Maintenance between Ages 65-84 (Alternative Method 1)

	Married	Single	Single Men	Single Women
Cumulative Investment Ages 65-85	75,390	40,156	41,975	39,724
Cumulative Investment as if Ages 55-64	97,877	43,746	49,418	41,477
Difference	22,488	3,589	7,443	1,752
Average per year	1,124	179	372	88
Percent of House Value	10.1	2.1	3.6	1.1

Notes: This table shows what the actual cumulative value of maintenance is from ages 65-84 and compares it to the counterfactual of what the cumulative value of maintenance would have been had households maintained the same level of investment as they did while in their late working years, ages 55-64 using the valuation of time from column (1) in Table 2. The difference between the two give the implied level of disinvestment. Percent of house value is calculated by dividing the difference by the house value for each household type from Table 1.

Table B3: Cumulative Investment in Maintenance between Ages 65-84 (Alternative Method 2)

	Married	Single	Single Men	Single Women
Cumulative Investment Ages 65-85	67,177	37,714	38,355	37,594
Cumulative Investment as if Ages 55-64	89,235	40,389	43,612	39,100
Difference	22,058	2,675	5,258	1,506
Average per year	1,103	134	263	75
Percent of House Value	9.9	1.6	2.5	0.9

Notes: This table shows what the actual cumulative value of maintenance is from ages 65-84 and compares it to the counterfactual of what the cumulative value of maintenance would have been had households maintained the same level of investment as they did while in their late working years, ages 55-64 using the valuation of time from column (2) in Table 2. The difference between the two give the implied level of disinvestment. Percent of house value is calculated by dividing the difference by the house value for each household type from Table 1.