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Older Adult Out-of-Pocket Pharmaceutical Spending After Home Mortgage Payoff

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Abstract

Older adult homeowners increasingly carry mortgage debt into retirement. The share of homeowners aged 65 and older with outstanding mortgages doubled between 1989 and 2016, while the outstanding loan-to-value ratio tripled from 13 to 39 percent over the same period (JCHS 2018). This research expands our understanding about the relationship between housing and health by demonstrating spillover impacts between mortgage debt and healthcare, as many older adults struggle to simultaneously pay their health and housing costs. This paper examines changes in out-of-pocket pharmaceutical spending around the time of mortgage payoff to assess whether mortgage payments constrain healthcare spending for some households. Findings suggest that out-of-pocket pharmaceutical spending increased by 25 percent for all households that paid off their mortgage, and by 50 percent for households whose residents were roughly between the ages of 50 and 64 after payoff. This research fills gaps in the literature around household spending changes at mortgage payoff and the relationship between mortgage debt and health expenditures.

Keywords: aging, homeownership, mortgage, pharmaceutical spending, health

JEL: D12, H31, I14

Introduction

With advancing age, health needs compound and healthcare consumes an increasingly large share of the household budget (Mutchler et al., 2017). Households may not have the financial capacity to meet emerging health costs, even with steady and consistent income. Older householders also experience retirement and disability-related reductions in employment which can impact their earnings. The combination of rising healthcare needs and falling income could strain budgets and force older householders to forgo expenses related to well-being. Cost-constrained older adult households may forfeit food or healthcare to pay their housing costs, which are typically the single largest budget items for most households. With limited income and rising health costs, concerns specifically arise that some householders will forgo needed medications in order to maintain other necessary budget items, particularly and especially their housing payments. During this period of change in older adults' lives, as people retire and health needs arise, households that have consistently paid down their mortgages will begin to reach the end of their mortgage term. Behavior changes surrounding the last mortgage payment made by homeowners have been little documented for older adults in the US.

This research is motivated by the hypothesis that the end of the mortgage payment period, the point at which housing costs are reduced to only taxes, utilities, and home maintenance, acts as an economic windfall to financially constrained older homeowners who want to allocate more money to pay for healthcare. This analysis asks whether, around this period of home mortgage payoff, older adults will change their pharmaceutical spending behavior, an indicator of health spending that is particularly sensitive to income constraints. Changes in spending around the end of their mortgage term would suggest that some households have artificially constrained spending on medications so they could preferentially allocate limited financial resources to their housing payments.

Literature

The literature review for this study describes what we know about trends in late-life housing debt management and the welfare impacts of these choices. The literature that is relevant to this research explores the implications for older adults who live with housing-cost burdens. Our work contributes to this literature by offering evidence that older adults appear to make budgetary trade-offs between housing payments and health spending.

Late-Life Mortgage Debt

Of all age groups, older adults are the most likely to own their home. Joint Center analysis of Housing Vacancy Survey (HVS) data shows that, in 2019, homeownership rates peaked at 80.6 percent for households headed by someone aged 70–74. Ownership tends to decline with older age. In 2019, it fell to 77.3 percent for those age 75 and over; previous studies using Health and Retirement Study data have shown a rapid decline in homeownership rates as people reach their 90s (Coile and Milligan, 2009). While the house is typically the largest asset in the financial portfolio of older homeowners (Stucki, 2014), Americans are increasingly less likely to own their homes free and clear as more older adults carry larger amounts of housing debt later into life. The share of homeowners aged 65 and older who carry mortgage debt doubled between 1989 and 2016 to reach 41 percent, while the amount of debt relative to home value tripled over this period to 39 percent (Joint Center for Housing Studies, 2018).

This increased reliance on housing debt could have positive implications if it suggests that older adults are managing their financial portfolio to leverage their housing assets toward more preferred and healthier lifestyles. However, there is also cause for concern that this rising debt carried into retirement will increase older adult financial insecurity. In 2017, homeowners aged 65 and older with a mortgage paid \$1,310 monthly on average for housing as compared with \$458 paid by homeowners without a mortgage (Joint Center for Housing Studies, 2019). Housing costs comprise the largest proportion of a household budget and nearly 10 million older adults were burdened by their housing costs in 2017. These housing-cost burdens are defined as spending 30 percent or more of their income on housing costs (Joint Center for Housing Studies, 2019). Nearly 40 percent of older adult homeowners with a mortgage were housing-cost

burdened in 2017 as compared to just 16 percent of homeowners without a mortgage (Hermann et al., 2020). These increased mortgage debt trends could also have negative implications if they suggest that older adults are increasingly strapped for the resources they need to maximize their health and lifestyle preferences during their early retirement years and that they will enter their oldest years with fewer assets to leverage into options for supportive care environments.

While it is not entirely clear how housing debt trends impact older adult welfare, connections between housing wealth management and health suggest that rising health costs could contribute to expansion of housing debt. Older adults experiencing a health shock, or sudden and unpredictable change of health status, are more likely to liquidate housing assets, either through home sale or additional borrowing, than any other asset (Poterba et al., 2017). Following a decline in ability to perform Activities of Daily Living (ADLs) without assistance, for instance, housing wealth declines at an estimated \$12,000 on average for a married couple (Dalton and LaFave, 2017). Older adults with a new health shock will borrow against their mortgage to cover cost of care in the short run (Gupta et al., 2018.; Moulton et al., 2020.; Wood et al., 2013). While term lengths differ by age, a health shock will add, for example, a quarter of a year to the mortgage term of a 60-year-old (Zhang, 2019). The death of a spouse is particularly associated with wealth draw-down and likely impacts housing and borrowing decisions (Venti and Wise, 2004). Even in the absence of a health shock, people often make strategic decisions about home wealth management with future health needs in mind. Homeowners who build up housing equity often consider it as a hedge against out-of-pocket medical expenses (Murray, 2019).

Budgets: Older Adult Housing-Cost Burdens and Out-of-Pocket Pharmaceuticals

Households are considered cost burdened if they spend more than 30 percent of their income on housing, based on the argument that spending such a high share of income on this necessity will constrain spending for other needs (Airgood-Obrycki et al., 2021). Evidence suggests that severely cost-burdened older households (those who spent more than 50 percent of their income on housing) in the bottom quartile for expenditures spent 50 percent less on food and out-of-pocket healthcare costs in 2018 compared with others in the same expenditure category who were affordably housed (Joint Center for Housing Studies, 2019). This research doesn't

specifically model housing-cost burden, but rests on a similar idea that when budgets are unaffordable, householders will make trade-offs between housing and other essential items.

Healthcare is a proportionally large and critical component of the older adult budget, both as a share and by impact, due to the potentially severe implications of rationing. Costs paid directly by consumers, or out-of-pocket (OOP) health costs, are a key metric of healthcare use. On the whole, these OOP costs have been on an upward trajectory, particularly among people diagnosed with multiple chronic conditions (Martin et al., 2021; Paez et al., 2009). We focus this analysis on pharmaceuticals, a category of out-of-pocket health spending with known sensitivity to budget constraints, as described in the following discussion. This is a good indicator for the relationship between financial constraints, housing costs, and health spending with plausible impacts on health and welfare.

Between 2008 and 2012, prescription medication represented 16 percent of non-nursing OOP spending for adults 55 and older, or \$760 in 2014 dollars (Fahle et al., 2016). This share is fairly consistent across age segment for adults 55 and older, likely related to the similarities in prescription drug coverage between employer-provided insurance and Medicare supplemental coverage. Patients who are faced with unaffordable OOP health costs may choose to forgo needed medical care and decide to cut back on healthcare spending to fund other needed areas, and prescription drugs are particularly sensitive to nonadherence due to OOP costs. One-third of older adults are estimated to take less medication than they were prescribed as a strategy to avoid the OOP cost (Briesacher et al., 2007). Other cost-cutting strategies included seeking free samples from physicians and buying medications from other countries or over the internet (Musich et al., 2015). But a growing body of evidence suggests that these decisions to reduce medical care are not made strategically. Patients are as likely to cut back on high-value, high-return therapies as they are to reduce their spending on less critical interventions (Brot-Goldberg et al., 2017; Chandra et al., n.d.; Choudhry et al., 2011). Cost-related medication nonadherence reduces patient welfare by increasing health risks and overall cost of care, as it is associated with increases in both nursing home admission and all-cause mortality (Heisler et al., 2004; Jenkins Morales and Robert, 2020; Van Alsten and Harris, 2020).

Healthcare Coverage Mitigates Out-of-Pocket Spending

Insurance coverage reduces OOP health spending (Blavin et al., 2018; Narang and Nicholas, 2017) and increases utilization (Freeman et al., 2008). Though public insurance coverage for older adults is nearly universal through Medicare, the coverage is incomplete. Traditional Medicare pays for the majority of short-term hospital stays and 80 percent of outpatient medical visits, but it does not cover things such as pharmaceuticals, dental care, or hearing aids without supplemental coverage purchases. For that reason, some beneficiaries choose to keep their employer-based insurance even after becoming Medicare-eligible. Employer-based insurance is considered the primary payer for businesses with at least 20 employees and the coverage may be more comprehensive than traditional Medicare alone. There is little evidence that Medicare supplemental plans crowded out market-based and employer plans. In 2006, for instance, even after the introduction of Part D, 37 percent of Medicare beneficiaries continued to receive their prescription drug coverage through employer plans (Levy and Weir, 2010).

On average, older adults pay 20 percent of their medical costs out-of-pocket, amounting to roughly \$2,700 in 2014 dollars paid yearly by each recipient across the income spectrum (De Nardi et al., 2016). Total mean out-of-pocket (OOP) spending (inclusive of insurance premiums) was relatively evenly distributed across income quintiles for adults age 55 and older, with 15 percent of all OOP expenditures coming from the bottom quintile and 23 percent from the top (Fahle et al., 2016). This distribution doesn't take into account differences in healthcare consumption, or health differences across the quintiles. The competing tensions between these factors affect OOP costs in different directions and result in some odd trends, such as pharmaceutical OOP spending for older adults being highest in the middle-income quintile and lowest in the top and bottom quintile (Fahle et al., 2016). However, given the vast differences in total income between the top and bottom percentiles and the relatively similar raw OOP expenditures totals, older adults at the lower end of the income spectrum are clearly spending a much larger proportion of their income on OOP health costs. While half of traditional Medicare beneficiaries spent at least 14 percent of their total per capita income on OOP health in 2014, this proportion was much higher for lower-income older adults whose OOP health spending was equivalent to 41 percent of average SSI payments. These OOP payment burdens were more pronounced for those who were older, those with significant medical care needs, and for women (Cubanski et al., 2018; Cunningham, 2009).

Basic Medicare coverage paid a little over half of total personal medical care expenditures for older adults in 2010 (De Nardi et al., 2016). Supplemental coverage through private Medicare Advantage plans, Medigap plans, and Part D plans further insulate a household against high OOP expenditures. For instance, Medicare beneficiaries with employer supplements or who were enrolled in Medicare HMOs spent \$1,600 less OOP than traditional Medicare beneficiaries alone. However, households must pay additional premium costs for this supplemental coverage. Medicaid coverage performs a similar function for financially destitute beneficiaries, protecting them from large OOP health costs. Federal rules limit the ability of Medicaid programs to charge a premium, prohibit or severely limit cost sharing, and set a low maximum household OOP liability for Medicaid programs that do incorporate premiums and other OOP costs. Lower-income older adults who don't qualify for their state's Medicaid program, who don't receive employer coverage, and who can't afford to purchase supplemental plans likely experience a coverage gap which exposes them to potentially high OOP costs (Goldman and Zissimopoulos, 2003). Medicare's Part D drug benefit was enacted in 2006 specifically to reduce beneficiary OOP pharmaceutical costs, but households must be able to afford the premiums to benefit from this coverage.

Additionally, Part D coverage has been incomplete and pharmaceutical costs continue to be meaningful for many households. Part D left a coverage gap, or "doughnut hole," between initial and catastrophic coverage limits. Beneficiaries in this doughnut hole paid full cost of their medications. Despite cost-sharing limits imposed by the Affordable Care Act (ACA), beneficiaries approaching catastrophic coverage could still incur very high OOP prescription drug costs, especially during our observation period, prior to 2020 when the beneficiary responsibility was limited to 25 percent of drug prices (Trish et al., 2016). This gap continued to impact prescription drug utilization (Joyce et al., 2013), especially for Black and Hispanic recipients (Zissimopoulos et al., 2015). To address potential outlier pharmaceutical spending in our data, this analysis excluded households with any wave of OOP pharmaceutical spending in the top 5 percent of all observations, which amounted to roughly \$250 per month in 2016 dollars. All OOP spending was adjusted to 2016 dollars.

Cost-Related Pharmaceutical Nonadherence

Older adult households with less income or wealth tend to spend less on OOP healthcare (Pashchenko and Porapakarm, 2016). Excluding nursing home expenses, the bottom income quintile of adults aged 55 and older spends 1.72 times less on OOP medical care than the top quintile (Fahle et al., 2016). Since the price of medical care varies, these expenditures are not a direct measure of care received, but this disparity nonetheless raises concern that lower-income households may be forgoing medical care that is not affordable to them. Cost-related nonadherence to medications includes behaviors such as skipping or reducing doses or letting prescriptions go unfilled (Klein et al., 2004).

Older adults continue to experience gaps in prescription drug coverage. Prior to the implementation of Medicare Part D, which resulted in increased drug use and lower OOP expenses (Briesacher et al., 2011), especially for healthier older adults (Naci et al., 2014), pharmaceutical coverage was only available to the lowest income beneficiaries who received Medicaid or the beneficiaries who maintained employer or other private insurance coverage. Before Part D, the uninsured were less likely to use pharmaceutical medications than individuals with employer coverage, but they also spent more OOP on drugs (Levy and Weir, 2010). Cost-related medication nonadherence was widespread among Medicare beneficiaries, reported by 29 percent of disabled and 13 percent of older Medicare beneficiaries (Soumerai et al., 2006). This amounted to an estimated two million older adult Medicare beneficiaries a year who did not follow prescribed pharmaceutical regimens because of the cost (Mjtabai and Olfson, 2003). Medicare recipients without Medicaid who lived with low-income and poor health were particularly vulnerable to cost-related nonadherence to prescribed medical routines (Goldsmith et al., 2017). When take-up was examined at the outset of Part D, uninsured participants who purchased standalone Part D plans were sicker and more likely to use prescription drugs and incur OOP costs than Medicare participants who remained without drug coverage (Levy and Weir, 2010).

While Medicare Part D resulted in some measurable improvements in access to pharmaceuticals, improvements have been uneven. With potentially high cost sharing, differences in plan generosity, and administrative restrictions such as prior authorization requirements, vulnerable subpopulations, such as those with multiple conditions, showed slower improvements in drug adherence following the introduction of Part D (Madden et al., n.d.; Naci

et al., 2014). Between the years 2009 and 2011, well into the Medicare Part D policy regime, the proportion of Medicare beneficiary cost-related nonadherence ranged persistently between 10 and 11 percent and the share of Medicare beneficiaries forgoing other needs to pay for medicine ranged between 4 and 6 percent (Naci et al., 2014). Of all adults with a chronic disease surveyed in 2008, roughly half cited financial hardship as the reason for either medication nonfulfillment or nonpersistence (McHorney and Spain, 2011).

Consumption Changes at Mortgage Payoff

There is some evidence that consumption changes after the home mortgage is paid off, and this research will explore whether these consumption changes extend to pharmaceutical use. Using Consumer Expenditure Survey data, Coulibaly and Li found that US mortgage holders of all ages increased financial savings as well as some durable goods purchases in the year of their final mortgage payment (Coulibaly and Li, 2006). When anticipated income changes were large, regular, or predictable, increases in spending tended to be anticipatory, with increases on durable and semidurable goods preceding the arrival of the additional income (Borella et al., 2009; Hsieh, 2003; Scholnick, 2013). Much of the literature describing changes in post-mortgage consumption behavior utilizes data for households outside of the US, making applicability to US contexts tenuous, particularly given the unique health policy environment in the US. With OOP costs that tend to be higher than other countries, US health consumption changes that researchers expect to observe would be less likely to appear in the international literature. Prior to this research there have been no documented health expenditure changes associated with the end of mortgage period, either in the US or abroad.

Research Question

This research examines relationships between the end of the mortgage period and OOP pharmaceutical spending behavior. In particular, the analysis will examine whether households spend more on OOP pharmaceuticals after their mortgage has been paid off.

Methods

The following section will describe the data, the sample definition criteria, the variables used to operationalize the analysis, and the models used for each analysis.

Data

Description and Validation

The Health and Retirement Study (HRS) is a longitudinal panel study that surveys more than 20,000 American respondents over the age of 50 every other year. The HRS was initiated in 1992 to collect information on income, assets, work, health, disability, and insurance and health expenditures. The HRS is a good fit for this work, given that it includes detailed health information along with rich data about income, wealth, and housing. When compared with other data, including the Medicare Current Beneficiary Survey (MCBS) and the Medicare Expenditure Survey Panel Survey (MEPS), HRS produces good quality estimates for OOP medical spending, a key variable for this analysis (French and Jones, 2004; Goldman et al., 2011; Goldman and Zissimopoulos, 2003; De Nardi et al., 2016).

Sample Definition

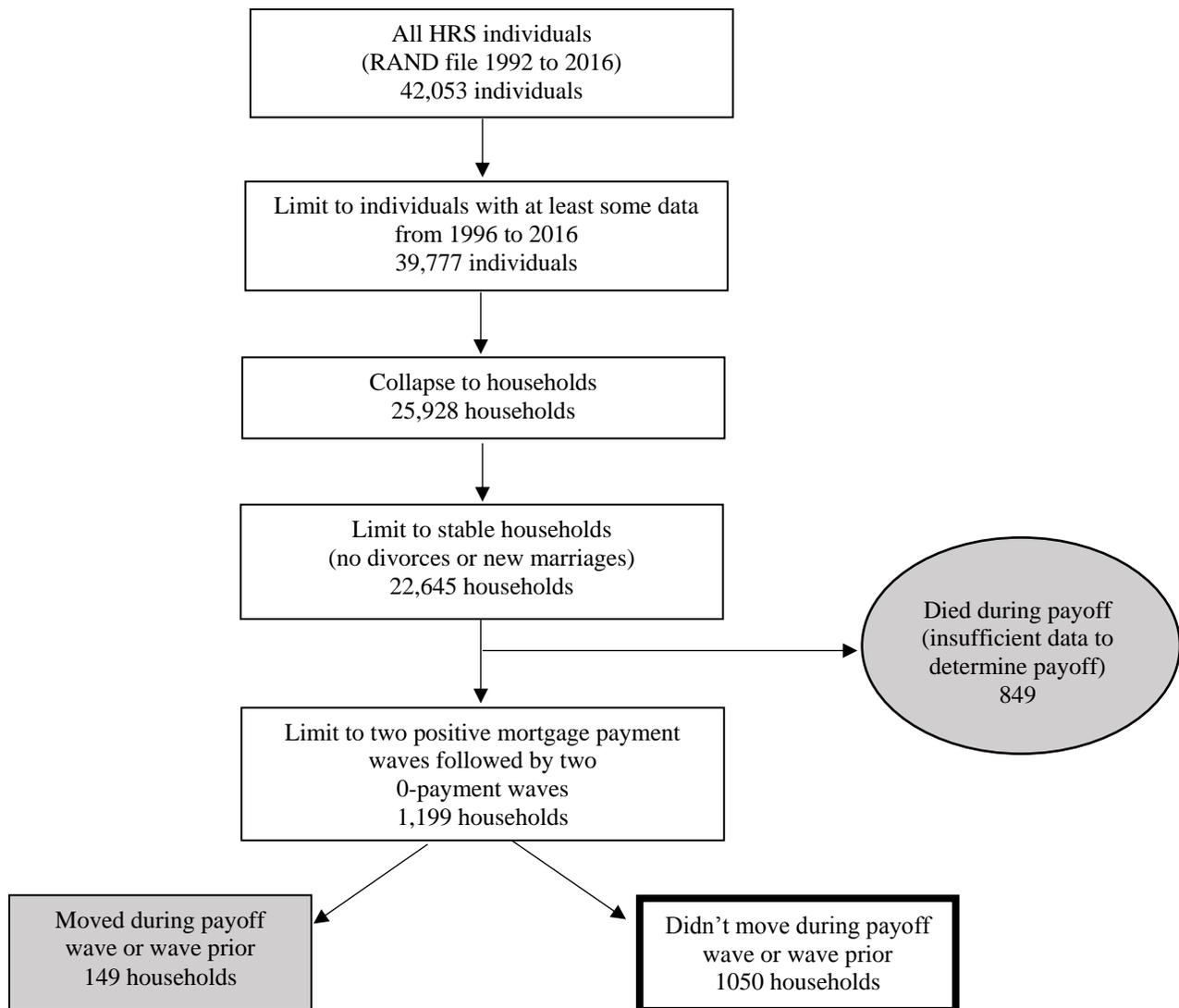
To create the treatment and control samples for the analysis, we first had to identify the end of a mortgage period. To do so we used the “mortgage payment variable.” Those households we considered to have paid off their mortgage reported positive mortgage payments for two or more consecutive waves of HRS between 1996 and 2016, followed by two or more consecutive waves in which mortgage payment was reported as zero. Those in the comparison group had at least four consecutive waves with a positive payment or four consecutive waves with a zero payment.

Inclusion Criteria

Our sample construction process is shown in Figure 1. Any household that reported the existence of a mortgage payment was included in the treated group, even if the actual value of the mortgage payment variable was missing or the respondent refused to give a specific amount. We excluded from this analysis any household that moved to a new residence during the four-wave

observation period, as this liquidation of housing assets could impact health spending through a different pathway. The sample also excluded households that experienced divorces or new marriages and single-person households in which the respondent died during the payoff period or married couples in which both members died during the payoff period.

Figure 1. Sample Inclusion Criteria



Variables

Treatment Group: Identifying households that ended their mortgage payments

We defined the end of mortgage using the mortgage payment variable for the primary residence. This question asked households, “About how much are the payments on the mortgage or land

contract?” Households for which we observed the end of the mortgage period had two waves of positive mortgage payments of any size followed by two waves with zero payment.¹

Comparison Group

To conduct an analysis focused on changes in spending behavior following the last mortgage payment period, we defined a comparison group as households that did not change their mortgage payments. Households were eligible for inclusion in the comparison group if residents were homeowners who were not included in the treatment group and met one of two additional criteria: they either had four consecutive waves of positive mortgage payments or had four consecutive waves with no mortgage payment. Some respondents met these qualifications over more than four waves of the 12-HRS waves. In those cases, four consecutive waves were chosen at random for analysis. Qualifying households with four consecutive waves of consistent payments or no payments were combined to comprise a comparison group. Note that these waves will be referred to as “Waves 1–4” in this discussion, with the second Wave referring to the last wave in which a mortgage payment was made, and the third wave referring to the first wave in which no mortgage payment was made. Our notation of “Waves 1–4” do not correspond to HRS waves of data gathering, in which Waves 1–4 signified the earliest phases of the survey. **Figure 2** shows the inclusion criteria of both the treatment and control groups.

Figure 2. Inclusion Description of Treatment and Comparison Group

	Wave 1	Wave 2	Wave 3	Wave 4
	<i>Treatment</i>			
T	Mortgage Payment	Mortgage Payment	No Mortgage Payment	No Mortgage Payment
	<i>Comparison</i>			
C1	Mortgage Payment	Mortgage Payment	Mortgage Payment	Mortgage Payment
C2	No Mortgage Payment	No Mortgage Payment	No Mortgage Payment	No Mortgage Payment

Note: Households that met either C1 or C2 criteria were eligible for inclusion in the comparison group.

Defining the Dependent Variable: Out-of-Pocket Pharmaceutical Spending

This analysis examines changes in OOP spending on pharmaceuticals. Though the drivers of OOP spending can be heterogenous by disease type, pharmaceutical costs are the single most

¹ Given known reporting errors that result in erratic changes in tenure between waves (swinging from ownership to rentership and back without reporting a move) (Wise, 2004), we do not use this variable in the logic chain for our mortgage definition.

important driver of additional expenses for some common chronic conditions including cardiovascular disease, diabetes, and hypertension (Fong, 2019). OOP spending on pharmaceuticals accounted for roughly 15 percent of all pharmaceutical spending in 2019, with year-over-year growth trends that were particularly driven by increasing costs for cash-paying patients (Martin et al., 2021). Rates of pharmaceutical spending are also more distributed across the economic spectrum. Unlike cost categories such as outpatient surgery, in which 73 percent of spending is concentrated in the top 10 percent of spenders, only 53 percent of pharmaceutical spending is attributed to the top 10 percent of medical spenders. Insurance premiums are the only OOP spending category that is less concentrated than pharmaceuticals (Fahle et al., 2016). To construct a measure of pharmaceutical spending, we used the field in which participants are asked to estimate their monthly OOP pharmaceutical spending over the prior two years. The structure of this question differs from other HRS OOP spending fields which ask about estimated annual spending. Complete nonresponse to this question was brought below 5 percent by imputation. Respondents who did not provide an exact amount were presented with a bracketed range of expenditures, and precise values were then imputed by RAND Corporation according to methodology described in other documentation (Bugliari et al., 2021). We develop an average spending per person measure by first aggregating at the household level and then dividing by the total number of respondents in the household (1 if a single individual or widowed and 2 if married and both still living). Since OOP spending can have a long right tail, we excluded households that fell into the top 5% of out-of-pocket spenders.

Other Variables

Health

The number and type of health conditions impact out-of-pocket health spending, with spending increasing with additional conditions (Lehnert et al., 2011; Meraya et al., 2015; Schoenberg et al., 2007). Health was operationalized as a count of chronic conditions per household divided by the number of household members (one for single-person households; two for married households). Conditions counted included high blood pressure, diabetes, cancer, lung disease, heart disease, stroke, psychiatric problems, and arthritis. Between the respondent and their

spouse or partner, a two-person household could have between zero and 16 total conditions (0 to 8, once adjusted to the per-household level).

Mortality

Medical costs increase in the last years of life (Fahle et al., 2016; Kelley et al., 2013). The analysis included an indicator for mortality which flagged households in which the third observed wave was within the last five years of life for the respondent or their spouse or partner.

Insurance

It is complex to model insurance coverage due to the wide differences in the cost and coverage of plans. But overall, more insurance coverage lowers OOP spending on prescription drugs, even with increases in utilization, especially for Medicaid recipients and for people with at least one chronic health condition (Mulcahy et al., 2016). For this research, insurance plans were categorized at the household level and considered all policies in the household. Seven mutually exclusive categories were constructed: (1) Medicaid or Veterans Administration coverage only, (2) private insurance only (employer-sponsored or individual marketplace plans), (3) traditional Medicare only, (4) Medicare plus some private coverage (Medigap, Medicare Advantage, or employer benefits), (5) Medicare plus other government insurance (Medicaid or Veterans Administration), (6) private insurance plus Veterans Administration or Medicaid coverage, and (7) no insurance.

Income

High OOP costs are a larger burden for lower-income households, and cost-related nonadherence to medication is often linked to financial burden (Briesacher et al., 2007; Khera et al., 2018; Levy and Weir, 2010). Effects are expected to be concentrated in lower-income households. For this study, income was modeled as a continuous variable that counted total annual income of the household. An additional indicator was used to identify households with total income that fell below \$24,000 for unmarried households and \$36,000 for married households. These levels were chosen to approximate income qualification upper limits for SSI, which are also the levels used in some states to indicate Medicaid qualification and other benefits. Sample sizes did not allow targeted analysis of low-income households. Incomes were all adjusted to 2016 dollars.

Wealth

Assets can be liquidated to pay health costs and many older adults reserve housing assets to cope with major health changes. Wealth was captured by two variables: one summing liquid assets and the other summing illiquid assets. Liquid assets included IRAs, stocks, checking, CDs, and bonds. Illiquid wealth included vehicles, homes, businesses, and assets reported in an “other” category (often jewelry or art). Both measures of wealth were converted to 2016 dollars.

Individual demographics

A number of individual demographic characteristics were modeled which are correlated with both income and health. Since the analysis was performed at the household level, some of these individual variables were approximated as described. Marital status was a dichotomous variable which described a married pair of co-residents. For married couples, the age covariate randomly reported the age of either the older or the younger spouse during the last wave of analysis. Age was a continuous variable by year and was also included as a squared term. For the demographic descriptions in Table 1, race or ethnicity was operationalized as an indicator that counted any household in which the respondent or spouse was white, Black, or Hispanic. For the analysis, this was simplified to a binary indicator that acknowledged households in which a resident might experience disparate health impacts correlated with race or ethnicity. This indicator flagged any household with a respondent or spouse who identified themselves as Black or Hispanic. While the analysis only considered the respondent and partner, an additional variable counted the total number of people in the household (including children, roommates, or other relatives).

Analysis

The pharmaceutical spending analysis leverages a difference-in-differences (DiD) approach to assess changes in OOP pharmaceutical behavior in the post-payoff period relative to the pre-payoff period, as compared with the control group. The key assumption of this approach is that the control group(s) represent a plausible counterfactual for the trend in spending that the group that paid off their mortgage would have seen, had they not paid off the mortgage. Wave 2 is the last wave in which respondents in the treatment group report paying a mortgage for the entire wave. So, we know that near the end of this wave, when HRS was conducting interviews, the household was making a mortgage payment. In our analysis, we designate the first wave which had a period of no mortgage payment as Wave 3 (the payoff wave). However, it is not possible to discern what proportion of this two-year period between survey waves was mortgage payment-free. We know that by the time of data collection, the household had no mortgage payment to report. Due to the heterogeneity of respondents who finished their mortgage at different times over the period of the wave, we expect impacts in Wave 3 to be weak. Wave 4 is the second no-payment wave, but the first wave for which we are confident there was never a mortgage payment from beginning to end. We particularly expect to observe effects in this wave.

The main DiD estimate is therefore calculated as $(T4-T2) - (C4-C2)$, where T4 and T2 represent the OOP spending for the treated group (mortgage payoff group) in the 4th and 2nd waves in which we observe them, and C4 and C2 represent the OOP spending for the control group at the 4th and 2nd waves in which we observe them. The difference-in-differences estimate

$$y_{it} = \alpha + \beta_1 Treated_i + \beta_2 Wave_t + \beta_3 (Treated_i * Wave_t) + \beta_4 X_{it} + \beta_5 CalYear_t + \epsilon_{it}$$

thus represents changes experienced by the mortgage payoff group, net of any secular changes experienced by all individuals in the study (e.g., natural trends in spending over time or common shocks which also impact the control groups).

In a regression framework, we calculate this treatment effect as: where B3 (the coefficients from the interaction of the treated indicator with the wave relative to Wave 2) are the causal effects of interest. Specifically, the first-year effect of the mortgage payoff on OOP

spending would be represented by the coefficient for $Treated1*Wave3$, and the second-year effect by the coefficient for $Treated1*Wave4$. The coefficient for $Treated1*Wave1$ gives a built-in test of whether the groups were on similar trajectories of OOP spending prior to the payoff (we would expect this coefficient to be close to zero and non-significant). X_{it} is a vector of household-level covariates and $CalYear$ is the calendar year of the particular wave to account for differences in the composition of the treatment and control groups of the years included.

An extension of this method, a triple difference, was used to examine the effects of subgroups. For this analysis, an indicator is created to designate two subgroups of interest: age and health. There were not enough low-income households to conduct a convincing analysis of this subgroup. The model interacts the Treated and Wave indicators with this third indicator variable to obtain the triple difference estimate (in addition to including the $Wave*SubgroupIndicator$ and the $Treated*SubgroupIndicator$ terms). The triple difference coefficient reports the difference of the differences between the two subgroups. The DiD estimate for the triple difference would be calculated for each subgroup as $(T4_a - T2_a) - (C4_a - C2_a) = D_a$, $(T4_b - T2_b) - (C4_b - C2_b) = D_b$, where $T4_a$ and $T2_a$ represent OOP spending by the treated group of one age cluster and $T4_b$ and $T2_b$ represent OOP spending by the treated group from the other age cluster. $C4$ and $C2$ similarly represent the spending of the control groups for each age cluster. Finally, D_a and D_b represent the differences in spending between Waves 2 and 4 for each subgroup. The triple difference reports the difference between the two subgroups ($D_a - D_b$). So, in the age example, the triple difference would compare the differences between the treatment and control groups for respondents under age 65 to respondents age 65 and older. Households in which respondents or spouses crossed that 65-year-old age threshold during the observation period were excluded from this triple difference subgroup analysis.

Results

Demographics of the Sample

Table 1 shows descriptive statistics for the groups used for the analysis. Unweighted descriptives can be found in the Appendix Table A1. Table 1 compares those who were excluded from the

treated group (households that moved) with the included households. The excluded households were quite similar to the included ones along most demographics, with differences by just race or ethnicity and housing type. These differences should be taken into account when considering generalizability of findings.

The table also compares the treated group to the control group. As would be expected given plausible links between demographic factors and mortgage payoff, the control group differs from treatment by income, age, race, and marital status. The strength of the DiD approach is that the control group does not need to be perfectly balanced with the treated group, but rather that, conditional on covariates, the two groups change on similar trajectories but for the treatment. While this is an inherently untestable assumption, the fact that these groups differed on demographics does not mean the control group is an inappropriate counterfactual, as long as we would expect each group's spending to have evolved along a similar trajectory to the treated group, even if at different absolute levels. We stratify the analyses by age (at age 65) to strengthen the plausibility of parallel trends, as 65 represents a key age for both retirement and for Medicare access.

Table 1. Descriptive Statistics of the Sample

	Out-of-Pocket Pharmaceutical Expenditure Analysis							
	Excluded from Sample		Included in Out-of-Pocket Health Payment Analysis Sample				Statistically Significant Differences: Treatment and Control	Statistically Significant Differences: Included and Excluded
	Number	%	Number	%	Number	%	<i>p</i> value	<i>p</i> value
			Treatment		Control			
Total	156		1,035		4,110			
Married	104	66.7	721	69.6	2,244	54.6	<0.0001	0.546
Median Income	\$68,586		\$73,300		\$52,683		<0.0001	0.193
Age	63.2		62.4		65.0		<0.0001	0.235
Low Income	27	17.4	189	18.3	1,135	27.6	<0.0001	0.818
<i>Race/Ethnicity</i>								
White	143	91.2	857	82.8	3608	87.8	<0.0001	0.0023

Black	9	5.8	105	10.1	263	6.4	<0.001	0.043
Hispanic	7	4.8	69	6.6	203	4.9	0.056	0.470

Household type (all levels of household type tested at once, but significance indicators only placed on single-family level)

Single-family	132	84.5	951	91.9	3,738	91.0	0.2367	0.0221
Multifamily	22	14.0	72	7.0	339	8.3		
Manufactured	0	0.0	1	0.1	1	0.0		

Note. Low-income households make less than \$24,000 for single-person households and \$36,000 for a two-person household. Income adjusted to 2016 dollars. Race or Ethnicity counts include households with a respondent, a spouse, or both who identify themselves in a given category. For a married couple, age is randomly reported for either the respondent or their spouse. This table reports weighted totals.

Table 2a shows life events occurring in treatment households at each wave. Retirements occur steadily in each wave, with a small jump in new retirements in Wave 4. Home sales occur at a fairly similar rate wave over wave, ranging from about 3 to 5 percent of households in each wave. The rates of IRA withdrawal increase consistently from one wave to the next, doubling from about 10 percent of the sample to 20 percent. Gifts and other lump-sum financial infusions were erratic over time, ranging from 8 to 12 percent of the sample in any given wave.

Table 2a. Sample Economic Trends

	Economic Events in Wave 1: Baseline		Economic Events in Wave 2: Last Full Wave with a Mortgage		Economic Events in Wave 3: First Wave with a Mortgage-Free Period		Economic Events in Wave 4: No Mortgage Payment	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
New retirement (respondent or partner)	147	14.2	159	15.3	144	13.9	207	20.0
Sale of primary residence	54	5.2	31	3.0	33	3.2	43	4.2
IRA withdrawal	108	10.4	126	12.1	174	16.8	212	20.5
Gift/lump sum received	126	12.2	82	7.9	115	11.1	83	8.0
Social Security retirement income reciprocity	345	33.3	430	41.6	537	51.9	640	61.8

Table 2b reports on events related to health in each wave for the treatment group. Rates of health change remained relatively steady over the period of observation, with 25 to 28 percent of households reporting new health diagnoses each wave, and new needs for support with at least one ADL ranging from 12 to 18 percent of each wave. However, these variables are generally additive, and many new health diagnoses and support needs will be represented in households by Wave 4 as compared to Wave 1. Household composition also changed at steady rates between waves, with 1 to 3 percent of households in the sample becoming widowed in each wave, and household size increasing for 6 to 8 percent of households in each wave. For households with a financial respondent under 65 years old, the per person average insurance premium cost rose by \$71 between Waves 1 and 4, from \$135 to \$206, while households with a respondent 65 or older had premiums that held steady between \$97 and \$114. Rates of Medicare coverage increased significantly as the sample aged wave over wave, ranging from an average of 33 percent of households in Wave 1 to 62 percent of households in Wave 4. Medicaid and VA coverage were static, with the share of households with Medicaid ranging from about 3 to 5 percent and the share of households with VA coverage hovering between 6 and 7 percent.

Table 2b. Sample Health Trends

	Economic Events in Wave 1: Baseline		Economic Events in Wave 2: Last Full Wave with a Mortgage		Economic Events in Wave 3: First Wave with a Mortgage-Free Period		Economic Events in Wave 4: No Mortgage Payment	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Spouse/partner death	13	1.2	26	2.5	25	2.4	35	3.4
New health diagnosis	260	25.1	297	28.6	267	25.8	259	25.0
1+ ADL support need in household	134	12.9	158	15.3	165	15.9	169	16.4
New ADL support need in household	119	11.5	171	17.2	182	17.6	174	16.9
Household size increase	63	6.2	81	7.8	73	7.1	77	7.4
Medicaid coverage	35	3.4	38	3.7	38	3.7	47	4.6
VA coverage	58	5.6	60	5.8	60	5.8	75	7.3
Medicare coverage	342	33.0	455	43.9	532	51.4	641	61.9
Per person premium cost under age 65	\$135	-	\$165	-	\$202	-	\$206	-

Per person premium cost 65 or older	\$98	-	\$99	-	\$114	-	\$97	-
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Note: Premiums reported in 2016 dollars.

Difference in Differences: Pharmaceutical Out-of-Pocket Spending when Mortgage Ends

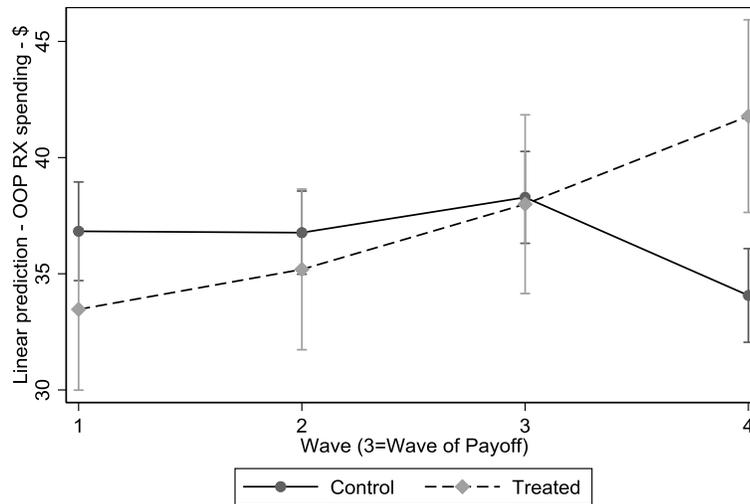
We performed a Difference in Differences (DiD) analysis to examine the relative size of changes in out-of-pocket (OOP) pharmaceutical spending before and after the final mortgage payment wave. A full table of regression statistics can be found in the Appendix Table A2.

Spending Changes after Payoff

This DiD analysis compared the difference in OOP pharmaceutical spending between the last wave in which a household paid their mortgage (Wave 2) with all other waves relative to the difference observed for the control group. We would expect no relative difference between the treated and control groups between Wave 2 and Wave 1 (the pre-period), but for the difference-in-differences coefficients to grow in Waves 3 and 4, which are the waves after payoff (for the treated group). This would indicate that the group that paid off their mortgage saw significant increases in OOP pharmaceutical spending following the payoff relative to the counterfactual, as modeled by the group that did not pay off a mortgage.

In the main analysis that included all households that paid off their mortgage between 2004 and 2014 (and their control group counterparts), we observe in **Figure 3** that households had similar pharmaceutical payment pretrends between Waves 1 and 2 with a clear diversion of trends which becomes particularly apparent by Wave 4.

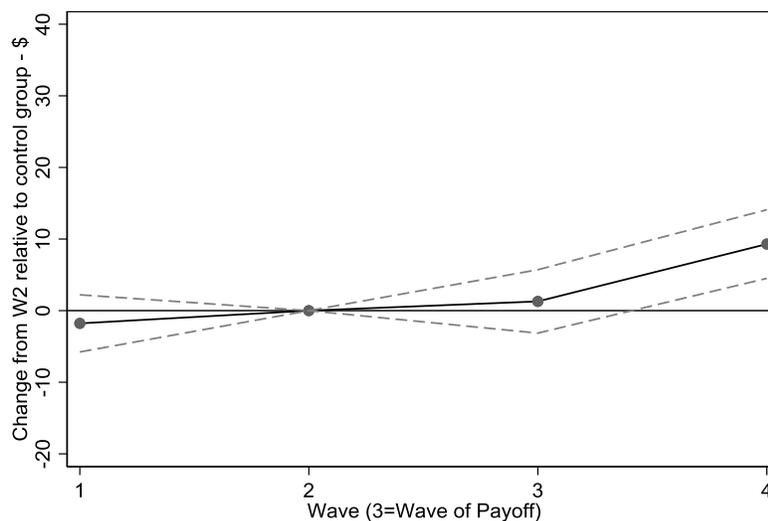
Figure 3. Out-of-Pocket Pharmaceutical Spending for Homeowners whose Mortgage Payments Ended in Wave 2 and for Homeowners whose Mortgage Remained Constant



Note: This analysis compares the size of differences in pharmaceutical spending between homeowners whose mortgage payments ended in Wave 2 and homeowners whose payment remained consistent during that wave to the size of differences in spending between the two groups in Wave 4.

We find no large increases in relative OOP pharmaceutical spending by the first wave with no mortgage (Wave 3), but a \$9.30 increase per capita per month by the second wave with no mortgage (Wave 4) (95% CI: \$4.50–\$14.09) (**Figure 3a**). This represents approximately a 25 percent increase in monthly OOP pharmaceutical spending.

Figure 3a. Difference in Differences: Out of Pocket Pharmaceutical Spending After Mortgage Payoff



Note: This analysis compares the size of differences in pharmaceutical spending between homeowners whose mortgage payments ended in Wave 2 and homeowners whose payment remained consistent during that wave to the size of differences in spending between the two groups in Wave 4. The dotted lines show confidence intervals.

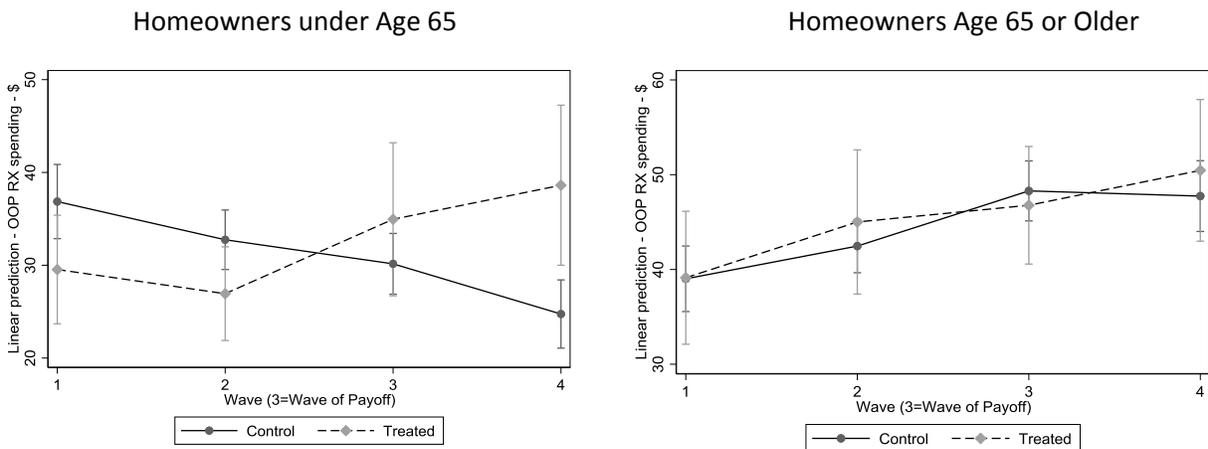
Subgroup Analyses

Subgroup Analysis by Age

Effects appear to be driven by households in which the financial respondent (and their spouse, if applicable) is less than 65 years old for the entire four-wave observation period. Households with adult respondents age 64 or under saw a \$19.75 (CI: \$11.99, \$27.51) increase in OOP pharmaceutical spending by the second post-payoff wave (Wave 4) relative to the control group. This is nearly a 50 percent increase in out-of-pocket pharmaceutical spending. Households with adults over 65 for the entire observation period saw only a \$0.41 increase and those findings were not significant (CI: -\$9.43, \$10.24). **Figure 4** shows out-of-pocket pharmaceutical spending for the treatment group (households which made their final mortgage payment in Wave 2) and control groups (households that had four consecutive waves either with or without a mortgage payment). Trends between Waves 1 and 2 are much more convincingly parallel in this age cohort analysis than in the analysis in which all households were compared. Baseline spending trends appear quite parallel for the under age 65 group until they diverge at the treatment wave. However for the 65 and older group, the OOP spending by treated and control remain quite

similar wave over wave. Notably, the HRS cohort was built around a target population of adults 50 or older at the time of first interview; however other members of the household who are included in the observational unit could be younger. Households were excluded from this subgroup analysis if either the respondent or spouse crossed from 64 to 65 during the four-wave observation period.

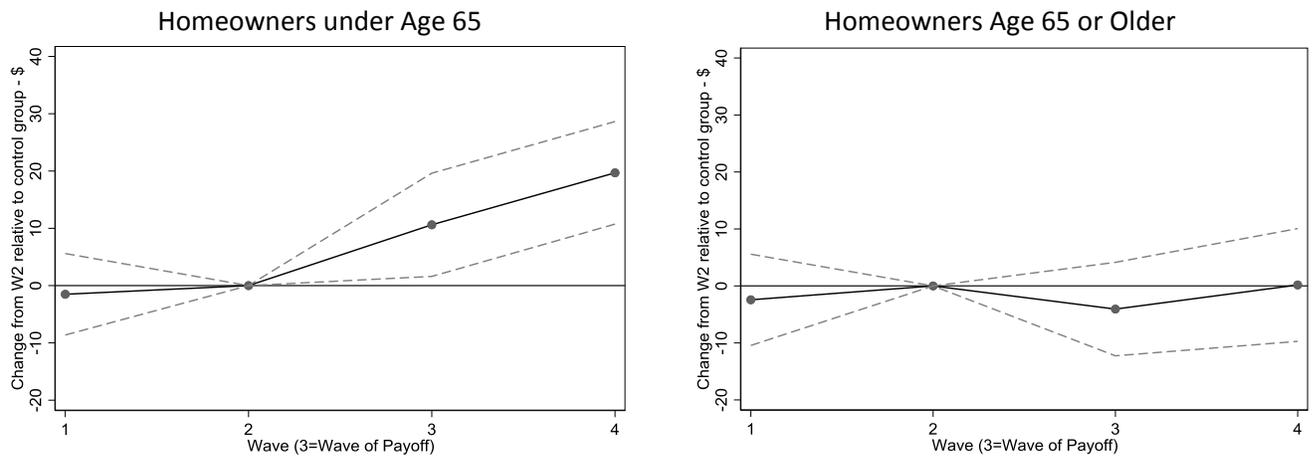
Figure 4. Out-of-Pocket Pharmaceutical Spending for Homeowners whose Mortgage Payments Ended in Wave 2 and Homeowners Whose Mortgage Remained Constant



Note: This analysis compares the size of differences in pharmaceutical spending between homeowners whose mortgage payments ended in Wave 2 and homeowners whose payment remained consistent during that wave to the size of differences in spending between the two groups in Wave 4.

The difference in the treatment effect between the two age groups, estimated by the triple difference analysis, was significant ($p=0.001$) with an estimate of $-\$20.45$ (CI: $-\$32.96$, $-\$7.94$). The size of the differences between the two groups as compared with their differences at Wave 2 are presented in **Figure 4a**. Effects are concentrated in the homeowners 64 or under. There is no evidence of significant differences for households in which the financial respondent is 65 or older.

Figure 4a. Difference in Differences of Out-of-Pocket Monthly Pharmaceutical Spending by Age



Note: This analysis compares the size of differences in pharmaceutical spending of under 65 and over 65 households between homeowners whose mortgage payments ended in Wave 2 and homeowners whose payment remained consistent. The size of differences was compared to Wave 2 spending. The dotted lines show confidence intervals.

Subgroup Analysis by Health

It is possible that the observed impacts of the main analysis were driven by changes in health. In this scenario, increased pharmaceutical costs were directly driven by emerging health needs, and changes in mortgage status were either incidental to the outcome or motivated by the health status changes. It is difficult to completely discount the possibility of an endogenous relationship without a good instrumental variable, which we lack. So, to consider this problem, we first examine the treatment group descriptive trends and note that there was no jump in either new health diagnoses or additional ADL support needs during the treatment period, between Waves 2 and 3. To further explore the potential role of health in this story, we utilized the indicator for new health diagnoses in a wave and conducted a subgroup analysis comparing spending changes between households which experienced at least one new health diagnosis in the treatment wave to households with no new health diagnoses that wave. This indicator for worsening health status should demonstrate whether the magnitude of the effect was stronger for households that experienced a decline in health during the treatment period (when they paid off the mortgage). Results suggested that there was no significant difference in treatment effect between households with stable health and households that experienced a new health diagnosis

during the treatment wave. Households with worsening health saw a non-significant \$0.72 lower relative change in OOP spending by Wave 4 compared with the effect among households with steady health (CI: -\$12.01, \$10.57). These null effects support the case that changes in health were not the primary driver of differences in pharmaceutical spending at the end of the mortgage period.

Robustness Checks

Subgroup Analyses

By Income

In general, we were not able to identify whether effects were dependent on income (independent of the observed difference by age) since there was a large difference in household income by age, with almost all low-income respondents being in the over-65 age group. We attempted to identify a specification for income which would be separate from age, but the small sample size of low-income households under age 65 prevented us from performing a convincing triple difference income analysis of this targeted group. While we are unable to report a reliable relative effect of living in a low-income household, we tested the main DiD model at different income bands and found the direction of coefficient trended larger among lower-income households, indicating potential evidence of a greater relative increase in out-of-pocket spending on medications after mortgage payoff for lower-income households. The close correlation with age also prevented a differential examination of income sources between households that received OASI and households that did not.

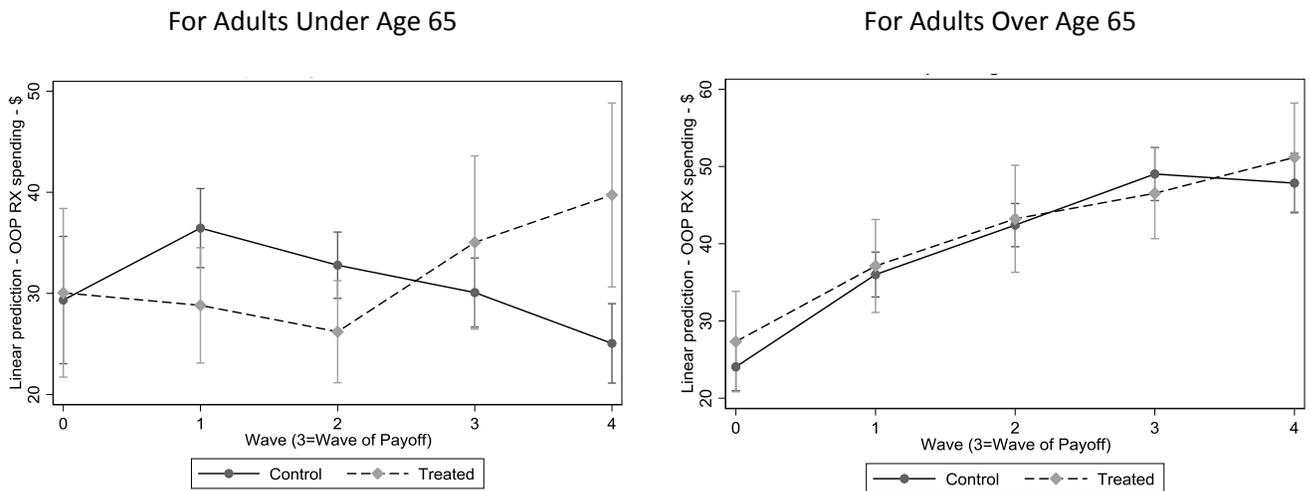
By Insurance Type

We attempted a similar triple difference framework to examine the impact of insurance coverage, which could also plausibly affect OOP spending. We tested whether the magnitude of the effect of mortgage payoff differed by prescription drug coverage among those with Medicare (either Part D or through a Medigap or Medicare Advantage plan). Medicare recipients with prescription

insurance (over 80% of the sample with Medicare) saw a larger effect (the DiD estimate is \$18.01 higher for those with prescription insurance than those without (CI: \$0.05, \$35.96; p-value for triple difference interaction term=0.05). We were unable to further examine the differences between insurance coverage for households under age 65 due to inconsistent measurement of prescription insurance.

Parallel Pretrends between Treatment and Control Groups

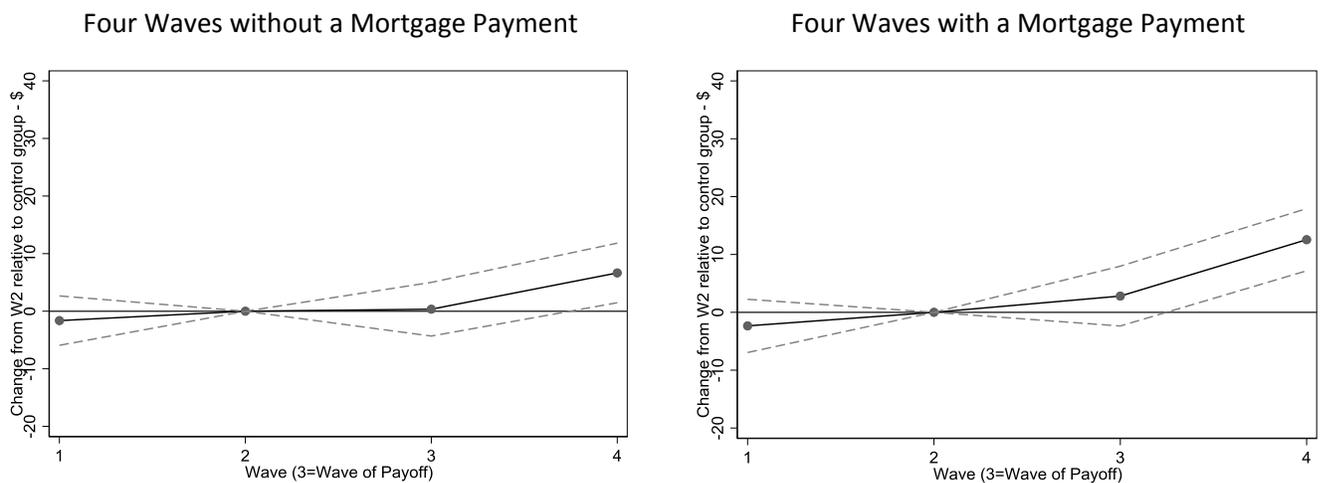
A basic assumption of a difference in differences analysis is that the treatment and control demonstrate parallel change trends prior to the treatment. To check this assumption, we examined trends prior to Wave 2, which was the last payment wave, to demonstrate that differences in payments observed in Wave 4 were attributable to the treatment. Mirroring the analysis, pretrends in out-of-pocket pharmaceutical spending were presented separately for adults under age 64 and or adults 65 or older. To better explore trends prior to treatment between the treatment and control groups, the following analysis added a wave prior to the beginning of the analytic sample to increase insight into changes of pharmaceutical out-of-pocket spending over time. This new wave, not included in the main analysis, was denoted as “Wave 0.” The spending of the treatment group under age 65 trended steadily down wave over wave between Waves 0 and 2, at which point the final mortgage payment was made and pharmaceutical out-of-pocket spending began steadily rising again. The control group showed somewhat lower payments in Wave 0, but overall payments trended steadily down wave over wave between Waves 1 and 4. Spending trends for homeowners over age 65 were very similar, rising wave over wave for both treatment and control groups.

Figure 5. Pharmaceutical Out-of-Pocket Spending with Additional Pretrend Wave

Note: This analysis compares the size of differences in pharmaceutical spending between homeowners whose mortgage payments ended in Wave 2 and homeowners whose payment remained consistent during that wave to the size of differences in spending between the two groups in Wave 4.

Control Group Trends

The control group used for the pharmaceutical spending analysis combined out-of-pocket spending data of homeowners who continually carried a mortgage balance for four consecutive waves with homeowners who did not carry a mortgage for a four-wave period. Since these two types of controls were demographically different from each other, and each was demographically dissimilar from the treatment group, we ran separate analyses with each type of control group (always mortgage or never mortgage). The effect estimate was similar in magnitude across the two control groups included in the main analysis.

Figure 6. Difference in Differences of Monthly Out-of-Pocket Prescription Spending

Note: This analysis compares the size of differences in pharmaceutical spending between homeowners whose mortgage payments ended in Wave 2 and homeowners whose payment remained consistent during that wave to the size of differences in spending between the two groups in Wave 4. The dotted lines show confidence intervals.

For control group households that had more than four waves of mortgage payment or no mortgage payment, a random four waves had been selected to compare with the treatment group. This random four-wave draw was additionally examined for stability. We iterated this random draw of four weeks 20 times to ensure that the draw of four wave periods used to construct the control group did not represent an outlier. Results remained stable across these draws, with pharmaceutical spending DiD effect estimates ranging from a low of \$7.34 to a high of \$10.58, with a mean DiD effect estimate of \$8.73. This is in line with the DiD effect reported for our main analysis of \$9.30.

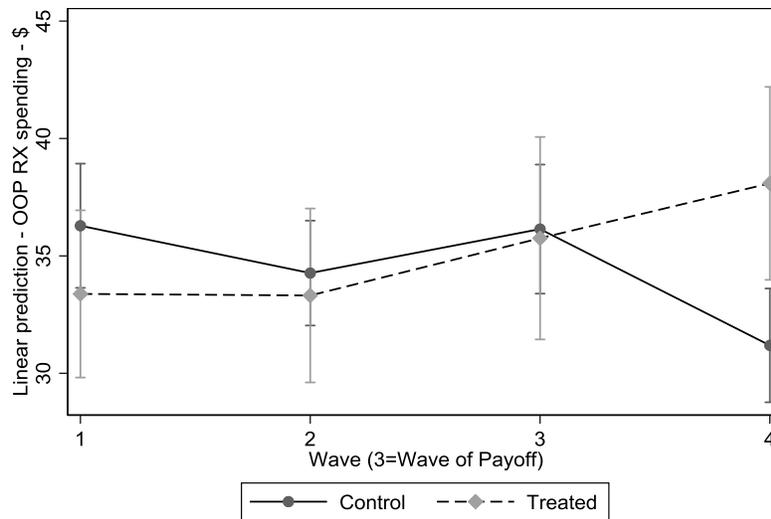
Matching Analysis

To address concerns that the control sample and the treatment sample were different across theoretically meaningful demographics, we ran a coarsened exact match (CEM) algorithm on the sample. The algorithm matched treated and control observations based on Wave 1 income, age, marital status, HRS cohort membership, wave of payoff, and number of chronic conditions to assess whether the results were robust to trimming non-overlapping observations and improving covariate balance at Wave 1. We allowed multiple control observations to match to each treated observation (matched treated observations=701, matched control observations=1,769). We found

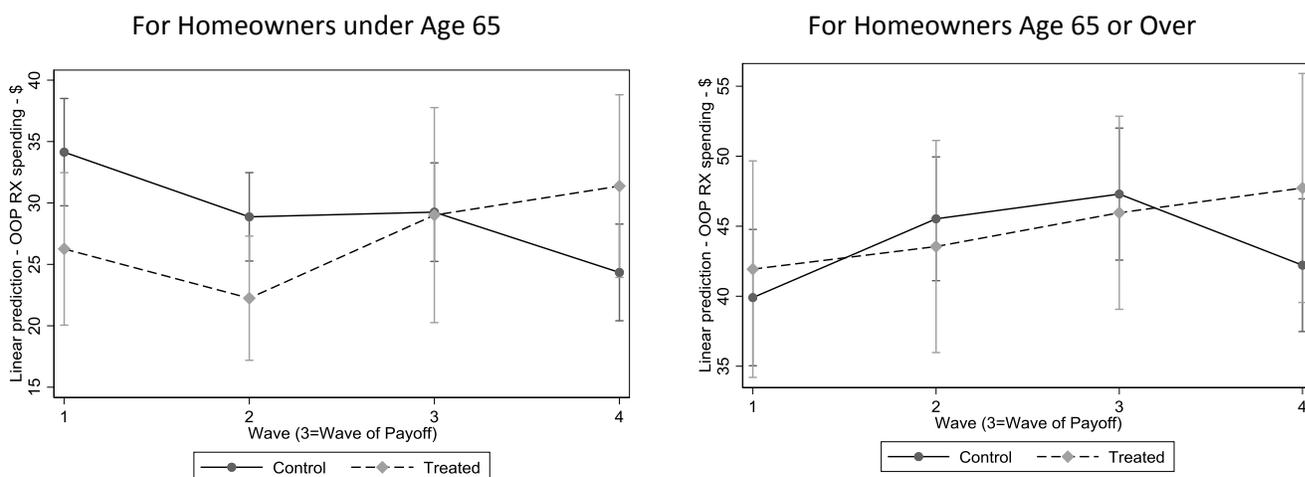
largely similar results using this method as the DiD analysis among the full sample, with those under 65 showing a larger increase in OOP pharmaceutical spending after mortgage payoff than those over 65.

Figure 7. Pharmaceutical Out-of-Pocket Spending Differences after Final Mortgage Payment

Note: This analysis compares the size of differences in pharmaceutical spending between homeowners whose mortgage payments



ended in Wave 2 and homeowners whose payment remained consistent during that wave to the size of differences in spending between the two groups in Wave 4.

Figure 7a. Pharmaceutical Out-of-Pocket Spending Differences after Final Mortgage Payment

Note: This analysis compares the size of differences in pharmaceutical spending between homeowners whose mortgage payments ended in Wave 2 and homeowners whose payment remained consistent during that wave to the size of differences in spending between the two groups in Wave 4.

Sensitivity Tests of Treatment of Outliers in Pharmaceutical Spending

We re-analyzed the data treating the outliers in two additional ways to test the stability of our results. In our main analysis, we excluded any households with any wave of pharmaceutical spending in the top 5 percent of all observations (approximately \$250 in 2016 dollars). In a primary sensitivity test, we Winsorized the outliers over \$300/month to take a value of \$300. In a secondary test, we Winsorized outliers over \$1,000/month to take a value of \$1,000. In both cases, we see a positive and statistically significant DiD estimate for the 4th observed wave, though the absolute magnitude and precision vary. For instance, in the version Winsorizing at \$1,000/month, the DiD coefficient becomes larger but less precise at \$23 ($p=0.02$), but the baseline mean spending increases to \$80, indicating a roughly 25 percent increase in spending by the 4th wave; in the version Winsorizing at \$300/month, the DiD coefficient becomes \$14 ($p<0.001$) off of a baseline mean of \$55 (a 21% increase). These both align with the 25 percent increase (\$9 off a base of \$35) that we observed in our main analysis.

Missing Out-of-Pocket Spending Data

The analyses presented above exclude observations from waves in which households report that they do not know or would prefer not to report their average monthly OOP pharmaceutical spending. We re-analyzed the data treating these observations in two different ways: first, we excluded all observations from any households who ever had one or more missing OOP spending value, and second, we coded any of these missing values to \$0 which allowed us to include all households for all waves. In both cases, the main DiD estimate was between \$8 and \$9, with younger households seeing a larger effect, reflecting consistency with the main results. The version excluding households with a missing outcome value in even a single wave resulted in a smaller sample with larger confidence intervals, but the point estimate was essentially identical in all three analyses.

Discussion

What We Learned about the Relationship between Housing Cost and Pharmaceutical Spending

This research demonstrated that OOP pharmaceutical spending increased after mortgage payoff, particularly for households in which the individual or couple was under 65 years old. During the fourth wave, the wave in which households had no mortgage to pay from beginning to end, households spent about 25 percent more OOP on pharmaceuticals than they spent prior to the end of their mortgage term. This amounts to an average of \$9.302 of additional monthly OOP pharmaceutical spending. Depending on plan copays, this could signify an additional prescription filled each month. These research findings suggest that while homeowners had outstanding mortgage debt, they might have been able to meet their housing costs, but there might not have been adequate resources left over to completely fund their healthcare.

Effects Were Concentrated in Younger Households and Could Have Been Insurance Related

The findings were even more pronounced for, and appear to be driven by, households in which the individual or couple never reached age 65 during the observation period. These households increased OOP spending on pharmaceuticals by 50 percent, with an average \$19.75 of additional monthly pharmaceutical purchases after they finished paying their mortgage. Households with respondents 65 or older during the entire four-wave period did not meaningfully increase pharmaceutical spending after mortgage payoff. Put another way, while OOP health spending of the under-age-65 mortgage payoff group diverged from control, the health spending of the over-age-65 group did not diverge. The change in OOP pharmaceutical expenditures of the respondents age 65 and older who paid off their mortgage during observation remained statistically similar to 65 and older respondents who experienced no major change in their housing payment over the eight observation years. This suggests that something happened around age 65 to smooth pharmaceutical out-of-pocket spending and make it less sensitive to budgetary pressures.

OASI programs could potentially smooth OOP health spending for adults beginning at age 65. The Extra Help program (also known as the Low-Income Subsidy, or LIS) subsidizes the cost of Medicare Part D plans and is worth about \$5,000 per year to beneficiaries. The program is available to lower-income Medicare beneficiaries with limited resources who live in all 50 states or the District of Columbia. Medicare recipients can apply for this program, but some low-income adults, such as those with Medicaid support or who receive SSI benefits, qualify for the program automatically, so the administrative barrier to participation is relatively low for some recipients. The LIS would increase access to healthcare by both making coverage more affordable to Medicare recipients, which can relieve pressure on the entire household budget, and also by reducing the OOP cost for pharmaceuticals through increased access to Part D.

Medicare qualification may also smooth OOP health spending. It may not be initially intuitive that Medicare qualification would shift OOP prescription drug use since traditional Medicare alone does not cover pharmaceuticals, and since cost and coverage of pharmaceuticals through Medicare Advantage, Medigap, or Medicare Part D plans roughly align with private insurance pharmaceutical coverage prior to age 65. So, it is useful to consider a mechanism by which Medicare coverage could shift the household budget and free up resources for additional spending on health. Medicare increases access to health insurance, plausibly reducing health

insurance costs, and relieving pressure on the household budget, which leaves health spending decisions less sensitive to changes in housing cost.

Medicare would reduce the sensitivity of pharmaceutical spending to housing costs along two pathways: it reduces premium costs for some households and expands access to insurance coverage. Insurance premium costs are high for many beneficiaries under 65 and some remain without coverage as a result. The average national monthly premium that was charged for a 40-year-old to purchase coverage from a silver marketplace plan in 2019 hovered around \$480. With geographic differences in pricing, this premium cost climbed to a high of \$865 for a beneficiary to purchase this level of coverage in Wyoming, and fell to \$311 in Rhode Island (“Average Marketplace Premiums by Metal Tier, 2018–2021,” 2020). Additionally, most states allow insurers to charge differential premium prices by age, so older beneficiaries pay increasingly higher premiums for coverage year over year, though the amount of this variation was limited by the Affordable Care Act (ACA) starting in 2014. As a result of this high cost of coverage and uneven access to Medicaid, particularly in states which did not expand coverage, 28.9 million adults under 65 remained uninsured in 2019 (Tolbert et al., 2020).

In contrast, adults 65 and older are almost universally covered by Medicare with premium prices that diverge widely from Marketplace premiums. Nearly two-thirds of Medicare Advantage plan enrollees in 2021 paid no premium beyond the cost of Part B coverage, which was less than \$150 that year. The remaining third of beneficiaries paid around \$60 per month on top of their Part B premium (Freed et al., 2021). This represents more than \$250 per month of potential savings on premium cost from the national average premium costs and without factoring age adjustments. In states where coverage is more expensive, monthly cost differences could be quite substantial. These premium figures do not enumerate other areas of potential difference in coverage terms or administrative burdens which also shift with Medicare enrollment. While some Medicare recipients may still experience financial burden from OOP health expenses, including potentially onerous premium costs for both Medicare and supplemental plans, the impact of qualifying for Medicare could be plausibly large enough to shift household budgets and reduce the need for trade-offs between health and housing. With Medicare health subsidies, housing costs also become more affordable. This might particularly be true in states with higher insurance cost and in states that did not expand Medicaid to cover low-income households more broadly.

Taken together, access to both the LIS and to Medicare are reasonable mechanisms to explain the differential burden experienced by homeowners under 65 who forgo prescription medication while they are making monthly mortgage payments. Both programs reduce healthcare cost and free up resources to purchase additional coverage or to obtain healthcare directly. These subsidies smooth the effects of changing housing costs for homeowners 65 and older because they allow this group to afford both housing payments and pharmaceutical medications. With public subsidy, spillover impacts between housing and health costs were limited for older householders.

Findings Raise Welfare Concerns

This research suggests a tension between homeowners' ability to make their mortgage payment and their ability to follow prescribed medication regimens. The sensitivity of pharmaceutical uptake to housing payment for homeowners under age 65 raises welfare concerns. Prior research has established that patients who do not adhere to prescribed pharmaceutical regimes are not strategic in the prescriptions they forgo. Nonadherents are as likely to go without critical medications that exert significant health impacts as they are to skip medications which are less critical to maintaining stable health. These decisions are explained by numerous factors, including the complexity of assessing the value of a drug regimen, the delayed or hidden effects of some drugs, and the administrative hurdles which make some drugs, even those of high health value, difficult to obtain. The evidence in this research, suggesting cost-related medication rationing which privileges housing payments in a limited household budget, raises serious concerns for healthcare quality and the costs to treat poorly managed conditions. Expanded access to pharmaceuticals accomplished by the introduction of Part D is estimated to have reduced older adult mortality, particularly cardiovascular mortality, by 2.2 percent each year. These welfare improvements underscore the serious implications of cost-related medication nonadherence (Huh and Reif, 2017).

Additional Work Is Needed

This analysis raises a number of questions which should be addressed by future research. Other types of healthcare, particularly dental care, hearing, and vision, are not covered by traditional Medicare and may be subject to rationing in households with limited budgets. Also, more profound health impacts are likely to be experienced by householders with diagnoses that are medication mediated. Future explorations should focus on the relationship between housing costs and health spending for residents with specific conditions such as cardiovascular disease or diabetes.

Additionally, this analysis did not explore other trade-offs that homeowners may make when housing costs demand a large share of the household's limited income. Since the household budget is fungible, other key consumer goods may also be subject to rationing. Food and utility purchasing behavior should also be carefully examined for their sensitivity to the household budget and housing payment. These are both expenses which have their own independent connection to the health and welfare of a homeowner, and if underprovided, could exacerbate health conditions.

Finally, further work is needed to clarify which subpopulations are most impacted by trade-offs older adults make between housing and health costs. While this research could not convincingly separate income and age effects, previous research has demonstrated that limited household income is a driver of cost-related pharmaceutical nonadherence. Low income is a likely driver of health spending changes observed in this research, but future research should confirm this mechanism of effect. Also, with the focus on the mortgage payment, this research did not consider the behavior of older renters, a vulnerable population with fewer assets than homeowners and less stable housing circumstances. Housing affordability and health can both impact housing stability for older adults and should be included together in an assessment of renter welfare. Future research should better explain the health trade-offs made by these older adults when they are faced with unaffordable housing payments.

Conclusion

This research, which examined health spending behavior as housing costs shift, suggested that the age of Medicare qualification may impact OOP pharmaceutical spending behavior and cost-related medication nonadherence. There are multiple pathways to relieve budgetary pressure on households struggling to simultaneously fund their housing and health needs. Public subsidy could target the costs of homeownership or other key items of the older adult budget such as food, utilities, or transportation. Subsidies could also target cost of or access to healthcare. At writing, a proposal is under consideration to lower the age of Medicare qualification to 60, which would expand Medicare coverage to an additional 11.7 million people with employer coverage, 2.4 million with non-group coverage, and 1.6 million uninsured. Policies to lower the age of entry to Medicare to 50 would include an additional 40 million adults in coverage (Garfield, et al., 2021). More work is needed to identify the welfare maximizing age of Medicare qualification and the results of this research suggest that studies must consider the relationship of Medicare to health-supporting behaviors as well as housing stability.

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Appendix

Table A1. Table of Unweighted Sample Descriptive Statistics

	Out-of-Pocket Pharmaceutical Expenditure Analysis					
	Excluded from Sample Out-of-Pocket Health Payment Analysis Sample		Included in Out-of-Pocket Health Payment Analysis Sample			
			Treatment		Control	
	Number	%	Number	%	Number	%
Total	149	-	1,050	-	4,135	-
Married	96	64.4	665	63.3	2,098	50.7
Median Income	\$65,189	-	\$57,999	-	\$42,008	-
Respondent Age	64.7	-	64.6	-	68.2	-
Low Income	27	18.1	267	25.4	1,432	34.6
<i>Respondent Race/Ethnicity (all levels of race tested at once, but significance indicators only placed on white level)</i>						
White	128	85.9	731	69.6	3,252	78.6
Black	11	7.4	197	18.8	510	12.3
Hispanic	4	2.7	100	9.5	280	6.8
Another Race/Eth	6	4.0	22	2.1	96	2.3
<i>Household Type (all levels of household type tested at once, but significance indicators only placed on single-family level)</i>						
Single family	121	81.2	949	90.4	3,741	90.4
Multifamily	25	16.8	85	8.1	363	8.8
Manufactured	0	0.0	1	0.1	1	0.0

Note. Low-income households make less than \$24,000 for single-person households and \$36,000 for a two-person household. Income adjusted to 2016 dollars. This table reports unweighted totals.

Table A2. Pharmaceutical Out-of-Pocket Spending: Coefficients from Full Model

VARIABLES	(1) Monthly OOP RX spending
Age (randomly selected if married)	0.405 (0.699)
Age ²	-0.00296 (0.00501)
Illiquid Wealth	-1.39e-07 (6.59e-07)
Liquid Wealth	2.26e-07 (6.74e-07)
Income	-1.21e-06 (1.89e-06)
<i>Insurance (ref=Medicaid/VA)</i>	
Private Ins Only	23.45*** (5.473)
Medicare Only	28.92*** (6.092)
Medicare+Priv	29.97*** (5.816)
Medicare+Medicaid/VA	-0.250 (5.956)
Medicare+Multiple Others	11.48* (6.091)
Private+Multiple Others	9.121 (5.954)
Uninsured	33.99*** (10.77)
SSI recipient	-17.07***

	(4.368)
Death in household w/in 5 years of payoff	-2.193
	(2.676)
Married	4.868***
	(1.498)
Household size	-0.449
	(0.646)
Black or Hispanic (either spouse)	-0.0978
	(1.765)
# health conditions (per person)	11.49***
	(0.612)
Post-ACA (2010)	-2.663*
	(1.400)
Post-Part D (2006)	-16.28***
	(1.737)
<i>Year of payoff (ref=2000)</i>	
2002	7.691***
	(2.657)
2004	8.513***
	(2.771)
2006	13.68***
	(3.252)
2008	15.48***
	(3.228)
2010	19.92***
	(3.547)
2012	12.50***
	(3.800)
2014	12.78***
	(4.142)
<i>Wave of observation period (ref=2)</i>	

1st Wave (4 years before payoff)	0.0591
	(1.004)
3rd Wave (first wave without payments)	1.519
	(1.075)
4 th Wave (2 years after payments end)	-2.701**
	(1.250)
Treated group indicator	-1.582
	(1.947)
<i>HRS cohort (ref=HRS/Ahead overlap)</i>	
Ahead	12.90
	(13.66)
Coda	11.01
	(13.79)
HRS	10.49
	(13.90)
War babies	14.40
	(14.26)
Early Baby Boomers	14.47
	(14.50)
Late Baby Boomers	20.38
	(14.93)
<i>Diff-in-Diff</i>	
Wave 1*Treated	-1.778
	(2.036)
Wave 3*Treated	1.289
	(2.258)
Wave 4*Treated	9.299***
	(2.446)
Constant	-36.31
	(28.59)

Households	4,391
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Robust standard errors (clustered at household ID) in parentheses

*** p<0.01, ** p<0.05, * p<0.1



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