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Does Aging at Home Make Older Adults Healthy: Evidence from Medicaid Home and Community-Based Services

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Abstract

The Medicaid Home and Community-Based Services (HCBS) subsidizes long-term care to satisfy the increasing desire to age at home among older adults. The HCBS program may improve health outcomes of this population by allowing them to age-in-place, but less quality and quantity of home-based care comparing to nursing home care could offset some of the potential benefits. We use plausibly exogenous policy expenditure across states over time linked with detailed health information from the restricted Health and Retirement Study (HRS) to identify the causal effects of HCBS on general health, physical health, and mental health of older adults. Overall, our findings suggest that HCBS is beneficial to health: a $1,000 increase in HCBS per older person improves health status by 6 percent, mitigates functional mobility limitations by 5 percent, and reduces negative psychological feelings by 10 percent. The positive effect on physical health is concentrated among people with limited financial resources, while the reducing impact on mental health is significant among the richer group. The HCBS program improves health outcomes mainly through three mechanisms: decreasing risk behavior on drinking, increasing healthcare use, and spending more time accompanying with family.

Keywords: Medicaid HCBS, Long-Term Care, Health, Aging

JEL classification I12, I18, I30

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1 INTRODUCTION

As the country's population ages, the need for long-term care (LTC) in the United States has increased dramatically (Kemper et al. 2005; Brown & Finkelstein 2008; National Center for Health Statistics 2009; Hagen 2013; Johnson 2017). To meet the increasing demand for LTC while reducing the financial burden on the government of covering high costs of nursing home care, Medicaid implemented the Home and Community-Based Services (HCBS) program in the mid-1980s, and it has been rapidly expanding since the early 1990s (Kaye et al. 2009; Ng et al. 2010).[1] As people generally prefer to age in their own homes and communities, the HCBS program is able to help older people delay entering nursing homes or decrease nursing home care (Wilmoth & Chen 2003; Muramatsu et al. 2007; Miller 2011; Guo et al. 2015; Segelman et al. 2017; Aguila et al. 2020).

However, whether the expansion of HCBS improves health outcomes for the older population remains unclear. On the one hand, a large body of literature demonstrates that aging-in-place can improve health by creating senses of belonging and self-control of lives, reducing feelings of loneliness, and facilitating social relationships (Nair 2004; Oswald & Wahl 2004; Wiles 2005; Grabowski 2006; Rojo-Pérez et al. 2007; Stancliffe et al. 2009; Prieto-Flores et al. 2011; Sereny & Gu 2011). On the other hand, compared to nursing home care, there is typically less oversight of quality and quantity of home-based care (Kane et al. 2007; Dick et al. 2019), which may lead to negative health outcomes for the affected population. For example, there is evidence that the training and skills of HCBS staff are inadequate for particular groups, such as people with dementia, who are at risk of being inaccurately evaluated and given unsuitable care (Sands et al. 2008; Cherry 2012). Furthermore, older people who receive home-based care may have less contact with medical professionals than in a nursing home. In this case, some of their illnesses may go undiagnosed, even if their underlying health has deteriorated. Thus, the overall effect of

[1]Many OECD countries have shifted resources toward providing more affordable home-based care to reduce the costs of providing long-term institutional care (Landers et al. 2016).

Medicaid HCBS on health of older people is ambiguous.

This paper provides the empirical evidence to address how the HCBS program affects older Americans' health outcomes. Using restricted data of the Health and Retirement Study (HRS) and detailed data on state-level policy spending from 1998 to 2014, we estimate the effects of HCBS expenditure per capita on a broad range of health outcomes controlling for individual, state, and year fixed effects. We show three dimensions of the benefits of HCBS on health. First, we demonstrate that a $1,000 increase in HCBS expenditure per older person decreases the probability of reporting worse health status by 6 percent. The self-reported health improvement effect is more significant for older people with limited financial resources who are more likely to be enrolled in HCBS. Second, we evaluate how HCBS affects the well-being of this older population on physical health. Our findings show that a $1,000 increase in HCBS expenditure is associated with a 5 percent decrease in the probability of individuals reporting mobility limitation while close-to-null effects on Activities of Daily Life (ADL) or Instrumental Activities of Daily Life (IADL) limitations. Third, our estimates also show that HCBS generosity improves mental health by reducing the probability of negative emotional feelings by 10 percent and increasing cognitive skills by 1 percent. The estimates above are robust across different specifications.

We further explore the mechanisms through which HCBS improves health outcomes of older adults. First, we find that HCBS leads to changes in risky behavior. An increase in HCBS generosity reduces the likelihood of older people to drink by 2 percentage points (5 percent with a mean of 0.43). HCBS also decreases drinking intensity by 8 percentage points weekly (8 percent with a mean of 1) and 6 percentage points daily (12 percent with a mean of 0.5). These changes are nontrivial taking the fact that it is harder for older adults to change long-maintaining habits. Second, we show that the HCBS expansion is associated with an increase in healthcare use. HCBS increases the probability of using inpatient service by about 6 percent and of regularly taking medication by 1 percent. Third, we provide suggestive evidence that HCBS significantly improves the chances of older people to interact

with family members. Specifically, Liu & Zai (2022) show that HCBS generosity substantially increases informal caregiving to older adults by their children and increases more incidents of co-residency with family members. In addition, we also find that HCBS improves the likelihood of older adults to be cared by either paid home aids or informal caregivers by about 38 percent. HCBS also increases the daily care by 0.6 days and hourly care by 3.9 hours provided to older adults during the past month of the interview date.

This paper is related to several branches of the literature. First, the results are related to the research on how HCBS affects care arrangements and well-being of older people. A large part of this literature focuses on analyzing how HCBS affects home stay or home/community return, nursing home entry, length of nursing home stay, and use of hospitals (Miller et al. 1998; Alecxih et al. 2006; Radke et al. 2006; Muramatsu et al. 2007; Miller 2011; Guo et al. 2015; Wang et al. 2020). This line of work finds that the expansion of HCBS allows older people more likely to stay at home/community longer and return to home after being discharged from nursing homes and hospitals. In addition, HCBS generosity decreases nursing home care use and the duration in nursing facilities. Another part of this literature shows that participants in HCBS are at higher risk of hospitalization than nursing home residents (Sands et al. 2008; Wysocki et al. 2014; Konetzka et al. 2020). Few papers on analyzing health effects of HCBS find that HCBS generosity is associated with more patients of functional and cognitive impairment at home (Kane et al. 2013; Wang et al. 2020). To our best knowledge, this paper is the first to provide extensive health effects of HCBS and contribute to the discussion of benefits of HCBS. We present more convincing estimates by using the longitudinal HRS with a large representative sample of aging people in the United States linked with state-level demographic and economic variables that allow for identification assumption tests and detailed robustness checks.

Second, the findings are broadly connected to the literature that estimates the benefits of public policy on health. Studies of other Medicaid program find that the Affordable Care Act (ACA) expansion improves self-reported health and the psychological health of low-income

adults as well as infant health (Currie & Gruber 1996a;b; Finkelstein et al. 2012; McMorrow et al. 2017; Simon et al. 2017; Kuka 2020). Studies of Medicare show that Medicare benefits are associated with an improvement in self-reported health among older people (Khwaja 2006; Card et al. 2008). Studies of government welfare and nutrition programs also find improvement in self-reported health status (Bitler et al. 2005; Hoynes et al. 2011; Evans & Garthwaite 2014; Kuka 2020). Our findings will add more evidence on the relationship between government policy and health.

Third, the study is related to a smaller literature that evaluates the cost-effectiveness of HCBS. Many studies show that the HCBS program increases the overall Medicaid expenditure on LTC (Kemper 1988; Levine & Barry 2003; Grabowski 2006; Kane et al. 2013). Our findings provide evidence that HCBS could save Medicaid health care spending by improving health of older people. The potential savings from health improvement justifies the increasing investment in HCBS from the policy perspective.

The paper is organized as follows. Section 2 introduces the institutional background of HCBS. Section 3 describes the data, explains some key health outcomes, and presents summary statistics. Section 4 introduces the empirical model and potential threats to identification. Section 5 reports the effects of HCBS on a variety of health outcomes, explore mechanisms, presents robustness checks, and analyzes heterogeneous effects. Section 6 concludes.

2 MEDICAID HCBS

Historically, Medicaid funded LTC only in institutional settings, such as in nursing homes for older people. Because nursing home care is costly, Medicaid's LTC expenditure increased significantly over the years. In an effort to contain the massive growth in LTC expenditure and to satisfy older people's expressed preferences to receive LTC at home or in their community, Medicaid implemented the HCBS program starting in the early 1980s.

The mission of HCBS is to provide LTC for older adults at home, as well as to improve their quality of life by allowing them to age-in-place. In response to court-ordered mandates of serving people with disabilities in home or community-based settings, HCBS has greatly expanded since 1999, as shown in Appendix Figure A1.[2] Our study period spans from 1998 to 2014 which begins from the expansion of HCBS and ends with the recent policy year. In section 4.1, we also use the pre-expansion HCBS periods (1992-1998) to test our identification assumptions.

Medicaid HCBS funds three main programs for older adults that comprise the majority of its enrollment and spending: a mandatory home health state plan, an optional personal care state plan, and optional waivers.[3] The Medicaid HCBS state plans are available to every Medicaid-eligible person with limited resources. In general, the eligibility limit for older applicants is around $2,313 per month in income and $2,000 in assets.[4]

The Medicaid optional waivers allow states to waive the general requirements of the regular Medicaid programs, such as Medicaid state plan programs. States can use waivers to target and serve different sub-groups, such as people aged 65 and older, the blind or the disabled, children with intellectual or developmental disabilities, children with mental illnesses, people with HIV/AIDS, and people with brain injuries. In this study, we focus on aging waivers that target adults aged 65 and older. The waivers are optional, and states need to apply for approval if they intend to implement one. More details of aging waivers can be found in Liu & Zai (2022). In 2017, total expenditure on aging waivers was approximately $40 billion, accounting for 65 percent of Medicaid's total waiver expenditure.

The HCBS waivers have several unique features. First, each state has flexibility in

[2]Per Americans with Disabilities Act (ADA)'s community integration mandate, Supreme Court's Olmstead decision promotes HCBS to cover for people with disabilities.

[3]Medicaid HCBS also includes other state plan programs, such as Community First Choice, which provides supplementary services for people who prefer to stay at home; and Section 1915(i), which supports intellectually or developmentally disabled people. In 2018, about $62.5 billion was spent on waivers, accounting for 58 percent of total Medicaid expenditure; another $20.6 billion was spent on state plans, representing 23 percent of total Medicaid expenditure; while the Community First Choice program was much smaller, accounting for around 9 percent of total Medicaid expenditure.

[4]For details about the eligibility rules in each state, see: https://www.medicaidplanningassistance.org/medicaid-eligibility/.

determining the scope of the subsidized services, and can limit the coverage of each service offered to participants through waivers. Second, the waiver needs to be cost-neutral. This means that the expenditure on home-based care per participant covered through the waiver cannot exceed the costs per participant of nursing facility care. Each state must justify that its proposed waiver application meets the cost-neutral requirement, and the federal Centers for Medicare and Medicaid Services (CMS) determine whether the requirement is met. Third, the final realized expenditure on waivers in each state depend largely on the development of the service delivery system and the supply of qualified care providers. Liu & Zai (2022) offer a detailed discussion of the qualifications of providers.

In 2018, approximately 3 million people were enrolled in Medicaid HCBS, and 2.5 million beneficiaries received waivers (85 percent). Home health state plans mainly cover services provided by nurses and professionals; while personal care state plans cover services such as personal care and assistance with household activities provided at home, in the workplace, in foster care, or in an assisted living facility. Some of the services covered by HCBS overlap between programs as shown in Appendix Table A1. Figure 1 shows the variation in HCBS expenditure over time and across states. Figure 1 splits the 50 states into four sub-graphs to make the variation more noticeable.[5] The expenditure levels vary considerably across states. Moreover, within each state, the variation in spending over time is also large.[6] In section 4, we show that the variation of HCBS are uncorrelated with state-level current or lagged economic and demographic characteristics and comes mainly from long-standing institutional features of states.

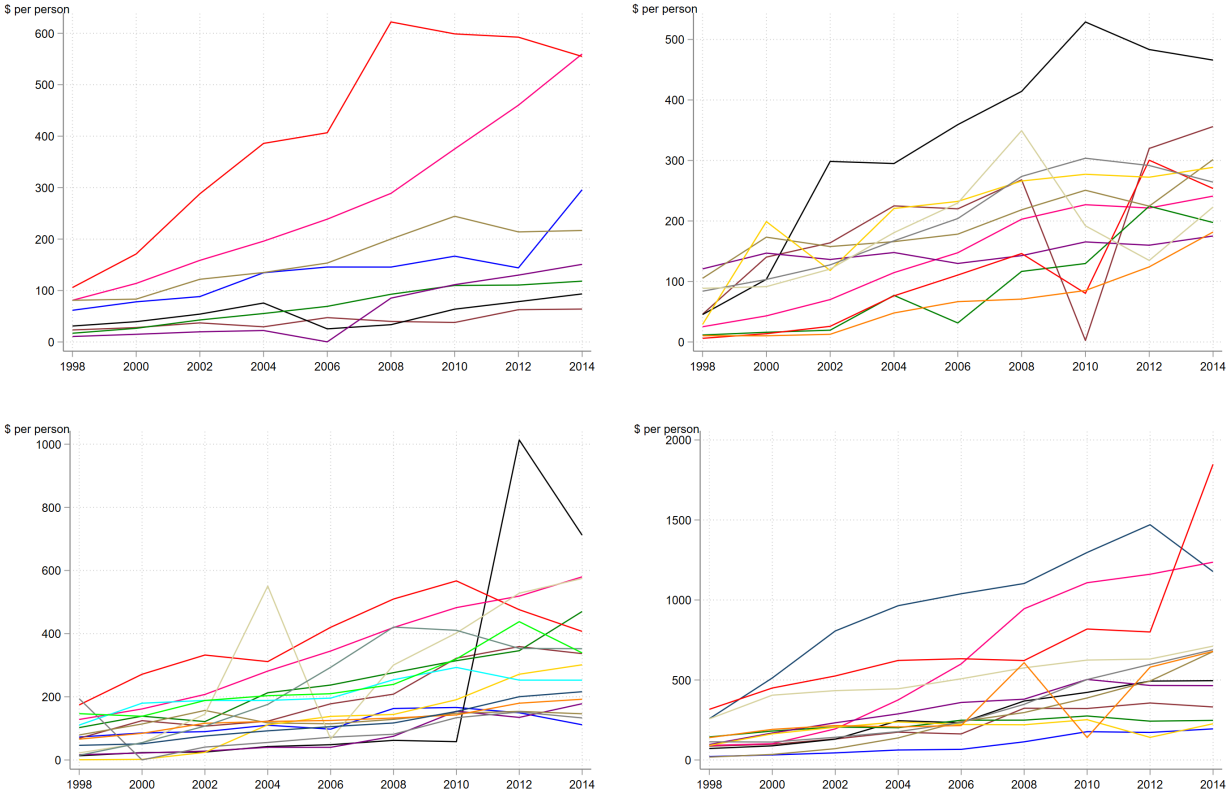
3 DATA

Our first data source is the Medicaid HCBS policy information for older adults of each state from 1996 to 2014. This publicly available information includes data on expenditure on

[5]District of Columbia is not shown here.

[6]More details on the variation in each state can be found in Appendix of Liu & Zai (2022).

Figure 1: State Level Variation in HCBS Expenditures 1998 to 2014



Notes: The four graphs display the HCBS expenditure per person from 1998 to 2014 across states. The lines of the sub-graph on the top-left correspond to Delaware, Nevada, North Dakota, South Dakota, Utah, and Wyoming; the lines of the sub-graph on the top-right correspond to Alaska, Hawaii, Idaho, Indiana, Iowa, Louisiana, Maine, Montana, Nebraska, New Hampshire, New Mexico, Rhode Island, and Vermont; the lines of the sub-graph on the bottom-left correspond to Alabama, Arizona, Arkansas, Connecticut, Kansas, Kentucky, Maryland, Massachusetts, Michigan, Mississippi, Missouri, New Jersey, New York, Oklahoma, South Carolina, Tennessee, and West Virginia; the lines of the sub-graph on the bottom-right correspond to California, Colorado, Florida, Georgia, Illinois, Minnesota, North Carolina, Ohio, Oregon, Pennsylvania, Texas, Virginia, Washington, and Wisconsin.

home health state plans, on personal care state plans, and on aging waivers for older people, respectively.[7] The level of HCBS expenditure per capita, which is our main independent variable, is calculated using the population of individuals aged 65 and older.

Our second data source is the Health and Retirement Study (HRS), a longitudinal dataset that begins in 1992. Respondents are surveyed every other year. The HRS is representative of Americans aged 51 and older. The survey includes different cohorts who enter the study as they become eligible. The core cohort, the HRS cohort, has been followed

[7] https://www.medicaid.gov/

and interviewed since 1992. Since 1993, the HRS has included the Study of Assets and Health Dynamics Among the Oldest Old (AHEAD) cohort of individuals born before 1924; the Children of the Depression Age (CODA) cohort of people born between 1924 and 1930; and the War Babies cohort (WB) of individuals born between 1942 and 1947. An additional Early Baby Boomers (EBB) cohort of people born between 1948 and 1953 was added to the sample in 2004, and the Mid-Baby Boomers cohort of individuals born between 1954 and 1959 was added in 2010. A detailed questionnaire that asks respondents about their demographic characteristics, health outcomes, employment status, financial situation, and intergenerational transfers is administered in person or via telephone.

We use restricted access data that include the state of residence for each respondent, and merge these data with the policy information of our first data source at the state level. We restrict the main sample to respondents who are over age 65, the eligibility age for HCBS aging waivers.[8] The resulting dataset includes approximately 21,400 unique individuals, and 98,000 observations from 1998 to 2014.

We also supplement with other data sources to address possible threats to our identification assumption that the changes in HCBS within states are orthogonal to other state-level confounders that may affect the health outcomes. First, we use information about state-level unemployment rates and employment rates from the Bureau of Labor Statistics (BLS) from 1999 to 2014. In addition, we extract information about GDP, personal income (PI), personal consumption expenditure (PCE) and detailed PCE from the Bureau of Economic Analysis (BEA) Regional Economic Accounts from 1998 and 2014. Second, we employ information from American Community Survey (ACS) about demographic characteristics at the state level from 2004 to 2014.[9] The population data from 1998 to 2014 is from Census Bureau. These state-level economic and demographic characteristics are used to test the exogeneity of HCBS in section 4.

[8]Details of HCBS aging waiver introduction can be referred to Liu & Zai (2022).
[9]See Liu & Zai (2022) for detailed description of variables.

3.1 Key Variables

First, we use information about health status to estimate how HCBS affect the well-being of older people. The HRS asks respondents to self-report their general health status, ranging from 1 for excellent, 2 for very good, 3 for good, 4 for fair, and to 5 for poor. We create a health indicator, which is one if self-reported health is fair or poor, and is zero otherwise. The self-reported fair or poor health indicator is also employed using the same HRS data in Dave et al. (2006), in Eibich (2015) using the German Socio-Economic Panel Study (SOEP), and in Kuka (2020) using the Survey of Income and Program Participation (SIPP). We also utilize alternative health scale to show robustness in section 5.1. While the self-reported health is subjective and prone to recall errors, it is a good predictor of mortality (Idler & Benyamini 1997; DeSalvo et al. 2006; Kuka 2020).

Second, we use more objective measures about physical health conditions. The HRS includes detailed information about functional limitations. Specifically, the mobility difficulty index refers to respondents having any problem in walking 1 block, walking several blocks, walking across a room, climbing 1 flight of stairs, and climbing several flights of stairs. In addition, the HRS provides indexes about physical limitations that measure difficulties of Activities of Daily Living (ADLs) and difficulties with instrumental activities of daily living (IADLs). The ADLs include items such as bathing, eating, dressing, getting in or out of bed, and walking across a room and the IADLs assess difficulties in using the phone, managing money, taking medications, shopping for groceries, and preparing hot meals. These mobility/ADL/IADL indexes all range from 0 to 5. We create some dichotomous indicators which equal one if an individual has a certain amount of limitations and zero, otherwise. For example, an index with a value of 5 means that an individual has difficulties with all of the functional limitations, while a value of zero means that the individual has no limitations at physical health. Section 5.2 mainly reports the estimates using the indicator with at least 2 items of limitations. Some results of other

indicators are shown in the Appendix.[10] More details on the construction of these measures can be found in Chien et al. (2015).

Third, we further use information about mental and cognitive health. The HRS asks respondents about their mental health using the Center for Epidemiologic Studies Depression (CESD) score. The CESD score captures the number of adverse sentiments a respondent experienced all or most of the time in the past two years, including whether an individual was depressed, felt alone, felt sad, had restless sleep, felt everything was an effort, could not get going, felt unhappy, and did not enjoy life. The CESD scale has been validated in the research as an instrument to identify major depression in older adults (Irwin et al. 1999). Besides, the cognition summary score calculates an individual's total scores on word recall and mental status tests, with outcomes ranging from 0 to 35. The word recall test, which is widely used to measure cognitive skills, asks respondents to listen to a list of words, and then to recall them immediately and with a delay (Bonsang et al. 2012; Mazzonna & Peracchi 2012). The mental status test score includes an individual's scores on serial 7s, counting backwards from 20, naming objects, recalling dates, and naming the president and the vice-president. These cognitive tests are important measures of the mental health of older adults, as the aging process is strongly associated with a decline in the ability to perform cognitive tasks (Souchay et al. 2000; Anderson & Craik 2000; Prull et al. 2000; Dixon 2004; Hertzog et al. 2008).

Fourth, we use information about health event diagnosis. HRS asks respondents if they have ever had a diagnosis of cancer, lung disease, heart disease, or stroke. These dichotomous indicators are used to measure the morbidity events of individuals.

3.2 Sample Statistics

Table 1 presents the summary statistics of the sample of HRS respondents who are aged 65 and older in each survey year. About 58 percent of the sample are female. The average

[10] Full results are available upon request.

educational attainment of the respondents is around 12 years. On average, each individual has about two siblings. The majority of the respondents are white, and 13 percent are black. The average age of the respondents is about 75 years. While 58 percent of the respondents are married or are living with a partner, approximately 30 percent have lost their spouse or partner.

The average self-reported health status of the respondents is good. On average, individuals report 1 to 2 items of limitations in mobility. The average ADL limitation index score is close to one, which indicates that an individual has one limitation of the activities of daily living. The average IADL limitation index score is similar to the average of ADL limitation score. The average CESD depression score is 1.5 out of 8. The average cognition score is close to 21. In addition, around 19 percent of the respondents report ever having a cancer diagnosis, 15 percent report ever having a lung disease diagnosis, and 39 percent report ever having a heart-related disease diagnosis. In terms of other health variables used to explore mechanisms in section 5.4, about 43 percent of the respondents report ever drinking alcohol, and of those who drinks, the average consumption is about 1 drink per week. Approximately 33 percent of older people have used inpatient service and 37 percent regularly take medications. Among people who receive help, the frequency of daily help is about 5 days per month and the average hours is about 27 hours per month. The detailed definitions of these variables can be found in Appendix Table A2.

4 ESTIMATION MODEL

We estimate the health effects of HCBS on older individuals with the following specification:

$$Y_{ist} = \delta HCBS_{s\bar{t}} + \alpha_i + \mu_t + \eta_s + \boldsymbol{X}'_{\boldsymbol{ist}}\boldsymbol{\beta} + \epsilon_{ist} \tag{1}$$

where Y_{ist} is health outcome of individual i in state s surveyed in year t. $HCBS_{s\bar{t}}$ is the average expenditure of Medicaid HCBS per older person in state s in year t and $t-1$. For

Table 1: Summary Statistics of the Sample

Variable	Mean	S.D.	Unique individuals	Obs.
Time-invariant demographics				
Female	0.58	0.49	21,421	98,116
Education	11.97	3.40	21,406	98,087
Siblings	2.31	2.23	21,199	97,776
Race/ethnicity				
White	0.83	0.37	21,409	98,091
Black/African	0.13	0.34	21,409	98,091
Other	0.03	0.18	21,409	98,091
Time-varying demographics				
Age	75.33	7.51	21,421	98,116
Marital status				
Married/partnered	0.58	0.49	21,420	98,060
Separated/divorced	0.09	0.28	21,420	98,060
Widowed	0.31	0.46	21,420	98,060
Never married	0.03	0.16	21,420	98,060
Heath variables				
Self-reported health	3.00	1.11	21,417	98,027
Mobility limitation	1.39	1.62	21,534	99,412
ADL limitation	0.51	1.16	21,409	98,040
IADL limitation	0.50	1.19	21,406	98,023
CESD scores	1.47	1.90	19,975	88,184
Cognition scores	21.28	5.39	19,951	87,999
Cancer diagnosis	0.19	0.45	21,418	98,035
Lung disease diagnosis	0.15	0.49	21,413	98,028
Heart disease diagnosis	0.39	0.73	21,416	98,004
Stroke	0.13	0.41	21,414	98,029
Other dependent variables				
Drink ever	0.43	0.50	21,421	98,098
Drink days	1.00	2.05	21,410	97,915
Drink number	0.50	1.10	21,403	97,889
Inpatient use	0.33	0.47	21,401	97,738
Medication take	0.87	0.33	21,406	97,972
Number of helpers	0.34	0.86	20,030	87,336
Days of help	5.24	14.57	20,023	87,209
Hours of help	27.37	118.45	19,972	86,204

Notes: The data used are from HRS 1998 to 2014 of individuals who are aged 65 and older. The definitions of these variables can be found in Appendix Table A2.

example, the health outcome in survey year 2000 is regressed on HCBS expenditure averaged between 2000 and 1999. This policy construction takes that HRS survey is conducted every two years into consideration. The individual fixed effect, α_i, controls for the unobservable factors that are constant within individuals across time, such as protective health behavior like exercise, and preferences for health care providers. The year fixed effect, μ_t, controls for common shocks across states that could affect health outcomes. The state fixed effect, η_s, controls for unobserved time-invariant state characteristics, such as the political environment for promoting health and the basic infrastructure that facilitates entertainment activities among older people. X_{ist} is a set of time-varying characteristics of individuals, such as demographics, income, and health behavior. In section 5, we report results of the baseline model which includes the year, state, and individual fixed effects without any controls and results of alternative models controlling for different sets of covariates. The standard errors are clustered at the individual level to improve the precision of estimates and allow for heteroskedasticity across individuals. In section 5.5, we also show robustness checks using clusters at the state level.

The coefficient of interest, δ, measures the health change of individuals exposed to HCBS generosity across years, conditional on controls. To interpret this coefficient as causal, the assumption that states with different HCBS expenditure are on parallel trends needs to be satisfied so the year-to-year health change in states with low HCBS expenditure represents the counterfactual change in states with high HCBS expenditure. With the continuous treatment variable, we cannot directly test this assumption. Instead, we use the most demanding specification that includes individual fixed effects. The identifying variation of this specification employs variation within-individuals who experience HCBS expenditure change across years. This treatment change might come from their state's HCBS expenditure change or they move to states with different generosity of HCBS across years. Since we are restricting to our sample of individuals with age 65 and above, the moving sample is very small and the state's HCBS policy change is

our main variation. We also test the sensitivity of our results using samples without moving individuals in section 5.5.

One way to relax the identification assumption is to include state time trends into our model which allows differential paths across states. However, it can also decrease the precision of estimates discussed in detail in Cantoni & Pons (2021). First, the linear time trend can attenuate the effect of interest when treatment effects vary across time (Neumark et al. 2014; Meer & West 2016; Goodman-Bacon 2021). Second, the linear time trend attributes more weight to recent observations in our longitudinal data and bias the accuracy of estimates (Goodman-Bacon 2021). Third, the linear time trends reduce the treatment variation used to identify the causal estimator, leading less precise results (Cantoni & Pons 2021). All these sources of bias make inclusion of state time trends less appealing. As the robustness check, we also run these models but the results need to be interpreted with caution.

4.1 Threats to Identification

Our main identification assumption relies on that the variation of HCBS generosity within states across years is not correlated with other observable or unobservable confounders that might also affect health outcomes of interest. First, one might be concerned that states decide the expansion of HCBS generosity during the 1990s based on the health level and socio-demographic characteristics of residents in each state. For example, states could be more likely to expand HCBS if health of older adults at home is worse or other related well-being factors are taken into consideration. One might also be worried that individuals changed health behavior in anticipation of the HCBS expansion. To test these possible concerns, we estimate the effect of pre-expansion of HCBS spending in 1998 on a range of health outcomes, socio-demographic, and health care use variables for individuals in 1992 to 1998 as follows (Bailey & Goodman-Bacon 2015; Goodman-Bacon 2018):

$$y_{ist} = \alpha + \beta_0 HCBS_s^{1998} + \beta_1 HCBS_s^{1998} \times (y - y^{1998}) + \xi_{st} \tag{2}$$

where y is a series of dependent variables to be tested against the HCBS spending in 1998 when the program expansion begins. We test for balance in levels ($H_0 : \beta_0 = 0$) in 1998 and in linear pre-1998 trends ($H_0 : \beta_1 = 0$) both.

Panel A of Table 2 tests whether the HCBS spending in 1998 is correlated with levels or trend in pre-expansion health outcomes. The results provide little evidence that HCBS generosity is determined by the general health status of residents in each state. Panel B shows the tests on socio-demographic characteristics of HCBS in 1998. There is no significant estimates that suggest HCBS increases more in states with more older population or states with better economic conditions. Panel C further explores the relationship between pre-expansion HCBS and health care use. Overall, there is no persuasive evidence that residents change health care pattern in anticipation of HCBS expansion. The detailed test results shown in Tables 2 and 3 reassure that there is no systematic correlation between HCBS expansion and socio-demographic factors or health outcomes in each state. The findings further confirms that the changes in HCBS spending are more institutional feature driven than economic or social environment driven.

One may also be worried that HCBS generosity is correlated with the state-level economy, which impacts individual health outcomes. To address this issue, we construct a state-year panel from 1999 to 2014 using different sources of economic variables such as unemployment rate, employment rate, GDP per capita, personal income per capita, and personal consumption expenditure per capita. These state economic measures are regressed on HCBS generosity controlling for state and year fixed effects. We allow flexible functional form of these variables and the results are reported in Table 4. For the first two columns, we use flexible functions of unemployment rate and employment rate. We then further add different income and consumption variables.

Overall, the results show that state-specific economic variables are not correlated with

Table 2: Balance Test: Relationship Between HCBS in 1998 and Pre-Expansion Characteristics in Levels and Trends

		Univariate		Multivariate	
Dependent Variable	Mean in 1998	Level ($HCBS_s^{1998}$)	Trend ($HCBS_s^{1998} \times Year$)	Level ($HCBS_s^{1998}$)	Trend ($HCBS_s^{1998} \times Year$)
	(1)	(2)	(3)	(4)	(5)
		Panel A: Health outcomes (1992-1998)			
Self-reported health status (0-5)	2.839	0.017	0.008	1.015	-0.008
		(0.075)	(0.005)	(1.491)	(0.011)
Fair or poor health status (0-1)	0.289	0.000	0.000	0.357	-0.005
		(0.028)	(0.002)	(0.591)	(0.004)
Mobility limitation (0-5)	0.924	-0.009	0.001	1.830	-0.021
		(0.060)	(0.012)	(1.837)	(0.017)
Mobility limiation (0-1)	0.086	-0.004	0.002	-0.714	-0.005
		(0.010)	(0.002)	(0.479)	(0.004)
ADL limitation (0-5)	0.297	0.045**	0.006	1.274	-0.003
		(0.022)	(0.006)	(0.984)	(0.012)
ADL limiation (0-1)	0.023	0.004	0.002*	0.618*	-0.002
		(0.003)	(0.001)	(0.318)	(0.002)
IADL limitation (0-5)	0.246	0.019	-0.021**	0.184	-0.027
		(0.029)	(0.010)	(1.221)	(0.016)
IADL limiation (0-1)	0.018	0.009*	-0.001	0.496	-0.001
		(0.005)	(0.001)	(0.359)	(0.003)
Mental CESD (0-8)	1.549	0.073	0.006	2.246	0.030
		(0.124)	(0.016)	(2.920)	(0.025)
Mental depression (0-1)	0.098	0.002	0.000	0.667	0.004
		(0.016)	(0.002)	(0.421)	(0.004)
Cognition (0-35)	22.810	-0.507*	-0.053	-15.031***	-0.050
		(0.265)	(0.096)	(2.827)	(0.098)

Notes: The data used are from HRS 1992 to 1998 of individuals who are aged 65 and older. The first column reports the mean of each dependent variable tested in 1998. Column 2 and 3 estimate the univariate relationship between HCBS spending in 1998 and health outcomes. Column 4 and 5 estimate the multivariate model controlling for state, year, and individual fixed effects as well as demographic controls of individuals. Column 2 and 4 report the weighted estimates of level coefficients and columns 3 and 5 report the weighted estimates of the trend coefficients from the model: $y_{ist} = \alpha + \beta_0 HCBS_s^{1998} + \beta_1 HCBS_s^{1998} \times (y - y^{1998}) + \xi_{st}$. Standard errors are clustered at the state level and shown in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Table 3: Balance Test: Continued

		Univariate		Multivariate	
Dependent Variable	Mean in 1998	Level ($HCBS_s^{1998}$)	Trend ($HCBS_s^{1998} \times Year$)	Level ($HCBS_s^{1998}$)	Trend ($HCBS_s^{1998} \times Year$)
	(1)	(2)	(3)	(4)	(5)
		Panel B: Demographic outcomes (1992-1998)			
Age	64.990	0.744	0.117	0.000	0.000
		(0.494)	(0.107)	(0.000)	(0.000)
Living siblings	2.526	0.009	-0.005	0.000	0.000
		(0.145)	(0.012)	(0.000)	(0.000)
Marital status	2.886	0.272***	0.024	0.000	0.000
		(0.093)	(0.014)	(0.000)	(0.000)
Earnings	13931	-372.811	-87.164	0.000	0.000
		(1513.390)	(203.423)	(0.000)	(0.000)
Pensions	3265	532.945	132.964***	0.000	0.000
		(325.381)	(46.181)	(0.000)	(0.000)
Annuities	2957	396.122	104.810***	0.000	0.000
		(325.342)	(34.768)	(0.000)	(0.000)
Smoke	0.175	-0.012	-0.001	0.000	0.000
		(0.015)	(0.003)	(0.000)	(0.000)
Drink	1.105	0.080	0.002	0.000	0.000
		(0.160)	(0.028)	(0.000)	(0.000)
		Panel C: Health care use (1992-1998)			
Home health care	0.071	0.005	0.001	0.024	-0.002
		(0.005)	(0.001)	(0.495)	(0.006)
Hospital stay	0.251	0.000	-0.001	-0.999	0.011
		(0.014)	(0.002)	(1.043)	(0.008)
Drugs	0.714	-0.018	-0.006**	0.046	-0.014**
		(0.012)	(0.002)	(0.455)	(0.005)
Outpatient surgery	0.931	-0.001	-0.004*	0.290	-0.007
		(0.007)	(0.002)	(0.335)	(0.005)
Doctor visit	0.195	-0.032***	-0.011***	1.477	-0.004
		(0.011)	(0.003)	(0.903)	(0.010)
Nurse home stay	0.013	-0.002	0.001	-0.070	-0.003
		(0.003)	0.000	(0.058)	(0.003)

Notes: The data used are from HRS 1992 to 1998 of individuals who are aged 65 and older. The first column reports the mean of each dependent variable tested in 1998. Column 2 and 3 estimate the univariate relationship between HCBS spending in 1998 and outcomes. Column 4 and 5 estimate the multivariate model controlling for state, year, and individual fixed effects as well as demographic controls of individuals. Column 2 and 4 report the weighted estimates of level coefficients and columns 3 and 5 report the weighted estimates of the trend coefficients from the model: $y_{ist} = \alpha + \beta_0 HCBS_s^{1998} + \beta_1 HCBS_s^{1998} \times (y - y^{1998}) + \xi_{st}$. Standard errors are clustered at the state level and shown in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Table 4: Effect of State Economic Conditions on HCBS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Unemployment rate	-0.195	0.222			0.008	-0.218	0.099	-0.661
	(0.131)	(0.859)			(1.000)	(1.193)	(1.111)	(1.443)
Unemployment rate^2		-0.121			-0.085	-0.068	-0.074	0.003
		(0.134)			(0.140)	(0.131)	(0.141)	(0.139)
Unemployment rate^3		0.007			0.006	0.006	0.006	0.003
		(0.007)			(0.007)	(0.006)	(0.007)	(0.006)
Employment rate			0.229	-1.080	-1.765	-4.819	7.674	6.036
			(0.141)	(7.471)	(8.929)	(11.136)	(12.207)	(10.992)
Employment rate^2				0.025	0.044	0.094	-0.109	-0.079
				(0.123)	(0.148)	(0.187)	(0.194)	(0.175)
Employment rate^3				0.000	0.000	-0.001	0.001	0.000
				(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
GDP per capita					0.000			0.000
					(0.000)			(0.000)
PI per capita						0.000		-0.001
						(0.000)		(0.001)
PCE per capita							0.001	0.001
							(0.001)	(0.001)
Observations	816	816	816	816	816	816	816	816
Adjusted R-squared	0.989	0.989	0.989	0.989	0.989	0.989	0.989	0.990

Notes: The data used are from 1999 to 2014 state-year panel. HCBS generosity is HCBS spending from each year, scaled to 100 millions. Each cell reports estimates from a separate specification. The unemployment and employment level is from BLS, the state population is from Census Bureau, the GDP, personal income (PI), personal consumption expenditure (PCE) is from the Bureau of Economic Analysis Regional Analysis Accounts. All regressions include state, year fixed effects, and state-specific linear time trends. All statistics are weighted using state population. Standard errors are clustered at the state level and shown in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

the HCBS spending. The employment rate is positively related to HCBS and the unemployment rate is negatively related to HCBS, as we suppose. These relationships, however, are not statistically significant and close to null effects across specifications. One might also worry that the HCBS size could be correlated with lagged economic conditions. For example, if states experienced high unemployment rates, the size of HCBS for older population could be decreased if state legislators are constrained by fiscal resources. Appendix Table A3 reports the results of lagged economic conditions on HCBS spending. As predicted in column 1, states with high unemployment rate in the last year have less HCBS spending and the estimate is statistically significant. When we further allow flexible unemployment rate format and add more state-level economic controls, the relationship between lagged economic factors and HCBS generosity becomes not significant. We also report the sensitively of our results after controlling for state-level factors in section 5.5.

Another possible concern could be that the health change of older individuals might be driven by other contemporaneous social programs. We use the detailed consumer spending expenditure from Bureau Economic Analysis on health-related products to address this concern. Specifically, we explore the relationship between HCBS generosity and health care spending, net health insurance spending, and life insurance spending which are mostly relevant to the health outcomes and interest the older population. Appendix Table A4 shows the estimates for respective spending in each column. All specifications control for state-economic factors, state fixed effects, year fixed effects, and state-specific linear time trends. As expected, the HCBS spending is significantly correlated with consumption on health care paid by governments and consumers. The relationship of HCBS with health insurance or life insurance spending is not obvious and significant, which is assuring to our results. Nevertheless, we check the robustness of our results controlling for the health care spending in section 5.5.

One may also challenge that our results might be driven by spending on alternative setting, nursing homes, for the older population. This worry seems less implausible as we

show in Liu & Zai (2022) that the spending on nursing homes is stable across years and does not drop significantly due to increases in HCBS spending. In addition, we do not find the number of nursing homes is negatively correlated with expansion of the HCBS program. Also, the capacity of nursing homes such as nursing beds or occupancy rates does not correlate with HCBS generosity.

5 RESULTS

5.1 Effect on Self-Reported Health

Table 5 shows the self-reported health effect of HCBS from equation 1 with different specifications. Model 1 is the demanding specification without any controls. To test the credibility of our estimates with continuous treatment, we check the robustness of our results to the inclusion of covariates with three additional specifications. Model 2 adds the individual demographics such as age, marital status, and number of living siblings. Model 3 further adds in income controls such as the amount of earnings, pensions, and annuity. Model 4 also includes some health behavioral variables, such as drinking and smoking. The scale of the independent variable, HCBS expenditure per older person, is in increments of $1,000. The baseline estimate without any controls in the first column shows that an increase in HCBS expenditure has a negative effect on the probability of an individual reporting fair or poor health. The models with more controls in columns 2 to 4 report similar patterns. Specifically, a $1,000 increase in HCBS expenditure per older person is associated with a decrease of approximately 2 percentage points in the probability of reporting worse health across specifications. On an outcome mean of 0.33, the estimated effect size corresponds to a reduction of the probability reporting bad health at 6 percent. Overall, the self-reported health effect of HCBS is stable and consistent across models.

Appendix Table A5 shows the self-reported health effect of HCBS using alternative models and with different scale of outcomes. Specifically, Panel A estimates an alternative

Table 5: Self-Reported Fair or Poor Health Effect of HCBS

	(1)	(2)	(3)	(4)
HCBS expenditure per older person ($1,000)	-0.016*	-0.018*	-0.018*	-0.020**
	(0.010)	(0.010)	(0.010)	(0.010)
Outcome mean	0.330	0.329	0.329	0.329
Number of individuals	21,417	21,195	21,195	21,126
Observations	98,027	97,632	97,632	96,841
Year + State + Individual FEs	Y	Y	Y	Y
Demographic controls		Y	Y	Y
Income			Y	Y
Health behavior				Y

Notes: The data used are from HRS 1998 to 2014 of individuals who are aged 65 and older. Each cell reports estimates from a separate specification. Self-reported health is based on the general health status of the HRS respondent: one for excellent, two for very good, three for good, four for fair, and five for poor. Self-reported fair or poor health is an indicator showing that an individual self-assesses his or her general health status as fair or poor. The mean of HCBS expenditure per older person ($1,000) is around $500. Demographic controls include age, age squared, marital status, and number of siblings of individuals. Income includes the amount of pension, the amount of earnings, and the amount of annuity of individuals. Health behavior includes whether an individual drinks and smokes or not. The detailed definition of these variables can be referred to Appendix Table A2. *** p<0.01, ** p<0.05, * p<0.10.

model controlling for state fixed effects, year fixed effects, and state linear trend with different controls. Panel B regresses the outcome with the original definition of self-reported health status. The results in Panel A are similar and robust across specifications. The magnitude of the self-reported fair or poor health effect is about 1 percentage points and statistically insignificant. As the caveats discussed in section 4, one needs to be careful about interpreting the estimates. Panel B uses the original scale as the dependent variable and shows that the self-reported health effect of HCBS is negative without statistical significance. The magnitude of coefficients is similar, however.

5.2 Effect on Physical Health

Now we show the effect of HCBS on functional health with three dimensions: mobility, ADL, and IADL limitations. We create a bunch of indicators with different limitation cutoffs. Here we report the estimates using an indicator with at least two items of limitations in respective outcomes.[11] Similar as Table 5, we report each set of physical health estimates in each panel using different specifications in Table 6. The HCBS program is negatively associated with the probability of individuals reporting mobility limitations as in Panel A. The improvement in mobility health is about 2 percentage points with a $1,000 increase in HCBS expenditure. This corresponds to an approximate 5 percent increase with a baseline mean at 0.37. Panel B reports the estimates on ADL and Panel C shows the results on IADL limitations, respectively. The baseline model in specification 1 shows that the HCBS is positively related to worse functional health in ADL or IADL. After controlling for individual demographics, the effect is reduced largely and becomes indistinguishable from null effect. This change in magnitude of coefficients also validates the bias from omission of covariates discussed in Angrist & Pischke (2014). Across columns 2 to 4, we obtain a robust effect of HCBS on ADL/IADL limitation close to null and not statistically significant.

Appendix Table A6 shows the robustness of the physical health effects using the most

[11] The full results of each indicator are available upon request.

Table 6: Physical Health Effect of HCBS

	(1)	(2)	(3)	(4)
	Panel A: mobility limitation			
HCBS expenditure per older person ($1,000)	-0.011	-0.018*	-0.018*	-0.020*
	(0.010)	(0.010)	(0.010)	(0.010)
Outcome mean	0.369	0.369	0.369	0.369
Number of individuals	21,408	21,194	21,194	21,125
Observations	97,995	97,611	97,611	96,817
	Panel B: ADL limitation			
HCBS expenditure per older person ($1,000)	0.009	-0.000	-0.000	-0.002
	(0.008)	(0.008)	(0.008)	(0.008)
Number of individuals	21,409	21,194	21,194	21,125
Observations	98,040	97,655	97,655	96,860
	Panel C: IADL limitation			
HCBS expenditure per older person ($1,000)	0.011	0.001	0.001	-0.001
	(0.008)	(0.008)	(0.008)	(0.008)
Number of individuals	21,406	21,191	21,191	21,122
Observations	98,023	97,640	97,640	96,845
Year + State + Individual FEs	Y	Y	Y	Y
Demographics		Y	Y	Y
Income of individuals			Y	Y
Health behavior				Y

Notes: The data used are from HRS 1998 to 2014 of individuals who are aged 65 and older. Each cell reports estimates from a separate specification. HRS asks respondents about mobility limitation in walking one block, walking several blocks, walking across a room, climbing one flight of stairs, and climbing several flights of stairs activities. The ADL index of difficulties in Activities of Daily Living (ADL) ranges from 0 to 5, indicating whether respondents are having difficulties in bathing, eating, dressing, getting in/out of bed, and walking across a room. The IADL index of difficulties in Instrumental Activities of Daily Living (IADL) ranges from 0 to 5, indicating respondents having any problem in using the phone, managing money, taking medications, shopping for groceries, and preparing hot meals. The outcomes are a dummy indicating whether an individual has at least two limitations. The mean of HCBS expenditure per older person ($1,000) is around $500. Demographic controls include age, age squared, marital status, and number of siblings of individuals. Income includes the amount of pension, the amount of earnings, and the amount of annuity of individuals. Health behavior includes whether an individual drinks and smokes or not. The detailed definition of these variables can be referred to Appendix Table A2. *** p<0.01, ** p<0.05, * p<0.10.

demanding specification with all controls. Each column uses an alternative measurement of outcomes: original scale in column 1, indicators with at least one limitation in column 2, indicators with at least three limitations in column 3, and indicators with five limitations in column 4.[12] Across models in Panel A, the policy is negatively associated with likelihood to report worse mobility health. The effect is statistically significant on probability of reporting at least three limitations. The effect on ADL/IADL across all measurements is statistically insignificant and close to null.

5.3 Effect on Mental and Cognitive Health

Table 7 reports the effect of HCBS on mental health using the CESD scale in Panel A and on cognitive health in Panel B, respectively, with a similar format as Table 5. The HCBS expenditure are negatively correlated with individuals reporting depressive feelings. Specifically, a $1,000 increase in HCBS per older person decreases the probability of individuals reporting negative emotional feelings by 1 percentage point (10 percent of outcome mean 0.10). The coefficients across columns are robust and statistically significant. Overall, HCBS improves positive psychological outcomes. To check the sensitivity of these outcomes, we use different measurements to show how the estimates change as reported in Appendix Table A7. The policy appears to improve individuals' mental status with the spectrum of CESD scores. The improvement is significant for individuals who experience more severe emotional stress.

Panel B of Table 7 reports the estimates of the effect of HCBS on cognitive scores. An increase in HCBS expenditure is significantly associated with an improvement in cognitive skills. The estimates are consistent and robust across specifications. The HCBS increases the cognitive scores of old people by 0.2 points, which is approximately 1 percent increase with an average score of 21.

We also analyze a variety of morbidity outcomes such as cancer (Panel A), lung disease

[12]To save space, we do not include all indicators with combinations of limitations. The results are available upon request.

Table 7: Depression and Cognitive Effect of HCBS

	(1)	(2)	(3)	(4)
	Panel A: Depression			
HCBS expenditure per older person ($1,000)	-0.011*	-0.011*	-0.011*	-0.012*
	(0.007)	(0.007)	(0.007)	(0.007)
Outcome mean	0.097	0.097	0.097	0.097
Number of individuals	19,975	19,823	19,823	19,746
Observations	88,184	87,894	87,894	87,265
	Panel B: Cognitive			
HCBS expenditure per older person ($1,000)	0.119	0.233**	0.233**	0.217**
	(0.100)	(0.100)	(0.100)	(0.100)
Outcome mean	21.336	21.343	21.343	21.349
Number of individuals	19,951	19,798	19,798	19,722
Observations	87,999	87,707	87,707	87,084
Year + State + Individual FEs	Y	Y	Y	Y
Demographics		Y	Y	Y
Income of individuals			Y	Y
Health behavior				Y

Notes: The data used are from HRS 1998 to 2014 of individuals who are aged 65 and older. Each cell reports estimates from a separate specification. Depression scores are based on the Center for Epidemiologic Studies Depression (CESD) scale: i.e., the sum of five negative indicators minus two positive indicators. The negative indicators measure whether respondents have the following sentiments all or most of the time: depression, everything is an effort, restless sleep, feeling alone, sad, and cannot get going. The positive indicators measure whether respondents feel happy and enjoy life. The scores range from 0 to 8. The outcome defined in Panel A is a dummy using the cutoff of 5, meaning having at least five negative emotional feelings. The total cognition score in Panel B sums the total word recall and mental status ranging from 0 to 35. The word recall index sums the immediate and delayed word recall scores. The mental status index includes the scores for serial 7's, backwards counting from 20, object, date, and President/Vice-President naming tasks. The mean of HCBS expenditure per older person is around $500. Demographic controls include age, age squared, marital status, and number of siblings of individuals. Income includes the amount of pension, the amount of earnings, and the amount of annuity of individuals. Health behavior includes whether an individual drinks and smokes or not. The detailed definition of these variables can be found in Appendix Table A2. *** p<0.01, ** p<0.05, * p<0.10.

(Panel B), heart disease (Panel C), and stroke (Panel D) in Appendix Table A8. All the estimates across models are not dissimilar and statistically insignificant. Overall, the HCBS does not have obvious effect on incidence of health conditions. Similarly as the discussion in Finkelstein et al. (2012) and Kuka (2020), two possible explanations for the results might be that the HCBS program has null effects on detection of health conditions and that the morbidity outcomes are implausibly to detect in the short-run. Another possible explanation for the older group in our context is that they might well develop these health conditions if any before they are impacted by HCBS policy.

5.4 Mechanisms

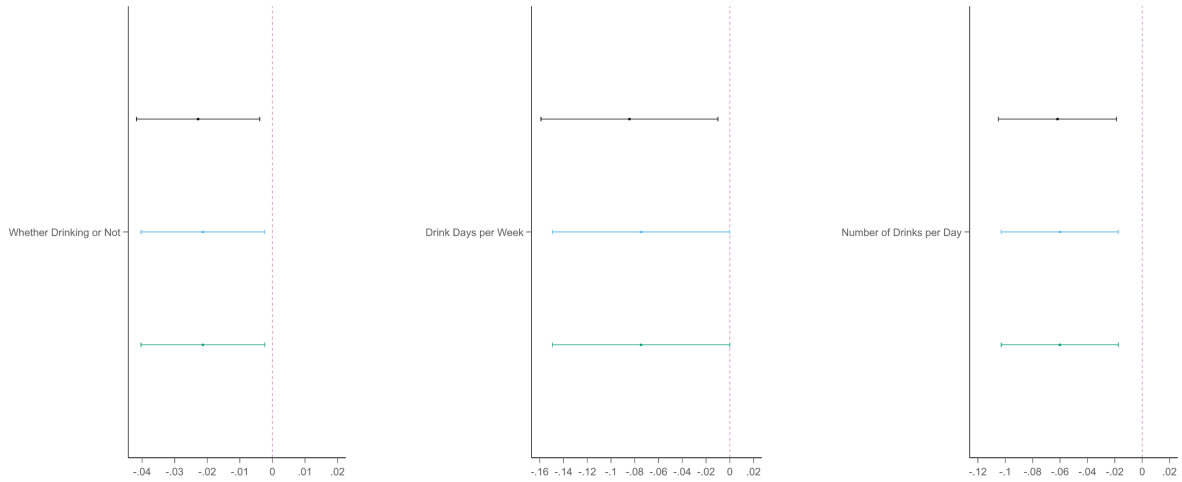
We explore three channels through which HCBS might improve health outcomes: risky behaviors, healthcare use, and family companionship. First, we show how HCBS affects risky behaviors of older people such as drinking and smoking. Figure 2 plots the estimates on different behavior outcomes in the baseline model (top-black), in the model with demographic controls (middle-blue), and in the model with income controls (bottom-green). Specifically, HCBS significantly reduces the probability of pick up drinking. An increase in HCBS generosity leads to approximately 2 percentage points decrease in drinking. Moreover, HCBS reduces drinking intensity. With more generous HCBS policy, individuals reduce drinking days per week by about 8 percentage points and the number of drinks per day by about 6 percentage points (See Appendix Table A9 for details).[13]

Second, we demonstrate that HCBS increases healthcare use among older people. Appendix Table A10 reports the correlation between HCBS spending and different healthcare use. The findings show that HCBS is significantly correlated with increased use of inpatient service and medication. More generous HCBS is associated with about 2 percentage points increase in inpatient service (6 percent with a mean of 0.33) and 1

[13]We also run results on other health behavior such as smoking and do not find any relationships. Results are available upon request.

percentage point increase in medication take (1 percent with a mean of 0.87). In addition, HCBS increases the times to visit a hospital and doctor. The coefficients are not statistically significant, though.

Figure 2: Risky Behavior Effects of HCBS



Notes: The data used are from HRS 1998 to 2014 of individuals who are aged 65 and older. Each line reports an estimate corresponding to a specification in each column of Table A9. Health behavior includes whether an individual drinks and smokes.

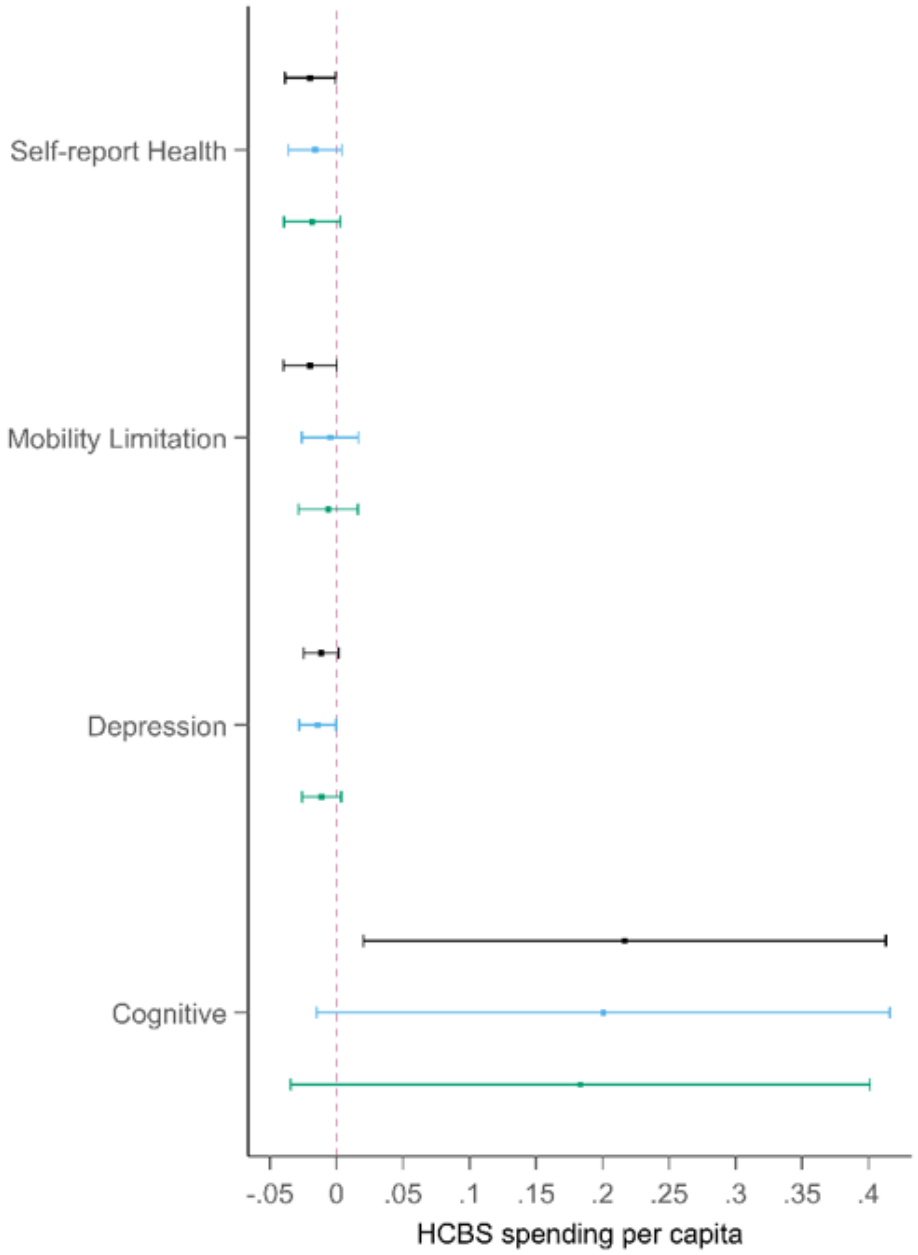
Third, we explore whether family members play a role in health improvement by HCBS. As shown in Liu & Zai (2022), HCBS not only increases the probability of older adults getting care from their children but also increases the chances of family members living together with older adults, which can potentially improve mental health and overall health with increasing time spent with family members. Appendix Table A11 further reports the correlation between HCBS and helpers (informal and formal) received by older adults. Informal care accounts for the majority of help (70 percent). An increase in HCBS spending is positively associated with the number of available helpers ever helped in the previous two years. Specifically, the HCBS increases the likelihood to receive paid help by about 10 percentage points with a mean of 0.26. In addition, the HCBS is associated with intensive care provided to older adults: increased days got help (0.6 days) and increased hours got help (3.9 hours) in the last month.

5.5 Robustness

In this section, we report a series of robustness checks of our estimates of HCBS on health outcomes. First, one possible concern about our results might come from the correlation between state-level characteristics and HCBS spending as discussed in section 4.1. Even though the results in Table 4 show no evidence on such relationship, one might still be interested in how our health results change when we further control for some state-level demographic such as percentage of people with high school education, percentage of female, birth rate, and fertility rate and economic factors such as unemployment rate and personal income per capita (or GDP). Second, as discussed in section 4.1, the health care spending is significantly correlated with HCBS generosity. One might worry that our results could be driven by these health care programs rather than HCBS. To alleviate this concern, we further check the sensitivity of our results by controlling for the health care spending by government and other health insurance spending. Figure 3 plots the main health estimates (top-black) from column 4 of tables in section 5, the estimates (middle-blue) adding state-level controls, and the estimates (bottom-green) adding extra spending controls on self-reported fair or poor health, mobility status with at least 2 limitations, mental health with depressive feelings, and cognitive health, respectively. Overall, our main estimates are robust across these specifications with different controls. The estimates on mobility limitation outcome become statistically insignificant in models with state-level covariates and spending controls while the main estimate (top-black) is still within the confidence intervals of these estimates. The point estimates of these robustness outcomes are reported in Appendix Table A12.

Second, as discussed in section 4, our main identifying variation comes from HCBS policy change across years within states. However, one may be concerned about the endogeneity of variation coming from individuals who move across years. Individuals could have incentives to move to more generous HCBS states if they happen to be more self-aware of their health or they value health more than others. However, in the HRS sample, moving individuals

Figure 3: Robustness Effects of HCBS With State and Spending Controls



Notes: The data used are from HRS 1998 to 2014 of individuals who are aged 65 and older. Each line reports an estimate corresponding to a specification in each column of Table A12: main estimates (top-black), estimates with state controls (middle-blue), estimates with spending controls (bottom-green). State-level controls include percentage of people with high school education, percentage of female, birth rate, and fertility rate and economic factors such as unemployment rate and personal income per capita (or GDP). Spending controls include the health care spending by government and other health insurance spending. All models control for state, year, individual fixed effects, and individual controls including demographics and income.

account for only less than 10 percent so we would not worry that the potential endogenous moving motivation might drive our results. Appendix Table A20 shows the main health effects do not change much when removing the small sample across specifications.

Third, one might be concerned about the sensitivity of our results with sample restrictions. In the main regressions, we use the sample of individuals at least 65, who are potentially eligible for the HCBS program. Some state HCBS aging waivers are more generous and allow individuals who are at least 60 to be qualified for the HCBS.[14] We then expand the sample to individuals aged 60 and above and show the health estimates in Appendix Table A13. All estimates are robust to the sample restriction and consistent with the main results shown in section 5. In addition, Appendix Table A14 further shows the results limiting the sample to individuals who are at least 70. The sample size shrinks about 30 percent, with approximately 16,000 unique individuals and 71,000 observations. The magnitude of the estimates is similar to that in the main results while some lose the statistical significance. The standard errors increase much with a smaller sample. One needs to be careful with the higher age cutoff and sample size trade-off.

Fourth, one might be concerned about the sensitivity of the results with different ways of clustering the standard errors in the model. The main results cluster the standard errors at the individual level with the assumption that the health outcomes are independent of the HCBS policy and unobserved characteristics at the individual level. One advantage of this clustering is to increase the precision of the confidence interval of our estimates and allow for more variation across individuals within one state. However, individuals living in the same state might interact with each other and their health behavior might be impacted by neighbors or relatives nearby who are covered by the HCBS. Appendix Table A15 reports the main estimates with standard errors clustered at the state level. The effects on self-reported health and mobility limitation maintain statistically significant while the effects on emotional health of depression and cognitive lose the significance. The social interactive attributes of

[14]For details, see Liu & Zai (2022) about the introduction of aging waivers.

depression and cognitive health might be one explanation that the significance disappears when clustering the standard errors at the state level.

Fifth, one might be interested to check the sensitivity of our results with different possibilities of weights in the specifications. One possible weight is to use individual weights imputed by HRS based on the survey design per se. Another possible weight is to use state-level population (or older population) weight since our policy of interest HCBS comes at the state level. Figure 4 plots the main estimates (top-black), the estimates with HRS individual weight (middle-blue), and the estimates with population weights (bottom-green), respectively. These estimates are largely robust across possible weights and the main estimates lie between these 95 percent confidence levels. The one noticeable change of estimates is on cognitive outcome: the population weighted cognitive outcome is much smaller than the main estimate and the estimate with individual-level weights. The detailed point estimates across models are reported in Appendix Table A16.

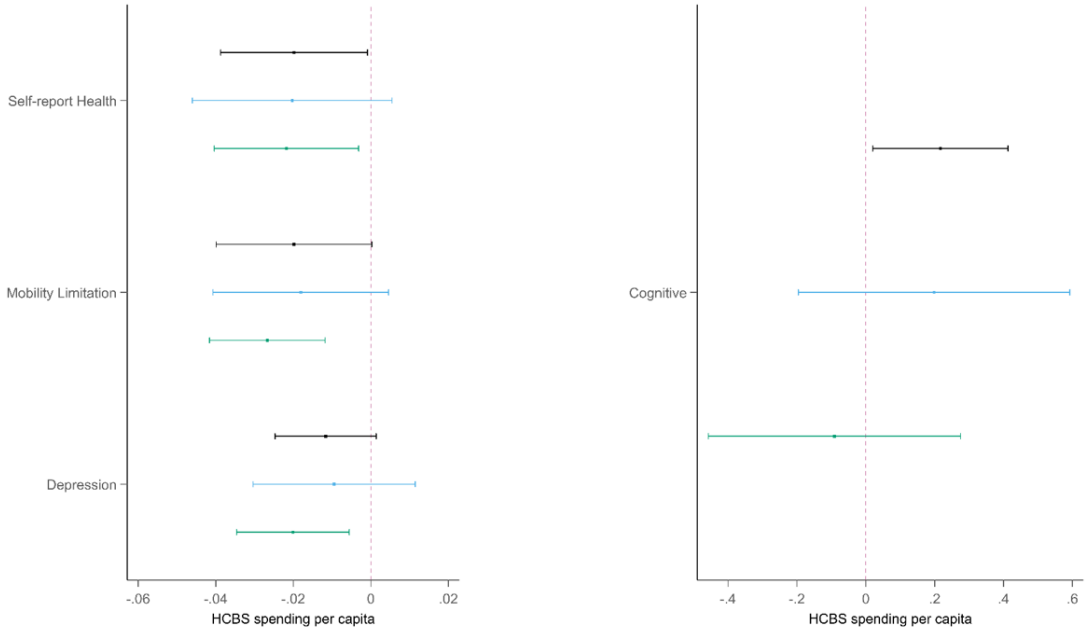
5.6 Heterogeneity Analysis

The overall results show that the HCBS program seems effective to improve self-reported health status, reduce negative emotions, mitigate functional mobility limitations, and increase cognitive abilities on older individuals who are potential beneficiaries of the program. However, the estimates on the whole sample might mask some null effects on groups who are less likely to be impacted by the HCBS or some stronger positive effects on minorities who are targeted by the HCBS. We further explore the heterogeneous effects of HCBS by demographics: income, race/ethnicity, and education. We also test the differences between groups of the treatment effects.

Table 8 shows the estimates of HCBS for the main dimension of heterogeneity: income. HRS asks respondents about their pension and annuity every survey year. We use the total of pension and annuity as the income measure.[15] As discussed in section 2 , one has to be

[15]Results are indifferent when we use other measurement such as pension only. Since most of our sample

Figure 4: Robustness Effects of HCBS With Weights



Notes: The data used are from HRS 1998 to 2014 of individuals who are aged 65 and older. Each line reports an estimate corresponding to a specification in each column of Table A16: main estimates (top-black), estimates with individual weights (middle-blue), estimates with population weights (bottom-green). All models control for state, year, individual fixed effects, and individual controls including demographics and income.

Table 8: Heterogeneous Health Effect of HCBS by Income

	(1)	(2)	(3)
	Panel A: self-reported health		
HCBS × high income	-0.006	-0.008	-0.009
	(0.011)	(0.011)	(0.011)
HCBS × low income	-0.023**	-0.025**	-0.027***
	(0.010)	(0.010)	(0.010)
$\lambda^{low} - \lambda^{high}$	-0.018**	-0.017**	-0.018**
	(0.008)	(0.008)	(0.008)
	Panel B: mobility limitation		
HCBS × high income	-0.002	-0.010	-0.012
	(0.011)	(0.011)	(0.011)
HCBS × low income	-0.017	-0.023**	-0.026**
	(0.011)	(0.011)	(0.011)
$\lambda^{low} - \lambda^{high}$	-0.015*	-0.013	-0.014*
	(0.008)	(0.008)	(0.008)
	Panel C: depression		
HCBS × high income	-0.014**	-0.014**	-0.014**
	(0.007)	(0.007)	(0.007)
HCBS × low income	-0.008	-0.009	-0.009
	(0.007)	(0.007)	(0.007)
$\lambda^{low} - \lambda^{high}$	0.006	0.005	0.005
	(0.006)	(0.006)	(0.006)
	Panel D: cognitive		
HCBS × high income	0.196*	0.335***	0.318***
	(0.110)	(0.109)	(0.109)
HCBS × low income	0.053	0.149	0.132
	(0.107)	(0.106)	(0.107)
$\lambda^{low} - \lambda^{high}$	-0.143*	-0.187**	-0.186**
	(0.081)	(0.080)	(0.081)
Demographics		Y	Y
Health behavior			Y

Notes: The data used are from HRS 1998 to 2014 of individuals who are aged 65 and older. Each cell reports estimates from a separate specification. Income includes pension and annuity of individuals. High income indicates individuals having more than average income every survey year. Demographic controls include age, age squared, marital status, and number of siblings of individuals. Income includes the amount of pension, the amount of earnings, and the amount of annuity of individuals. Health behavior includes whether an individual drinks and smokes or not. *** p<0.01, ** p<0.05, * p<0.10.

either resources limited or medically needy to be eligible for Medicaid HCBS thus individuals with low income are more likely to be treated. We use the same specifications as in Table 5 of high income, above the average, and low income, below the average. Panel A reports the results on self-reported health effect. The estimates across models for both groups are consistent and robust. The effect on improving self-assessed health status is close to null and statistically insignificant for high income individuals while this effect is much larger and statistically significant for low income individuals. The size of the effect on low income group is similar to that estimated in Table 5. The heterogeneous HCBS effects test confirms the significant differences between low and high income group on self-reported health effect. Panel B shows the mobility health effect by income. The pattern is similar as Panel A. The HCBS benefits more on mitigating mobility limitation for low income individuals.

In contrast, Panel C and D reports the depression and cognitive effect, respectively, of HCBS. High income individuals seem more responsive to the generous HCBS on relieving depression and the estimates are statistically significant. The depression effect on low income individuals is close to null and statistically insignificant. The test between groups is no different from zero. For cognitive improvement, the effect is stronger on high income group and estimates are consistent across specifications. The heterogeneity test rejects the identical effects on both groups at the 95% confidence intervals.

How to understand the different patterns of heterogeneous effects of HCBS by income? First, the positive health estimates in Panel A and B corroborate that HCBS is good for people who are most likely to receive the health care covered by the program. Specifically, individuals with limited resources are more likely to be treated by more generous HCBS funding. The health care provided at home for these individuals is more likely to improve their physical and self-assessed health status. The estimates are close to the treatment on the treated (TOT) effects. Second, the mental health estimates in Panel C and D suggest

have already retired and have no earnings, we do do not use the earning variable. The results are also robust when we use this variable, though. In addition, results are robust when we use income level cutoff, such as $2,000.

other important health improving evidence on the intent-to-treat (ITT) group. High income individuals might not be immediately qualified for HCBS. However, they can also be treated by the HCBS program. On the one hand, they are exposed to the uncertainty of health deterioration and risk of high medical expenditure which make them potentially be treated in the future. The HCBS functions as a safety-net program for these high income individuals and reduces the uncertainty and stress of becoming indigent once the health shock is realized. They might feel less pessimistic and spend more time learning policy details by searching more or watching more news on these public insurance programs. We do not have information on such behavior to test this evidence. On the other hand, high-income individuals might be influenced by peers or close contacts who are treated by HCBS. Their mental health could be improved directly from interacting with their less-depressed peers or from knowing that they could also be covered sometime in the future. Their cognitive skills could be incentivized by learning the policy details of HCBS from peers.

In order to give a more comprehensive picture of heterogeneous treatment effects by other dimensions, Appendix Table A17 and A18 further report the effect by race in detail. The HCBS program indeed benefits minority individuals of Black and Other on improving self-reported health, mitigating functional mobility limitation, and reducing depressive emotions. The pattern on cognitive health is similar to that by the main dimension, income, in Table 8. Appendix Table A19 shows the heterogeneous treatment effects of HCBS by another individual characteristic, education. Though education is highly correlated with economic status, the education might play other roles affecting health outcomes differentially of HCBS. More educated individuals are more likely to be cognitively improved with more generous HCBS funding. Here we use high school education years to construct high education and low education groups. The effect for high education on mobility limitation in Panel B of Table A17 might mask some significant effect on other education groups with relatively low income. Overall, the estimates with other individual characteristics present evidence that more generous HCBS helps

individuals with limited resources better both mentally and physically.

6 CONCLUSION

In this paper, we explore how Medicaid HCBS affects health outcomes among people aged 65 and older. We find evidence that HCBS is beneficial for health of older population. The HCBS program significantly increases the probability of individuals to self-report better health, mitigates the likelihood to experience mobility limitations, improves mental health and cognitive skills. In addition, we find that these findings are larger for older people with limited resources who are more likely to be covered by HCBS. We also present three potential mechanisms through which HCBS is beneficial to older adults: decreasing risk behavior on drinking, increasing healthcare use such as doctor visits and inpatient use, and spending more time with family members by living together and receiving more informal care.

The findings of this study have several policy implications. First, the results are informative for the development of long-term care policy. During the 2020 pandemic, CMS changed the implementation rules for the aging waiver program. States were permitted to loosen quality requirements for home health care providers in order to ensure that services would continue to be provided to HCBS clients. In addition, some states increased pay rates in order to attract more providers and to compensate providers for the increased risk of entering homes during the pandemic. Understanding the detailed effects of the program on health outcomes is essential, as the federal government is planning for the eventual return to regular operations after the public health emergency ends. The results of this study can inform policy debates about what share of home health services should be covered, and about what types of care are more efficient in improving the quality of life of older people aging in place. Moreover, strategies aimed at better coordinating the incentives of home care providers, patients, family caregivers, and social workers can further increase the efficiency of care delivery. Second, the benefits of HCBS shown in the

paper justifies the $400 billion expansion of the American Jobs Plan to increase HCBS coverage by the Biden Administration at the end of March 2021.

Third, improving the quality of care provided by home health agencies is a leading priority of CMS while reducing costs by shifting resources to home- or community-based settings, While each state HCBS program has minimum requirements for the certification of service providers that are guided by the federal government, these requirements vary across states. In addition, states are responsible for surveying and monitoring home health agencies to ensure that they are providing a high standard of care. However, with so many individuals being served by thousands of agencies, it is difficult to monitor their activities, and to ensure that all patients are treated fairly. The findings in this paper provide direct evidence on health effects of HCBS, which can be discussed in depth, and be used to create better quality indicators to regulate home health care providers.

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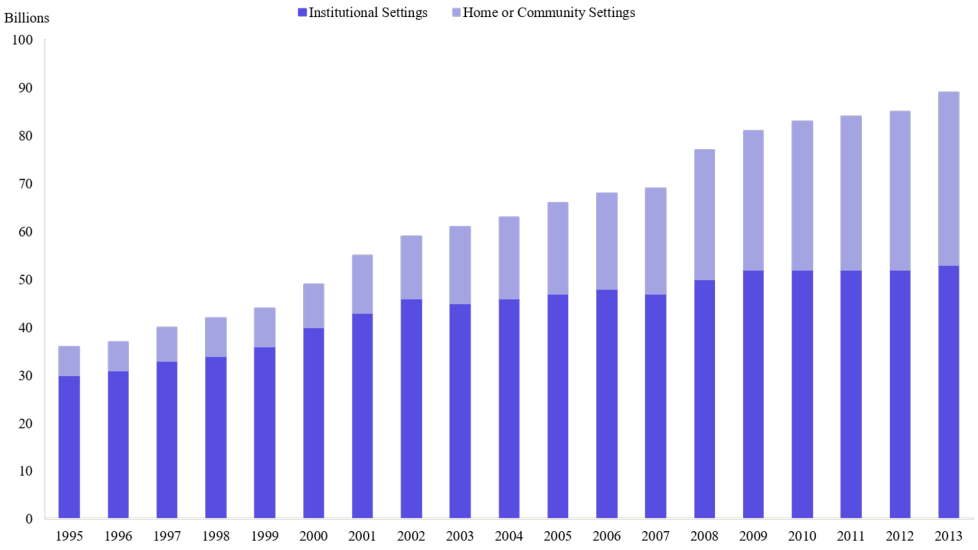
Figure A1: Medicaid LTC Spending by Service Settings



Notes: The graph shows Medicaid LTC spending by service settings, i.e., institutional settings and home or community-based settings, between 1995 and 2013. While spending on institutional settings dominated for much of this period, spending on home or community-based settings rose dramatically in later years. The data source is annual CMS 64 forms

Table A1: Medicaid HCBS Programs

Home Health State Plan (every resident is eligible)
Nursing services
Home health aide services
Medical supplies, equipment and appliances
Optional therapy services like physical, occupational and speech pathology therapy
Personal Care State Plan (every resident is eligible)
Assistance with self-care (e.g., bathing, dressing)
Household activities (e.g., preparing meals)
Cueing or monitoring
Injections by nurses
Work sites, foster care or assisted living facilities
Aging Waivers
Round-the-clock services (in-home residential rehabilitation)
Home-based services like personal care, assistance with household chores, and respite care
Day services (day rehabilitation and adult day care services)
Case management services

Notes: The table shows in detail the services covered under each Medicaid HCBS authority. Mandatory home health state plans mainly cover home-based aide services and professional services for all Medicaid-qualified participants. Personal care state plans mainly provide assistance to eligible people with ADL and IADL limitations. Aging waivers provide intensive round-the-clock services, as well as assistance to individuals with ADL and IADL limitations. The information is adjusted from the annual Kaiser Family Foundation Waiver Program Survey.

Table A2: Definitions of Variables

Variable	Definition
Heath variables	
Self-reported health	Respondent's self-reported general health status, one for excellent, two for very good, three for good, four for fair, and five for poor.
Mobility difficulty	Index of mobility difficulties ranging from 0 to 5, indicating respondents having any problem in walking 1 block, walking several blocks, walking across a room, climbing 1 flight of stairs, and climbing several flights of stairs
ADL difficulty	Index of difficulties in Activities of Daily Living (ADL) ranging from zero to five, indicating whether respondents are having any difficulties in bathing, eating, getting dressed, getting in/out of bed, and walking across a room
IADL difficulty	Index of difficulties in Instrumental Activities of Daily Living (IADL) ranging from zero to five, indicating whether respondents having any difficulties in using the phone, managing money, taking medications, shopping for groceries, and preparing hot meals
Depression scores	Index of mental health ranging from zero to eight based on the score on the Center for Epidemiological Studies Depression (CESD) scale, which represents the sum of five negative indicators minus two positive indicators. The negative indicators measure sentiments all or most of the time: depression, everything is an effort, restless sleep, feeling alone, sad, and cannot get going. The positive indicators measure whether respondents feel happy and enjoy life
Cognition scores	The total cognition score is the sum of the total word recall and mental status test scores ranging from zero to 35. The word recall index sums the immediate and delayed word recall test scores. The mental status index includes the scores for serial 7's, counting backwards from 20, naming objects, recalling dates, and naming the president/vice-president
Cancer diagnosis	Dichotomous indicator of whether respondents have ever been diagnosed with a cancer or a malignant tumor of any kind
Lung diagnosis	Dichotomous indicator of whether respondents have ever been had a lung-related disease
Heart diagnosis	Dichotomous indicator of whether respondents have ever been told by a doctor that they have had a heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems
Stroke	Dichotomous indicator of whether respondents have ever had a stroke

Table A3: Effect of Lagged State Economic Conditions on HCBS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Unemployment rate lag 1	-0.581*	1.600							1.328
	(0.338)	(1.643)							(1.365)
Unemployment rate lag 2			-0.813	1.250					0.521
			(0.517)	(1.463)					(1.225)
Unemployment rate lag 1^2		-0.285							-0.193
		(0.256)							(0.185)
Unemployment rate lag 2^2				-0.237					-0.124
				(0.226)					(0.175)
Unemployment rate lag 1^3		0.011							0.008
		(0.010)							(0.008)
Unemployment rate lag 2^3				0.008					0.004
				(0.009)					(0.007)
Employment rate lag 1					0.273	-8.068			6.718
					(0.218)	(14.188)			(12.009)
Employment rate lag 2							0.217	3.513	13.862
							(0.179)	(17.711)	(17.408)
Employment rate lag 1^2						0.153			-0.120
						(0.237)			(0.196)
Employment rate lag 2^2								-0.017	-0.202
								(0.280)	(0.277)
Employment rate lag 1^3						-0.001			0.001
						(0.001)			(0.001)
Employment rate lag 2^3								0.000	0.001
								(0.002)	(0.002)
Observations	765	765	714	714	765	765	714	714	714
Adjusted R-squared	0.990	0.990	0.993	0.993	0.990	0.990	0.992	0.993	0.994

Notes: The data used are from 1999 to 2014 state-year panel. HCBS generosity is HCBS spending from each year, scaled to 100 millions. Each cell reports estimates from a separate specification. The unemployment and employment level is from BLS, the state population is from Census Bureau, the GDP, personal income (PI), personal consumption expenditure (PCE) is from the Bureau of Economic Analysis Regional Analysis Accounts. All regressions include state, year fixed effects, and state-specific linear time trends. The last column includes all economic factors. All statistics are weighted using state population. Standard errors are clustered at the state level and shown in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Table A4: Effect of HCBS on Other Spending

	(1)	(2)	(3)
	Health care per capita	Net health insurance per capita	Life insurance per capita
HCBS spending	-1,473.259***	-51.984	58.6
	(337.78)	(132.248)	(73.757)
Observations	816	816	816
Adjusted R-squared	0.997	0.97	0.955
Mean Y	465,469	41,855	24,849
Mean HCBS	11.62	11.62	11.62

Notes: The data used are from 1999 to 2014 state-year panel. HCBS generosity is HCBS spending from each year, scaled to 100 millions. The health care, net health insurance, and life insurance spending is from the Bureau of Economic Analysis Regional Analysis Accounts. All regressions include state, year fixed effects, and state-specific linear time trends. All statistics are weighted using state population. Standard errors are clustered at the state level and shown in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Table A5: Effects of HCBS on Self-Reported Health

	(1)	(2)	(3)	(4)
	Panel A: alternative model			
HCBS expenditure per older person ($1,000)	-0.011	-0.012	-0.012	-0.012
	(0.017)	(0.015)	(0.015)	(0.015)
Observations	98,027	97,632	97,632	96,841
Year + State FEs	Y	Y	Y	Y
State linear trends	Y	Y	Y	Y
Demographics		Y	Y	Y
Income			Y	Y
Health behavior				Y
	Panel B: original scale of health			
HCBS expenditure per older person ($1,000)	-0.014	-0.017	-0.017	-0.021
	(0.021)	(0.021)	(0.021)	(0.021)
Number of individuals	21,417	21,195	21,195	21,126
Observations	98,027	97,632	97,632	96,841
Year + State + Individual FEs	Y	Y	Y	Y
Demographics		Y	Y	Y
Income			Y	Y
Health behavior				Y

Notes: The data used are from HRS 1998 to 2014 of individuals who are aged 65 and older. Panel A uses alternative model with state fixed effect, year fixed effects, and state linear trends. The standard errors are clustered at the state level. Panel B uses the main model in the text with the original self-assessed health status. Each cell reports estimates from a separate specification. Self-reported health is based on the general health status of the HRS respondent: one for excellent, two for very good, three for good, four for fair, and five for poor. Self-reported fair or poor health is an indicator showing that an individual self-assesses his or her general health status as fair or poor. The mean of HCBS expenditure per older person is around $500. Demographic controls include age, age squared, marital status, and number of siblings of individuals. Income includes the amount of pension, the amount of earnings, and the amount of annuity of individuals. Health behavior includes whether an individual drinks and smokes or not. The detailed definition of these variables can be found in Appendix Table A2. *** p<0.01, ** p<0.05, * p<0.10.

Table A6: Robustness Checks of Functional Limitation Health Effect of HCBS

	(1)	(2)	(3)	(4)
	Original	One Limitation	Three Limitations	Five Limitations
		Panel A: mobility limitation		
HCBS expenditure per older person ($1,000)	-0.052	-0.008	-0.018*	-0.002
	(0.033)	(0.010)	(0.009)	(0.007)
Number of individuals	21,125	21,125	21,125	21,125
Observations	96,817	96,817	96,817	96,817
		Panel B: ADL limitation		
HCBS expenditure per older person ($1,000)	0.013	-0.003	0.005	0.005
	(0.028)	(0.009)	(0.007)	(0.004)
Number of individuals	21,125	21,125	21,125	21,125
Observations	96,860	96,860	96,860	96,860
		Panel C: IADL limitation		
HCBS expenditure per older person ($1,000)	0.013	-0.004	0.005	0.006
	(0.030)	(0.009)	(0.007)	(0.005)
Number of individuals	21,122	21,122	21,122	21,122
Observations	96,845	96,845	96,845	96,845
Year + State + Individual FEs	Y	Y	Y	Y
Demographics	Y	Y	Y	Y
Income of individuals	Y	Y	Y	Y
Health behavior	Y	Y	Y	Y

Notes: The data used are from HRS 1998 to 2014 of individuals who are aged 65 and older. Each cell reports estimates from a separate specification. HRS asks respondents about mobility limitation in walking one block, walking several blocks, walking across a room, climbing one flight of stairs, and climbing several flights of stairs activities. The outcome is a dummy indicating whether an individual has at least two mobility limitations. The ADL index of difficulties in Activities of Daily Living (ADL) ranges from 0 to 5, indicating whether respondents are having difficulties in bathing, eating, dressing, getting in/out of bed, and walking across a room. The IADL index of difficulties in Instrumental Activities of Daily Living (IADL) ranges from 0 to 5, indicating respondents having any problem in using the phone, managing money, taking medications, shopping for groceries, and preparing hot meals. The mean of HCBS expenditure per older person is around $500. Demographic controls include age, age squared, marital status, and number of siblings of individuals. Income includes the amount of pension, the amount of earnings, and the amount of annuity of individuals. Health behavior includes whether an individual drinks and smokes or not. The detailed definition of these variables can be found in Appendix Table A2. *** p<0.01, ** p<0.05, * p<0.10.

Table A7: Robustness of Depression Effect of HCBS

	(1)	(2)	(3)	(4)
	Original	Three	Four	Six
HCBS expenditure per older person ($1,000)	-0.000	-0.005	-0.009	-0.012**
	(0.040)	(0.009)	(0.008)	(0.005)
Number of individuals	19,746	19,746	19,746	19,746
Observations	87,265	87,265	87,265	87,265
Year + State + Individual FEs	Y	Y	Y	Y
Demographics	Y	Y	Y	Y
Income of individuals	Y	Y	Y	Y
Health behavior	Y	Y	Y	Y

Notes: The data used are from HRS 1998 to 2014 of individuals who are aged 65 and older. Each cell reports estimates from a separate specification. Depression scores are based on the Center for Epidemiologic Studies Depression (CESD) scale: i.e., the sum of five negative indicators minus two positive indicators. The negative indicators measure whether respondents have the following sentiments all or most of the time: depression, everything is an effort, restless sleep, feeling alone, sad, and cannot get going. The positive indicators measure whether respondents feel happy and enjoy life. The scores range from 0 to 8. Column 1 uses original CESD scores; column 2 uses the cutoff of three negative feelings to create an indicator; column 3 uses the cutoff 4; and column 4 uses the cutoff of 6. The mean of HCBS expenditure per older person is around $500. Demographic controls include age, age squared, marital status, and number of siblings of individuals. Income includes the amount of pension, the amount of earnings, and the amount of annuity of individuals. Health behavior includes whether an individual drinks and smokes or not. The detailed definition of these variables can be found in Appendix Table A2. *** p<0.01, ** p<0.05, * p<0.10.

Table A8: Morbidity Effect of HCBS

	(1)	(2)	(3)	(4)
		Panel A: Cancer		
HCBS expenditure per older person ($1,000)	0.003	0.004	0.004	0.003
	(0.010)	(0.010)	(0.010)	(0.010)
		Panel B: Lung		
HCBS expenditure per older person ($1,000)	-0.012	-0.011	-0.011	-0.012
	(0.011)	(0.011)	(0.011)	(0.011)
		Panel C: Heart		
HCBS expenditure per older person ($1,000)	-0.007	-0.004	-0.004	-0.004
	(0.015)	(0.015)	(0.015)	(0.015)
		Panel D: Stroke		
HCBS expenditure per older person ($1,000)	0.001	-0.002	-0.002	-0.003
	(0.010)	(0.010)	(0.010)	(0.010)
Year + State + Individual FEs	Y	Y	Y	Y
Demographics		Y	Y	Y
Income of individuals			Y	Y
Health behavior				Y

Notes: The data used are from HRS 1998 to 2014 of individuals who are aged 65 and older. Each cell reports estimates from a separate specification. Outcome variables are dichotomous dependent variables indicating whether an individuals have been diagnosed with cancer, lung disease, heart disease, and stroke. The mean of HCBS expenditure per older person is around $500. Demographic controls include age, age squared, marital status, and number of siblings of individuals. Income includes the amount of pension, the amount of earnings, and the amount of annuity of individuals. Health behavior includes whether an individual drinks and smokes or not. The detailed definition of these variables can be found in Appendix Table A2. *** p<0.01, ** p<0.05, * p<0.10.

Table A9: Drinking Effect of HCBS

	(1)	(2)	(3)
	Panel A Outcome: whether drinking or not		
HCBS expenditure per older person ($1,000)	-0.023**	-0.021**	-0.021**
	(0.010)	(0.010)	(0.010)
Number of individuals	21,421	21,199	21,199
Observations	98,098	97,705	97,705
	Panel B Outcome: drink days per week		
HCBS expenditure per older person ($1,000)	-0.084**	-0.075*	-0.075*
	(0.038)	(0.038)	(0.038)
Number of individuals	21,410	21,188	21,188
Observations	97,915	97,524	97,524
	Panel C Outcome: drink numbers per day		
HCBS expenditure per older person ($1,000)	-0.062***	-0.060***	-0.060***
	(0.022)	(0.022)	(0.022)
Number of individuals	21,403	21,181	21,181
Observations	97,889	97,498	97,498
Demographics		Y	Y
Income of individuals			Y

Notes: The data used are from HRS 1998 to 2014 of individuals who are aged 65 and older. Each cell reports estimates from a separate specification. Demographic controls include age, age squared, marital status, and number of siblings of individuals. Income includes the amount of pension, the amount of earnings, and the amount of annuity of individuals. Health behavior includes whether an individual drinks and smokes. All models control for individual, state and year fixed effects. The detailed definition of these variables can be found in Appendix Table A2. *** p<0.01, ** p<0.05, * p<0.10.

Table A10: Correlation Between HCBS Spending and Healthcare Use

	(1)	(2)	(3)	(4)	(5)
	Inpatient Service	Medication	Hospital Stays	Nights at Hospitals	Doctor Visits
HCBS ($1,000)	0.016*	0.013**	0.022	0.151	0.213
	(0.009)	(0.006)	(0.021)	(0.134)	(0.427)
Mean	0.33	0.87	0.60	3.03	11.30
Observations	97,738	97,972	97,439	96,886	92,350

Notes: The data used are from HRS 1998 to 2014 of individuals who are aged 65 and older. Each cell reports estimates on dependent variables of healthcare use. Inpatient service means whether a respondent has ever visited a hospital in the previous two years. Medication use indicates whether a respond regularly takes medications in the past two years. Hospital stays and nights is the number of hospital use and doctor visits is number of visiting a doctor in the previous two years. The mean of each dependent variable is summarized in the mean row. All models control for state and year fixed effects. *** p<0.01, ** p<0.05, * p<0.10.

Table A11: Correlation Between HCBS Spending and Helper Use

	(1)	(2)	(3)	(4)	(5)
	Number of Helpers	Helpers Last Month	Days Helped	Hours Helped	Paid Helpers
HCBS ($1,000)	0.056***	0.051***	0.579*	3.944	0.099***
	(0.016)	(0.015)	(0.310)	(2.643)	(0.016)
Mean	0.34	0.31	5.24	27.37	0.26
Observations	87,336	87,293	87,209	86,204	16,196

Notes: The data used are from HRS 1998 to 2014 of individuals who are aged 65 and older. Each cell reports estimates on dependent variables of helpers. Column 1 shows the number of helpers ever helped in the last two years; column 2, the number of helpers helped in the last month; column 3, total days got helped last month; column 4, total hours got helped last month; column 5, total number of helped paid to help last month. The mean of each dependent variable is summarized in the mean row. *** p<0.01, ** p<0.05, * p<0.10.

Table A12: Robustness Effects of HCBS With State and Spending Controls

	(1)	(2)	(3)
	Panel A Outcome: self-reported health		
HCBS expenditure per older person ($1,000)	-0.020**	-0.016	-0.018*
	(0.010)	(0.010)	(0.011)
Number of individuals	21,126	21,126	21,126
Observations	96,841	96,841	96,841
	Panel B Outcome: mobility limitation		
HCBS expenditure per older person ($1,000)	-0.020*	-0.005	-0.006
	(0.010)	(0.011)	(0.011)
Number of individuals	21,125	21,125	21,125
Observations	96,817	96,817	96,817
	Panel C Outcome: depression		
HCBS expenditure per older person ($1,000)	-0.012*	-0.014**	-0.011
	(0.007)	(0.007)	(0.007)
Number of individuals	19,746	19,746	19,746
Observations	87,265	87,265	87,265
	Panel D Outcome: cognitive		
HCBS expenditure per older person ($1,000)	0.217**	0.201*	0.183*
	(0.100)	(0.110)	(0.111)
Number of individuals	19,722	19,722	19,722
Observations	87,084	87,084	87,084

Notes: The data used are from HRS 1998 to 2014 of individuals who are aged 65 and older. Each column reports an estimate corresponding to a specification. Column 1 use the specification with all controls from column 4 of tables in section 5 which corresponds to the line of main estimates (top-black) in Figure 3. Column 2 adds in state controls which corresponds to the line (middle-blue) in Figure 3. Column 3 further adds spending controls which corresponds to the line (bottom-green) in Figure 3. State-level controls include percentage of people with high school education, percentage of female, birth rate, and fertility rate and economic factors such as unemployment rate and personal income per capita (or GDP). Spending controls include the health care spending by government and other health insurance spending. All models control for state, year, individual fixed effects, and individual controls including demographics and income.

Table A13: Health Effect of HCBS With Sample 60+

	(1)	(2)	(3)	(4)
	Panel A Outcome: self-reported health			
HCBS expenditure per older person ($1,000)	-0.016*	-0.018*	-0.018*	-0.020**
	(0.010)	(0.010)	(0.010)	(0.010)
Number of individuals	21,417	21,195	21,195	21,126
Observations	98,027	97,632	97,632	96,841
	Panel B Outcome: mobility limitation			
HCBS expenditure per older person ($1,000)	-0.011	-0.018*	-0.018*	-0.020*
	(0.010)	(0.010)	(0.010)	(0.010)
Number of individuals	21,408	21,194	21,194	21,125
Observations	97,995	97,611	97,611	96,817
	Panel C Outcome: depression			
HCBS expenditure per older person ($1,000)	-0.011*	-0.011*	-0.011*	-0.012*
	(0.007)	(0.007)	(0.007)	(0.007)
Number of individuals	19,975	19,823	19,823	19,746
Observations	88,184	87,894	87,894	87,265
	Panel D Outcome: cognitive			
HCBS expenditure per older person ($1,000)	0.119	0.233**	0.233**	0.217**
	(0.100)	(0.100)	(0.100)	(0.100)
Number of individuals	19,951	19,798	19,798	19,722
Observations	87,999	87,707	87,707	87,084
Year + State + Individual FEs	Y	Y	Y	Y
Demographics		Y	Y	Y
Income of individuals			Y	Y
Health behavior				Y

Notes: The data used are from HRS 1998 to 2014 of individuals who are aged 60 and older. Each cell reports estimates from a separate specification. Demographic controls include age, age squared, marital status, and number of siblings of individuals. Income includes the amount of pension, the amount of earnings, and the amount of annuity of individuals. Health behavior includes whether an individual drinks and smokes or not. All models control for individual, state and year fixed effects. The detailed definition of these variables can be found in Appendix Table A2. *** p<0.01, ** p<0.05, * p<0.10.

Table A14: Health Effect of HCBS With Sample 70+

	(1)	(2)	(3)	(4)
	Panel A Outcome: self-reported health			
HCBS expenditure per older person	-0.017	-0.018	-0.018	-0.019
	(0.012)	(0.012)	(0.012)	(0.012)
Number of individuals	17,578	17,406	17,406	17,339
Observations	71,773	71,473	71,473	70,878
	Panel B Outcome: mobility limitation			
HCBS expenditure per older person	-0.017	-0.020	-0.020	-0.023*
	(0.012)	(0.012)	(0.012)	(0.013)
Number of individuals	17,566	17,399	17,399	17,331
Observations	71,736	71,443	71,443	70,845
	Panel C Outcome: depression			
HCBS expenditure per older person	-0.012	-0.012	-0.012	-0.012
	(0.009)	(0.009)	(0.009)	(0.009)
Number of individuals	16,228	16,114	16,114	16,045
Observations	63,604	63,390	63,390	62,923
	Panel D Outcome: cognitive			
HCBS expenditure per older person	0.200	0.287**	0.287**	0.264**
	(0.128)	(0.129)	(0.129)	(0.129)
Number of individuals	16,237	16,123	16,123	16,054
Observations	63,620	63,405	63,405	62,938
Year + State + Individual FEs	Y	Y	Y	Y
Demographics		Y	Y	Y
Income of individuals			Y	Y
Health behavior				Y

Notes: The data used are from HRS 1998 to 2014 of individuals who are aged 70 and older. Each cell reports estimates from a separate specification. Demographic controls include age, age squared, marital status, and number of siblings of individuals. Income includes the amount of pension, the amount of earnings, and the amount of annuity of individuals. Health behavior includes whether an individual drinks and smokes or not. All models control for individual, state and year fixed effects. The detailed definition of these variables can be found in Appendix Table A2. *** p<0.01, ** p<0.05, * p<0.10.

Table A15: Health Effect of HCBS With State Clusters

	(1)	(2)	(3)	(4)
	Panel A Outcome: self-reported health			
HCBS expenditure per older person ($1,000)	-0.016*	-0.018**	-0.018**	-0.020**
	(0.008)	(0.008)	(0.008)	(0.009)
	Panel B Outcome: mobility limitation			
HCBS expenditure per older person ($1,000)	-0.011	-0.018*	-0.018*	-0.020**
	(0.011)	(0.009)	(0.009)	(0.009)
	Panel C Outcome: depression			
HCBS expenditure per older person ($1,000)	-0.011	-0.011	-0.011	-0.012
	(0.009)	(0.009)	(0.009)	(0.009)
	Panel D Outcome: cognitive			
HCBS expenditure per older person ($1,000)	0.119	0.233	0.233	0.217
	(0.154)	(0.180)	(0.180)	(0.183)
Year + State + Individual FEs	Y	Y	Y	Y
Demographics		Y	Y	Y
Income of individuals			Y	Y
Health behavior				Y

Notes: The data used are from HRS 1998 to 2014 of individuals who are aged 65 and older. Each cell reports estimates from a separate specification. Demographic controls include age, age squared, marital status, and number of siblings of individuals. Income includes the amount of pension, the amount of earnings, and the amount of annuity of individuals. Health behavior includes whether an individual drinks and smokes or not. All models control for individual, state and year fixed effects. The detailed definition of these variables can be found in Appendix Table A2. *** p<0.01, ** p<0.05, * p<0.10.

Table A16: Robustness Effects of HCBS With Weights

	(1)	(2)	(3)
	Panel A Outcome: self-reported health		
HCBS expenditure per older person ($1,000)	-0.020**	-0.020	-0.022**
	(0.010)	(0.013)	(0.009)
Number of individuals	21,126	21,126	21,126
Observations	96,841	96,841	96,841
	Panel B Outcome: mobility limitation		
HCBS expenditure per older person ($1,000)	-0.020*	-0.018	-0.027***
	(0.010)	(0.011)	(0.007)
Number of individuals	21,125	21,125	21,125
Observations	96,817	96,817	96,817
	Panel C Outcome: depression		
HCBS expenditure per older person ($1,000)	-0.012*	-0.009	-0.020***
	(0.007)	(0.010)	(0.007)
Number of individuals	19,746	19,746	19,746
Observations	87,265	87,265	87,265
	Panel D Outcome: cognitive		
HCBS expenditure per older person ($1,000)	0.217**	0.198	-0.091
	(0.100)	(0.196)	(0.182)
Number of individuals	19,722	19,722	19,722
Observations	87,084	87,084	87,084

Notes: The data used are from HRS 1998 to 2014 of individuals who are aged 65 and older. Each column reports an estimate corresponding to a specification. Column 1 use the specification with all controls from column 4 of tables in section 5 which corresponds to the line of main estimates (top-black) in Figure 4. Column 2 uses HRS individual weights which corresponds to the line (middle-blue) in Figure 4. Column 3 uses state-level old population weights which corresponds to the line (bottom-green) in Figure 4. All models control for state, year, individual fixed effects, and individual controls including demographics and income.

Table A17: Health Effect of HCBS by Race

	(1)	(2)	(3)
	Panel A: self-reported health		
HCBS × White	-0.009	-0.012	-0.013
	(0.010)	(0.010)	(0.010)
HCBS × Black	-0.046**	-0.046**	-0.046**
	(0.022)	(0.022)	(0.023)
HCBS × Other	-0.078***	-0.077***	-0.078***
	(0.029)	(0.029)	(0.029)
$\lambda^{black} - \lambda^{white}$	-0.036*	-0.034	-0.033
	(0.022)	(0.022)	(0.023)
$\lambda^{other} - \lambda^{white}$	-0.069**	-0.065*	-0.065*
	(0.029)	(0.029)	(0.030)
	Panel B: mobility limitation		
HCBS × White	-0.008	-0.016	-0.018
	(0.011)	(0.011)	(0.011)
HCBS × Black	-0.020	-0.019	-0.017
	(0.021)	(0.021)	(0.021)
HCBS × Other	-0.051*	-0.049*	-0.052*
	(0.031)	(0.030)	(0.031)
$\lambda^{black} - \lambda^{white}$	-0.012	-0.003	0.001
	(0.021)	(0.021)	(0.021)
$\lambda^{other} - \lambda^{white}$	-0.043	-0.033	-0.034
	(0.031)	(0.031)	(0.031)
Demographics		Y	Y
Health behavior			Y

Notes: The data used are from HRS 1998 to 2014 of individuals who are aged 65 and older. Each cell reports estimates from a separate specification. Race is self-reported race/ethnicity. Demographic controls include age, age squared, marital status, and number of siblings of individuals. Health behavior includes whether an individual drinks and smokes or not. *** p<0.01, ** p<0.05, * p<0.10.

Table A18: Health Effect of HCBS by Race Continued

	(1)	(2)	(3)
	Panel C: depression		
HCBS × White	-0.006	-0.006	-0.007
	(0.007)	(0.007)	(0.007)
HCBS × Black	-0.042**	-0.040**	-0.038**
	(0.017)	(0.017)	(0.017)
HCBS × Other	-0.049**	-0.047**	-0.046**
	(0.023)	(0.023)	(0.023)
$\lambda^{black} - \lambda^{white}$	-0.036**	-0.033*	-0.031*
	(0.016)	(0.017)	(0.017)
$\lambda^{other} - \lambda^{white}$	-0.044*	-0.041*	-0.039*
	(0.023)	(0.023)	(0.023)
	Panel D: cognitive		
HCBS × White	0.142	0.289***	0.273***
	(0.105)	(0.104)	(0.104)
HCBS × Black	-0.247	-0.308	-0.320
	(0.243)	(0.244)	(0.246)
HCBS × Other	0.395	0.252	0.222
	(0.288)	(0.285)	(0.286)
$\lambda^{black} - \lambda^{white}$	-0.389	-0.597**	-0.593**
	(0.240)	(0.241)	(0.243)
$\lambda^{other} - \lambda^{white}$	0.252	-0.037	-0.051
	(0.291)	(0.288)	(0.288)
Demographics		Y	Y
Health behavior			Y

Notes: The data used are from HRS 1998 to 2014 of individuals who are aged 65 and older. Each cell reports estimates from a separate specification. Race is self-reported race/ethnicity. Demographic controls include age, age squared, marital status, and number of siblings of individuals. Health behavior includes whether an individual drinks and smokes or not. *** p<0.01, ** p<0.05, * p<0.10.

Table A19: Health Effect of HCBS by Education

	(1)	(2)	(3)
	Panel A: self-reported health		
HCBS × high education	-0.011	-0.012	-0.010
	(0.012)	(0.012)	(0.012)
HCBS × low education	-0.019*	-0.022**	-0.026**
	(0.011)	(0.011)	(0.011)
$\lambda^{low} - \lambda^{high}$	-0.008	-0.010	-0.016
	(0.013)	(0.013)	(0.013)
	Panel B: mobility limitation		
HCBS × high education	-0.030**	-0.033**	-0.034***
	(0.013)	(0.013)	(0.013)
HCBS × low education	0.002	-0.007	-0.011
	(0.012)	(0.012)	(0.012)
$\lambda^{low} - \lambda^{high}$	0.032**	0.026*	0.023*
	(0.014)	(0.014)	(0.014)
	Panel C: depression		
HCBS × high education	-0.006	-0.005	-0.005
	(0.008)	(0.008)	(0.008)
HCBS × low education	-0.014*	-0.016**	-0.016**
	(0.008)	(0.008)	(0.008)
$\lambda^{low} - \lambda^{high}$	-0.008	-0.011	-0.012
	(0.009)	(0.009)	(0.009)
	Panel D: cognitive		
HCBS × high education	0.311**	0.417***	0.398***
	(0.122)	(0.123)	(0.123)
HCBS × low education	-0.016	0.102	0.087
	(0.120)	(0.118)	(0.118)
$\lambda^{low} - \lambda^{high}$	-0.327**	-0.315**	-0.311**
	(0.135)	(0.135)	(0.135)
Demographics		Y	Y
Health behavior			Y

Notes: The data used are from HRS 1998 to 2014 of individuals who are aged 65 and older. Each cell reports estimates from a separate specification. Education is the reported years in school. Low education means individuals who have less than high school education years (cutoff years 13). Demographic controls include age, age squared, marital status, and number of siblings of individuals. Health behavior includes whether an individual drinks and smokes or not. *** p<0.01, ** p<0.05, * p<0.10.

Table A20: Health Effect of HCBS Without Moving Sample

	(1)	(2)	(3)	(4)
	Panel A Outcome: self-reported health			
HCBS expenditure per older person ($1,000)	-0.015	-0.017*	-0.017*	-0.019*
	(0.010)	(0.010)	(0.010)	(0.010)
Number of individuals	20,106	19,884	19,884	19,818
Observations	89,937	89,552	89,552	88,815
	Panel B Outcome: mobility limitation			
HCBS expenditure per older person ($1,000)	-0.012	-0.020*	-0.020*	-0.022**
	(0.011)	(0.011)	(0.011)	(0.011)
Number of individuals	20,097	19,883	19,883	19,817
Observations	89,898	89,524	89,524	88,785
	Panel C Outcome: depression			
HCBS expenditure per older person ($1,000)	-0.012*	-0.012*	-0.012*	-0.013*
	(0.007)	(0.007)	(0.007)	(0.007)
Number of individuals	18,695	18,543	18,543	18,470
Observations	80,852	80,571	80,571	79,990
	Panel D Outcome: cognitive			
HCBS expenditure per older person ($1,000)	0.091	0.214**	0.215**	0.197*
	(0.107)	(0.106)	(0.106)	(0.106)
Number of individuals	18,670	18,517	18,517	18,445
Observations	80,678	80,395	80,395	79,820
Year + State + Individual FEs	Y	Y	Y	Y
Demographics		Y	Y	Y
Income			Y	Y
Health behavior				Y

Notes: The data used are from HRS 1998 to 2014 of individuals who are aged 65 and older. Each cell reports estimates from a separate specification. Demographic controls include age, age squared, marital status, and number of siblings of individuals. Income includes the amount of pension, the amount of earnings, and the amount of annuity of individuals. Health behavior includes whether an individual drinks and smokes or not. All models control for individual, state and year fixed effects. The detailed definition of these variables can be found in Appendix Table A2. *** p<0.01, ** p<0.05, * p<0.10.