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# The Benefits of Medicaid Home and Community- Based Services on Health\*

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## Abstract

The Medicaid Home and Community- Based Services (HCBS) program in the United States subsidizes the long-term care provided at home or in community-based settings for older adults. Little is known about how HCBS affects the well-being of the aging population. Using detailed information about health from the Health and Retirement Study (HRS) linked with state-level HCBS policy expenditures, we show that HCBS is beneficial to improve general health outcomes of older individuals. Our results find that HCBS generosity is positively associated with the probability of older individuals self-reporting better health status, mitigating functional mobility limitations, showing better emotional feelings, and increasing cognitive skills. In addition, these health benefits of HCBS differ across groups by resources and demographic characteristics.

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

**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).<sup>1</sup> 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 would bring better 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 Medicaid HCBS on health of

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<sup>1</sup>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).

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 effect 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 expenditures per older person decreases two percentage points in the probability of reporting worse health status. 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 expenditures is associated with a 5 percent decrease in the probability of individuals reporting mobility limitation while null effects on Activities of Daily Life (ADL) or Instrumental Activities of Daily Life (IADL). Third, our estimates also show that HCBS generosity improves the aging population's 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.

To better understand these effects, we further examine some potential channels through which HCBS expenditures could improve health outcomes, including risky health behaviors and exercise. Our results show that HCBS generosity significantly reduces the likelihood of older people to drink by two percentage points and decrease drinking frequency by eight percentage points weekly or six percentage points daily. We also find that HCBS is effective to reduce vigorous activities such as aerobics, running, swimming, and bicycling for at least 3 times a week among older population.

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; Alexih 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 homes after being discharged from nursing homes and hospitals. In addition, HCBS generosity decreases nursing home care usage 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 the 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 programs. Many studies in this literature present that the HCBS program increases the overall Medicaid expenditures 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 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 the summary statistics. Section 4 introduces the empirical models and potential threats to identification. Section 5 reports the effects of HCBS on a variety of health outcomes, presents robustness checks, and explores heterogeneous effects. Section 6 concludes.

## 2 Medicaid Home and Community-Based Services

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 expenditures increased significantly over the years. In an effort to contain the massive growth in LTC expenditures, 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. HCBS expenditures rose sharply from 1995 to 2013, as shown in Appendix Figure A1.

Medicaid HCBS funds three main programs that comprise the majority of its enrollment and spending: a mandatory home health state plan, an optional personal care state plan, and optional waivers.<sup>2</sup> The Medicaid HCBS state plans are available to every Medicaid-eligible

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<sup>2</sup>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 expenditures; another \$20.6 billion was spent on state plans, representing 23 percent of total Medicaid expenditures; while the Community First Choice program was much smaller, accounting for around 9 percent of total Medicaid expenditures.

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.<sup>3</sup>

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 expenditures on aging waivers was approximately \$40 billion, accounting for 65 percent of Medicaid's total waiver expenditures.

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

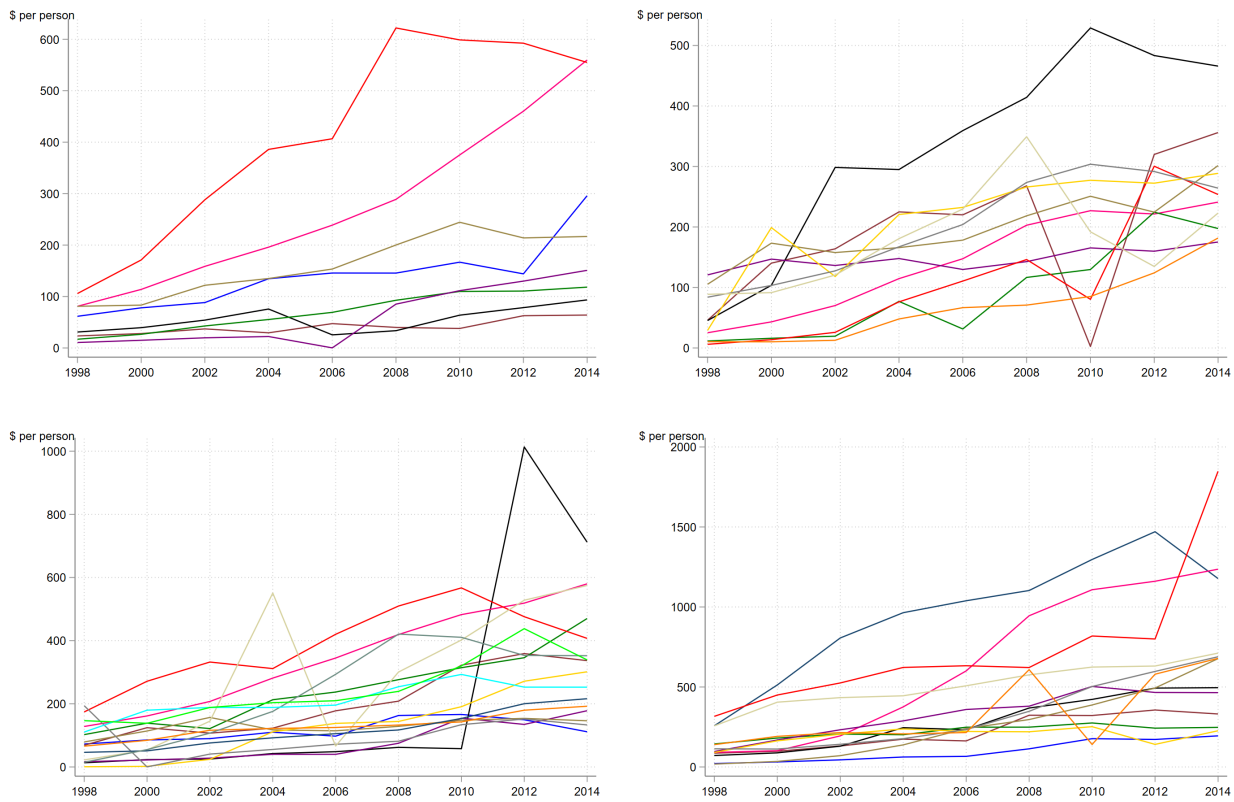
In 2018, approximately 3 million people were enrolled in Medicaid HCBS, and 2.5 million beneficiaries received waivers (85 percent). Home health state plans mainly cover services provided by nurses and professionals; while personal care state plans cover services such as personal care and assistance 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

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<sup>3</sup>For details about the eligibility rules in each state, see: <https://www.medicaidplanningassistance.org/medicaid-eligibility/>.

between programs as shown in Appendix Table A1. Figure 1 shows the variation in HCBS expenditures over time and across states. Figure 1 splits the 50 states into four sub-graphs to make the variation more noticeable. The expenditure levels vary considerably across states. Moreover, within each state, the variation in spending over time is also large.<sup>4</sup> In Section 4, we show that the variation of HCBS are uncorrelated with state-level current or lagged economic and demographic characteristics and more comes from long-standing institutional features of states.

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



Notes: The four graphs display the HCBS expenditures 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.

<sup>4</sup>More details on the variation in each state can be found in Appendix of Liu & Zai (2022).



### 3 Data

Our first data source is the Medicaid HCBS policy information of each state from 1995 to 2014. This publicly available information includes data on expenditures on home health state plans, on personal care state plans, and on aging waivers for older people.<sup>5</sup> The level of HCBS expenditures 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 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 state level. We restrict the main sample to respondents who are over age 65, the eligibility age for HCBS aging waivers.<sup>6</sup> 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

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<sup>5</sup><https://www.medicaid.gov/>

<sup>6</sup>Details of HCBS aging waiver introduction can be referred to [Liu & Zai \(2022\)](#).

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 expenditures (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 2000 to 2014.<sup>7</sup> 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.

### 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

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<sup>7</sup>See [Liu & Zai \(2022\)](#) for detailed description of variables.

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.<sup>8</sup> 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-

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<sup>8</sup>Full results are available upon request.

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 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 disease-related diagnosis. In terms of the risky behavioral health variables, about 57 percent of individuals report ever smoking, and about nine percent report currently smoking. Forty-three percent of the respondents report ever drinking alcohol, and of those who say they currently drink alcohol, the average consumption is

about one drink per week, and about one half of a standard drink per sitting. The detailed definitions of these variables can be found in Table A2 in the Appendix.

## 4 Estimation Model

We estimate the health effects of HCBS on older individuals with a difference-in-difference (DD) specification as follows:

$$Y_{ist} = \delta HCBS_{s\bar{t}} + \beta X_{ist} + \alpha_i + \mu_t + \eta_s + \epsilon_{ist} \quad (1)$$

where  $Y_{ist}$  is health outcome of individual  $i$  in state  $s$  surveyed in year  $t$ .  $HCBS_{s\bar{t}}$  is the average expenditures of Medicaid HCBS per older person in state  $s$  and averaged in year  $t$  and  $t - 1$ . For example, the health outcome in survey year 2000 is regressed on HCBS expenditures averaged between 2000 and 1999. This policy construction takes that HRS survey takes place every two years into consideration.  $X_{ist}$  is a set of time-varying characteristics of individuals, such as age, marital status, and number of living siblings. The individual fixed effect,  $\alpha_i$ , 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,  $\mu_t$ , controls for common shocks across states that could affect health outcomes. The state fixed effect,  $\eta_s$ , 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. The standard errors are clustered at the individual level.

The coefficient of interest,  $\delta$ , 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 expenditures are on parallel trends needs to be satisfied so the year-to-year health change in states with low HCBS expenditures represents the counterfactual change in states with high HCBS expenditures. With the

Table 1: Summary Statistics of the Sample

Variable	Mean	S.D.	Unique individuals	Obs.
<i>Time-invariant demographics</i>				
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
<i>Time-varying demographics</i>				
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
<i>Health variables</i>				
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
Smoke now	0.09	0.29	21,363	97,510
Smoke ever	0.57	0.49	21,237	97,250
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

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.

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 within-individual variation 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.

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 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 may be concerned that individuals in different states might respond differently to HCBS and the unobserved individual traits that affect health behavior could correlate with the differences in HCBS spending across time. As shown in [Liu & Zai \(2022\)](#), the observable demographic characteristics do not predict HCBS generosity. Residents in each state have little chances to anticipate and control the

size of HCBS. In addition, we control individual fixed effects in the empirical analysis which can remove time-invariant unobservable individual factors.

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 expenditures per capita. These state economic measures are regressed on HCBS generosity controlling state and year fixed effects. We allow flexible functional form of these variables and the results are reported in Table 2. 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 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.

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 expenditures 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.

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 3 shows the self reported health effect of HCBS from equation 1 of different specifications. Model 1 is the demanding specification without any controls. To test the credibility of DD 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 expenditures per older person, is in increments of

Table 2: Effect of State Economic Conditions on HCBS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Unemployment rate	-0.1948	0.2222			0.0075	-0.2176	0.0989	-0.6607
	(0.1306)	(0.8589)			(0.9996)	(1.1928)	(1.1105)	(1.4434)
Unemployment rate <sup>2</sup>		-0.1214			-0.0854	-0.0683	-0.0741	0.0033
		(0.1338)			(0.1398)	(0.1314)	(0.1414)	(0.1387)
Unemployment rate <sup>3</sup>		0.0072			0.0060	0.0055	0.0055	0.0027
		(0.0070)			(0.0071)	(0.0064)	(0.0067)	(0.0056)
Employment rate			0.2287	-1.0795	-1.7647	-4.8189	7.6737	6.0362
			(0.1410)	(7.4709)	(8.9292)	(11.1364)	(12.2071)	(10.9918)
Employment rate <sup>2</sup>				0.0246	0.0440	0.0944	-0.1087	-0.0788
				(0.1225)	(0.1483)	(0.1874)	(0.1938)	(0.1752)
Employment rate <sup>3</sup>				-0.0002	-0.0003	-0.0006	0.0005	0.0003
				(0.0007)	(0.0008)	(0.0010)	(0.0010)	(0.0009)
GDP per capita					-0.0000			-0.0000
					(0.0000)			(0.0000)
PI per capita						-0.0003		-0.0005
						(0.0004)		(0.0007)
PCE per capita							0.0007	0.0013
							(0.0008)	(0.0013)
Observations	816	816	816	816	816	816	816	816
Adjusted R-squared	0.9891	0.9892	0.9892	0.9891	0.9893	0.9893	0.9894	0.9897

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 expenditures (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.

\$1,000. Without any controls, the estimate in the first column shows that an increase in HCBS expenditures 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 expenditures per older person is associated with a decrease of approximately 2 percentage points in the probability of reporting worse health across specifications. On a baseline 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.

Table 3: Self-Reported Fair or Poor Health Effect of HCBS

	(1)	(2)	(3)	(4)
HCBS expenditures 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 FEs	Y	Y	Y	Y
State FEs	Y	Y	Y	Y
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 expenditures 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 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.

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 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.<sup>9</sup> Similar as Table 3, we report mobility estimates using different specifications in Table 4. The HCBS program is negatively associated with the probability of individuals reporting mobility limitations. The improvement in mobility health is about 2 percentage points with a \$1,000 increase in HCBS expenditures. This corresponds to an approximate 5 percent increase with a baseline mean at 0.37. Panel A of Table 5 reports the estimates on ADL and Panel B shows the results on IADL limitations, separately. Without any controls in specification 1, the HCBS is positively related to worse functional health in ADL or IADL. After controlling 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.

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<sup>9</sup>The full results of each indicator are available upon request.

Table A6 in the Appendix shows the robustness of the physical health effects using the most 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.<sup>10</sup> 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.

Table 4: Mobility Limitation Health Effect of HCBS

	(1)	(2)	(3)	(4)
HCBS expenditures 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
Year FEs	Y	Y	Y	Y
State FEs	Y	Y	Y	Y
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 outcome is a dummy indicating whether an individual has at least two mobility limitations. The mean of HCBS expenditures 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 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.

<sup>10</sup>To save space, we do not include all indicators with combinations of limitations. The results are available upon request.

Table 5: ADL/IADL Limitation Health Effect of HCBS

	(1)	(2)	(3)	(4)
Panel A: ADL limitation				
HCBS expenditures per older person (\$1,000)	0.009 (0.008)	-0.000 (0.008)	-0.000 (0.008)	-0.002 (0.008)
Number of individuals	21,409	21,194	21,194	21,125
Observations	98,040	97,655	97,655	96,860
Panel B: IADL limitations				
HCBS expenditures per older person (\$1,000)	0.011 (0.008)	0.001 (0.008)	0.001 (0.008)	-0.001 (0.008)
Number of individuals	21,406	21,191	21,191	21,122
Observations	98,023	97,640	97,640	96,845
Year FEs	Y	Y	Y	Y
State FEs	Y	Y	Y	Y
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. 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 expenditures 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 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.

### 5.3 Effect on Mental and Cognitive Health

Table 6 reports the effect of HCBS on mental health using the CESD scale with a similar format as Table 3. The HCBS expenditures 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.

Table 7 reports the estimates of the effect of HCBS on cognitive scores. An increase in HCBS expenditures 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.

### 5.4 Effect on Risky Behavior

We are also interested in how HCBS affects risky behaviors of older people such as drinking and smoking. Table 8 Panel A shows that HCBS significantly reduces the probability of pick up drinking. An increase in HCBS generosity leads to approximately 2 percentage points decrease in drinking. Panel B and C further estimate the effect on 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. Panel D reports the effect on heavy exercise such as aerobics, running, swimming, and bicycling at least 3 times a week. The HCBS program reduces the incidence of doing vigorous activities by around 9 percentage points. These estimates are robust to different controls. We do not

Table 6: Depression Effect of HCBS

	(1)	(2)	(3)	(4)
HCBS expenditures 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
Year FEs	Y	Y	Y	Y
State FEs	Y	Y	Y	Y
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 here is a dummy using the cutoff of 5, meaning having at least five negative emotional feelings. The mean of HCBS expenditures 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 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 7: Cognitive Effect of HCBS

	(1)	(2)	(3)	(4)
HCBS expenditures 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 FEs	Y	Y	Y	Y
State FEs	Y	Y	Y	Y
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. The total cognition score 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 expenditures 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 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.

find any relationship between HCBS and other risky behavior such as smoking and obesity, however.

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

## 5.5 Robustness

In this Section, we further report how our health results of HCBS are sensitive to sub-samples. First, 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 account for only less than 10 percent so we would not worry that the potential endogenous moving motivation might drive our results. Appendix Table A15 shows the main health effects do not change much when removing the small sample across specifications.

Second, one may be concerned about the sensitivity of our sample restriction. 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.<sup>11</sup> We then expand the sample to individuals aged 60 and above and show the health estimates in Appendix Table A9. All estimates are

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<sup>11</sup>For details, see Liu & Zai (2022) about the introduction of aging waivers.

Table 8: Drinking Effect of HCBS

	(1)	(2)	(3)
Panel A Outcome: whether drinking or not			
HCBS expenditures per older person	-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 expenditures per older person	-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 expenditures per older person	-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
Panel D Outcome: vigorous activity 3+ a week			
HCBS expenditures per older person	-0.095**	-0.093**	-0.094**
	(0.037)	(0.037)	(0.037)
Number of individuals	14,025	13,808	13,808
Observations	32,406	32,090	32,090
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 individual drinks, smokes, and exercise vigorously. All models control for individual, state and year fixed effects. The detailed definition of these variables can be found in Appendix Table A2. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .

robust to the sample restriction and consistent with the main results shown in Section 5. In addition, Appendix Table A10 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.

Third, one may be concerned about the sensitivity 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 A11 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 depression and cognitive health might be one explanation that the significance disappears when clustering the standard errors at the state level.

## 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. To explore this heterogeneity, we use the following model:

$$Y_{ist} = \lambda HCBS_{st} \times Z_{ist} + \eta Z_{ist} + \beta X_{ist} + \alpha_i + \mu_t + \eta_s + \epsilon_{ist} \quad (2)$$

where  $Z_{ist}$  is the characteristic we use to analyze the heterogeneous treatment effects. Similar as model 1, we control for individual fixed effects, year fixed effects, and state fixed effects. The coefficient  $\lambda$  represents the effects of HCBS on respective groups by the characteristic.<sup>12</sup> We also test the differences between groups of the treatment effects.

Table 9 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.<sup>13</sup> As discussed in Section 2, one has to be 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 3 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 3. 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

<sup>12</sup>We do not include policy un-interacted so the model directly produces the effect on different groups.

<sup>13</sup>Results are indifferent when we use other measurement such as pension only. Since most of our sample have already retired and have no earnings, we 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.

Table 9: Health Effect of HCBS by Income

	(1)	(2)	(3)
Panel A: self-reported health			
HCBS $\times$ high income	-0.006 (0.011)	-0.008 (0.011)	-0.009 (0.011)
HCBS $\times$ low income	-0.023** (0.010)	-0.025** (0.010)	-0.027*** (0.010)
$\lambda^{low} - \lambda^{high}$	-0.018** (0.008)	-0.017** (0.008)	-0.018** (0.008)
Panel B: mobility limitation			
HCBS $\times$ high income	-0.002 (0.011)	-0.010 (0.011)	-0.012 (0.011)
HCBS $\times$ low income	-0.017 (0.011)	-0.023** (0.011)	-0.026** (0.011)
$\lambda^{low} - \lambda^{high}$	-0.015* (0.008)	-0.013 (0.008)	-0.014* (0.008)
Panel C: depression			
HCBS $\times$ high income	-0.014** (0.007)	-0.014** (0.007)	-0.014** (0.007)
HCBS $\times$ low income	-0.008 (0.007)	-0.009 (0.007)	-0.009 (0.007)
$\lambda^{low} - \lambda^{high}$	0.006 (0.006)	0.005 (0.006)	0.005 (0.006)
Panel D: cognitive			
HCBS $\times$ high income	0.196* (0.110)	0.335*** (0.109)	0.318*** (0.109)
HCBS $\times$ low income	0.053 (0.107)	0.149 (0.106)	0.132 (0.107)
$\lambda^{low} - \lambda^{high}$	-0.143* (0.081)	-0.187** (0.080)	-0.186** (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 individual drinks and smokes or not. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .

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 not 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 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 expenditures 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 [A12](#) and [A13](#) 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 9. Appendix Table A14 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 A12 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 that HCBS generosity seems to improve risky behavior such as reducing drinking episodes, decreasing drinking intensity, and avoiding heavy exercise among the older population.

The findings of this study 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.

To realize the goal of reducing costs by shifting resources to home- or community-based settings, improving the quality of care provided by home health agencies is a leading priority of CMS. 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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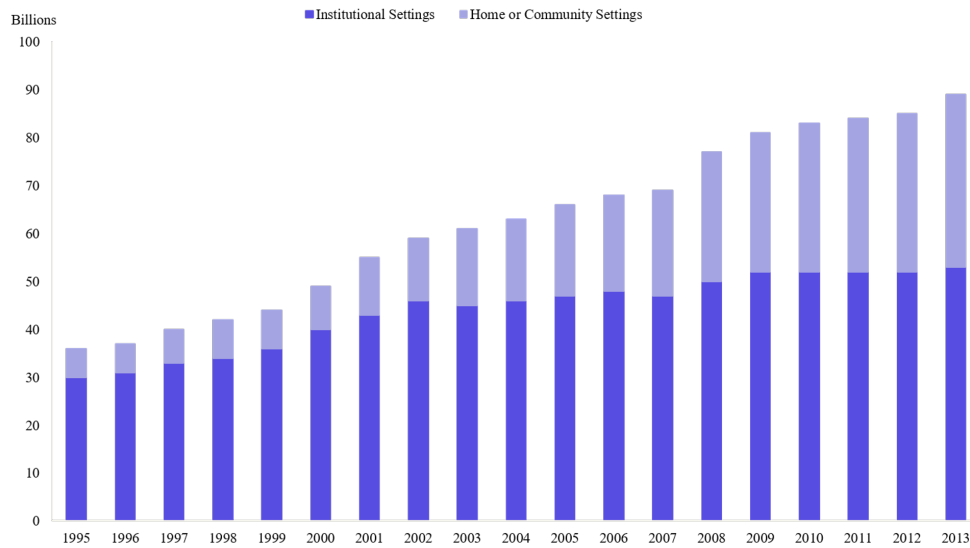
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Figure A1: Medicaid LTC Spending by Service Settings



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

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*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

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*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

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*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

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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
<i>Health variables</i>	
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
Smoke now	Dichotomous indicator of whether respondents were smoking at the time of being surveyed
Smoke ever	Dichotomous indicator of whether respondents have ever smoked
Drink ever	Dichotomous indicator of whether respondents have ever drank alcohol
Drink days	The number of days per week respondents have had any alcohol to drink in the last three months, for example, beer, wine, or any drink containing liquor
Drink number	The number of drinks per day respondents have consumed in the last three months on the days they have been drinking

Table A3: Effect of lagged State Economic Conditions on HCBS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Unemployment rate lag 1	-0.5814*	1.5997							1.3276
	(0.3383)	(1.6434)							(1.3653)
Unemployment rate lag 2			-0.8126	1.2497					0.5211
			(0.5166)	(1.4630)					(1.2246)
Unemployment rate lag 1 <sup>2</sup>		-0.285							-0.1925
		(0.2561)							(0.1852)
Unemployment rate lag 2 <sup>2</sup>				-0.2374					-0.1244
				(0.2261)					(0.1749)
Unemployment rate lag 1 <sup>3</sup>		0.0113							0.0080
		(0.0103)							(0.0081)
Unemployment rate lag 2 <sup>3</sup>				0.0081					0.0039
				(0.0090)					(0.0073)
Employment rate lag 1					0.2727	-8.0678			6.7184
					(0.2184)	(14.1878)			(12.0089)
Employment rate lag 2							0.2174	3.5134	13.8616
							(0.1785)	(17.7113)	(17.4082)
Employment rate lag 1 <sup>2</sup>						0.1534			-0.1203
						(0.2370)			(0.1957)
Employment rate lag 2 <sup>2</sup>								-0.0171	-0.2015
								(0.2802)	(0.2774)
Employment rate lag 1 <sup>3</sup>						-0.0009			0.0007
						(0.0013)			(0.0011)
Employment rate lag 2 <sup>3</sup>								-0.0001	0.0009
								(0.0015)	(0.0015)
Observations	765	765	714	714	765	765	714	714	714
Adjusted R-squared	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99

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 expenditures (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*** (337.78)	-51.984 (132.248)	58.6 (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 expenditures per older person (\$1,000)	-0.011 (0.017)	-0.012 (0.015)	-0.012 (0.015)	-0.012 (0.015)
Observations	98,027	97,632	97,632	96,841
Year FEs	Y	Y	Y	Y
State FEs	Y	Y	Y	Y
State linear trends	Y	Y	Y	Y
Demographics		Y	Y	Y
Income of individuals			Y	Y
Health behavior				Y
Panel B: original scale of health				
HCBS expenditures per older person (\$1,000)	-0.014 (0.021)	-0.017 (0.021)	-0.017 (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 FEs	Y	Y	Y	Y
State FEs	Y	Y	Y	Y
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. Panel A uses alternative model with state fixed effect, year fixed effects, and state linear trends. The standard errors are clustered at 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 expenditures 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 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 expenditures per older person (\$1,000)	-0.052 (0.033)	-0.008 (0.010)	-0.018* (0.009)	-0.002 (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 expenditures per older person (\$1,000)	0.013 (0.028)	-0.003 (0.009)	0.005 (0.007)	0.005 (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 limitations				
HCBS expenditures per older person (\$1,000)	0.013 (0.030)	-0.004 (0.009)	0.005 (0.007)	0.006 (0.005)
Number of individuals	21,122	21,122	21,122	21,122
Observations	96,845	96,845	96,845	96,845
Year FEs	Y	Y	Y	Y
State FEs	Y	Y	Y	Y
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 expenditures 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 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 expenditures per older person	-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 FEs	Y	Y	Y	Y
State FEs	Y	Y	Y	Y
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 expenditures 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 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 expenditures 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 expenditures 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 expenditures 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 expenditures per older person (\$1,000)	0.001	-0.002	-0.002	-0.003
	(0.010)	(0.010)	(0.010)	(0.010)
State FEs	Y	Y	Y	Y
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 individuals have been diagnosed with cancer, lung disease, heart disease, and stroke. The mean of HCBS expenditures 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 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: Health Effect of HCBS with Sample 60+

	(1)	(2)	(3)	(4)
Panel A Outcome: self-reported health				
HCBS expenditures per older person	-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 expenditures per older person	-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 expenditures per older person	-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 expenditures per older person	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
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 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 A10: Health Effect of HCBS with Sample 70+

	(1)	(2)	(3)	(4)
Panel A Outcome: self-reported health				
HCBS expenditures 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 expenditures 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 expenditures 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 expenditures 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
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 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 A11: Health Effect of HCBS with State Clusters

	(1)	(2)	(3)	(4)
Panel A Outcome: self-reported health				
HCBS expenditures per older person	-0.016*	-0.018**	-0.018**	-0.020**
	(0.008)	(0.008)	(0.008)	(0.009)
Panel B Outcome: mobility limitation				
HCBS expenditures per older person	-0.011	-0.018*	-0.018*	-0.020**
	(0.011)	(0.009)	(0.009)	(0.009)
Panel C Outcome: depression				
HCBS expenditures per older person	-0.011	-0.011	-0.011	-0.012
	(0.009)	(0.009)	(0.009)	(0.009)
Panel D Outcome: cognitive				
HCBS expenditures per older person	0.119	0.233	0.233	0.217
	(0.154)	(0.180)	(0.180)	(0.183)
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 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 A12: Health Effect of HCBS by Race

	(1)	(2)	(3)
Panel A: self-reported health			
HCBS × White	-0.009 (0.010)	-0.012 (0.010)	-0.013 (0.010)
HCBS × Black	-0.046** (0.022)	-0.046** (0.022)	-0.046** (0.023)
HCBS × Other	-0.078*** (0.029)	-0.077*** (0.029)	-0.078*** (0.029)
$\lambda^{black} - \lambda^{white}$	-0.036* (0.022)	-0.034 (0.022)	-0.033 (0.023)
$\lambda^{other} - \lambda^{white}$	-0.069** (0.029)	-0.065* (0.029)	-0.065* (0.030)
Panel B: mobility limitation			
HCBS × White	-0.008 (0.011)	-0.016 (0.011)	-0.018 (0.011)
HCBS × Black	-0.020 (0.021)	-0.019 (0.021)	-0.017 (0.021)
HCBS × Other	-0.051* (0.031)	-0.049* (0.030)	-0.052* (0.031)
$\lambda^{black} - \lambda^{white}$	-0.012 (0.021)	-0.003 (0.021)	0.001 (0.021)
$\lambda^{other} - \lambda^{white}$	-0.043 (0.031)	-0.033 (0.031)	-0.034 (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 individual drinks and smokes or not. \*\*\* p<0.01, \*\* p<0.05, \* p<0.10.

Table A13: Health Effect of HCBS by Race Continued

	(1)	(2)	(3)
Panel C: depression			
HCBS × White	-0.006 (0.007)	-0.006 (0.007)	-0.007 (0.007)
HCBS × Black	-0.042** (0.017)	-0.040** (0.017)	-0.038** (0.017)
HCBS × Other	-0.049** (0.023)	-0.047** (0.023)	-0.046** (0.023)
$\lambda^{black} - \lambda^{white}$	-0.036** (0.016)	-0.033* (0.017)	-0.031* (0.017)
$\lambda^{other} - \lambda^{white}$	-0.044* (0.023)	-0.041* (0.023)	-0.039* (0.023)
Panel D: cognitive			
HCBS × White	0.142 (0.105)	0.289*** (0.104)	0.273*** (0.104)
HCBS × Black	-0.247 (0.243)	-0.308 (0.244)	-0.320 (0.246)
HCBS × Other	0.395 (0.288)	0.252 (0.285)	0.222 (0.286)
$\lambda^{black} - \lambda^{white}$	-0.389 (0.240)	-0.597** (0.241)	-0.593** (0.243)
$\lambda^{other} - \lambda^{white}$	0.252 (0.291)	-0.037 (0.288)	-0.051 (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 individual drinks and smokes or not. \*\*\* p<0.01, \*\* p<0.05, \* p<0.10.

Table A14: Health Effect of HCBS by Education

	(1)	(2)	(3)
Panel A: self-reported health			
HCBS $\times$ high education	-0.011 (0.012)	-0.012 (0.012)	-0.010 (0.012)
HCBS $\times$ low education	-0.019* (0.011)	-0.022** (0.011)	-0.026** (0.011)
$\lambda^{low} - \lambda^{high}$	-0.008 (0.013)	-0.010 (0.013)	-0.016 (0.013)
Panel B: mobility limitation			
HCBS $\times$ high education	-0.030** (0.013)	-0.033** (0.013)	-0.034*** (0.013)
HCBS $\times$ low education	0.002 (0.012)	-0.007 (0.012)	-0.011 (0.012)
$\lambda^{low} - \lambda^{high}$	0.032** (0.014)	0.026* (0.014)	0.023* (0.014)
Panel C: depression			
HCBS $\times$ high education	-0.006 (0.008)	-0.005 (0.008)	-0.005 (0.008)
HCBS $\times$ low education	-0.014* (0.008)	-0.016** (0.008)	-0.016** (0.008)
$\lambda^{low} - \lambda^{high}$	-0.008 (0.009)	-0.011 (0.009)	-0.012 (0.009)
Panel D: cognitive			
HCBS $\times$ high education	0.311** (0.122)	0.417*** (0.123)	0.398*** (0.123)
HCBS $\times$ low education	-0.016 (0.120)	0.102 (0.118)	0.087 (0.118)
$\lambda^{low} - \lambda^{high}$	-0.327** (0.135)	-0.315** (0.135)	-0.311** (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 individual drinks and smokes or not. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .



Table A15: Health Effect of HCBS without Moving Sample

	(1)	(2)	(3)	(4)
Panel A Outcome: self-reported health				
HCBS expenditures per older person	-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 expenditures per older person	-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 expenditures per older person	-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 expenditures per older person	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
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 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. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .