

ABSTRACT

PATHAK, ADITI SANJIV. The Role of Health and Healthcare Delivery in Elderly Well-Being. (Under the direction of Dr. Melinda Morrill).

This dissertation explores the role of health and healthcare delivery for the well-being of individuals in retirement. The summary section provides an introduction to the themes explored throughout this dissertation. Chapters 1 and 2 consider public policies regarding long-term care delivery methods. The final chapter, chapter 3, explores how employer-provided retirement benefits and health interact to influence the retirement behavior and impact the well-being of the older population.

This dissertation explores two important decisions facing older individuals- long-term care choices and retirement decisions. The findings in this dissertation are relevant to understanding the role of health status and public healthcare programs in well-being of the elderly. These will also help inform policy decisions regarding public provision of long-term services and design of policies incentivizing later retirement.

Expanding funding for home-and-community-based services has become a key priority for state Medicaid programs. Chapter 1 examines the impact of Medicaid home-and-community-based care policies on long-term care utilization. Particularly, I exploit variation in the timing of implementation of Personal Care Services (PCS) benefit and home-and-community-based services (HCBS) elderly waivers between the period 1984 and 2004. Using six waves of the National Long- Term Care Survey, I find that living in a state with the Personal Care Services (PCS) benefit leads to a small reduction in nursing home utilization but induces a relatively larger decrease in informal care use. These results suggest Medicaid costs could increase under the PCS benefit as the program expands access to those previously relying on informal care. Home-and-community-based services (HCBS) elderly waivers reduce nursing home utilization

for individuals with high long-term care needs but increase their informal care use. This suggests that formal home-and-community-based care is likely to be complementary to informal care at higher levels of disability.

The second chapter studies the effects of a more recent policy to expand home-and-community-based services on formal care utilization of the elderly. I investigate the impact of the Money Follows the Person (MFP) grants awarded to states under the DRA on utilization of formal care among the elderly. Using claims data from the Medicare Current Beneficiary Survey, I find that enhanced federal funding for Medicaid home-and-community-based programs leads to modest reduction in nursing home use. On the other hand, there is a significant increase in utilization of home-and-community based services. In addition, I do not find any effect on the utilization of other formal care such as inpatient and outpatient services under both Medicaid and Medicare programs.

The third chapter studies how own and spouse's health interact with financial incentives embedded in pensions to determine retirement among public sector workers. One solution to the increased concerns regarding sustainability of Social Security and defined benefit pensions is to increase eligibility age under these programs. However, workers in poor health may not be able to work longer or may be less sensitive to financial incentives to extend working life. For this purpose, I use a panel dataset that combines administrative records and survey responses for public sector workers in North Carolina. Estimates using pension eligibility for unreduced benefits fail to find a significant difference in responsiveness to financial incentives by health status. However, using peak value incentive that measures financial gain of working until optimal retirement age, I find that individuals in poor health are more responsive to financial incentives. These findings suggest that the concern regarding success of policies incentivizing

later retirements through changes in pension or Social Security incentives may be misplaced.

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The Role of Health and Healthcare Delivery in Elderly Well-Being

by
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DEDICATION

To all teachers, beginning with my mother and father, who have guided and supported me throughout the years. Thank you for helping make my dreams come true.

BIOGRAPHY

After completing my undergraduate degree in Commerce in 2006, I taught economics and accounting to high school students in India. During those years, I realized my interest in pursuing higher education in economics. I began the terminal Master's program in economics at North Carolina State University in 2011. Through the applied econometrics course in the program, I met my advisor and was impressed by her research. I decided to continue into the PhD program. Working with my advisor, I developed interests in Health and Labor Economics. I worked as a research assistant for the entire duration of my PhD, and it has been a tremendous learning experience in research design, data analysis, survey design and programming. My research assistant experience also helped create a solid foundation for independent research in this dissertation. During my tenure at NC State University, I have been actively engaged in research which led to a co-authored publication in the Journal of Pension Economics and Finance.

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I have learnt a lot writing this dissertation, and not just about economics. The most valuable lesson has been the kindness and wisdom of my advisors, family and friends. First and foremost, I want to thank my advisor Melinda Morrill. It has been an honor to be her PhD student. She has taught me, both consciously and unconsciously, about good research. Her enthusiasm for research was contagious and motivational for me, especially during the tough times in the PhD pursuit. I am grateful for her ability to give me a pep-talk when I needed it, and for providing reality checks when I needed those. She forced me to think hard about the motivation behind my research and to make my writing more precise. I hope to carry these lessons in my future work.

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TABLE OF CONTENTS

LIST OF TABLES	vii
LIST OF FIGURES	viii
Summary	1
Chapter 1: The Impact of Medicaid Funding for Home-And-Community-Based Services on Long-Term Care Choices	5
1.1 Introduction.....	5
1.2 Background.....	9
1.3 Medicaid home-and-community-based services.....	12
1.4 Literature.....	14
1.5 Expected effects of policies	17
1.6 Data and empirical strategy	20
1.6.1 Data.....	20
1.6.2 Empirical strategy	22
1.7 Main results.....	24
1.8 Robustness checks	27
1.8.1 Pre-implementation trends.....	27
1.8.2 Contemporaneous shocks.....	28
1.8.3 Heterogeneity by age and severity of long-term care needs	30
1.8.4 Heterogeneity by education level.....	33
1.8.5 Medicaid enrollment	34
1.8.6 Paid care.....	35
1.9 Conclusion	36
Chapter 2: Medicaid Home-and-Community-Based Services and Formal Care Use Among the Elderly	48
2.1 Introduction.....	48
2.2 Literature.....	50
2.3 Money Follows the Person demonstration.....	52
2.4 Data and empirical strategy	54
2.4.1 Data.....	54
2.4.2 Empirical strategy	56
2.5 Results.....	57
2.5.1 Main results.....	57
2.5.2 Robustness checks	58
2.6 Other sources of care	62
2.7 Intensive margin of care.....	62
2.8 Conclusion	63
Chapter 3: Health Status and Retirement: New Evidence from Public Sector Employees 75	
3.1 Introduction.....	75
3.2 Existing Approaches and Issues.....	77
3.3 Data and methodology	82
3.3.1 Data	82

3.3.2 Health variables	83
3.3.3 Financial incentives	84
3.4 Main results.....	86
3.5 Conclusion	88
References	96
Appendices	102
Appendix A.....	103
Appendix B.....	109
Appendix C.....	112

LIST OF TABLES

Table 1.1	State polices for home-and-community-based services	39
Table 1.2	Summary statistics.....	40
Table 1.3	Effect of state Medicaid home-and-community-based policies on care	41
Table 1.4	Robustness check for timing of implementation.....	42
Table 1.5	Sensitivity check for contemporaneous policies	43
Table 1.6	Heterogeneity by age in the effect of state Medicaid home-and-community-based policies on care	44
Table 1.7	Heterogeneity by type of disability in the effect of state Medicaid home-and-community-based policies on care.....	45
Table 1.8	Heterogeneity in the effect of state Medicaid home-and-community-based policies on care by education	46
Table 1.9	Effect of Medicaid home-and-community-based services on Medicaid enrollment and utilization of paid care.....	47
Table 2.1	Money Follows the Person grants 2007.....	68
Table 2.2	Sample means	69
Table 2.3	Skilled nursing facility and home-and-community-based care utilization	70
Table 2.4	Effect of HCBS policies on care utilization.....	71
Table 2.5	Sensitivity check for contemporaneous shocks	72
Table 2.6	Effect of HCBS policies on utilization of inpatient and outpatient care.....	73
Table 2.7	Effect of HCBS policies on intensive margin of care utilization.....	74
Table 3.1	Retirement eligibility of survey respondents	91
Table 3.2	Actively claiming regular benefit in April 2016.....	92
Table 3.3	Retirement status by self-reported health (among eligible individuals).....	93
Table 3.4	Summary statistics	94
Table 3.5	Interaction effects of pension eligibility and health status on probability of retirement	95
Table 3.6	Interaction effects of peak value accrual and health status on probability of retirement	96
Table 3.7	Sensitivity check for interaction effects of peak value accrual and health status.....	97
Table A1.	Sample construction.....	105
Table A2.	Effect of state Medicaid home-and-community-based policies on care for married individuals.....	106
Table A3.	Program interactions in the effects of state Medicaid home-and-community-based policies on care	107
Table A4.	Sensitivity to specification.....	108
Table A5.	Robustness check for timing of implementation of PCS benefit.....	109
Table A6.	Robustness check for policy adoption	110
Table B1.	Determinants of receipt of MFP grants	111

LIST OF FIGURES

Figure 2.1 Proportion of nursing home residents by treatment and control states	65
Figure 2.2 Home-and-community-based services waiver enrollment rates.....	66
Figure 2.3 Placebo estimates of Money Follows the Person grants on nursing home and home health care.....	67
Figure 3.1 Status of individuals in April 2016 who were actively working in March 2014	90

SUMMARY

This dissertation consists of three essays exploring how health and healthcare delivery mechanisms impact public programs such as Medicaid, Medicare and public pensions, and in turn, affect well-being of the elderly. In chapters 2 and 3, I focus on long-term care policies and healthcare utilization among older individuals. The fourth chapter pertains to understanding how financial incentives and health interact to influence the retirement decision.

By 2050, one-fifth of the total U.S. population will be 65 or older, up from 12 percent in 2000 and 8 percent in 1950.¹ Current estimates suggest that more than two-thirds of elderly individuals would require some form of long-term care in their lifetime. Hence, provision of adequate and appropriate long-term services and supports is an important policy concern. A key priority of the states is to ensure access to cost-effective long-term care in the most integrated settings. This has led to an expansion of home-and-community-based long-term services under Medicaid programs in the past three decades.

The Affordable Care Act of 2010 expanded options and substantially increased federal funding for these services. For the first time, in 2015, proportion of long-term care expenditures on home-and-community-based services under Medicaid exceeded that on skilled nursing facilities. Hence, the first two essays analyze the impact of policies expanding home-and-community-based services on care utilization of elderly individuals. In chapter 2, I study the effect of state Medicaid home-and-community-based-services policies on utilization of nursing home and unpaid care from friends and family. Particularly, I focus on two Medicaid policies that provide home-and-community-based services adopted by states between 1984 and 2004. Findings suggest that policies expanding home-and-community-based care reduce nursing home

¹ <https://www.cbo.gov/publication/44363>

utilization to a small extent but improve access to individuals who would have otherwise relied on unpaid and unskilled care. These results suggest that home-and-community-based services may not be a cost-effective option. However, improving access to formal home-based care may improve well-being of both care-recipients and family caregivers.

The next chapter builds on this work to examine a recent policy that awarded federal grants to states to extend home-and-community-based care. In addition to the effect on utilization of long-term care options such as nursing homes, home-and-community-based care policies could impact public health care expenditures and elderly health outcomes by modifying utilization of other services like inpatient and outpatient care. Hence, in this chapter, I analyze the utilization of all formal healthcare services among the elderly. While estimates in chapter 2 report long-term effects of home-and-community-based policies, chapter 3 presents estimates for short-term impacts of expanding these services. The primary findings are consistent with those in chapter 1. Expanding funding for home-and-community-based services have modest effects on nursing home use, but they induce a significant increase in utilization of paid home-and-community-based services.

Expanding funding of home-and-community-based services has become a key policy goal of state Medicaid programs. However, there is little evidence regarding the health outcomes and cost-effectiveness of home-based care. An important reason for this is lack of exogenous variation in long-term care choices. Findings from this dissertation provide evidence of plausible exogenous changes in sources of long-term care. Thus, estimates presented here are the crucial first stage to evaluate whether home-and-community-based care would lower public expenditures and whether such care improves health outcomes for the elderly. Future research analyzing impact of home-and-community-based care expansions on health and public

healthcare expenditures will help inform public long-term care policies. Long-term care choices not only influence well-being of the care-recipients but are also likely to affect health and labor market outcomes of caregivers. Findings from chapter 2 suggest that Medicaid home-and-community-based services policies have a significant impact on utilization of care from friends and family. Thus, to conduct a comprehensive evaluation of these policies, it is important to consider costs and benefits to all stakeholders. Hence, future research will explore these issues to develop a complete understanding of the effects of public long-term care policies.

With an aging population and increased longevity, there are serious concerns about the sustainability of public programs like Social Security, Medicare, as well as, defined benefit pensions. One of the solutions is to extend working life of individuals. However, the success of policies to incentivize later retirement may be hampered if individuals in poor health are less responsive to financial incentives. Hence, the final chapter examines whether own and spouse's poor health alter responsiveness of older individuals to pension financial incentives. In particular, reduced form estimates using eligibility for normal benefits do not suggest significant differences in responsiveness to financial incentives by own or spouse's health status. Estimates based on forward-looking measures of financial incentives provide evidence that poor health reinforces the effects of financial incentives and encourages retirement.

This dissertation studies two of the most important issues facing older individuals- long-term care and retirement decisions, with particular focus on health and healthcare delivery. In three chapters, this dissertation analyzes how public policies related to long-term care or pension provisions may alter behavior of older individuals. Thus, this research presents important insights about the role of health status and public healthcare programs in well-being of the elderly. In addition, the information and findings in this dissertation will help inform policy

decisions regarding public provision of long-term services and design of policies incentivizing later retirement.

CHAPTER 1: THE IMPACT OF MEDICAID FUNDING FOR HOME-AND-COMMUNITY-BASED SERVICES ON LONG-TERM CARE CHOICES

1.1 Introduction

In 2013, Medicaid paid over half of the \$310 billion total long-term care expenditures in the US (Kaiser Commission on Medicaid and the Uninsured, 2015).² With the nation's roughly 78 million baby boomers moving into old age, these expenditures will continue to increase.³ To provide services in the most integrated settings and to control costs at the same time, states increasingly rely on home-and-community-based services in place of the more expensive institutional care. With the same objectives, the Affordable Care Act (ACA) introduced several home-and-community-based care initiatives and substantially increased funding for home-and-community-based services. In 2013, Medicaid expenditures for home-and-community based services reached close to \$75 billion, exceeding those for institutional services for the first time. Increased Medicaid spending under the ACA is a key component of the ongoing debate on health care reform. Thus, it is crucial to assess whether home-and-community-based services lead to better health outcomes and to lower Medicaid costs.

A key assumption behind the expansion of home-and-community-based services is that, as a lower cost alternative to institutional care, these services would help to curb rising Medicaid costs. However, if these policies improve access to those previously receiving informal care or no care but do not divert individuals from nursing homes, the costs of state Medicaid programs may actually grow. Additionally, to understand whether home-and-community-based services lead to better health outcomes, we must examine how these policies alter the pool of those receiving institutional care, informal care and formal home care. For example, even though these

² Individuals need long-term care when a chronic condition, trauma, or illness limits their ability to carry out basic self-care tasks, called activities of daily living (ADLs) such as bathing, dressing or eating.

³ Rising Demand for Long-Term Services and Supports for Elderly People- <https://www.cbo.gov/publication/44363>

policies increase in utilization of formal home-and-community-based care among those who would have relied on no care or informal care, this may be desirable if these programs cater to previously unmet needs. On the other hand, if these policies shift individuals with high long-term care needs away from institutional or residential settings, states would have to design appropriate services to meet their needs in the community.

Thus, to determine if home-and-community based care programs would lead to lower Medicaid costs and improve health outcomes of the elderly, we must first understand how these programs alter the utilization of long-term care options and the case-mix of care recipients. This paper provides causal evidence of expanding funding for Medicaid home-and-community based services on institutional care and informal (unpaid) care.⁴ Particularly, I exploit variation in the timing of implementation across states of two Medicaid programs providing home-and-community-based long-term care- the Personal Care Services benefit (PCS benefit) and the home-and-community-based services elderly waivers (HCBS elderly waivers) to study the impact on utilization of institutional and informal care for single elderly individuals. In addition, this paper provides insights about how these policies might affect the composition of the nursing home, informal care and formal home-and-community-based care population.

Although this paper studies earlier policy reforms, the results inform expected effects of home-and-community-based services expansions under the Affordable Care Act (ACA). The ACA extends the Money Follows the Person demonstration, wherein states receive enhanced federal matching funds to transition Medicaid beneficiaries out of nursing homes into the

⁴ Researchers and policymakers sometimes prefer the term “family caregivers” or “carers” instead of informal care to describe unpaid help provided by friends and family. (<http://blog.aarp.org/2014/05/01/family-caregiving-theres-nothing-informal-about-it/>) In this study, I use the term informal care to indicate unpaid care received from any helper not limited to family and friends.

community. States also receive additional matching funds to make structural changes to their Medicaid programs to increase availability of home-and-community-based services under the Act's New Balancing Incentive Program. Finally, the ACA relaxed some waiver requirements to decrease the administrative burden associated with state expansions of home-and-community based initiatives. To examine the effects of these changes, it would be ideal to exploit variation in the availability or generosity of home-based care as a result of the ACA provisions. However, identifying these effects is difficult due to the concurrent changes to the health insurance market and Medicaid eligibility expansions across several states. Hence, this paper studies the impact of implementation of earlier Medicaid home-and-community based care initiatives to help inform the current debate.

Historically, Medicaid provided long-term care almost exclusively in nursing homes. Consequently, eligible individuals with less severe needs ended up in nursing homes when community-based care would have been less expensive and more desirable. Even at present, states are required to cover nursing facility benefits, while coverage of most home-and-community-based services is optional. The movement towards home-and-community-based services gained support in order to correct this structural bias towards institutional care under the Medicaid program.⁵ Over the years, states have expanded funding for home-and-community-based care by implementing the PCS benefit and HCBS waivers to rebalance the Medicaid long-

⁵ The movement began with a young girl named Katie Beckett, whose mother successfully advocated that providing the ventilator support and other services that Katie needed at home, instead of in the hospital, would be a more humane and cost-effective approach to caring for her. Additionally, since the enactment of Americans with Disabilities Act in 1990, there has been a concerted effort at the state, federal, and community levels to transform one of the Medicaid program's primary roles as an institutional care-focused financing mechanism into a comprehensive and flexible community-based long-term services and supports program. The *Olmstead vs. L.C.* ruling said that the unnecessary institutionalization of people with disabilities is a form of discrimination. State Medicaid programs were then required to provide alternatives so that the elderly and disabled can choose to get their care at home, instead of in state institutions or nursing homes.

http://healthaffairs.org/healthpolicybriefs/brief_pdfs/healthpolicybrief_144.pdf

term care system. Thus, these policies and the provisions under the ACA were designed to provide true long-term care options to consumers and to divert individuals away from long-term care facilities.

However, little is known about these policies' impact on utilization of nursing homes and other skilled care facilities. Most previous studies in this area examine specific states or programs, limiting the generalizability of these results (Hahn et al., 2011; Sands et al. 2012; Kane et al. 2013). Further, studies using national data rely on cross-state variation in Medicaid home-and-community-based care policies, which could lead to biased estimates due to unobserved heterogeneity of the resident population (Laditka 1998; Aykan 2002; Miller 2011). This study addresses these limitations by using within-state variation over time in the availability of the PCS benefit and HCBS elderly waivers. The differences in the services provided under the PCS benefit and HCBS elderly waivers also allow me to explore how these policies might affect the composition of elderly receiving institutional care, formal home-and-community-based care and informal care.

I find that the PCS benefit decreases the probability of utilizing nursing home and residential facilities for care by 1.6 percentage points for single elderly individuals. Further, the PCS benefit induces a comparatively larger (6.2 percentage points) reduction in informal care use. This is coupled with an increase in paid care for helpers by approximately 3.8 percentage points and an increase in the probability of Medicaid enrollment by 3.7 percentage points. Together, these findings suggest that while the PCS benefit may reduce nursing home utilization by a small amount, utilization of paid services under Medicaid programs is likely to rise under the PCS benefit. It is however important to note that the PCS benefit induces a similar sized reduction in informal care utilization for both individuals with high long-term care needs and with low long-

term care needs. Although Medicaid costs could increase, the PCS benefit possibly provides formal services to elderly who would otherwise suffer adverse health outcomes by relying on informal care or no care.

While HCBS elderly waivers are targeted towards individuals at risk of institutionalization, I find no overall effect of these programs on institutional care. However, for individuals with intensive long-term care needs, HCBS elderly waivers do reduce nursing home and residential facility use by 1 percentage point and are associated with a 6.9 percentage point higher probability of receiving informal care. This is consistent with previous findings that formal care is likely to be complementary to informal care at higher levels of disability. Further, these findings suggest that the HCBS elderly waivers are likely to transition or divert individuals with greater long-term care needs, who would require more intensive long-term services and supports.

1.2 Background

Long-term care in the US

Long-term care services include a broad range of health, personal care, and supportive services that meet the needs of individuals whose capacity for self-care is limited because of a chronic illness, disability or other health-related conditions. Long-term care services include assistance with activities of daily living [(ADLs) e.g., dressing, bathing, and toileting]; instrumental activities of daily living [(IADLs) e.g., medication management and housework]; and health maintenance tasks.

The majority of long-term care is unpaid care provided by friends and family caregivers.⁶

⁶ Who Provides Long-Term Care in the U.S.? (2012) <https://aspe.hhs.gov/basic-report/disabled-elderly-and-their-use-long-term-care> This is also true for the study period, that is, between 1984 and 2004 (Burwell and Jackson 1994; Thompson, L., 2004). http://www.thescanfoundation.org/sites/thescanfoundation.org/files/us_who_provides_ltc_us_oct_2012_fs.pdf

There are over 30 million caregivers who provide unpaid care to a person (50+) who needs assistance with everyday activities.⁷ Prior to the growth of formal home care and residential care options, paid long-term care usually referred to nursing home care. However, long-term care in the United States has evolved significantly over the past few decades to include a variety of settings. Individuals may receive long-term care services in the home, in community settings like an adult day services center or in residential settings including assisted living communities and continuing care communities. In 2013, formal long-term care costs in the United States added up to \$310 billion, or over 10 percent of all health expenditures for all ages (Kaiser Commission on Medicaid and the Uninsured, 2015). Medicaid finances a major portion of paid, long-term care services (51 percent), followed by other public sources including Medicare (21 percent) and out-of-pocket payments (19 percent).

Many seniors mistakenly believe that Medicare will pay for all long-term care needs.⁸ However, Medicare only covers post-acute long-term care, which focuses on medically related skilled nursing and therapy services after hospital or outpatient treatment. Medicare covers up to 100 days of skilled nursing facility care, but only after a hospital stay of at least three days and only for people with a daily need for skilled care, such as intravenous injections or physical therapy. Additionally, Medicare home care benefit pays only for skilled care visits, in other words, services performed by a medical professional. Custodial care, such as bathing, feeding and getting in and out of bed, is covered only while the care recipient also needs skilled care.⁹

⁷ Caregiving in the U.S. 2015

http://www.caregiving.org/wp-content/uploads/2015/05/2015_CaregivingintheUS_Final-Report-June-4_WEB.pdf

⁸ According to a 2015 survey conducted by the Associated Press-NORC Center for Public Affairs Research, 34 percent of Americans assumed Medicare would cover ongoing nursing home care, while another 27 percent were unsure. Available at <http://www.longtermcarepoll.org/Pages/Polls/long-term-care-in-america-americans-outlook-and-planning-for-future.aspx>

⁹ About 20 percent of Medicare home health visits include home aide visits, for patients who also require skilled care such as nursing care (95 percent of visits) and physical therapy visits (approximately 75 percent of visits). Also,

Medicaid is the largest payer of long-term care services, with long-term care expenditures under the program totaling close to \$158 billion in 2015.¹⁰ Medicaid covers both medically necessary long-term care and personal care services. Eligibility for Medicaid coverage requires that an individual's income and assets fall below defined thresholds. Because Medicaid is jointly funded by the federal and state governments, states have some flexibility in determining the level of generosity of their programs. State Medicaid programs are required to cover nursing facility services, while most home-and-community-based services are optional.

The ACA enacted significant opportunities for states to extend Medicaid-financed home-and-community-based services, leading to substantial expansion of these services in the last few years. Three provisions, the Balancing Incentive Program (BIP), the Community First Choice (CFC) state plan option, and the health home state plan option, offer states enhanced federal Medicaid matching funds. Furthermore, The ACA also expanded two programs established under the Deficit Reduction Act of 2005 (DRA). The Act extended the Money Follows the Person (MFP) Rebalancing program through 2016. Under the MFP states receive federal grants to transition individuals out of institutional settings. The ACA also expanded the scope of services and eligibility under the section 1915(i) HCBS state plan. This provision established a pathway to receive home-and-community-based care without a beneficiary having to meet institutional level of care criteria.¹¹

In this study, I examine the impact of Medicaid home-and-community-based programs that were in place prior to the ACA. There are three programs under Medicaid that provide home-

significant portion of home aide visits go to people with temporary, not long-term, needs for personal assistance. <https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/Archives/MMSS/2013.html>

¹⁰ For more information, see Medicaid Long-Term Services and Supports, FY 2015 report available here- <https://www.medicaid.gov/medicaid/ltss/downloads/reports-and-evaluations/ltssexpendituresffy2015final.pdf>

¹¹ More information about home and community based services authorities under ACA and state activities to expand these options here- <https://kaiserfamilyfoundation.files.wordpress.com/2013/04/8079-02.pdf>

and-community-based care- the mandatory home health benefit, the personal care services optional state plan benefit (PCS benefit) and Section 1915(c) waivers. Section 1.2 describes these programs in detail.

1.3 Medicaid home-and-community-based services

All states are required to cover some home health services in their Medicaid plans. Consequently, Medicaid mandatory home health services are available, when medically necessary, to all Medicaid-eligible individuals in every state. The home health benefit has three mandatory elements- (1) part-time or intermittent nursing services (2) home health aide services and (3) medical supplies, equipment and appliances suitable for use in the home. As these services must be available and comparable across all qualifying beneficiaries, states usually offer limited services under the mandatory benefit. The most widely used programs to provide home-and-community-based services to the elderly are the PCS benefit and Section 1915(c) waivers.

Personal care services state plan benefit (PCS benefit)

Since 1975, states were allowed to offer an optional state plan benefit for providing personal care services, in other words, assistance with ADLs and IADLs. However, if a state chooses to offer this option, it must meet the ‘statewideness’ and ‘comparability’ criteria under federal regulations. This implies that personal care services must be available to all Medicaid beneficiaries; the state cannot restrict availability to certain geographic areas or to particular categories of beneficiaries such as the elderly or the disabled. Over the last 30 years, states have introduced this benefit at different points in time. Prior to 1984, 21 states offered a PCS state plan option which increased to 30 states by 2004. Currently 31 states have implemented the PCS

state plan benefit.

Section 1915(c) home-and-community-based services waivers (HCBS elderly waivers)

In 1981, section 1915(c) of the Social Security Act allowed states to offer home-and-community-based services through waiver programs. These programs waive the comparability and statewideness requirements under Medicaid law. Effectively, states can use these programs to target home-and-community-based services to categories of beneficiaries (e.g., the elderly or the physically disabled) and limit provision of services to certain geographic areas. Since waivers grant substantial flexibility to states, there has been a tremendous growth in HCBS waivers.

Nearly all states and the District of Columbia offer services through HCBS waivers – currently more than 300 HCBS waiver programs are active nationwide. States implement HCBS waivers for different subgroups of beneficiaries (e.g., waivers for children with special health care needs, HIV/AIDS waivers, intellectual/developmental disability (I/DD) waivers and elderly waivers).

Seniors can receive home-and-community-based care through different adult waivers operational in the state. In this study, I focus on waivers specifically targeted towards the elderly. Elderly waivers were among the earliest waivers to be implemented by most states beginning 1981.

Additionally, most elderly waivers are available statewide as they cater to the age groups who are more likely to require home-and-community-based care. Thus, we would expect a larger impact of these programs in our data.

Table 1.1 shows the adoption of PCS optional benefit and HCBS waiver programs between 1984 and 2004. Since states have much flexibility with respect to HCBS waivers, we can see that states have been slow to adopt the PCS state plan benefit but there was a rapid growth in number of HCBS elderly waivers during the study period. During the study period, 9 states implemented the PCS state plan benefit and 36 states introduced an HCBS elderly waiver.

1.4 Literature

Elderly individuals in the U.S. who are unable to live independently have a variety of care options other than a nursing home including home health care, assisted living facilities, or informal care from family and friends.¹² The incentives to choose among these options relate to many factors including the individual's health, family dynamics and income and wealth. The generosity of public programs may also explain the choice of long-term care sources of the elderly.

The literature has found conflicting and inconclusive evidence on the causal effect of home-and-community-based care receipt on nursing home risk, primarily due to endogeneity issues. The Channeling demonstration, which expanded home-and-community-based services to individuals with long-term care needs, provides an opportunity to assess this relationship through randomized evaluation. Studies using these data do not find any effect of publicly financed home-and-community-based care on care utilization (Wooldridge and Schore 1988; Kemper et al. 1986; Rabiner et al. 1994). However, the Channeling sample was particularly selected, as the demonstration provided services to frail individuals who lacked informal supports. In particular, it has been shown that on a national level, elderly that would have met Channeling functional limitation criteria were much less likely than Channeling participants to live alone (Applebaum, 1988). Therefore, if Channeling participants were also less likely to change their care sources than a population of similarly impaired individuals at the national level, it may be difficult to generalize the results from the experiment.

Few studies examine the effect of Medicaid home-and-community-based care policies on

¹² Researchers and policymakers sometimes prefer the term “family caregivers” or “carers” instead of informal care to describe unpaid help provided by friends and family. (<http://blog.aarp.org/2014/05/01/family-caregiving-theres-nothing-informal-about-it/>) In this study, I use the term informal care to indicate unpaid care received from any helper not limited to family and friends.

nursing home utilization. Furthermore, the majority of studies focus on evaluating Medicaid programs in one or few states (Hahn et al., 2011; Sands et al. 2012; Kane et al. 2013) or studying the response of Medicaid eligible individuals (Mitchell et al. 2006; Guo et al. 2015), limiting the generalizability of results. Studies using data on a representative sample of all elderly provide mixed evidence on the effect of these policies on nursing home use. Laditka (1998) and Aykan (2002) examine specific strategies that states use to control long-term care utilization (such as Medicaid eligibility criteria and availability of Medicaid HCBS waivers) and find no association with nursing home admission. On the other hand, Muramatsu, et al. (2007) and Miller (2011) use state level HCBS expenditures and conclude that increase in state's commitment to HCBS leads to significant reduction in nursing home utilization. Muramatsu, et al. report that a 10 percent increase in a state's share of home-and-community-based services in total long-term care expenditures reduces the risk of nursing home admission by approximately 3 percent among childless seniors. However, these studies rely on cross-state variation across Medicaid policies in a single period, which could lead to biased estimates due to unobserved heterogeneity of the resident population. For example, states where the older population has higher preference for nursing home care may offer less or more generous home-and-community-based services policies. Additionally, interpreting the effects of state level expenditures on long-term care choices is difficult due to potential reverse causality. This paper improves upon previous studies by using within-state variation in home-and-community-based services and national sample of single elderly.

Several theoretical models predict that informal and formal care are substitutes (Greene 1983; Moscovice, Davidson and McCaffrey 1988; Penning 2000; Van Houtven and Norton 2004; Agree, et al. 2005). Others model complementarities between the two types of care

(Cantor 1979, 1991; Litwak 1985; Litwak and Messeri 1989; Litwak, Messeri, and Silverstein 1990; Cantor, Brennan, and Sainz 1994). Previous research finds evidence for both hypotheses and does not definitively establish the relationship between informal and formal home care. Van Houtven and Norton (2004) and Bolin et al. (2008) find that an increase informal care hours significantly reduces the probability of receiving formal home care. In addition, studies examining the effect of sharp declines in Medicare reimbursement of home health find support for the substitution hypothesis. Using regional variation in overall decreases, Orsini (2010) and Engelhardt, et al. (2010) find significant reductions in independent living. Golberstein (2009) finds higher informal care utilization among community dwelling elderly. These studies suggest substantial substitution between formal home care and informal care. However, the Medicare home health benefit is limited to post-acute care, implying that in-home services are available only to individuals who need skilled nursing services and are homebound. Thus, these results may not reflect long-term care choices of the elderly. It is essential to compare these findings to the effect of Medicaid home-and-community-based care policies to improve our understanding of seniors' response to availability of formal home care. To the best of my knowledge, this is the first study to examine the effect of Medicaid home care policies on informal care use.

There are a few studies that suggest that care recipients need both forms of care simultaneously (Moscovice, Davidson, and McCaffrey 1988; Litwin and Attias-Donfut 2009), especially as levels of disability increase (Bonsang 2009). This is plausible since beyond a certain point in the need for care, such as becoming bed ridden or having advanced Alzheimer's, an informal caregiver may not be able or willing to provide care, suggesting that informal and formal care are not substitutes in some cases. As Van Houtven and Norton (2004) point out, even when the two types of care occur simultaneously, informal care may be a substitute for ADL care

but a complement for higher skilled tasks such as physical therapy. Using two separate policies that offer personal care and skilled care, this study contributes to the literature by studying the heterogeneity in the relationship between informal and formal home care by severity of long-term care needs.

1.5 Expected effects of policies

Survey evidence suggests that seniors desire to stay in their own homes for as long as possible (The United States of Aging Survey, 2012; AARP and Metlife Survey on the Future of Retirement, 2014). However, seniors may move to long-term care facilities due to lack of access to home care (formal or informal) or intensive medical needs that cannot be met in community settings. If the elderly have strong preferences for living in the community, we would expect the PCS benefit and HCBS elderly waivers to allow individuals to substitute away from long-term care facilities. However, if individuals use nursing home care as a last resort, the response to subsidizing home-and-community-based care may not be large.

The PCS benefit is a state plan option, thus states must provide these services to all Medicaid eligible individuals. In order to provide comparable services to all categorically eligible individuals, states cannot cap enrollment in the PCS benefit or establish waiting lists. As the name suggests, the personal care services (PCS) benefit only covers personal care services and household chores. The program does not provide coverage for any skilled medical care in the community settings. Thus, we predict that the introduction of a PCS benefit would decrease facility-based care utilization only for individuals with less intensive long-term care needs. We anticipate seeing a decrease in nursing home care only for those requiring limited personal care and whose medical needs may be met on an outpatient basis. Furthermore, most states impose service restrictions in the form of weekly limits on hours. Thus, individuals who require round

the clock care or assistance with ADLs at full dependence level are unlikely to be affected by introduction of the PCS benefit.

HCBS waivers (including elderly specific waivers), on the other hand, are specifically targeted towards individuals at risk of institutionalization and nursing home residents. In addition to personal care services, HCBS waivers offer health services like skilled nursing care, physical therapy and hospice care. There are, however, limited slots in each HCBS waiver and states usually have waiting lists for these programs. In 2012, nearly 524,000 people were on HCBS waiver waiting lists nationally, with the average waiting time exceeding two years. Waiting lists vary both across states and within states among waiver target populations.¹³ In addition, HCBS waivers require that the participants be nursing home certifiable and cost neutral. In other words, to receive matching federal funds for waiver services, states must ensure that waiver participants require a level-of-care comparable to nursing home care and the costs of providing such care in the community do not exceed institutional care costs. While the HCBS elderly waivers offer a mix of services comparable to those provided by nursing homes, the effect of HCBS elderly waivers on nursing home use of the elderly may be limited due to stringent restrictions. We predict that the HCBS elderly waiver programs should affect nursing home utilization for individuals with high personal care needs or non-intensive medical treatment needs, but that the effect may be small on average due to limited availability and waiting lists. Previous studies that specifically study the effect of availability of HCBS waivers find no association with nursing home admission (Laditka 1998; Aykan 2002).

Theoretical models put forth competing propositions regarding the relationship between

¹³ For more information, see Kaiser Commission on Medicaid and the Uninsured, Medicaid Long-Term Services and Supports: An Overview of Funding Authorities (Sept. 2013), available at <http://kff.org/medicaid/fact-sheet/medicaid-long-term-services-and-supports-an-overview-of-funding-authorities/>

informal care and formal care. Although these models do not distinguish between the types of formal care, these can provide useful insights regarding the link between formal home care and informal care. The substitution hypothesis maintains that the entry of formal care into the care-giving network weakens and eventually replaces informal care (Greene 1983; Moscovice, Davidson and McCaffrey 1988; Penning 2000; Van Houtven and Norton 2004; Agree et al. 2005). According to the Task-specific theory championed by Litwak and others, formal and informal care have different structural characteristics and cannot function as substitutes (Litwak 1985; Litwak and Messeri 1989; Litwak, Messeri, and Silverstein 1990). These characteristics include proximity to caregivers, the caregivers' technical skill, commitment, and motivation. Individuals choose care providers based on a match between potential caregiver and the characteristics of the specific task with which assistance is needed. Examining the characteristics of the PCS benefit and HCBS elderly waivers in the context of these competing ideas will help us anticipate how they will affect the decision to receive informal or unpaid care.

Informal care usually refers to personal care and help with household chores, which are covered services under both PCS benefit and HCBS elderly waivers. In this case, availability of these programs is likely to reduce seniors' reliance on informal care. However, since HCBS elderly waivers also cover skilled care, according to the Task-specific theory care recipients will use these services in conjunction with informal help. For example, skilled medical services under HCBS elderly waivers may supplement personal care assistance from informal sources. This could imply an increase in the amount of formal services received by the elderly person without substituting for care provided by family. In addition, since HCBS elderly waivers assess eligibility based on severity of long-term care needs, they might lead to higher identification of previously unmet needs. If this is true, we would expect HCBS elderly waivers to be

complementary to informal care and we may see an increase in the utilization of unpaid care. We can therefore expect that the introduction of PCS benefit will decrease the use of informal care sources. But, the effect of HCBS elderly waivers on informal care usage is ambiguous.

Finally, states may (and generally do) set higher financial eligibility standards for waivers than for regular Medicaid coverage. This means individuals who would not otherwise be eligible for Medicaid home-and-community-based care services may be able to become eligible for waiver services if they meet functional eligibility criteria. Policymakers are concerned that greater reliance on publicly financed home-and-community-based care would give rise to a phenomenon referred to as the "woodwork effect". According to the argument, when publicly funded home-and-community-based care becomes available, many older individuals who did not receive any formal services or who would have relied on family caregivers, would come forward to claim these attractive home-and-community based care benefits. Generous financial eligibility requirements under HCBS waivers may expand the population of home-and-community-based care users to include those not receiving any formal long-term care. Thus, nursing home rates may remain unchanged in response to HCBS elderly waivers, but the number of people receiving some long-term services is likely to increase.

1.6 Data and Empirical Strategy

1.6.1 Data

The main data source for this paper is five waves of the National Long-Term Care Survey¹⁴ between 1984 and 2004. The NLTCs is a nationally-representative longitudinal sample both of the community and of institutionalized populations. Sample persons age in to the sample once they reach 65 years of age and stay in the survey until they either die or are lost to attrition. A

¹⁴ More information about the survey can be found here- <http://www.nltcs.aas.duke.edu/overview.htm>

significant strength of the NLTCS is its renewing panel design in which respondents who were determined to be chronically disabled on at least one of nine personal care tasks (activities of daily living [ADLs]) and at least one of seven household management tasks (instrumental activities of daily living [IADLs]), as well as a subsample of nondisabled respondents, are followed from the time they were screened into the study. Because the NLTCS has been repeatedly replenished during each wave with a supplementary sample of 65 to 69-year-olds to replace those who died between surveys, it continues to be representative of the entire elderly Medicare beneficiary population. The survey provides detailed cross-sectional weights to account for oversampling of the population over 85 and the fact that the survey only follows a sample of the non-disabled elderly into following waves. The NLTCS is a rich data source on demographics, disability measures and caregiver characteristics of the elderly.

Appendix Table A1 describes the criteria for constructing the analysis sample. I keep individuals between the ages of 65 and 115 for whom information on living quarters, marital status and education are not missing. I drop three states- Arizona, Rhode Island and Vermont from the analysis. These states offer Medicaid home-and-community-based services under section 1115 managed care waivers which greatly differ from the section 1915(c) HCBS waivers that majority of the states have.

The primary sample consists of single individuals. I restrict the focus of the analysis to single elderly because their long-term care decisions are likely to indicate their own long-term care needs. Because married individuals usually live together, it is possible that individuals may live in a residential care facility to be together with their spouse, but they themselves may not need any assistance. In addition, previous studies show that married individuals generally rely on their spouses for their long-term care needs and are unlikely to opt for other sources of care. This is

evident from low utilization rates of nursing home and residential care facilities and high informal care use among the subsample of married individuals. Less than 1 percent of the married individuals live in a nursing home, 1.3 percent if we look at nursing home and residential care combined. Furthermore, 27 percent of the married sample receives informal care. Spouse is the primary source of long-term care for married individuals, making them unlikely to switch to other sources of care.¹⁵ Among all elderly, more than 60 percent are single and close to 80 percent of the single individuals are widowed.

Table 1.2 reports summary statistics for the NLTCs sample of single individuals aged 65 and over. Approximately 6 percent individuals live in a nursing home and an additional 3% live in residential care facilities. About a fifth of the sample received unpaid care from friends and family. Not shown here, informal caregivers include adult children (14 percent), other relatives (6 percent) and friends (6 percent). About 49 percent of sample resides in a state with the PCS optional benefit and 60% of the sample lives in a state with an HCBS elderly waiver program. The sample is mainly female, white and widowed. Nearly a fourth of the sample faces difficulty with at least one ADL, and among those, on average they had 2.7 ADLs.

1.6.2 Empirical Strategy

Most previous studies analyzing the effect of publicly subsidized home care on institutional care utilization restrict attention to nursing homes and intensive care facilities. In addition to these traditional long-term care facilities, over the last few decades, seniors have been increasingly relying on residential care facilities like assisted living and continuing care communities. In this study, I use two measures of facility-based care utilization to include the range of long-term care facilities available to the elderly. The restrictive measure is an indicator

¹⁵ Appendix Table A2 explores the effect of these policies on married individuals and finds no effect of policies on institutional care or informal care use.

for whether an individual resided in a nursing home or intensive care facility at the time of the survey. The broad measure includes both individuals living in nursing care and residential care facilities. The NLTCs also includes detailed information about all caregivers and their relation to the sample person. The measure of informal care I use is whether the individual receives unpaid help with ADLs from family members or friends, irrespective of whether they reside with the care provider.¹⁶

Using individual level data, I estimate the following model specification-

$$\Pr(Y_{ist} = 1) = \Phi(\alpha_0 + \alpha_1 PCS_{st} + \alpha_2 HCBS_{st} + \alpha_3 X_{ist} + \delta_s + \delta_t + \delta_s * trend_t)$$

in which i indexes individual, s the state, and t the year. PCS and HCBS denote whether the state had the corresponding Medicaid home-and-community-based services program in year t .

Y_{ist} is either an indicator for residing in a long-term care facility or for receiving informal care.

X_{ist} is a set of individual characteristics.

The vectors δ_s and δ_t are state and year fixed effects. The year fixed effects, δ_t , control for changes in institutional and informal care use in a given year that are common to all states.

Pooled cross-section estimates may confound underlying differences between states such as long-term care infrastructure in states, morbidity of the elderly population and household structure. State fixed effects account for the fact that utilization of institutional care and informal care had always been different in states implementing the PCS benefit and HCBS elderly waivers. By adding state-fixed effects, the estimates are identified from the states that adopted

¹⁶ The NLTCs asks whether the person received any help with ADLs. Further questions verify the relationship of the helper with the care recipient and if they are paid to provide such help. To measure informal care use, I use the following questions-

- a) *You mentioned that (name of helper) helps . . . Is (name of helper) a relative, friend, someone hired to help . . ., someone from helping organization, or someone else?*
- b) *How is (name of helper) related to . . .?*
- c) *Is (name of helper) paid to help . . .?*

policies holding all time-invariant characteristics of those states constant. However, states may have different underlying trends in the outcomes. Additionally, there could be a gradual change in the preferences of the older population about long-term care options among states over the study period. Hence, in addition to state and year fixed effects, all specifications also include linear state-specific time trends ($\delta_s * trend_t$). By including these in the model, I control for the possibility that states where there is generally growing/shrinking demand for alternate sources of care (institutional and unpaid care) are the ones where policies are changed to facilitate or mitigate utilization of facility based and informal care. Controlling for these time trends allows us to compare the effects of the policies relative to the average trend for that state. For all specifications, I use a probit model and cluster the standard errors at the state level. All estimations are adjusted using person weights.

An important concern in identifying the effect of home-and-community-based care policies on care is if states choose to implement these policies due to unobserved factors that may be correlated with the outcomes. For example, states might adopt home-and-community-based care policies due to excess demand for long-term care facilities or due to pressure by advocacy groups for the elderly. In this case, these policies may be endogenous to long-term care choices and lead to biased estimates. In Section 1.8.1, I test for this possibility using data from pre-implementation years for states that introduced these policies during the study period and find no evidence of endogenous policy adoption.

1.7 Main Results

Table 1.3 presents the main results of the regression analysis of the effect of the PCS benefit and HCBS elderly waivers on alternate sources of care. The sample includes single individuals over age 65. The first two columns present estimates for care received in a nursing home or in a

nursing home or residential care facility. The third column estimates the impact of the policies on informal, unpaid care. If home-and-community-based services are a substitute to these alternative sources of care, we would anticipate a negative coefficient on both residential and nursing home care and on informal care. On the other hand, if these services are complementary to alternative sources of care we would anticipate a positive coefficient. All columns report the marginal effects at the mean from a probit regression.

Table 1.3, columns (1) and (2) report estimates for two separate measures of facility based care described in section 4.2, nursing home care and nursing home or residential care, respectively. Estimates imply that the introduction of a PCS program induces a small but significant decrease (0.6 percentage points) in individuals living in nursing homes. This is about 9 percent of the mean of 6.5 percent. For the broader definition of nursing home, which includes residential care facilities, the introduction of the PCS benefit lowers the probability of living in such facilities by 1.6 percentage points. This estimate is approximately 18 percent of the sample average of 8.7 percent. Although the point estimate is small, this represents a meaningful impact in economic terms. As the PCS benefit only covers personal care services, these results suggest that many older individuals might reside in long-term care facilities for custodial care and can be transitioned to other sources of care under alternative funding arrangements.

On the other hand, in the first two columns of Table 1.3 the estimated coefficient on HCBS elderly waivers are not statistically significant. This is consistent with earlier findings by Laditka (1998) and Aykan (2002) and indicates that elderly-specific waivers do not statistically significantly alter utilization of facility-based care. This result is also consistent with our hypothesis that waitlists and cost restrictions render HCBS elderly waivers ineffective as a substitute to facility based care.

Table 1.3, column (3) presents results from a regression on informal care use. Informal care is defined as unpaid care from any source. The PCS benefit is associated with a significant reduction of informal care use among the elderly. Estimates imply that living in a state with a PCS benefit is likely to lower the probability of any unpaid care from friends and family by 6.2 percentage points, approximately 32 percent of the mean of 19.5 percent. These large effects of the PCS benefit on unpaid care receipt suggest that individuals are likely to substitute away from unpaid care from friends and family for formal (paid) services. Thus, while the PCS benefit may reduce nursing home utilization by a small amount, utilization of paid services under Medicaid programs is likely to rise under a PCS benefit.

Again, the estimated coefficient on HCBS elderly waivers is not statistically significant. This result is surprising since HCBS elderly waivers provide a broader range of services as compared to the PCS benefit. However, as waivers are specifically targeted towards individuals with more intensive needs, the average effect could hide heterogeneity at important margins of care needs such as age and severity of ADLs. Section 1.8.3 investigates this heterogeneity in detail.¹⁷ The coefficients on control variables are consistent with previous findings. Both nursing home and informal care utilization increases with age, which is expected since most long-term care is needed at older ages. Availability of informal care, proxied by number of adult children, reduces the probability of living in a nursing home or a transitional facility and significantly increases the probability of receiving informal help. Note that the sample includes single individuals over age 65, hence availability of informal care by adult children is a significant predictor of facility-

¹⁷ Availability of both programs could have a larger effect on care sources compared to states that implement only one of the two policies. Appendix Table A3 explores interaction effects between the two programs. The availability of both programs has a marginally significant effect on nursing home and residential care use. Thus, the effect of the PCS benefit on nursing home and residential care use is concentrated among states that also had HCBS elderly waivers in place.

based care and informal care. Individuals who have a difficulty with at least one ADL are significantly more likely to require skilled facility care or informal care.¹⁸

1.8 Robustness checks

1.8.1 Pre-implementation trends

The discrete specification does not provide a sense of the dynamics of the effect of home-and-community-based care policies. The overall results suggest that the PCS benefit is associated with a significant decrease in utilization of both facility-based care and informal care. However, if the demand for these alternate sources of care leads to the adoption of these programs, the above results may hide this reverse causality. For example, states where demand for nursing home care is low, state Medicaid programs may have greater funds to invest in home-and-community-based services and may in turn offer the PCS benefit under their state plan. If this is true, the estimates we observe would not reflect the effect of state policies on long-term care choices. Thus, we need to study the pre-implementation and post implementation trends in the outcome variables between treatment and control groups.

However, as the NLTCs was conducted every five years, I do not have continuous data to estimate a trend for states implementing these programs. Instead, I use the time to adoption for states that implemented the PCS benefit during the study period to explore the dynamics. Specifically, I create two lead variables- 1-3 years prior to adoption and 4-5 years prior to adoption, and two lag variables to indicate 1-3 years after adoption and 4-5 years after adoption. Thus, I group states that are between 1-3 years and 4-5 years from PCS benefit introduction from

¹⁸ Since health measured by ADLs is a potentially endogenous variable, Appendix Table A4 shows effects of these policies excluding the dummy variable for difficulty with any ADL. While there is little effect on the results of informal care use, there is a dramatic increase in standard errors of policy coefficients in nursing home regressions. This reflects the importance of health variables in explaining nursing home utilization, the partial R-squared associated with ADL indicator is 0.27. Thus, loss of precision due to excluding this measure may be a more severe consequence compared to potential concerns about endogeneity of ADL indicator.

survey years to ensure there is at least one state in each category. If states adopt these policies based on unobserved factors that may be correlated with facility based and informal care, we would find statistically and economically significant coefficients on the lead variables.

Coefficients close to zero would provide some confidence in our previous results. Additionally, the coefficients on the lag variables will provide some insights into whether the effects of these policies are immediate or gradual and whether they dissipate over time.

Table 1.4 adds leads and lags for the PCS benefit in addition to all the control variables from Table 1.3. We can see that estimated coefficients on lead variables are small and insignificant for both lead variables for all outcomes. The effect of the PCS benefit on both measures of facility-based care utilization is higher during the first three years of adoption. However, we observe that the effect of the PCS benefit on informal care is delayed, the estimate for 4-5 years after the PCS benefit is introduced suggests a 8.2 percentage point reduction in the probability of receiving unpaid care. This is plausible since seniors may be more comfortable receiving care from their loved ones as compared to professional caregivers. Hence, many individuals may initially be reluctant to substitute formal services in place of informal care in response to the introduction of the PCS benefit. While the strategy I employ is not ideal, as the lead and lag variables are identified off of states who implemented policies during these intervals, these results alleviate the concern of policy endogeneity to some extent.¹⁹

1.8.2 Contemporaneous shocks

Another identifying assumption of the difference-in-differences strategy is that no

¹⁹ Appendix Table A5 adds a dummy variable in the data year prior to PCS implementation. The results are similar. These coefficients now reflect the pre-policy differences up to 5 years before implementation. Further, Appendix Table A6 estimates state-level regressions of adoption of the PCS benefit and HCBS elderly waivers on factors that could influence the states' decision to introduce these policies. I use data between 1991-2004 and find no effect of on state characteristics on the decision to adopt these programs.

contemporaneous policies should differentially affect treatment and control groups. One such policy is the cap on the average reimbursement per patient that home care agencies were entitled to receive when treating elderly Medicare patients under the Balanced Budget Act (BBA) 1997. McKnight (2006) shows that due to the regional component of the reimbursement caps, states that had similar pre-policy utilization of home health care may face different levels of restrictiveness. Following these changes, there was substantial reduction in Medicare home health care utilization between 1997 and 1999 in all states, but states that were subject to more restrictive caps experienced greater reductions. Further, in 2000 Medicare switched to Prospective Payment System (PPS), a method of reimbursement in which Medicare payment is made based on a predetermined, fixed amount. This amount was based on the national average cost of providing care in 1997, not on actual home health agency cost. While the PPS payments do not create variation in reimbursements and visits across states, states that faced a greater (or smaller) degree of restrictiveness under the earlier changes may also respond differently to these changes. If states choose to adopt or defer adoption of Medicaid home-and-community-based services policies due to the restrictiveness of Medicare home health care, my estimates would be biased. In addition, if control states were exposed to higher or lower reimbursement caps than treatment states, they may not provide a good counterfactual for trends in the absence of Medicaid policies.

To address these concerns, I control directly for changes in Medicare home health visits due to the BBA (1997) and the adoption of the PPS reimbursement. McKnight (2006) provides evidence that the restrictiveness of the reimbursement caps led to reductions in the number of visits for Medicare beneficiaries. Hence, I add Medicare home health visits per person to the specification in Table 1.3. Unfortunately, I was not able to obtain data on Medicare home health

visits before 1994. Hence, I estimate these regressions for the last three waves of the NLTCs. Due to data limitations, I do not include state-specific time trends in these regressions.

Table 1.5 presents these results, where the specification in last three columns controls for Medicare home health visits per person. The first three columns are identical to Table 3, except these are now estimated for the last three waves of the data. The effects of the PCS benefit and HCBS elderly waivers are similar to those in Table 1.3. Living in a state with the PCS benefit is associated with a 0.5 percentage point and a 2.3 percentage point reduction in probability of nursing home utilization and nursing home and residential facility utilization. These represent a 9 percent and a 24 percent decrease relative to the mean of 6.4 percent and 9.5 percent respectively. The coefficient on the PCS benefit suggests a 4.7 percentage point decrease in probability of informal care use

Columns (3)-(6) present regression results controlling for Medicare home health visits. Consistent with McKnight (2006), we see no effect of Medicare home health visits on nursing home or residential care use. However, the coefficient on Medicare home health visits in column (6) is negative and almost significant at the 10 percent level. An additional Medicare visit per person reduces informal care use by approximately 0.3 percentage points.²⁰ Importantly, we can see that the effects of the PCS benefit remain stable with the inclusion of Medicare home health visits. These results provide some confidence in the earlier findings.

1.8.3 Heterogeneity by age and severity of long-term care needs

Long-term care needs increase with age and severity of disability. Thus, we can expect that publicly financed home-and-community-based care would mainly affect care choices of seniors in older age groups and who experience difficulties with ADLs. Tables 1.6 and 1.7 explore these

²⁰ Orsini (2010) reports that decline in reimbursement of one visit per user increases the fraction of elderly Medicare beneficiaries that live in shared living arrangements by 0.19 percentage points.

sources of heterogeneity through which the effect of the PCS benefit and HCBS elderly waivers could work. We can see that effects of the PCS benefit on both measures of facility-based care are concentrated among individuals over 75. Columns (1) and (2) of Table 1.6 show that the effects are fairly consistent across all older age groups for nursing home and residential care facilities. Estimates suggest that HCBS elderly waivers are associated with statistically and economically significant reduction in facility-based care utilization among the youngest group. For 65-69 year-olds, the estimated coefficients on HCBS elderly waivers imply a 1.5 percentage point reduction in nursing home care and a 2.8 percentage point reduction in nursing home and residential facility utilization. These represent about 23 percent and 32 percent decreases relative to the means of 6.5 percent and 8.7 percent, respectively. Since these individuals are younger, facility-based care utilization in this age group is likely to indicate greater health care needs as opposed to custodial care needs. As HCBS elderly waivers include skilled medical services, we expect that these programs would alter the choices of individuals who require such care. HCBS elderly waivers, however, do not have a significant impact on facility-based care for older age groups.

When we consider informal care, point estimates suggest that the introduction of the PCS benefit induces a decrease in unpaid care receipt for all age groups, though we do not see a statistically significant effect for the individuals below age 75. There is 4.3-8.5 percentage point decrease in informal care use for individuals ages 75 and over in response to the introduction of the PCS benefit. Although we do not observe a statistically significant effect of HCBS elderly waivers on informal care use, the coefficients suggest that these programs are likely to alter care utilization among seniors between the ages of 75 and 84. HCBS elderly waivers are associated with a 3.8 percentage point reduction in utilization of unpaid care for individuals in this age

group.

Given the differences between services offered under the PCS benefit and HCBS elderly waivers (details in Section 1.4), we expect that the two programs cater to separate groups of the elderly by long-term care needs. Particularly, we expect that the PCS benefit would provide a substitute to individuals with low needs and HCBS elderly waivers cater to individuals who have non-intensive medical needs or relatively higher personal care needs. In Table 1.7, I test this hypothesis by interacting the policy variables with categories of ADLs. Particularly, I group ADLs based on how much assistance an elderly individual who faces difficulty with those ADLs would need. For example, eating and toileting are essential activities, and individuals who face difficulties with these are likely to be sicker than an average individual. Additionally, seniors who require assistance with these ADLs are likely to need care for several hours in the day. Accordingly, I classify difficulty with eating and toileting as high dependence ADLs, and bathing, dressing and walking around the house as low dependence ADLs. Any individual who has both a high dependence ADL and a low dependence ADL is classified into the high dependence category. We expect that the PCS benefit and HCBS elderly waivers would alter long-term care choices of low and high needs elderly, respectively. Column (1) shows that the PCS benefit is associated with significant reduction in nursing home use for both categories of ADLs. Elderly specific waivers do not affect nursing home utilization for either of the ADL categories. In column (2), we can see that the PCS benefit induces a 1.7 percentage point reduction in nursing home and residential facility use for low dependence ADLs. The point estimate is similar for high dependence ADLs, but the effect is not statistically significant. Interestingly, the HCBS elderly waivers imply a 1 percentage point reduction in facility based care utilization, which is approximately an 11 percent reduction from the mean of 8.7 percent.

The estimates of the effect of elderly waivers suggest these programs may be more effective in reducing utilization of residential care facilities as compared to reducing nursing home care.

Column (3) reports estimates by ADL categories for informal care utilization. We observe that introduction of the PCS benefit is likely to reduce receipt of unpaid care by 5.5-6.7 percentage points. For individuals with no ADLs, the PCS benefit is associated with a 6.1 percentage point decrease in informal care use. It is possible that individuals who only need cueing with ADLs or who may only have needs with IADLs like medicine management or buying groceries may reduce their reliance on help from friends and family once the PCS benefit becomes available. HCBS elderly waivers, on the other hand, induce a 6.9 percentage point increase in unpaid care use for individuals with high dependence ADLs, which is approximately 35 percent of the mean. The positive coefficient indicates that services under HCBS elderly waivers are complementary to informal care for high-needs individuals. This is consistent with earlier findings that as levels of disability increase individuals require both informal and formal care (Bonsang 2009; Litwin and Attias-Donfut 2009; McMaughan et al. 2012).

1.8.4 Heterogeneity by education level

Medicaid is a means-tested insurance program. Thus, individuals who are most likely to benefit by paid home-and-community-based care under Medicaid programs are low-income individuals. However, income may be endogenous to living and long-term care arrangements. It is particularly difficult to measure income for institutionalized individuals. Additionally, the income measures in the NLTCs are not consistent across all years with missing data on income for over a quarter of the sample. I use educational attainment as proxy for income levels to test the hypothesis that the effects of Medicaid home-and-community-based care policies are concentrated among low-income individuals. We can see in Table 1.8 that the effects of PCS are

concentrated among the expected group- those without a college degree. Although the effects are small and insignificant, HCBS elderly waivers appear to alter long-term care choices for individuals with a college degree. This could be possible if, given the generous financial criteria, those with comparatively higher income enroll in Medicaid through the HCBS waiver pathway.

1.8.5 Medicaid enrollment

The presumed mechanism through which Medicaid home-and-community-based care policies affect long-term care outcomes in Section 1.5 is through changes in Medicaid enrollment by way of asset transfers or spend-down to Medicaid eligibility due to high medical expenses. Hence, in addition to using education as proxy for potential Medicaid eligibility, I also test for differences in Medicaid enrollment in response to implementation of the PCS benefit and HCBS elderly waivers. The NLTCS asks respondents about public insurance coverage, as well as payment sources for all paid services received by them. I find several discrepancies when comparing self-reported Medicaid status with payment sources. One reason could be that many people are confused about the difference between Medicare and Medicaid, especially since all sample persons are Medicare beneficiaries.²¹ To mitigate this issue, I classify individuals as enrolled in Medicaid if they self-report enrollment in Medicaid and they present their Medicaid card to the NLTCS interviewer.²² Column (1) of Table 9 examines Medicaid enrollment in response to the introduction of the PCS benefit and HCBS elderly waivers. Living in a state with

²¹ <http://www.agingfamilyservices.com/elder-care-resources/medicare-medicaid-whats-the-difference/>
http://www.huffingtonpost.com/carol-marak/shocking-things-people-dont-know-about-medicare_b_8217036.html

²² The NLTCS asks the following questions regarding Medicaid coverage -

There is a national program called Medicaid which pays for health care for persons in need. In this state it is called (name..)

During the past 12 months, has . . . received health care which has been or will be paid for by Medicaid (or (name))?

b. Does . . . NOW have a Medicaid (or (name)) card?

c. May I please see . . . card?

the PCS benefit increases the probability of enrolling in Medicaid by 3.7 percentage points, which is approximately 30 percent of the baseline level of 12.4 percent. HCBS elderly waivers increase probability of Medicaid enrollment by 1.8 percentage points, though I do not find statistically significant effect.

1.8.6 Paid care

In response to the introduction of the PCS benefit and HCBS elderly waivers, we expect utilization of home-and-community-based services under Medicaid to increase. Unfortunately, the NLTCs does not ask for source of payment for all types of paid care. Hence, I am only able to estimate the effects of the policies on all paid care.

Table 1.9 reports estimates for the regressions of paid care utilization on the PCS benefit and HCBS elderly waivers. The outcome variable in column (2) is an indicator for receiving any paid care services including paid helpers and paid services at adult day care centers or senior centers (center-based services). Estimates suggest those living in a state with a PCS benefit have a 3.5 percentage point higher probability of receiving some paid care. The coefficient on HCBS elderly waivers is negative and implies lower probability of receiving paid services. But, both these effects are not statistically significant.

Previous results suggest that seniors substitute informal personal care for PCS benefit services, but services under the HCBS elderly waivers generally complement informal care. Center-based services are usually offered under HCBS elderly waiver programs, and only a few states cover adult day care or senior center services within the state plan.²³ Thus, we anticipate that the PCS benefit would increase reliance on paid helper services, while HCBS elderly waivers are likely to induce higher consumption of services that could complement personal care

²³ As of 2017, only 11 out of 30 states offering PCS benefit cover adult day care or senior center services.

provided by friends and family. An aggregated measure of paid care may mask these differential effects. Hence, columns (3) and (4) further separate the measure of paid services into two groups- paid helpers and center-based services. The probability of receiving services from paid helpers (who generally provide assistance with ADLs) is higher by 3.8 percentage points for those living in a state with the PCS benefit. The coefficient is marginally significant with a p-value of 0.11. Living in a state with an HCBS elderly waiver is associated with significantly lower probability (4.8 percentage point) of having paid helpers, but a 2.5 percentage point higher probability of receiving center based paid care. This is consistent with our observation that center-based services are most likely covered by waiver programs, and the PCS benefit reimburses care at home.

1.9 Conclusion

This paper estimates the causal effects of expanding publicly financed home-and-community-based care on facility based long-term care and informal care. I exploit variation in the timing of implementation of two Medicaid programs across states- Medicaid personal care services benefit (PCS) that provides personal care (assistance with daily activities like dressing and bathing), and home-and-community-based services elderly waivers (HCBS elderly waivers) that provide both skilled medical care and personal care. This study uses a unique dataset combining information on these policies with data on a nationally representative sample of community dwelling and institutionalized single elderly.

I find that Medicaid home-and-community-based services significantly alter elderly long-term care sources and settings. Further, the type of services offered under home-and-community-based care programs affect the composition of the care recipients receiving facility-based care, informal care and formal home-and-community-based services. The Personal Care Services

(PCS) benefit induces a reduction in nursing home and residential care use (approximately 9 percent of the mean of 6.7 percent), but a much larger reduction in informal care use (approximately 32 percent of the mean of 19.5 percent). I interpret this as while the PCS benefit could reduce Medicaid nursing home expenditures by a small amount, we could see an increase in overall Medicaid long-term care spending as seniors substitute formal services for care from friends and family. To provide a measure of the effect of expanding home-and-community-based services on Medicaid spending I perform some back-of-the-envelope calculations for the PCS benefit. The median annual costs in 2015 for nursing home care and home health care were \$91,250 and \$17,940.²⁴ Using population estimates from the Census projections, I assume that single elderly constitute 60 percent of the total elderly population. A 9 percent decrease in nursing home care users would translate into savings of \$16 billion. Further, estimates suggest that introduction of the PCS benefit would lead to a 32 percent reduction in informal care users relative to the mean. A parallel increase in Medicaid home-and-community-based care users would lead to a cost increase of \$79 billion, which would imply a net increase of \$63 billion in Medicaid spending. Taking into consideration Medicaid eligibility requirements, it may be realistic to assume that half of the individuals who substitute away from informal care enroll into Medicaid home-and-community-based care programs. In this case, Medicaid spending may increase up to \$23 billion. Note that these are long-term spending calculations since my estimates capture long-term effects of the PCS benefit. These calculations suggest that while home-and-community-based care is cost-effective on average, expanding these programs may not be cost-saving for Medicaid.

²⁴ SOURCES: Genworth, Genworth 2015 Cost of Care Survey (Richmond, VA: Genworth Financial, Inc., April 2015), https://www.genworth.com/dam/Americas/US/PDFs/Consumer/corporate/130568_040115_gnw.pdf

For individuals with intensive long-term care needs, HCBS elderly waivers lead to a significant reduction in nursing home and residential care use and increase their informal care use. Thus, the pool of formal home-and-community-based care users is likely to be unhealthier on average under the HCBS elderly waivers. Further, the opposite effects of the PCS benefit and HCBS elderly waivers on informal care support previous findings that home-and-community-based care may substitute for informal care up to a certain level of need, beyond which these types of care complement each other. Currently, HCBS waivers (both elderly specific and other waivers) are the most widely used option by states to provide home-based care. My findings indicate that states must be careful in expanding funding for HCBS waivers since home-and-community-based care may not be less expensive for individuals with high long-term care needs and lack of appropriate services could lead to worse health outcomes.

The results presented here will help to investigate the impact of home-and-community-based policies on the welfare of the elderly. Findings suggest that both policies decrease the use of long-term care facilities like nursing homes and assisted living communities, which may otherwise deplete savings for many older individuals. On the other hand, home-and-community-based care may not be suitable for all seniors and may lead to adverse health consequences. While the NLTCs contains detailed information about functional limitations, the survey does not collect information on health outcomes such as medical conditions and hospitalizations. Future research should explore the effect on health outcomes for the elderly by underlying health conditions.

Table 1.1: State policies for home-and-community-based services.

	Prior to 1984	1985-1989	1990-1994	1995-1999	2000-2004
<i>Number of states</i>					
PCS State Plan benefit in place	21	25	26	27	30
States adding PCS benefit	AK, AR, CO, ID, MD, MA, MI, MN, MO, MT, NE, NV, NH, NJ, NY, OK, OR, SD, TX, UT, WI	ME, NC, WA, WV	CA	FL	LA, NM, ND, VT
HCBS elderly waiver	9	19	40	44	45
States adding waivers	AL, GA, HI, MN, MO, NH, NY, NC, WA	CO, CT, DE, IL, KY, MT, NJ, SD, WV, WI	AK, AR, CA, FL, ID, IN, IA, LA, ME, MD, MA, MI, MS, NE, NV, ND, OH, OK, TX, UT, WY	D.C., KS, PA, VA,	SC

Source: State Medicaid websites, published reports and state waiver applications obtained from https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/waivers_faceted.html

Table 1.2 Summary statistics.

Variables	Mean/Percent
Nursing home	6.5%
Nursing home + residential care	8.7%
Informal care	19.5%
PCS benefit	49.2%
HCBS elderly waivers	60.4%
Age	76.6
Female	78.6%
Widowed	77.5%
Number of children	2.6
White	85.5%
Black	12.3%
Other	2.2%
<i>Education</i>	
High school or less	77.7%
College	14.6%
Master's/professional degree	7.7%
Any ADLs	23.9%
Number of ADLs, if any	2.7
<i>N</i>	16,605

Notes: Data includes 1984, 1989, 1994, 1999 and 2004 waves of the NLTCs. All estimates using sample weights. The sample includes single individuals between age 65 and 115.

Table 1.3 Effect of state Medicaid home-and-community-based policies on care.

Variables	Nursing home (0/1)	Nursing home + residential care (0/1)	Informal (unpaid) care (0/1)
	(1)	(2)	(3)
PCS benefit	-0.006* (0.003)	-0.016† (0.009)	-0.062* (0.032)
HCBS elderly waivers	-0.0003 (0.002)	-0.004 (0.005)	-0.012 (0.033)
Age 70-74.9	0.003 (0.002)	0.010† (0.005)	0.045† (0.024)
Age 75-79.9	0.005† (0.003)	0.020** (0.006)	0.042† (0.026)
Age 80-84.9	0.009** (0.002)	0.028** (0.006)	0.073** (0.025)
Age 85-89.9	0.013** (0.002)	0.038** (0.005)	0.090** (0.026)
Age 90 and above	0.020** (0.002)	0.051** (0.005)	0.078* (0.031)
Female	-0.007** (0.002)	-0.010** (0.003)	-0.007 (0.015)
Widowed	-0.005** (0.002)	-0.014** (0.004)	-0.015 (0.019)
Black	-0.010** (0.002)	-0.027** (0.003)	0.042** (0.013)
Other race	-0.004 (0.004)	0.007 (0.013)	0.010 (0.033)
One child	-0.005** (0.002)	-0.011** (0.004)	0.072** (0.021)
2-4 children	-0.004** (0.001)	-0.009** (0.003)	0.058** (0.015)
5 or more children	-0.012** (0.002)	-0.032** (0.004)	0.103** (0.019)
College degree	-0.004** (0.001)	0.001 (0.003)	-0.071** (0.019)
Any ADL	0.056** (0.006)	0.099** (0.004)	0.157** (0.014)
<i>N</i>	16,605	16,605	16,605
Mean of dependent variable	0.065	0.087	0.195

Notes: ** p<0.01 * p<0.05 †p<0.1. Marginal effects from probit estimation with standard errors in parentheses clustered at state level. The sample includes single individuals aged 65 and over. Nursing home is dichotomous indicating if individual resides in a skilled nursing facility or intensive care facility at the time of the survey. Residential care facilities including assisted living, continuing care communities etc. Informal care is an indicator for receiving unpaid help with any ADL from family members or friends. Each regression is weighted using person weights and includes controls for age categories, race, college degree, gender, indicator for widowed, number of children and an indicator for difficulty with at least one ADL. All regressions include state and year fixed effects and state-specific time trends.

Table 1.4 Robustness check for timing of implementation.

Variables	Nursing home (0/1)	Nursing home + residential care (0/1)	Informal care (0/1)
	(1)	(2)	(3)
PCS benefit, 4-5 years before adoption	-0.002 (0.003)	-0.005 (0.008)	0.001 (0.036)
PCS benefit, 1-3 years before adoption	-0.001 (0.006)	-0.008 (0.020)	-0.001 (0.079)
PCS benefit, 1-3 years after adoption	-0.011* (0.005)	-0.025 (0.015)	-0.029 (0.058)
PCS benefit, 4-5 years after adoption	-0.004 (0.007)	-0.016 (0.023)	-0.082 (0.069)
HCBS elderly waivers	-0.001 (0.002)	-0.005 (0.005)	-0.012 (0.033)
<i>N</i>	16,605	16,605	16,605
Mean of dependent variable	0.065	0.087	0.195

Notes: * $p < 0.05$ † $p < 0.1$ Marginal effects from probit estimation with standard errors in parentheses clustered at state level. The sample includes single individuals aged 65 and over. See Table 3 for details. Each regression is weighted using person weights and includes controls for age categories, race, education categories, gender indicator for widowed and an indicator for difficulty with at least one ADL. All regressions include state and year fixed effects and state-specific time trends.

Table 1.5 Sensitivity check for contemporaneous policies.

Variables	Nursing home (0/1)	Nursing home + residential care (0/1)	Informal care (0/1)	Nursing home (0/1)	Nursing home + residential care (0/1)	Informal care (0/1)
	(1)	(2)	(3)	(4)	(5)	(6)
PCS benefit	-0.005** (0.002)	-0.023** (0.008)	-0.047 (0.026)	-0.005** (0.002)	-0.023** (0.008)	-0.050 [†] (0.027)
HCBS elderly waivers	0.002 (0.003)	0.006 (0.009)	-0.018 (0.023)	0.002 (0.003)	0.005 (0.009)	-0.021 (0.022)
Medicare home health visits				-0.00001 (0.00009)	0.0001 (0.0003)	-0.003 (0.002)
<i>N</i>	9,840	9,840	9,840	9,840	9,840	9,840
Mean of dependent variable	0.064	0.095	0.146	0.064	0.095	0.146

Notes: ** p<0.01 * p<0.05 †p<0.1 Marginal effects from probit estimation with standard errors in parentheses clustered at state level. The sample includes single individuals aged 65 and over. See Table 3 for details. Regressions use observations from three years- 1994,1999 and 2004. Medicare home health visits measure the number of Medicare home health visits per beneficiary. Each regression is weighted using person weights and includes controls for age categories, race, education categories, gender indicator for widowed and an indicator for difficulty with at least one ADL. All regressions include state and year fixed effects.

Table 1.6 Heterogeneity by age in the effect of state Medicaid home-and-community-based policies on care.

Variables	Nursing home (0/1)	Nursing home + residential care (0/1)	Informal care (0/1)
	(1)	(2)	(3)
PCS benefit, Age 65-69.9	0.005 (0.005)	0.007 (0.010)	-0.073 (0.053)
PCS benefit, Age 70-74.9	-0.002 (0.003)	-0.003 (0.010)	-0.046 (0.046)
PCS benefit, Age 75-79.9	-0.009** (0.003)	-0.025** (0.009)	-0.067† (0.039)
PCS benefit, Age 80-84.9	-0.008* (0.003)	-0.011 (0.011)	-0.085* (0.040)
PCS benefit, Age 85-89.9	-0.005* (0.002)	-0.017* (0.008)	-0.043 (0.039)
PCS benefit, Age 90 and above	-0.008* (0.003)	-0.018* (0.009)	-0.068† (0.040)
HCBS elderly waivers, Age 65-69.9	-0.015* (0.007)	-0.028* (0.014)	0.027 (0.071)
HCBS elderly waivers, Age 70-74.9	-0.003 (0.003)	-0.011 (0.008)	-0.038 (0.031)
HCBS elderly waivers, Age 75-79.9	-0.0002 (0.003)	-0.003 (0.007)	-0.038 (0.037)
HCBS elderly waivers, Age 80-84.9	0.001 (0.002)	-0.003 (0.006)	-0.012 (0.035)
HCBS elderly waivers, Age 85-89.9	0.005 (0.003)	0.006 (0.005)	-0.013 (0.041)
HCBS elderly waivers, Age 90 and above	0.002 (0.003)	-0.001 (0.007)	0.034 (0.039)
<i>N</i>	16,605	16,605	16,605
Mean of dependent variable	0.065	0.087	0.195

Notes: ** p<0.01 * p<0.05 †p<0.1. Marginal effects from probit estimation with standard errors in parentheses clustered at state level. See Table 3 for details. Each regression is weighted using person weights and includes controls for age categories, race, education categories, gender indicator for widowed and an indicator for difficulty with at least one ADL. All regressions include state and year fixed effects and state-specific time trends.

Table 1.7 Heterogeneity by type of disability in the effect of state Medicaid home-and-community-based policies on care.

Variables	Nursing home (0/1) (1)	Nursing home + residential care (0/1) (2)	Informal care (0/1) (3)
PCS benefit, No ADLs	0.0004 (0.004)	-0.011 (0.010)	-0.061 [†] (0.032)
PCS benefit, Low dependence ADLs	-0.008** (0.003)	-0.017 [†] (0.010)	-0.067 [†] (0.041)
PCS benefit, High dependence ADLs	-0.006* (0.003)	-0.015 (0.010)	-0.055 (0.042)
HCBS elderly waivers, No ADLs	-0.005 (0.004)	-0.004 (0.008)	-0.045 (0.036)
HCBS elderly waivers, Low dependence ADLs	0.006 (0.005)	0.005 (0.007)	0.040 (0.032)
HCBS elderly waivers, High dependence ADLs	-0.003 (0.003)	-0.010 [†] (0.006)	0.069* (0.034)
<i>N</i>	16,605	16,605	16,605
Mean of dependent variable	0.065	0.087	0.195

Notes: ** p<0.01, * p<0.05, †p<0.1. Marginal effects from probit estimation with standard errors in parentheses clustered at state level. See Table 3 for details. Each regression is weighted using person weights and includes controls for age categories, race, college degree, gender, indicator for widowed. Low dependence ADLs include dressing, walking around the house and bathing. High dependence ADLs defined as eating and toileting. All regressions include state and year fixed effects and state-specific time trends.

Table 1.8 Heterogeneity in the effect of state Medicaid home-and-community-based policies on care by education.

Variables	Nursing home (0/1) (1)	Nursing home + residential care (0/1) (2)	Informal care (0/1) (3)
PCS benefit, no college degree	-0.007* (0.003)	-0.015* (0.007)	-0.075* (0.033)
PCS benefit, college degree	-0.001 (0.004)	-0.012 (0.011)	-0.008 (0.041)
HCBS elderly waivers, no college degree	0.001 (0.003)	-0.002 (0.006)	-0.010 (0.029)
HCBS elderly waivers, college degree	-0.005 (0.005)	-0.012 (0.009)	-0.011 (0.066)
<i>N</i>	16,605	16,605	16,605
Mean of dependent variable	0.065	0.087	0.195

Notes: ** $p < 0.01$ * $p < 0.05$ † $p < 0.1$. Marginal effects from probit estimation with standard errors in parentheses clustered at state level. See Table 3 for details. Each regression is weighted using person weights and includes controls for age categories, race, education categories, gender indicator for widowed and an indicator for difficulty with at least one ADL. All regressions include state and year fixed effects and state-specific time trends.

Table 1.9 Effect of Medicaid home-and-community-based services on Medicaid enrollment and utilization of paid care.

Variables	Enrolled in Medicaid	Paid care (All)	Paid care (Helpers)	Paid care (center based)
	(1)	(2)	(3)	(4)
PCS benefit	0.037 [†] (0.020)	0.035 (0.027)	0.038 (0.024)	-0.007 (0.011)
HCBS elderly waivers	0.018 (0.027)	-0.020 (0.027)	-0.048 [†] (0.027)	0.025 [†] (0.013)
<i>N</i>	16,605	16,605	16,605	16,605
Mean of dependent variable	0.124	0.202	0.145	0.077

Notes: ** p<0.01 * p<0.05 †p<0.1. Marginal effects from probit estimation with standard errors in parentheses clustered at state level. The sample includes single individuals aged 65 and over. Enrolled in Medicaid defined as individuals who self-reported Medicaid enrollment and presented their card to the NLTCS interviewer. In column (2), paid care is a dummy variable for receiving paid care from helpers or at a center like adult day care or senior center. Columns (3) and (4) show estimates separately for paid care from helpers and center based paid care respectively. Each regression is weighted using person weights and includes controls for age categories, race, college degree, gender, indicator for widowed and an indicator for difficulty with at least one ADL. All regressions include state and year fixed effects and state-specific time trends.

CHAPTER 2: MEDICAID HOME-AND-COMMUNITY-BASED SERVICES AND FORMAL CARE USE AMONG THE ELDERLY

I am grateful to the Department of Economics at NC State University to provide funds to purchase the Medicare Current Beneficiary Survey data used in this essay.

2.1 Introduction

The demand for long-term care in the U.S. is anticipated to double over the next forty years.²⁵ Long-term care (LTC) encompasses a continuum of services and supports needed to meet health or personal care needs over an extended period.²⁶ Public sources, primarily Medicaid and Medicare pay over two-thirds of all long-term care expenditures in the U.S. Thus, long-term care is an important public policy concern. Nursing home costs are the largest component of public long-term care spending. Hence, exploring cost-effective alternatives to nursing home care has been a priority for many states. In addition, the 1999 Supreme Court Olmstead decision has motivated states to rebalance publicly funded long-term care services away from nursing homes. In its decision, the Court ruled that states must provide services in the most integrated settings appropriate to the needs and wishes of people with disabilities. Further, it also stated that a failure to do so could constitute discrimination under the Americans with Disabilities Act. Thus, over the past two decades, there has been a considerable growth in home-and-community based long-term services and supports.

The Deficit Reduction Act (2005) and the Affordable Care Act (2010) increased federal funding to expand access to home-and-community-based services as a less expensive and more desirable alternative for institutional care. An important assumption driving the expansion of home-and-community-based services is that long-term care recipients have strong preferences to

²⁵ Medicaid and Long-Term Services and Supports: A Primer (December, 2015)

<http://kff.org/medicaid/report/medicaid-and-long-term-services-and-supports-a-primer/>

²⁶ Individuals need long-term care when a chronic condition, trauma, or illness limits their ability to carry out basic self-care tasks, called *activities of daily living*, (such as bathing, dressing or eating), or *instrumental activities of daily living* (such as household chores, meal preparation, or managing money).

remain in the community. However, if individuals turn to nursing homes as a last resort, these policies may not reduce nursing home utilization. Furthermore, home-and-community-based services may expand access to individuals who would have otherwise relied on unpaid care from friends and family. In this case, public long-term care expenditures could increase. Thus, the effectiveness of policies expanding home-and-community-based services depends on their effect on utilization of long-term care, and in turn on the costs of providing such care. Additionally, it is important to consider how these policies affect the utilization of other formal care such as inpatient and outpatient care. If availability of formal home care improves health outcomes, they could reduce utilization of these other formal services. Thus, the increase in Medicaid costs due to increased utilization of formal home-based care may be offset by decreases in utilization of other formal services. On the other hand, regular monitoring of health from home-based care providers may lead to timely identification of medical needs and could increase overall formal care utilization. This paper provides evidence of the effect of expanding home-and-community-based services on utilization of long-term care services, as well as other healthcare services such as inpatient and outpatient care. Particularly, I investigate the effect of the enhanced federal funding for home-and-community-based services under the Deficit Reduction Act (2005) on utilization of formal health services by the elderly.

Previous studies examining the effect of Medicaid home-and-community-based services have focused on specific programs or states, limiting the generalizability of their results (Hahn et al., 2011; Sands et al. 2012; Kane et al. 2013). In the first chapter, using a nationally representative sample of single elderly, I find evidence that expanding Medicaid home-and-community-based services leads to a small reduction in nursing home use, but lead to a significantly larger reduction in unpaid care use. These findings suggest that while home-and-community-based

programs may divert individuals from nursing homes, they are likely to improve access to individuals who would have otherwise relied on unpaid care. In this study, I verify these results using a recent policy and detailed care utilization information from the Medicare Current Beneficiary Survey. In addition, to my knowledge, this is the first paper to examine the effect of Medicaid home-and-community-based services on utilization of inpatient and outpatient care.

I find that living in a state that was awarded a MFP grant and enhanced federal matching funds for home-and-community-based services has modest effects on nursing home utilization. On the other hand, expanding funding for home-and-community-based services significantly increases utilization (1.8 percentage points or 10 percent of the mean) of these services. In addition, I test whether these policies reduce utilization of other formal care services such as inpatient and outpatient care. I find no effect of these policies on utilization of these formal services both at the extensive margin (whether to receive such care) and at the intensive margin (number of inpatient and outpatient visits).

2.2 Literature

A growing literature studies the relationship between formal home-based care and other sources of long-term care including skilled facilities like nursing homes and unpaid care from friends and family. To reduce long-term care costs, the Channeling demonstration used randomized experimental design to improve access to community-based services. Studies relying on data from the Channeling demonstration find no effect of extending home-and-community-based care on nursing home risk (Wooldridge and Schore 1988; Kemper et al. 1986; Rabiner et. al 1994). However, (Applebaum, 1988) found that elderly that would have met Channeling functional limitation criteria were much less likely than Channeling participants to live alone. Thus, the results from the Channeling demonstration may not be generalizable if Channeling

participants were also less likely to change their sources of care.

Studies examining the effect of Medicaid home-and-community-based care policies on nursing home utilization provide conflicting evidence, mainly due to endogeneity issues. Laditka (1998) and Aykan (2002) examine specific strategies that states use to control long-term care utilization (such as Medicaid eligibility criteria and availability of Medicaid HCBS waivers) and find no association with nursing home admission. On the other hand, Muramatsu, et al. (2007) and Miller (2011) use state level HCBS expenditures and conclude that increase in state's commitment to HCBS leads to significant reduction in nursing home utilization. However, these studies rely on cross-state variation across Medicaid policies in a single period, which could lead to biased estimates due to unobserved heterogeneity of the resident population. For example, states where the older population has higher preference for nursing home care may offer less or more generous HCBS policies. In Chapter 2, I use within-state variation in two Medicaid home-and-community-based care policies and finds that availability of these programs significantly reduces the probability of nursing home utilization.

Few studies examine the effect of home-and-community-based care on formal care utilization measures such as hospitalizations and outpatient services. Punchik et al. (2017) find that home care for homebound patients with congestive heart failure significantly decreases number of hospitalizations, as well as in-hospital days. Mattke et al. (2015) evaluate the HouseCalls program available to Medicare Advantage plan members in Arkansas, Georgia, Missouri, South Carolina and Texas. Compared to no HouseCalls Medicare Advantage plan members, HouseCalls participants had 1 percent and 14 percent reduction in admissions to hospitals. Further they had lower risk of nursing home admissions by 0.67 percent and 1.3 percent respectively. Depending on the comparison group, the participants' number of visits

increased by 2-6 percent. Together, these findings suggest that home care is likely to reduce public healthcare spending. In this paper, I examine the effect of Medicaid home-and-community-based care on utilization of all formal healthcare services on a nationally representative sample of the elderly.

2.3 Money Follows the Person Demonstration

The Deficit Reduction Act (DRA) of 2005 introduced the Money Follows the Person demonstration. This demonstration program authorizes the Secretary of Health and Human Services to award competitive grants to increase the use of home-and-community-based rather than institutional long-term services. The DRA appropriated \$1.8 billion for the period 2007-2011 and the Affordable Care Act (ACA) provided \$2.2 billion for FY 2012 to FY 2016, totaling almost \$4 billion.²⁷ The MFP program, administered by the federal Centers for Medicare and Medicaid Services (CMS), is the largest demonstration program of its kind in the history of Medicaid. Over 50,000 people have transitioned out of institutional care under the MFP demonstration as of December 2014.²⁸ The CMS initially awarded MFP grants to 30 states and the District of Columbia in 2007, another 13 states in February 2011, and 3 more in 2012. Column (2) of Table 1 shows the dollar amount of MFP grants awarded to each state in 2007 and the total amount of funds sanctioned over a period of five years.

In addition to the federal grants, states receive enhanced federal funding for providing home-and-community-based services for individuals transitioning out of skilled care facilities. Eligible individuals must be residents of an institution and must meet a length of residency requirement

²⁷ https://www.nhpf.org/uploads/announcements/BP85_MFP_05-10-13.pdf

²⁸ <https://www.medicaid.gov/medicaid-chip-program-information/by-topics/long-term-services-and-supports/balancing/money-follows-the-person.html>

set by the state (usually ranges between 6 months and 2 years). The enhanced Federal Medical Assistance Program (FMAP)²⁹ is based on the state's existing FMAP, but will cover from 75-90% of total expenditure for an individual's community based long term services. The formula for the enhanced FMAP is

$$\text{Enhanced FMAP} = \text{Current FMAP} + \frac{1}{2} [100 - \text{Current FMAP}]$$

Thus, the additional federal funding creates incentives for states to transition individuals from institutions including hospitals, nursing homes and intermediate care facilities for persons with mental retardation (ICF-MRs). States are also required to maintain access to community services after the demonstration period as long as participating beneficiaries need such services and remain eligible for Medicaid.

Each state participating in the MFP demonstration must establish a program that has two components- a transition program and a rebalancing program. State transition programs are aimed at identifying Medicaid beneficiaries in institutional care who wish to live in the community and helping them do so. In addition, the rebalancing program allows a greater proportion of Medicaid long-term care expenditures to flow to community services and supports.

Transition Programs

The MFP program is targeted towards people institutionalized in nursing homes, hospitals and intermediate care facilities. To become eligible to participate in the MFP program individuals had to be institutionalized for a minimum of 180 days and had to be eligible for full Medicaid benefits for at least the month before transition to the community. Upon transitioning into the community, MFP participants begin receiving a package of home-and-community-based

²⁹ The Federal Medical Assistance Percentages (FMAPs) are used in determining the amount of Federal matching funds for State expenditures for assistance payments for certain social services, and State medical and medical insurance expenditures.

services financed by the state's MFP grant funds. MFP financed services continue for up to one year after the date of transition. After one year, MFP participants become regular Medicaid beneficiaries and receive home-and-community-based services through the state plan and/or a waiver program, depending on their eligibility status.

Rebalancing Programs

In addition to transitioning people residing in institutions, the MFP program requires states to rebalance Medicaid expenditures in favor of home-and-community-based services. Hence, states use enhanced federal funds to introduce changes in their long-term care systems. No formal requirements for how these funds are to be used or reinvested. States can use the enhanced funds in a variety of ways, including (1) reducing the use of institutional care (such as financing the costs of closing beds or facilities), (2) supporting transitions of people not eligible for MFP, (3) expanding the availability of HCBS programs (such as increasing HCBS waiver slots or adding a self-direction program), or (4) improving the infrastructure (such as expanding the availability of affordable and accessible housing). Each state sets specific benchmarks for measuring the success of the selected rebalancing strategy.

2.4 Data and Empirical Strategy

2.4.1 Data

To answer the research question, we need data that includes both nursing home residents and community-based care recipients and contains some measure of HCBS utilization under respective state Medicaid programs for before and post policy years. The main data source for this paper is the Medicare Current Beneficiary Survey, a nationally representative sample of Medicare beneficiaries conducted by the Centers for Medicare and Medicaid Services (CMS). Each year, approximately 10,000 Medicare beneficiaries are surveyed as a part of a rotating

panel. The annual survey portion of the dataset consists of responses to questions from an in-person interview and includes information on demographic and household characteristics, residential location, general health, the presence of chronic conditions, smoking, body mass index, and measures of health care use including home health services. Being nationally representative of the Medicare population, it includes individuals that are dually eligible for Medicare and Medicaid which will help me exploit the variation in expansion of Medicaid HCBS created by the MFP demonstration program.

MFP grants were awarded beginning July 2007 however, states began enrolling participants in 2009.³⁰ Taking the delay in implementation into consideration, I use 2007 as pre-policy period and 2010 as post-policy period. I focus on Medicare beneficiaries aged 65 and over. I drop individuals with missing information for education, marital status and number of children. Table 2.2 presents the summary statistics for the final sample. Approximately 7 percent of individuals resided in a skilled nursing facility and about 16 percent received home health services. The sample is predominantly white and female. Approximately 40 percent of individuals are in poor health indicated by a physical disability or a cognitive condition such as dementia or Alzheimer's. Columns (2) and (3) present means separately by treatment and control states for pre-policy period. Column (4) reports p-values for two-sided test of equality of proportions. There are some noticeable differences between the two groups. Nursing home utilization is significantly higher in treatment states (5.3 percent) compared to control states (4.1 percent). Further, baseline level of home-and-community-based care utilization is significantly lower in treatment states (12.6 percent versus 13.9 percent). These differences suggest that treatment effects over time must be interpreted with caution, if differences in baseline levels reflect

³⁰ Only 10 states had plans for implementation approved by Center for Medicare and Medicaid Services (CMS) in summer 2008. These 10 states began implementation beginning 2009.

differential trends in care utilization between the two groups. In addition to these differences, there are important differences in the racial composition of the two groups. Blacks constitute 5.6 percent of individuals in treatment states as opposed to 8.7 percent in control states. The proportion of married individuals is significantly lower in treatment states (approximately 54 percent) compared to that in the control states (57 percent). Given these differences, it is crucial to control for these demographic characteristics in the regression specifications.

Table 2.3 reports nursing home utilization and home-and-community-based services utilization for the treatment and control states in the year before and after MFP grants were awarded in 2007. For both outcomes, the first column corresponds to the average utilization in the pre-policy period and the second column to the average utilization after the policy was implemented. The last column presents the difference-in-differences estimate of nursing home and home-and-community-based services utilization. The nursing home utilization decreased by 0.4 percentage points from 5.3 percent to 4.9 percent within treatment states and increased by 0.4 percentage points within control states between 2007 and 2010. However, none of these are significant and the difference-in-differences estimate is small and insignificant. Further, home-and-community-based service utilization increased by 2.7 percentage points (from 12.6 percent to 15.1 percent) in treatment states. On the other hand, utilization of home-and-community-based services increased by 0.9 percentage points in control states. The difference-in-difference estimate suggests a significant policy effect of 1.6 percentage points.

2.4.2 Empirical Strategy

I employ a difference-in-differences specification to compare differences in uptake of formal home-and-community-based services and nursing home use.

$$\Pr(\text{Outcome}_{ist} = 1) = \Phi(\alpha_1 + \beta_1 X_{ist} + \gamma_s + \lambda_1 \text{Post}_t + \delta_1 (\text{Treat}_s * \text{Post}_t))$$

i: individual *s*: state *t*: year X_{ist} : covariates and γ_s : state fixed effects,

The coefficient of interest is δ_1 , which is the difference-in-differences estimate of the effect of the policy. The vectors γ_s and Post_t are state fixed effects and year dummy for 2010. The state-fixed effects control for time-invariant characteristics of the states such as morbidity of the population. X_{ist} includes demographic characteristics including age categories, gender, marital status, number of children and health status. For all specifications, I use a probit model and cluster the standard errors at the state level. All estimations are adjusted using person weights.

I consider two key outcomes- nursing home utilization and paid home-and-community-based services. Nursing home care is an indicator for person residing in a skilled facility for entire duration of the year. I define paid home-and-community-based services as a dichotomous variable for positive number of home health claims during the year. Additional specifications consider inpatient events and outpatient care. Similar to paid home-and-community-based services, inpatient and outpatient care are binary outcomes denoting positive number of such claims during the year.

2.5 Results

2.5.1 Main Results

Table 2.4 presents the main results for the effect of MFP grants on nursing home and home health care utilization. Columns report the marginal effects at the mean from a probit regression. Column (1) report estimates for nursing home utilization defined as residing in a skilled nursing facility for the entire duration of the survey year.³¹ Estimates suggest that receiving a MFP grant led to a small and insignificant decrease in nursing home utilization (0.8 percentage points). This

³¹ The results are consistent using an indicator for any skilled care facility stay during the year. This measure includes short-term nursing home stays, usually for post-acute care.

is consistent with previous findings on the impact of Medicaid home-and-community-based services on nursing home use (Laditka 1998; Aykan 2002). On the other hand, there was a 1.8 percentage point increase in home-and-community-based care use in states that received an MFP grant. This represents a 10 percent increase from a mean of 16.6 percent. These findings provide evidence in support of the “woodwork effect” hypothesis- funding home-and-community-based services leads to a small decrease in institutional care utilization, but they would lead to a more than proportionate increase in formal home-based care. However, it is important to note that, most states began enrolling participants under the MFP program during 2009. Thus, my estimates capture the short-term effect of the MFP grants.

2.5.2 Robustness Checks

Pre-Implementation Trends

One concern in identifying the effects of expanding home-and-community-based services is that states may receive MFP grants due to unobserved characteristics that are correlated with care utilization. If MFP grants are awarded to states that have increasing or decreasing utilization of nursing home care or home-and-community-based care, estimates reported in Section 2.5.1 would be biased. Thus, this section studies pre-implementation trends in the outcome variables between treatment and control groups.³²

I have access to only two waves of the MCBS. Thus, I rely on other public sources of data to test for differential trends between treatment and control states. Particularly, I use data on nursing home residents from multiple editions of the Nursing Home Data Compendium published by the Centers for Medicare and Medicaid Services. I construct a measure of nursing

³² Further, I test whether receiving an MFP grant is correlated with other determinants of changes in utilization of long-term care sources. Most socio-demographic characteristics of states (in the pre-policy period) fail to predict whether a state receives an MFP grant (Appendix Table B1).

home rate for each state-year as individuals above age 65 who resided in an institutional setting as a percent of population of individuals in the same age group.³³ Note that these rates are slightly higher than those observed in the MCBS since these include short-term nursing home residents as well. Figure 2.1 shows the nursing home rates for treatment and control states between 2005 and 2011. There is no evidence of differential trends in nursing home use of elderly between the treatment and control states in the pre-policy period.

Using data from the annual data updates from Kaiser Commission on Medicaid and the Uninsured, I create a measure of home-based care using enrolment in home-and-community-based services waiver programs. I define home-based care utilization rate as number of home-and-community-based services waivers enrollees in state as a percent of total population. Data for Figure 2.2 compares home-based care utilization rates across the two groups for the period 2005-2010. Note that enrollment data are not available by age groups. Hence, I compare enrollment rates for all age groups. Over the time period, enrollment in home-and-community-based services waiver programs increased among both treatment and control states. During the pre-policy period, we can observe similar trends in home-and-community-based waiver enrollment across treatment and control groups. In the post-policy period, there is a proportionately higher growth in home-and-community-based services enrollment post policy in treatment states. While this is not an accurate measure of home-based care, these results provide suggestive evidence that states receiving MFP grants do not differ in terms of home-and-community-based care utilization. Our main results are anticipated in Figures 2.1 and 2.2, which depict the evolution of nursing home and home-and-community-based services utilization for

³³ To ensure we have the same sample of states for both measures, I drop three states that do not offer 1915(c) HCBS waiver programs, i.e. Arizona, Rhode Island and Vermont. These states have 1115 managed care demonstration waivers for HCBS. Since this represents a different model for HCBS, I do not include them in the analysis.

MFP grantee states and non-grantee states.

Placebo Estimates

Trends in nursing home care and home health care utilization provide some confidence in our main results. However, one may be concerned that the difference-in-difference approach could capture spurious effects. Hence, I perform a placebo test by randomly assigning MFP grantee status to different states and rerun the analysis 500 times (Bertrand, Duflo and Mullainathan, 2004).

Figure 2.3 shows the kernel distribution of marginal effects from this procedure corresponding to the estimates reported in Table 2.4. The dotted vertical lines mark the 10th and 90th percentile of this distribution, and the solid line indicated the estimate from Table 2.4. The figure shows that the effect of the MFP grants on nursing home use and home health care lie outside the 10th or 90th percentile of the placebo distribution. These findings provide suggestive evidence that effects as large as the estimates in Table 2.4 are unlikely to occur under the null hypothesis.

Contemporaneous Changes

Another identifying assumption of the difference-in-differences strategy is that no contemporaneous changes should differentially affect treatment and control groups which also affect the outcomes. Starting mid-2007, the US experienced a severe recession. Economic conditions are likely to affect long-term care utilization, as well as, availability of services under public programs like Medicaid. Several studies report that recessions have significant effects on health behaviors, healthcare utilization and health outcomes (Ruhm 2000; Ruhm 2003; McInerney and Mellor 2012). Further, employer provided insurance coverage fell substantially as unemployment rates increased. Consequently, the Medicaid program saw significantly higher

than projected enrollment between 2007 and 2010, burdening state government finances (Smith et al. 2010). State Medicaid policies and efforts are likely to be influenced by the intensity of the recession that states experienced. Particularly, if the treatment states experienced different levels of severity during the recession, my estimates will be biased. To test this, Table 2.5 presents results adding controls for state-level unemployment rates for 2007 and 2010 obtained from the Bureau of Labor Statistics.

In addition, the recession could affect other factors that also influence long-term care choices. For example, budget deficits and lower Medicare and Medicaid reimbursement rates could lead to nursing home closures or reduction in bed availability.³⁴ Further, whether seniors receive healthcare in home-and-community-based settings would depend on housing prices and housing affordability during the study period. Hence, in addition to state unemployment rates, I control for number of nursing homes beds per 1000 state residents age 65 and above and housing price index at the state-by-year level.³⁵

There could be other explanation for the results in Table 2.4. Population in states that received the MFP grants could be in worse health on average, indicating higher long-term care needs. State fixed effects control for time invariant differences in observable and unobservable characteristics of the state population. However, there could still be some shift in population health concurrent to the MFP demonstration. To confirm if the MFP grantee status is not spuriously correlated with such changes, I include a measure of disability prevalence (percentage of state population with physical or emotional disability) and Medicare spending per enrollee.³⁶

³⁴ <https://khn.org/news/fiscal-times-nursing-home-shortage/>

³⁵ Data on nursing home beds obtained from Nursing Home Data Compendium published by the Center for Medicare and Medicaid Services. Housing price index data obtained from Federal Housing Finance Agency.

³⁶ Disability prevalence data obtained from the Behavioral Risk Factor Surveillance System (BRFSS) <https://www.cdc.gov/brfss/> and Medicare spending per enrollee gathered from Kaiser Family Foundation <https://www.kff.org/medicare/state-indicator/per-enrollee-spending-by-residence/>

Living in a state that received an MFP grant induces a 0.4 percentage point decrease and a 1.9 percentage point increase in the probability of nursing home and home-and-community-based care utilization respectively. Thus, the effects of expansion of home-and-community-based services under MFP grants are robust to the inclusion of state level unemployment rates and other contemporaneous changes.

2.6 Other Sources of Care

In addition to the effect on utilization of long-term care sources, expansion of home-and-community-based services is likely to alter utilization of other sources of care such as inpatient facility use and outpatient care. Changes in overall utilization of medical care will in turn determine the impact of improving access to home-and-community-based services on health care expenditures under public programs. Columns (1) and (2) of Table 2.6 report estimates for the effect of MFP grants on inpatient and outpatient care services. Inpatient care refers to services received during an overnight stay in a hospital or other skilled care facility. Outpatient services include a variety of services including physician visits, lab tests and preventative services. I define these variables using the number of inpatient and outpatient claim events during the survey year. We can see that receiving an MFP grant has no effect on the probability of receiving inpatient care. Receiving an MFP grant reduces the probability of outpatient service use by 2.4 percentage points. While the estimate is statistically significant, it represents less than 5 percent of the mean of 69.7 percent. These results suggest only modest effects of MFP grants on utilization of other sources of care.

2.7 Intensive Margin of Care

In addition to the effect on the probability of care use, expanding funding for home-and-community-based services may also alter the intensity of care. For example, greater funding for

home-and-community-based services could increase the number of home health visits. While I do not find significant decrease in overall probability of nursing home utilization, these policies could decrease post-acute or rehabilitative stays in nursing homes. On the other hand, if home-and-community-based care improves health, these services could decrease inpatient hospital visits or outpatient visits. Hence, Table 7 presents estimates for the intensive margin of care utilization. Columns (1) and (2) report the effects of MFP grants on number of nursing home visits and home health visits. Living in a state that was awarded the MFP grant and enhanced federal funding induces a small and insignificant reduction of 0.12 visits in skilled facility care. However, living in a state with an MFP grant is associated with an increase of 68.5 home health visits. This represents more than 50 percent of the mean of 128 home health visits. In columns (3) and (4), I consider the impact of receiving MFP grants on the number of inpatient care and outpatient visits. While MFP grants are not associated with a significant effect on inpatient care use, they induce a decrease of 0.46 outpatient visits. The estimate is marginally significant and represents approximately 8 percent of the average 6.1 outpatient visits.

2.8 Conclusion

This paper estimates the effect of expanding home-and-community-based services on utilization of formal health care by the elderly. Specifically, I study the effect of federal grants and enhanced federal matching funds under the Deficit Reduction Act (DRA) of 2005 for Medicaid home-and-community-based services on utilization of long-term care sources like nursing homes and home-and-community-based services. In addition, this paper examines the effect of the federal funding under the DRA on use of other formal services like inpatient and outpatient care. This study uses detailed information from claims and survey responses in the Medicare Current Beneficiary Survey on a nationally representative sample of elderly (age 65

and over) Medicare beneficiaries.

I find that living in a state that was awarded a MFP grant and enhanced federal matching funds for home-and-community-based services has modest effects on nursing home utilization. On the other hand, expanding funding for home-and-community-based services significantly increases utilization of these services. In addition, I test whether these policies reduce utilization of other formal care services such as inpatient and outpatient care. I find no effect of these policies on utilization of these formal services both at the extensive margin (whether to receive such care) and at the intensive margin (number of inpatient and outpatient visits). These results suggest that public healthcare costs are likely to increase in response to increased funding for Medicaid home-and-community-based services.

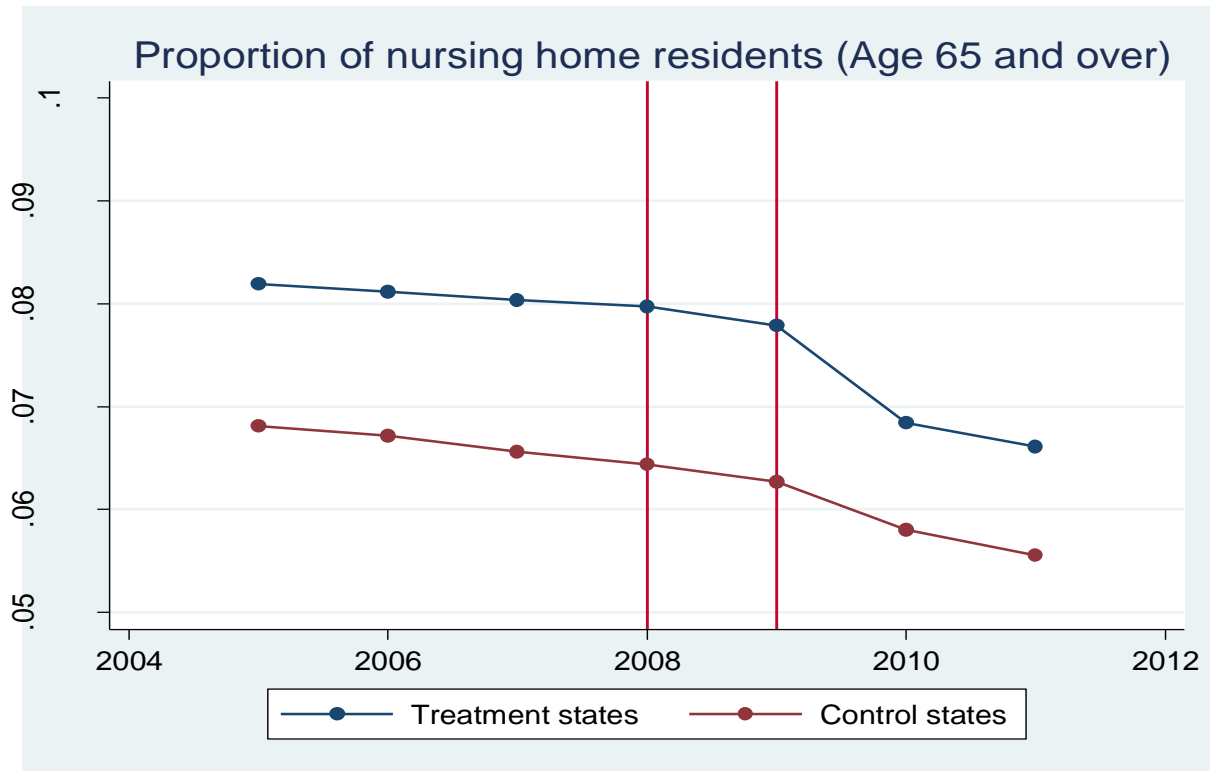


Figure 2.1 Proportion of nursing home residents

Notes: Data on nursing home residents by age obtained from Nursing Home Data Compendium. Population estimates from American Community Survey (obtained from IPUMS-USA, University of Minnesota, www.ipums.org). Data are weighted using person weights. Treatment states defined as states that received an MFP grant in 2007. Treatment states (n=30 including D.C.) control states (n=18).

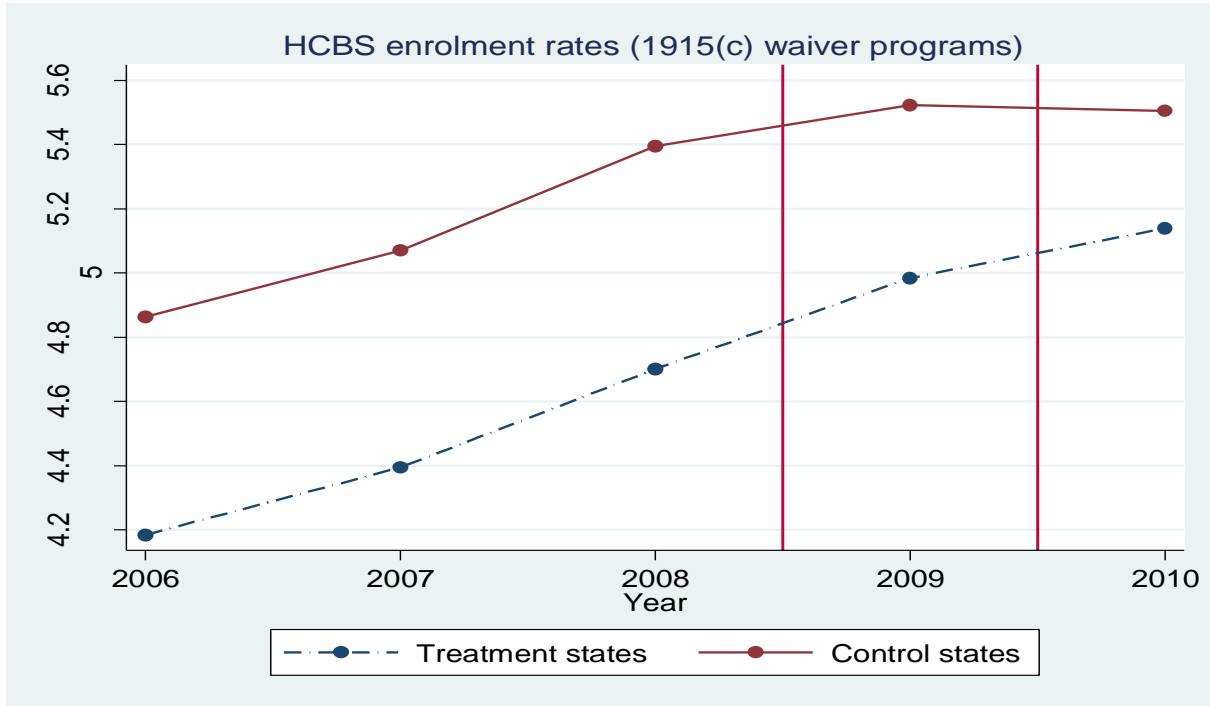


Figure 2.2 Home-and-community-based services waiver enrollment rates

Sources: Medicaid Home and Community-Based Services Programs: Data Update published by Kaiser Commission on Medicaid and the Uninsured. Population estimates from American Community Survey. (obtained from IPUMS-USA, University of Minnesota, www.ipums.org). Data are weighted using person weights. Treatment states defined as states that received an MFP grant in 2007. Treatment states (n=30 including D.C.) control states (n=18).

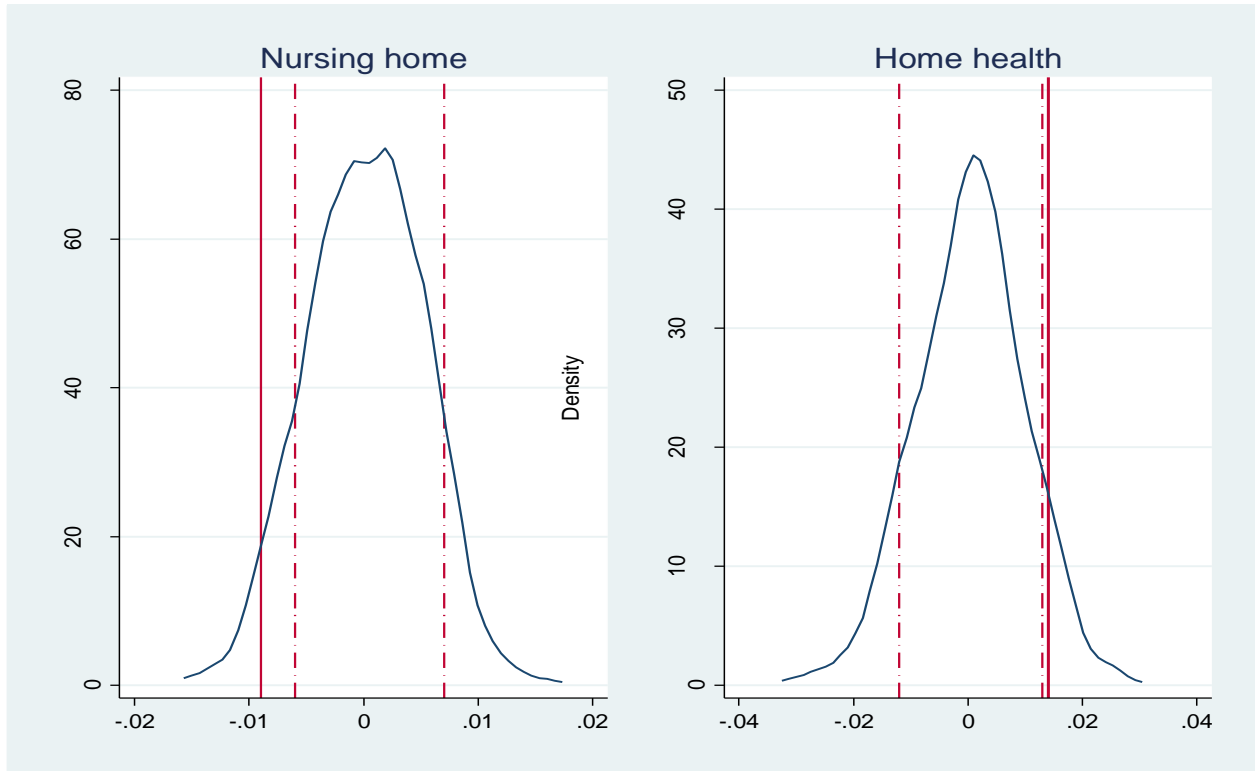


Figure 2.3 Placebo estimates of Money Follows the Person grants on nursing home and home health care.

Notes: This figure plots the distribution of marginal effects from a placebo exercise where states are randomly assigned MFP grantee status from the distribution of true state policies, repeated 500 times. The solid line in each figure represents the estimated marginal effects from Table 2.4 and the dashed vertical lines represent the 10th and 90th percentiles of the placebo distribution.

Table 2.1 Money Follows the Person grants 2007.

State	MFP Grant	Five Year Grant Amount (millions)	FY 2007 Grant Amount (millions)	State	MFP Grant	Five Year Grant Amount (millions)	FY 2007 Grant Amount (millions)
Alabama	N			Montana	N		
Alaska	N			Nebraska	Y	27.54	0.20
Arizona	N			Nevada	N		
Arkansas	Y			New Hampshire	Y	11.41	0.30
California	Y	130.39	0.09	New Jersey	Y	30.30	0.23
Colorado	N			New Mexico	N		
Connecticut	Y	24.21	1.31	New York	Y	82.64	0.19
Delaware	Y			North Carolina	Y	16.90	0.02
District of Columbia	Y	5.37	0.13	North Dakota	Y	8.95	0.02
Florida	N	26.38	2.55	Ohio	Y	100.65	2.08
Georgia	Y	34.09	0.48	Oklahoma	Y	41.81	3.53
Hawaii	Y	10.26	0.23	Oregon	Y	114.73	0.08
Idaho	N			Pennsylvania	Y	98.20	0.13
Illinois	Y	55.70	6.88	Rhode Island	N		
Indiana	Y			South Carolina	Y	5.77	0.03
Iowa	Y	21.05	0.86	South Dakota	N		
Kansas	Y	50.97	0.31	Tennessee	N		
Kentucky	Y	36.79	0.10	Texas	Y	142.70	0.14
Louisiana	Y	49.83	4.97	Utah	N		
Maine	N	30.96	0.52	Vermont	N		
Maryland	Y	21.05	0.86	Virginia	Y	28.63	0.01
Massachusetts	N	67.16	1.00	Washington	Y	19.63	0.11
Michigan	Y	67.83	2.03	West Virginia	N		
Minnesota	N			Wisconsin	Y	56.28	8.02
Mississippi	N			Wyoming	N		
Missouri	Y	17.69	3.40				

Source: <https://www.medicaid.gov/medicaid/ltss/downloads/money-follows-the-person/mfp-grant-awards.pdf>

Table 2.2 Sample means.

Variables	Mean/Percent (Full Sample)	Pre-policy year (2007)		p-value Difference
		Treatment States	Control States	
	(1)	(2)	(3)	(4)
Skilled Nursing Facility	0.049	0.053	0.041	0.027
Home health	0.142	0.126	0.139	0.028
Inpatient care	0.184	0.201	0.182	0.175
Outpatient care	0.697	0.717	0.678	0.103
<i>Age</i>				
65-69	0.291	0.278	0.286	0.500
70-74	0.227	0.227	0.235	0.394
75-79	0.186	0.192	0.188	0.582
80-84	0.149	0.153	0.154	0.837
85+	0.146	0.147	0.137	0.170
Female	0.565	0.571	0.558	0.175
College Degree	0.204	0.189	0.173	0.104
White	0.858	0.849	0.890	0.117
Black	0.079	0.085	0.056	0.110
Other	0.063	0.065	0.054	0.455
Married	0.545	0.539	0.567	0.081
Number of children				
0	0.082	0.082	0.084	0.850
1	0.114	0.112	0.112	0.899
2-4	0.624	0.617	0.624	0.863
5 or more	0.179	0.187	0.184	0.774
Poor health	0.382	0.385	0.378	0.665
N=	18042	6850	2654	

Notes: Data includes 2007 and 2010 waves of the MCBS cost and use module. All estimates using sample weights. The sample includes all individuals between age 65 and 105.

Table 2.3 Skilled nursing facility and home-and-community-based care utilization.

Variables	2007 (Pre-policy)	2010 (Post-policy)	Difference-in-differences
Skilled Nursing Facility			
Treatment states	0.053 (0.004)	0.049 (0.004)	-0.006 (0.006)
Control states	0.041 (0.005)	0.045 (0.005)	
Home health			
Treatment states	0.126 (0.012)	0.151 (0.010)	0.016 (0.008)
Control states	0.139 (0.005)	0.148 (0.007)	

Notes: Data includes 2007 and 2010 waves of the MCBS cost and use module. All estimates using sample weights. The sample includes all individuals between age 65 and 105.

Table 2.4 The effect of HCBS policies on care utilization.

Variables	Nursing home (0/1)	Home health (0/1)
MFP*Year 2010	-0.009 (0.006)	0.014† (0.008)
Year 2010	0.006 (0.005)	0.011* (0.004)
Age 70-74.9	0.002 (0.005)	0.049** (0.010)
Age 75-79.9	0.027** (0.003)	0.093** (0.007)
Age 80-84.9	0.042** (0.003)	0.135** (0.006)
Age 85+	0.059** (0.003)	0.186** (0.007)
Female	0.006 (0.006)	-0.002 (0.003)
Married	-0.018** (0.002)	-0.063** (0.005)
College	-0.009* (0.004)	-0.027** (0.006)
Black	0.002 (0.006)	0.033** (0.011)
Other race	-0.004 (0.008)	0.012 (0.015)
One child	-0.006 (0.005)	-0.012 (0.011)
2-4 children	-0.007* (0.003)	-0.004 (0.009)
5+ children	-0.005 (0.004)	0.016 (0.011)
Poor health	0.010** (0.002)	0.058** (0.004)
N	18042	18042
Mean of dependent variable	0.049	0.143

Notes: ** p<0.01 * p<0.05 †p<0.1. Marginal effects from probit estimation with standard errors in parentheses clustered at state level. The sample includes individuals aged 65 and over. Nursing home is dichotomous indicating if individual resides in a skilled nursing facility or intensive care facility in the year of the survey. Home health is an indicator for one or more home health visits during the year. Each regression is weighted using person weights. All regressions include state and year fixed effects.

Table 2.5 Sensitivity check for contemporaneous shocks.

Variables	Nursing home (0/1)	Home health (0/1)
MFP*Year 2010	-0.004 (0.005)	0.019 [†] (0.011)
Year 2010	-0.007 (0.018)	-0.012 (0.027)
State unemployment rate	0.0003 (0.002)	0.002 (0.003)
Housing price index	-0.0003 (0.010)	0.020 (0.023)
Nursing home beds (per 1000 state residents over 65)	-0.0002 (0.001)	-0.005** (0.002)
Disability prevalence	-0.002 (0.003)	-0.004 (0.005)
Medicare spending per enrollee	0.010 (0.012)	0.008 (0.024)
Age 70-74.9	0.002 (0.005)	0.049** (0.010)
Age 75-79.9	0.027** (0.003)	0.093** (0.007)
Age 80-84.9	0.042** (0.003)	0.135** (0.006)
Age 85+	0.059** (0.003)	0.186** (0.007)
Female	0.006 (0.006)	-0.002 (0.003)
Married	-0.018** (0.002)	-0.063** (0.005)
College	-0.009* (0.004)	-0.027** (0.006)
Black	0.002 (0.006)	0.033** (0.011)
Other race	-0.004 (0.008)	0.012 (0.015)
One child	-0.006 (0.005)	-0.013 (0.011)
2-4 children	-0.007* (0.003)	-0.004 (0.009)
5+ children	-0.005 (0.004)	0.016 (0.011)
Poor health	0.010** (0.002)	0.058** (0.004)
N	18042	18042
Mean of dependent variable	0.049	0.143

Notes: ** p<0.01 * p<0.05 †p<0.1. Marginal effects from probit estimation with standard errors in parentheses clustered at state level. The sample includes single individuals aged 65 and over. Inpatient care and outpatient care are indicators for respective claims for outpatient care under Medicare, Medicaid or other insurance program. Each regression is weighted using person weights. All regressions include state and year fixed effects.

Table 2.6 The effect of HCBS policies on utilization of inpatient and outpatient care.

Variables	Inpatient care (0/1)	Outpatient care (0/1)
MFP*Year 2010	-0.001 (0.011)	-0.024† (0.014)
Year 2010	-0.018† (0.009)	0.002 (0.012)
Age 70-74.9	0.054** (0.012)	0.045** (0.013)
Age 75-79.9	0.091** (0.009)	0.092** (0.016)
Age 80-84.9	0.122** (0.009)	0.111** (0.017)
Age 85+	0.148** (0.010)	0.075** (0.013)
Female	-0.034** (0.006)	0.057** (0.009)
Married	-0.025** (0.006)	0.004 (0.007)
College	-0.025** (0.010)	-0.004 (0.010)
Black	0.004 (0.009)	-0.030 (0.024)
Other race	-0.023* (0.011)	-0.026 (0.017)
One child	-0.002 (0.016)	0.012 (0.015)
2-4 children	0.000 (0.013)	0.031* (0.012)
5+ children	0.025† (0.014)	0.031* (0.014)
Poor health	0.043** (0.005)	0.072** (0.009)
N	18042	18042
Mean of dependent variable	0.184	0.697

Marginal effects from probit estimation with standard errors in parentheses clustered at state level. The sample includes single individuals aged 65 and over.

Table 2.7 The effect of HCBS policies on intensive margin of care utilization.

Variables	Nursing home stays	Home health visits	Inpatient visits	Outpatient visits
MFP* Year 2010	-0.290 (0.257)	68.599** (22.181)	0.008 (0.089)	-0.461 (0.380)
Year 2010	0.225 (0.202)	-59.473 [†] (31.244)	-0.117 (0.189)	1.533* (0.628)
Age 70-74.9	0.266 (0.277)	40.156 [†] (21.652)	0.107 [†] (0.055)	0.299 (0.326)
Age 75-79.9	0.221 (0.230)	8.515 (10.997)	0.105 (0.063)	1.062** (0.309)
Age 80-84.9	0.409+ (0.208)	61.632** (21.101)	0.201** (0.063)	1.257** (0.357)
Age 85+	-0.070 (0.110)	35.220** (11.500)	0.159** (0.039)	0.902** (0.276)
Married	-0.331** (0.116)	-26.961 [†] (14.894)	-0.065 [†] (0.034)	-0.047 (0.160)
College	0.041 (0.143)	-9.364 (10.635)	-0.132** (0.046)	-0.091 (0.289)
Black	0.595* (0.262)	50.642 [†] (25.753)	0.059 (0.058)	0.968* (0.435)
Other race	-0.114 (0.276)	61.822 (54.971)	0.175 [†] (0.097)	0.938 (0.639)
One child	-0.293 (0.275)	9.967 (19.029)	0.092 (0.060)	-0.103 (0.488)
2-4 children	-0.485+ (0.274)	15.011 (16.707)	0.100 (0.063)	0.281 (0.367)
5+ children	-0.103 (0.101)	5.113 (24.209)	0.070 (0.080)	0.912* (0.444)
Poor health	0.225 (0.202)	11.911 [†] (6.932)	0.076 [†] (0.041)	1.010** (0.222)
N	1195	2989	3732	12946
Mean of dependent variable	2.3	128.6	1.6	6.1

Notes: ** p<0.01 * p<0.05 †p<0.1. Standard errors in parentheses clustered at state level. The sample includes single individuals aged 65 and over. Each regression is weighted using person weights. All regressions include state and year fixed effects. The sample size for each regression is the number of individuals who utilized the corresponding source of care during the sample period.

CHAPTER 3: HEALTH STATUS AND RETIREMENT: NEW EVIDENCE FROM PUBLIC SECTOR EMPLOYEES

Much of the analysis and writing in this chapter is derived from co-authored work: “Retirement Timing among Public Sector Workers: Responsiveness to Pension Benefit Plan Design Features”, Robert L. Clark, Robert G. Hammond, Melinda S. Morrill, and Aditi Pathak. Prepared for the SIEPR 2017 Working Longer Conference

3.1. Introduction

Previous research has shown that financial incentives embedded in pension plans are important determinants of the retirement decision (Lumsdaine and Mitchell 1999; Gruber and Wise 2004). Increases in longevity have created serious concerns about the sustainability of employer-provided defined benefit pension plans and public programs including Social Security and Medicare. In this context, reforms targeting extension of working life are an important policy concern. The 1983 Amendments to the Social Security Act introduced a gradual increase in age of eligibility for full benefits from 65 to 67 by 2027.³⁷ These changes were introduced to delay retirement and ease financial burden on Social Security. Further increases to the normal retirement age under Social Security are under consideration. Similarly, public sector employers have pursued reforms increasing early and normal retirement ages under public sector defined benefit pensions. (Thom 2017). In the past two decades, several countries have adopted policies to incentivize later retirements such as , discontinuing early retirement schemes (Euwals et., al 2010) and increasing eligibility ages for public pensions (Casey et al. 2003; Sonnet et al 2014).

However, workers in poor health may be less sensitive to such changes, hampering the success of these policies aimed at extending working life. On the other hand, investments in improving health may have dual benefits for older individuals. In addition to the direct effect on productivity and utility of working, health improvements may extend working life through

³⁷ Details can be found her <http://www.ssa.gov/pressoffice/IncRetAge.html>

modifying responsiveness to financial incentives. This paper investigates if ill-health alters the responsiveness of retirement decisions to financial incentives using a unique panel dataset on public sector workers in North Carolina.

A large body of literature provides evidence on the importance of financial incentives on retirement behavior (Lindeboom 2006a). However, few papers explore the conditionality of the effects of financial incentives on retirement decision by health status (Banks et al. 2007; Erdogan-Ciftci et al 2011; Coile et al. 2014; Garcia-Gomez et al. 2017). These studies find conflicting evidence regarding the impact of financial incentives on the retirement decision by health status. Erdogan-Ciftci et al. find that financial incentives exert stronger effect on the chances of retirement for healthy workers.. These findings suggest that poor health, or in the presence of a health shock, workers are less sensitive to the embedded financial incentives. However, Coile et al. 2014 observe that the effect of financial incentives is three times stronger for those in lowest health quintile (poor health) as compared to those in the highest quintile. In this paper, I provide evidence regarding the conditionality of the effects of financial incentives by health status for public sector workers. In addition to own health, spouse's health status may affect employment and retirement decisions. For example, married individuals may choose to retire due to caregiving responsibilities due spouse's health needs. Hence, I study the interaction of financial incentives and own as well as spouse's health to study retirement behavior.

Most previous studies focus on private sector employees. In the public sector, workers often reach full eligibility at relatively young ages. In addition, many public sector retirees have access to retiree health insurance from their employer, which are uncommon in the private sector (Clark and Morrill 2010). Hence, for public sector workers, the incentive to work until Medicare eligibility at age 65 is comparatively lower. Previous research focusing on private sector workers

may not be appropriate to make predictions regarding retirement decisions of public sector workers. This research adds to the understanding of retirement behavior of public employees.

I use detailed information from two releases of administrative records made available by North Carolina retirement systems. I combine these with data from survey data for older public sector workers. Using pension benefit eligibility and peak value accruals, results confirm earlier findings that both ill-health and financial incentives are important predictors of retirement. I do not find evidence of differential effects of pension eligibility on probability of retirement by health status. However, using a forward looking peak value approach to model the financial incentives, I find that individuals in poor health are more responsive to financial incentives.

3.2 Existing Approaches and Issues

To understand if ill-health alters responsiveness of individuals to financial incentives, it is important to consider three issues. First issue concerns the measurement of poor health and in turn the effect of poor health on retirement. However, the main complication in estimating the effect of health on retirement is that deteriorating health could be both a cause and a consequence of retirement. Thus, estimates likely to be sensitive to the measure of health used. Second, researchers have used different measures of financial incentives to study their impact on the retirement decision. In addition to constructing a measure that provides a close approximation of financial incentives, it is necessary to consider the conditionality of such incentive calculations on health status. Finally, we must take into consideration the different pathways through which ill-health can modify the effect of financial incentives on the decision to retire.

Many studies have explored the relationship between health and retirement, with the earlier work summarized by Currie & Madrian (1999) and more recent work described by Deschryvere (2004) and Lindeboom (2006). Early work acknowledged the difficulties with the measurement of health and with the empirical analyses to study the effect of health on retirement (Quinn

1977). There is, however, still no consensus on how to measure health and how to address the issue that health and work status are jointly determined in modeling their interrelationship. The most common measure of health used in early studies is the subjective measure of self-assessed health (Bazzoli, 1985; Kerkhofs et al., 1999; Dwyer & Mitchell, 1999; McGarry, 2004). It is argued that self-reported measures lead to overestimation of the impact of health, as people who are inactive in the labor market have an incentive to report worse than actual health to justify their inactive status (justification bias). Hence, subsequent papers rely on measures that were believed to be less sensitive to the justification bias such as self-reports of specific medical conditions (Stern, 1989; Kreider, 1999) or health indices derived from multiple indicators (Lambrinos 1981, Bazzoli 1985, Breslaw & Stelcner 1987), or lagged health (Bazzoli 1985). These measures have also been shown to have some measurement bias (Baker et al. 2004).

Recent studies analyze temporal changes to an underlying “health stock” to examine the impact of health on the retirement decision. These models use predicted values from estimation of self-assessed health on reports of specific medical conditions, functional limitations and demographic variables. The resulting predictions are claimed to be free from justification bias with the belief that controlling for demographic variables removes the effect of employment status on reporting behavior. It is important to note that this will be true only if both demographic variables and objective health indicators are not correlated with the measurement error. Adverse health shocks provide a plausibly exogenous source of variation in health status which can be used to identify the causal effects of health on retirement. Few studies use data on unanticipated health shocks such as road accidents (Moller Dano 2005; Halla and Zweimuller 2013) and unanticipated hospitalizations (Garcia-Gomez et al. 2013; Dobkin et al. 2016). All these papers

show that ill-health and health shocks significantly increase the likelihood of retirement.

In this paper, to account for the endogeneity of self-reported health status and retirement, I construct a measure of lagged health status using survey data prior to retirement. While this measure does not suffer from justification bias due to simultaneous reporting of health and employment status, individuals who are actively considering retirement may report being in worse health. Hence, future work will consider changes in self-reported health status as a proxy for health shocks and health measures based on subjective life expectancy.

Previous studies analyzing the relationship between financial incentives and work status have put forth various approaches to model financial incentives. Several papers rely on one-year pension accruals to identify the effect of financial incentives on retirement timing (Burkhauser and Quinn, 1979; Allen, Clark and McDermed, 1993; Cornwell, Dorsey, and Mehrzad, 1991).

These measures, however, fail to take into account the future path of accruals. Stock and Wise (1990) put forth the option value approach to model retirement incentives in defined benefit plans. Defined benefit plans have nonmonotonic accrual patterns. For example, there are large returns to working in the year that an individual reaches the pension plan's early retirement age or the normal retirement age, but smaller accruals in other years. The one-year accrual measure fails to capture the fact that by working in the current year, the individual purchases an option to work in a future year with a higher accrual. Particularly, the option value is a measure of gain in utility from delaying retirement to the optimal age. It is calculated as-

$$\begin{aligned}
 OV_t(r^*) = & \sum_{s=r}^{r^*-1} \beta^{s-t} \pi(s|t) E_t((Y_s^Y)) + \sum_{s=r}^S \beta^{s-t} \pi(s|t) E_t(\kappa * B_s(r^*)) \\
 & - \sum_{s=t}^S \beta^{s-t} \pi(s|t) E_t(\kappa * B_s(t))
 \end{aligned}$$

Consider an individual who is currently working in year t . Let Y_s be earnings in year s if the individual is still working and $B_s(r)$ be retirement benefits in year s if the individual retires in year r . Let r^* be the future year that maximizes the expected value of retiring. $\pi(s|t)$ denotes the probability of living to age s conditional on being alive at age t . The utility specification allows for risk aversion through the parameter γ . The parameter κ measures the utility of a dollar of income obtained while retired relative to the utility of dollar earned while working, or in other words the relative value of leisure. Coile and Gruber (2001) suggest the peak value approach which calculates the financial gain (instead of utility gain) of working to the optimal retirement age. In other words, the peak value is a special case of the option value without the first term pertaining to future earnings in the above equation. Further, the peak value model assumes that the relative value of leisure (κ) equals one.

Although the forward-looking measures may better approximate financial incentives, there are complications in using these measures in estimating the interaction effects of financial incentives and poor health. Particularly, poor health should affect the parameters of the incentive measures, in turn affecting the valuation of these incentives for those in poor health. Poor health may lead to downward adjustment of survival probabilities $\pi(s|t)$ which would lower the peak value. In addition, poor health is likely to affect the time preference for individuals and in turn the discount factor β . Particularly, individuals in poor health may have higher time preference, and thus a lower discount factor, which would lower their valuation of the financial incentive. Thus, calculating peak value and option value measures using same parameter estimates for healthy and unhealthy individuals may lead to measurement error. While it is beyond the scope of current work to modify incentive valuations by health status, future work will consider these

issues.

In this paper, I focus on two measures of financial incentives- pension eligibility and peak value accruals. The indicator for pension eligibility captures the effect of the spike in pension accrual when an individual becomes eligible to receive unreduced benefits. Using both measures help us compare the effects of both reduced form and forward-looking measures of incentives.

Theoretically, it is ambiguous whether the effect of financial incentives on the decision to retire should be bigger or smaller for those in worse health. Unhealthy individuals may be less likely to respond to economic incentives as health becomes the most important factor in the retirement decision. On the other hand, financial incentives may be more important for individuals in poor health because they are more actively thinking about retirement. Those in good health may plan to continue working until they reach some critical age or until their health poses limitations to their work capacity.

Few studies that have focused on the interaction between financial incentives and health provide conflicting evidence regarding the effect of health on responsiveness to financial incentives. Banks et al. (2007) find that peak value accrual significantly affects the likelihood of retirement only for those in good health. Similarly, using Spanish data Erdogan-Ciftci et al. (2011) confirm these results and find that health shocks completely offset the negative impact of peak value accrual. Other studies report that individuals in poor health or who suffer from health shocks are more responsive to financial incentives (Garcia-Gomez 2013; Coile et al. 2014). Coile et al. (2014) measure poor health based on a health index. They find that a 10,000 unit increase in the option value would lower retirement probability by 6.2 percentage points for those in the lowest health quintile (those in poor health), but only by 2.0 percentage for those in the highest quintile. The authors suggest that people in worse health may think more actively about

retirement. Hence, the salience of financial incentives is likely to play a larger role in retirement decisions of these individuals. In this study, I study how poor health status alters the responsiveness to financial incentives among public sector workers in North Carolina. Additionally, I examine how interactions between pension incentives and spouse's poor health influence the decision to retire.

3.3 Data and Methodology

3.3.1 Data

The data are derived from a survey of older public sector workers (between ages 50 and 70) conducted in April 2014, merged with corresponding administrative records for the months of March 2014 and April 2016 maintained by the North Carolina Retirement System Division.³⁸ The survey included questions regarding household characteristics, health, finances and retirement planning.

Table 3.1 below shows the retirement eligibility of workers that were actively employed in March 2014. Eligibility is measured at two points in time: March 2014 and April 2016. About 56 percent of those actively working in March 2014 were eligible to claim early or normal retirement benefits in 2014, which increased to 69% in 2016. Table 3.2 presents the number of individuals who retired by April 2016 by type of eligibility in the two waves. Approximately 20 percent of the sample retired by April 2016, with a higher proportion (46 percent) retiring among those eligible for service retirement by April 2016. Thus, I am able to exploit differences in the eligibility for retirement benefits between 2014 and 2016.

Table 3.3 restricts the sample to individuals who are eligible for early or normal retirement

³⁸ These data are collected as a part of a larger project "Challenges to Retirement Readiness in the North Carolina Public Sector Workforce." Details about the project and data can be found here- <https://sites.google.com/a/ncsu.edu/retirementstudy/>

by April 2016. Columns (1) and (2) compare the proportion of individuals who retired or exit employment respectively by own and spouse's health status. There is no significant difference in proportion of individuals who retired by April 2016 among those in good health and those in poor health. About 33 percent of healthy individuals exit employment in contrast to 40 percent among unhealthy individuals. Testing for equality of proportions, however, we fail to see a significant difference.

In addition to claiming a benefit, poor health may lead individuals to exit from employment. This may be particularly true for those not eligible to claim a benefit. Individuals may exit employment by claiming a regular or a non-regular benefit (usually refers to disability benefits), terminating employment without claiming a benefit and due to death. Figure 1 shows the status of individuals in April 2016 who were actively working in March 2014. About 28 percent of the sample exit employment between the two waves.

3.3.2 Health Variables

To measure own and spouse's health, I use survey questions on self-reported health status. The survey questions on self-reported health measures are: 1. "How would you rate your health, generally?" and 2. "How would you rate the health of your spouse, generally?" Respondents could choose one from the following options: "excellent", "very good", "good", "fair" or "poor". I classify individuals (spouse, in the second case) as having poor health if they answered fair or poor on the respective questions. Note that health status is measured using survey responses as of May 2014. Thus, health status variables correspond to a lagged measure of health. Future work

will incorporate self-assessed life expectancy.

3.3.3 Financial Incentives

Pension Eligibility

Teachers and state employees in North Carolina are covered by the Teachers' and State Employees' Retirement System (TSERS), while local government workers participate in the Local Governmental Employees' Retirement System (LGERS).³⁹ In order to qualify for normal or unreduced benefits, the employee must have satisfied one of three criteria: reached age 65 with 5 years of membership service; reached age 60 with 25 years of service; or have completed 30 years of service at any age. Early retirement with reduced benefits are available to those who have reached age 50 and completed 20 years of creditable service and those who have reached age 60 and completed 5 years of service. I construct a variable denoting eligibility for normal retirement by April 2016 using age and years of service.

This reduced form measure only captures the effect of spike in pension wealth accrual due to eligibility for unreduced benefits. A priori, we cannot determine the direction of the effects for interaction between eligibility for full benefits and poor health. Ill-health may dampen responsiveness of individuals to eligibility for full benefits if individuals in ill-health retire early or exit employment through other pathways such as terminating employment without immediately claiming benefits. On the other hand, individuals in poor health could face higher financial restrictions due to increased medical expenditures and may continue to work until eligibility for full benefits. In this case, we could observe stronger effects of financial incentives on the retirement decisions of those in poor health. All individuals in the sample were actively

³⁹ The important characteristics of TSERS and LGERS are described in: <https://www.nctreasurer.com/ret/Benefits%20Handbooks/TSERSHandbook.pdf> and <https://www.nctreasurer.com/ret/Benefits%20Handbooks/LGERSHandbook.pdf>

working at the time of reporting health status. This implies that we are not able to observe individuals who were in poor health, but already claimed benefits or exited employment prior to the survey. Hence, for the current sample, we expect that individuals who are in poor health would wait until pension eligibility and claim benefits soon after.

Peak Value Pension Wealth

The second measure of financial incentives I model is the peak value introduced in Coile and Gruber (2000) and Coile and Gruber (2001). Coile and Gruber (2007) illustrate how this method can be used to estimate the impact of Social Security wealth on retirement timing. As described in Section 3.2, the peak value is a special case of the option value approach which can be modeled in the following framework. Consider an individual who is currently working in year t . Let Y_s be earnings in year s if the individual is still working and $B_s(r)$ be retirement benefits in year s if the individual retires in year r . Let r^* be the future year that maximizes the expected value of retiring. $\pi(s|t)$ denotes the probability of living to age s conditional on being alive at age t . The peak value incentive (or peak value difference) measures the difference in expected pension wealth if someone retires at a future optimal age versus retiring today (at age t) appropriately discounted.

$$PV_t(r^*) = \sum_{s=r}^S \beta^{s-t} \pi(s|t) E_t(B_s(r^*)) - \sum_{s=t}^S \beta^{s-t} \pi(s|t) E_t(B_s(t))$$

To calculate the peak value of pension benefits, I implement the following assumptions similar to Clark et al. (2017). First, I assume that *retirement* implies terminating employment and immediately claiming benefits. The annual benefit in a given year thus uses the corresponding year salary, multiplier, years of service, and any early retirement benefit reduction. I assume retirement must occur by age 70. Salary income is not included in the

present value except through the growth in pension wealth. The present value at each age of retirement is calculated by multiplying the benefit by the gender-specific survival probability as derived from the retirement plan's experience studies. A discount factor is then applied at a rate of 3 percent, which is the discount rate that the retirement system uses in adjusting the price of the annuity options and in other calculations.⁴⁰ The model includes assumed salary growth of 2 percent annually. For simplicity, the net present values also use gender-specific survival rates and a 3 percent discount rate.

Although poor health is likely to directly affect labor income through decline in productivity, we are concerned with the indirect effects on pension wealth accruals. Poor health may lead to downward adjustment of survival probabilities $\pi(s|t)$, which would lead to an increase in responsiveness to financial incentives and thereby increase probability of retirement

3.4 Results

To understand whether poor health alters individuals' responsiveness to financial incentives, I estimate linear probability models predicting retirement or exit from the labor market. I define retirement as claiming a regular benefit (early or normal) benefit by April 2016. Exit from labor market includes claiming a regular benefit, as well as, non-regular benefit (for example disability benefits) and terminating employment without claiming a benefit. In addition to financial incentive measures and health status, all specifications control for age, years of service, salary, gender, race, college degree and type of agency where individuals are employed.

Table 3.5 reports estimates for the effects of interactions between eligibility for normal (unreduced) benefits and health status in March 2014. Columns (1) and (2) present results for the

⁴⁰ Most public defined benefit plans assume that they will earn an annual return of between 7.0 and 8.5 percent on their investments. These relatively high assumed returns have been criticized by many economists (Novy-Marx and Rauh, 2011).

effect on retirement (defined as claiming an early or normal benefit). We can observe that being eligible for normal benefits is associated with a significantly higher (23 percentage points or 110 percent of the mean) probability of retirement. While poor health is associated with increased probability of retiring, the effect is not significant. Similarly, we do not find differential effects of ill-health on responsiveness to the financial incentive measure, although the large positive coefficient suggests that poor health is likely to reinforce the effects of financial incentives. The effect of interaction between pension eligibility and spouse's poor health is small and insignificant. Columns (3) and (4) report estimates for exit from employment. The coefficient on the interaction term is positive and larger, but the effect is not significant.

Next, I utilize the peak value framework described in Section 3.3.3. Table 3.6 presents results for the interaction effects of peak value accrual and health status. Estimates suggest that a \$10,000 increase in peak value difference implies a 0.6 percentage point (approximately 3 percent of the mean) lower probability of retiring. Our estimate is comparable to the effects reported in earlier studies. Coile and Gruber (2000) incorporate Social Security and pension wealth and find that \$10,000 increase in peak value lowers retirement by 5 percent of the sample average retirement rate. Asch et al. (2005) examine the impact of financial incentives on retirement behavior of federal civil service workers. Their results suggest that a \$10,000 increase in peak value decreases the retirement rate by about 4 percent of the mean.

The effects associated with the interaction between peak value incentive and poor health suggest that workers in poor health are more responsive to financial incentives. A \$10,000 increase in peak value difference is associated with 0.7 percentage point lower probability of retirement for individuals in poor health. The estimate is significant at the 10 percent level. Once again, the interaction effect for peak value incentive and spouse's poor health is close to zero. In

columns (3) and (4) we observe that the negative impact of the peak value incentive on exit from employment is stronger among individuals in poor health. A \$10,000 increase in peak value difference is associated with 1.3 percentage point lower probability of exiting employment for individuals in poor health. These findings are consistent with the reinforcement effect outlined in Garcia-Gomez et al. (2013) and Coile et al. (2014). Thus, within the framework of forward looking financial incentives, we find that unhealthy individuals are likely to be more responsive to financial incentives.

Since poor health is likely to affect how individuals value future income flows, the choice of discount rate is an important factor in the current analysis. Both structural estimations and reduced form analyses have used discount rates in the range of 2 to 3 percent. However, the North Carolina Retirement Systems Division uses a discount rate of 7.25 percent in the actuarial valuation of pension funding. Hence, Table 3.7 uses peak value incentives calculated using a 7.25 percent discount rate. The estimates are slightly larger, but they confirm the previous results that poor health leads to a higher responsiveness to financial incentives. A \$10,000 increase in peak value difference is associated with 1.2 percentage point (approximately 6 percent) lower probability of retirement for individuals in poor health. The estimate is marginally significant ($p=0.11$). When considering exits from employment, the coefficients suggest that a \$10,000 increase in peak value difference lowers probability of exit by 2.4 percentage points.

3.5 Conclusion

Increases in longevity have raised concerns regarding the sustainability of defined benefit pensions and public programs like Social Security and Medicare. One solution is to extend the working life of individuals. However, workers in poor health may not be able to work longer or may be less sensitive to financial incentives to extend working life. Hence, this paper

investigates the effect of interaction between financial incentives and health status on the decision to retire or exit the labor market. Further, I test whether spouse's health status affects responsiveness of individuals to financial incentives to determine retirement decisions.

Using administrative data on public sector workers in North Carolina matched to survey responses, I estimate the probability of retirement between March 2014 and April 2016. I use two measures of financial incentives- eligibility for normal (unreduced) pension benefits and peak value, and self-reported health status from survey responses. Reduced form estimates using eligibility for normal benefits do not suggest significant differences in responsiveness to financial incentives by own or spouse's health status. Further specifications include peak value incentive which calculates the difference between current pension wealth and projected pension wealth at optimal retirement age. Estimates associated with interaction between peak value incentive and health status suggest that unhealthy individuals are likely to be more responsive to financial incentives. A \$10,000 increase in peak value difference is associated with 1.2 and 2.4 percentage point lower probability of retirement and exit from employment for individuals in poor health. These findings do not support the concern regarding success of policies incentivizing later retirements through changes in pension or Social Security incentives.

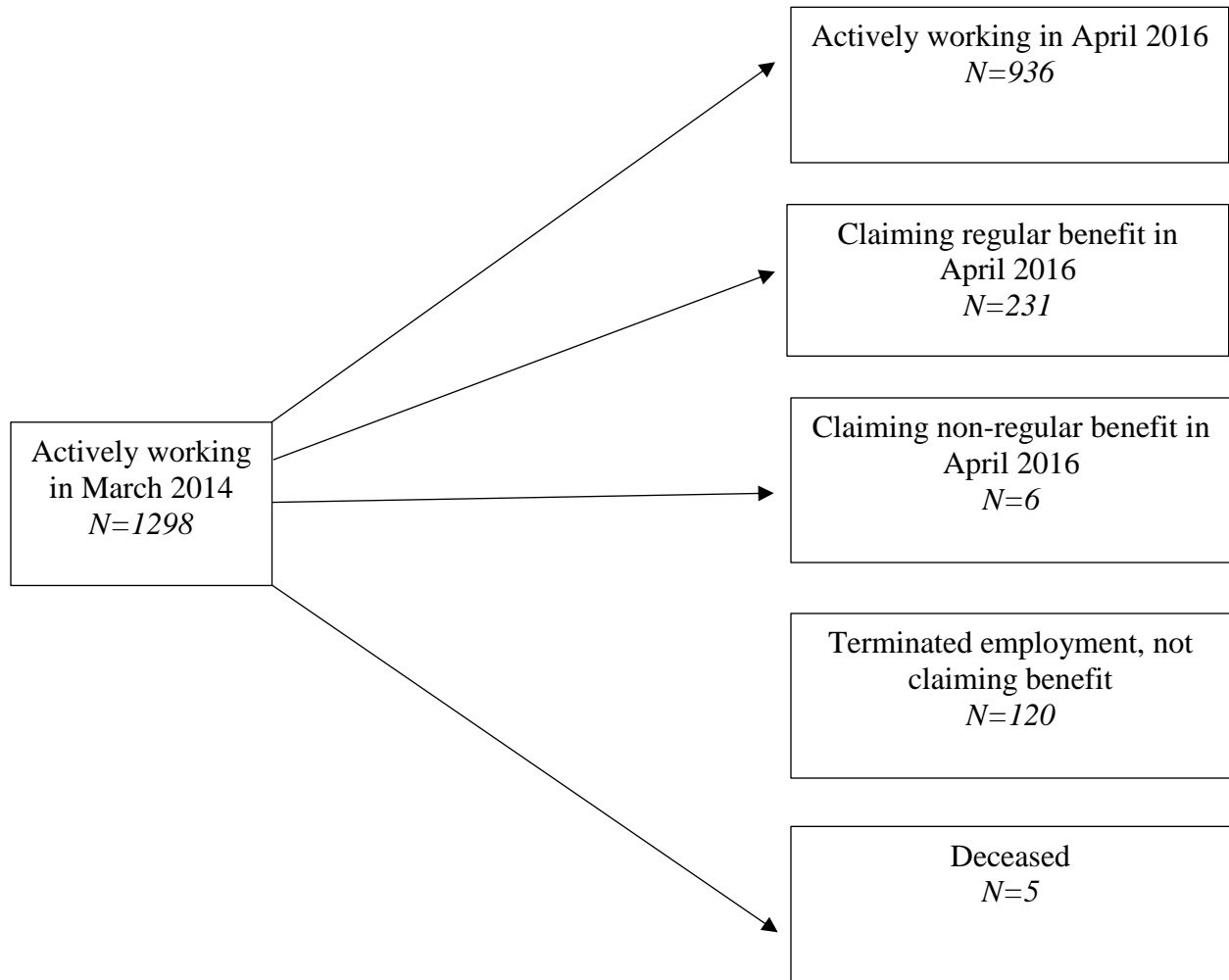


Figure 3.1 Status of individuals in April 2016 who were actively working in March 2014.

Table 3.1 Retirement eligibility of survey respondents.

March 2014	April 2016			Total
	Not eligible	Early	Normal	
	(1)	(2)	(3)	
Not eligible	405 (72.45%)	115 (26.12%)	7 (1.43%)	559
Early	--	388 (65.21%)	173 (34.79%)	595
Normal	--	--	144 (100%)	144
Total	405	534	359	1298

Notes: Two waves (July 2014 and April 2016) of administrative records on public sector workers in North Carolina between ages 50 and 64, actively employed in March 2014. The sample includes individuals who responded to the first survey. I drop individuals who did not answer questions about own or spouse's health.

Table 3.2 Actively claiming regular benefit in April 2016.

March 2014	April 2016			Total
	Not eligible	Early	Normal	
	(1)	(2)	(3)	
Not eligible	--	13	1	14
Early	--	74	92	166
Normal	--	--	74	74
Total		87	167	254

Notes: Two waves (July 2014 and April 2016) of administrative records on public sector workers in North Carolina between ages 50 and 64, actively employed in March 2014. The sample includes individuals who responded to the first survey. I drop individuals who did not answer questions about own or spouse's health. Individuals who terminated employment but are not claiming benefit classified as active.

Table 3.3 Retirement status by self-reported health (among eligible individuals).

March 2014	Retired (1)	Exit (2)	Total
<i>Own health</i>			
Good	234 (27.99%)	263 (33.00%)	836
Poor	20 (35.09%)	22 (40.74%)	57
p-value	0.25	0.24	
<i>Spouse health</i>			
Good	135 (28.00%)	171 (32.14%)	532
Poor	25 (36.36%)	30 (38.96%)	77
p-value	0.13	0.15	

Notes: Two waves (July 2014 and April 2016) of administrative records on public sector workers in North Carolina between ages 50 and 70, actively employed in March 2014. The sample includes individuals who responded to the first survey. I drop individuals who did not answer questions about own or spouse's health. Individuals who terminated employment but are not claiming benefit classified as active. Eligible individuals (n=851) calculated as sum of columns (2) and (3) in table 3.1. Row percentages in parentheses. P-value for test of equality of proportions. Similar results are obtained if I restrict to those eligible for full retirement benefits.

Table 3.4 Summary statistics.

Variable <i>N=1298</i>	Mean/ Percent
Retired	19.5%
Exit	27.5%
Eligibility for normal benefits (April 2016)	27.7%
Poor health	5.8%
Married* spouse poor health	39.6%
Age	58.8
Female	69.4%
Married	70.9%
White	79.5%
Other race	20.5%
College degree	65.3%
Years of service	19.3
City government	7.0%
County government	11.6%
Public school	38.7%
State government	13.6%
Department of Transportation	4.1%
Other	25.0%

Notes: Two waves (July 2014 and April 2016) of administrative records on public sector workers in North Carolina between ages 50 and 70, actively employed in March 2014. The sample includes individuals who responded to the first survey. I drop individuals who did not answer questions about own or spouse's health.

Table 3.5 Interaction effects of pension eligibility and health status on probability of retirement.

Variable	Retired by April 2016 (1)	Retired by April 2016 (2)	Exit by April 2016 (3)	Exit by April 2016 (4)
Eligibility for normal benefits	0.229*** (0.037)	0.239*** (0.043)	0.223*** (0.039)	0.232*** (0.045)
Poor health	0.024 (0.041)	0.022 (0.041)	0.026 (0.058)	0.024 (0.058)
Married*Spouse poor health	-0.001 (0.033)	0.006 (0.032)	0.003 (0.040)	0.010 (0.042)
Eligibility for normal benefits * poor health	0.073 (0.109)	0.079 (0.109)	0.139 (0.112)	0.145 (0.113)
Eligibility for normal benefits * spouse poor health		-0.025 (0.056)		-0.024 (0.059)
Age	0.023*** (0.003)	0.023*** (0.003)	0.017*** (0.004)	0.017*** (0.004)
(Projected) years of service	0.006*** (0.001)	0.006*** (0.001)	0.002 (0.002)	0.002 (0.002)
Total salary in 2013 (0000's)	-0.001 (0.006)	-0.001 (0.006)	-0.0002 (0.006)	0.0002 (0.006)
Female	-0.002 (0.023)	-0.001 (0.023)	0.013 (0.027)	0.014 (0.027)
Married	0.004 (0.035)	0.005 (0.035)	0.006 (0.043)	0.006 (0.043)
Non-white	0.011 (0.024)	0.012 (0.025)	0.016 (0.030)	0.017 (0.030)
College degree	0.022 (0.023)	0.021 (0.023)	0.047+ (0.028)	0.046+ (0.028)
City government	-0.043 (0.045)	-0.042 (0.045)	-0.060 (0.051)	-0.060 (0.051)
County government	0.001 (0.038)	0.001 (0.038)	0.005 (0.045)	0.004 (0.045)
Public school	0.062* (0.031)	0.062* (0.031)	0.096** (0.037)	0.096* (0.037)
Department of Transportation	0.017 (0.057)	0.016 (0.057)	0.041 (0.064)	0.041 (0.064)
Other	-0.030 (0.031)	-0.030 (0.032)	0.010 (0.038)	0.009 (0.038)
Observations	1,298	1,298	1,298	1,298
Mean of dependent variable	0.195	0.195	0.275	0.275

Notes: Survey responses from May 2014 matched with administrative records for April 2016. Retired defined as actively claiming a normal or early benefit. Robust standard errors in parentheses. Exit defined as actively claiming any benefit or terminating employment without claiming a benefit. *** p<0.001, ** p<0.01, *p<0.05, + p<0.1

Table 3.6 Interaction effects of peak value accrual and health status on probability of retirement.

Variable	Retired by April 2016 (1)	Retired by April 2016 (2)	Exit by April 2016 (3)	Exit by April 2016 (4)
Peak value	-0.006*** (0.001)	-0.006*** (0.001)	-0.005*** (0.001)	-0.004** (0.001)
Poor health	0.110 (0.072)	0.110 (0.073)	0.184* (0.075)	0.182* (0.075)
Married*Spouse poor health	0.005 (0.034)	0.004 (0.042)	0.011 (0.041)	0.017 (0.047)
Peak value* poor health	-0.007† (0.004)	-0.007† (0.004)	-0.013** (0.004)	-0.013** (0.004)
Peak value* spouse poor health		0.000 (0.001)		-0.001 (0.002)
Age	0.023*** (0.003)	0.023*** (0.003)	0.018*** (0.004)	0.017*** (0.004)
(Projected) years of service	0.009*** (0.001)	0.009*** (0.001)	0.005** (0.002)	0.005** (0.002)
Total salary in 2013 (0000's)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Female	-0.001 (0.023)	-0.001 (0.023)	0.013 (0.027)	0.013 (0.027)
Married	0.014 (0.036)	0.014 (0.036)	0.016 (0.044)	0.016 (0.044)
Non-white	0.014 (0.025)	0.014 (0.025)	0.020 (0.030)	0.019 (0.030)
College degree	0.030 (0.023)	0.030 (0.023)	0.055† (0.028)	0.055† (0.028)
City government	-0.027 (0.044)	-0.027 (0.044)	-0.046 (0.050)	-0.046 (0.050)
County government	0.008 (0.038)	0.008 (0.038)	0.011 (0.046)	0.011 (0.046)
Public school	0.066* (0.032)	0.066* (0.032)	0.099** (0.038)	0.099** (0.038)
Department of Transportation	0.023 (0.058)	0.023 (0.058)	0.048 (0.066)	0.048 (0.066)
Other	-0.021 (0.032)	-0.021 (0.032)	0.017	0.017
Observations	1,298	1,298	1,298	1,298
Mean of dependent variable	0.195	0.195	0.275	0.275

Notes: Survey responses from July 2014 matched with administrative records for April 2016. Retired defined as actively claiming a normal or early benefit. Exit defined as actively claiming any benefit or terminating employment without claiming a benefit. Robust standard errors in parentheses *** p<0.001, ** p<0.01, *p<0.05, † p<0.1

Table 3.7 Sensitivity check for interaction effects of peak value accrual and health status.

Variable	Retired by April 2016 (1)	Retired by April 2016 (2)	Exit by April 2016 (3)	Exit by April 2016 (4)
Peak value	-0.009*** (0.002)	-0.010*** (0.002)	-0.007** (0.002)	-0.007* (0.003)
Poor health	0.095 (0.068)	0.096 (0.068)	0.161* (0.071)	0.160* (0.072)
Married*Spouse poor health	0.006 (0.034)	0.003 (0.041)	0.011 (0.041)	0.016 (0.047)
Peak value* poor health	-0.012 (0.008)	-0.012 (0.008)	-0.024** (0.009)	-0.024** (0.009)
Peak value* spouse poor health		0.001 (0.003)		-0.001 (0.004)
Age	0.025*** (0.003)	0.025*** (0.003)	0.020*** (0.004)	0.020*** (0.004)
(Projected) years of service	0.010*** (0.001)	0.010*** (0.001)	0.006** (0.002)	0.006** (0.002)
Total salary in 2013 (0000's)	0.006 (0.006)	0.006 (0.006)	0.006 (0.007)	0.006 (0.007)
Female	-0.005 (0.023)	-0.005 (0.023)	0.009 (0.027)	0.009 (0.027)
Married	0.015 (0.036)	0.015 (0.036)	0.017 (0.044)	0.017 (0.044)
Non-white	0.014 (0.025)	0.014 (0.025)	0.020 (0.030)	0.020 (0.030)
College degree	0.029 (0.023)	0.029 (0.023)	0.054 [†] (0.028)	0.054 [†] (0.028)
City government	-0.025 (0.044)	-0.025 (0.044)	-0.045 (0.050)	-0.045 (0.050)
County government	0.009 (0.038)	0.009 (0.038)	0.010 (0.046)	0.011 (0.046)
Public school	0.068* (0.032)	0.068* (0.032)	0.100** (0.038)	0.101** (0.038)
Department of Transportation	0.025 (0.058)	0.025 (0.058)	0.050 (0.066)	0.050 (0.066)
Other	-0.020 (0.032)	-0.020 (0.032)	0.017 (0.039)	0.017 (0.039)
Observations	1,298	1,298	1,298	1,298
Mean of dependent variable	0.195	0.195	0.275	0.275

Notes: Peak value calculations use a 3 percent discount rate. Survey responses from July 2014 matched with administrative records for April 2016. Retired defined as actively claiming a normal or early benefit. Exit defined as actively claiming any benefit or terminating employment without claiming a benefit. Robust standard errors in parentheses *** p<0.001, ** p<0.01, *p<0.05, † p<0.1

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APPENDICES

Appendix A

Table A1. Sample construction.

Sample restrictions	Observations
All observations	29654
Age > 115	29635
Missing education	27460
Missing information on living quarters	27420
Observations for Rhode Island, Arizona and Vermont	27004
Single individuals	16605

Notes: Data includes 1984, 1989, 1994, 1999 and 2004 waves of the NLTCS.

Table A2. Effect of state Medicaid home-and-community-based policies on care for married individuals.

Variables	Nursing home (0/1) (1)	Nursing home + residential care (0/1) (2)	Informal (unpaid) care (0/1) (3)
PCS benefit	0.0001 (0.0001)	-0.001 (0.001)	0.033 (0.041)
HCBS elderly waivers	0.0001 (0.0001)	-0.001 (0.001)	0.033 (0.054)
Age 70-74.9	0.0005 (0.005)	0.001* (0.000)	0.059** (0.020)
Age 75-79.9	0.0004** (0.0001)	0.003** (0.001)	0.105** (0.019)
Age 80-84.9	0.001** (0.0002)	0.004** (0.001)	0.077** (0.020)
Age 85-89.9	0.001** (0.0001)	0.005** (0.001)	0.094** (0.031)
Age 90 and above	0.001** (0.0001)	0.005** (0.001)	-0.000 (0.039)
Female	-0.0002 (0.0001)	0.000 (0.000)	-0.152** (0.011)
Black	-0.0002 (0.0005)	-0.001* (0.001)	0.020 (0.036)
Other race	-0.0004 (0.0004)	-0.001 [†] (0.001)	-0.014 (0.056)
One child	-0.000* (0.0002)	-0.002* (0.001)	0.001 (0.036)
2-4 children	-0.001* (0.000)	-0.003* (0.001)	0.059* (0.028)
5 or more children	-0.001** (0.000)	-0.003* (0.001)	0.063* (0.029)
College degree	-0.0007 (0.0008)	0.000 (0.000)	-0.039* (0.016)
Any ADL	0.002** (0.00001)	0.008** (0.001)	0.349** (0.018)
<i>N</i>	10,232	10,232	10,232
Mean of dependent variable	0.009	0.013	0.273

Notes: ** p<0.01 * p<0.05 †p<0.1. Marginal effects from probit estimation with standard errors in parentheses clustered at state level. The sample includes married individuals aged 65 and over. Nursing home is dichotomous indicating if individual resides in a skilled nursing facility or intensive care facility at the time of the survey. Residential care facilities including assisted living, continuing care communities etc. Informal care is an indicator for receiving unpaid help with any ADL from family members or friends. Each regression is weighted using person weights and includes controls for age categories, race, education categories, gender indicator for widowed and an indicator for difficulty with at least one ADL. All regressions include state and year fixed effects.

Table A3. Program interactions in the effects of state Medicaid home-and-community-based policies on care.

Variables	Nursing home (0/1)	Nursing home + residential care (0/1)	Informal (unpaid) care (0/1)
	(1)	(2)	(3)
PCS benefit	-0.004 (0.003)	-0.005 (0.008)	-0.046 (0.043)
HCBS elderly waivers	0.001 (0.003)	0.003 (0.007)	-0.001 (0.028)
PCS benefit* HCBS elderly waivers	-0.004 (0.003)	-0.015 (0.010)	-0.034 (0.062)
Age 70-74.9	0.003 (0.002)	0.010 [†] (0.005)	0.045 [†] (0.024)
Age 75-79.9	0.005 [†] (0.003)	0.021** (0.006)	0.042 (0.026)
Age 80-84.9	0.009** (0.002)	0.029** (0.006)	0.074** (0.025)
Age 85-89.9	0.013** (0.002)	0.038** (0.005)	0.091** (0.026)
Age 90 and above	0.020** (0.002)	0.052** (0.005)	0.078* (0.031)
Female	-0.007** (0.002)	-0.010** (0.003)	-0.007 (0.015)
Widowed	-0.005* (0.002)	-0.014** (0.004)	-0.024 (0.020)
Black	-0.010** (0.002)	-0.027** (0.003)	0.045** (0.013)
Other race	-0.004 (0.004)	0.007 (0.013)	0.011 (0.033)
One child	-0.005** (0.002)	-0.011** (0.004)	0.072** (0.022)
2-4 children	-0.004** (0.001)	-0.009** (0.003)	0.058** (0.015)
5 or more children	-0.012** (0.002)	-0.032** (0.004)	0.103** (0.019)
College degree	-0.004** (0.001)	0.001 (0.003)	-0.072** (0.018)
Any ADL	0.056** (0.006)	0.099** (0.004)	0.157** (0.014)
<i>N</i>	16,605	16,605	16,605
Mean of dependent variable	0.065	0.087	0.195

Notes: ** p<0.01 * p<0.05 †p<0.1. Marginal effects from probit estimation with standard errors in parentheses clustered at state level. The sample includes single individuals aged 65 and over. See Table 3 for details. All regressions include state and year fixed effects and state-specific time trends.

Table A4. Sensitivity to specification.

Variables	Nursing home (0/1)	Nursing home + residential care (0/1)	Informal (unpaid) care (0/1)
	(1)	(2)	(3)
PCS benefit	-0.015 (0.015)	-0.016 (0.022)	-0.059 [†] (0.035)
HCBS elderly waivers	0.004 (0.009)	0.001 (0.013)	-0.006 (0.032)
Age 70-74.9	0.023** (0.007)	0.031** (0.008)	0.052* (0.024)
Age 75-79.9	0.046** (0.007)	0.068** (0.008)	0.063* (0.024)
Age 80-84.9	0.077** (0.007)	0.104** (0.008)	0.114** (0.023)
Age 85-89.9	0.109** (0.005)	0.145** (0.006)	0.154** (0.025)
Age 90 and above	0.152** (0.005)	0.198** (0.006)	0.172** (0.026)
Female	-0.007 (0.005)	-0.004 (0.006)	0.003 (0.015)
Widowed	-0.022** (0.006)	-0.032** (0.007)	-0.031 (0.021)
Black	-0.027** (0.005)	-0.042** (0.006)	0.045** (0.013)
Other race	-0.010 (0.013)	0.006 (0.016)	0.011 (0.036)
One child	-0.007+ (0.004)	-0.011+ (0.006)	0.077** (0.021)
2-4 children	-0.010** (0.003)	-0.013** (0.004)	0.059** (0.015)
5 or more children	-0.032** (0.004)	-0.047** (0.005)	0.104** (0.019)
College degree	-0.021** (0.004)	-0.011* (0.005)	-0.080** (0.017)
<i>N</i>	16,605	16,605	16,605
Mean of dependent variable	0.065	0.087	0.195

Notes: ** p<0.01 * p<0.05 †p<0.1. Marginal effects from probit estimation with standard errors in parentheses clustered at state level. The sample includes single individuals aged 65 and over. See Table 3 for details. All regressions include state and year fixed effects and state-specific time trends.

Table A5. Robustness check for timing of implementation of PCS benefit.

Variables	NH	NH + residential	Informal care
PCS	-0.009 (0.006)	-0.016 (0.020)	-0.069 [†] (0.040)
HCBS	-0.0004 (0.002)	-0.004 (0.005)	-0.015 (0.033)
PCS anticipation	-0.004 (0.005)	-0.003 (0.014)	-0.015 (0.034)
<i>N</i>	16,605	16,605	16,605

Notes: ** p<0.01 * p<0.05 †p<0.1. Marginal effects from probit estimation with standard errors in parentheses clustered at state level. See Table 3 for details. All regressions include state and year fixed effects and state-specific time trends.

Table A6. Robustness check for policy adoption.

Variables	PCS benefit (0/1)	HCBS elderly waivers (0/1)
	(1)	(2)
Population age 85 and over (%)	0.023 (0.114)	0.017 (0.140)
Non-white population (%)	0.015 (0.010)	0.012 (0.007)
Per capita personal income	-0.030 (0.026)	-0.010 (0.011)
Poverty rate	-0.004 (0.003)	-0.005 (0.003)
Work disability rate per 1000	-0.008 (0.015)	0.002 (0.003)
SSI/SSP payment rate	-0.0005 (0.001)	-0.001 (0.005)
N=	714	714

Notes: ** p<0.01 * p<0.05 †p<0.1. Marginal effects from probit estimation with standard errors in parentheses clustered at state level. State level variables obtained from U.S Bureau of the Census and Social Security Administration Bulletin. All regressions include state and year fixed effects and state-specific time trends.

Appendix B

Table B1. Determinants of receipt of MFP grants.

Variables	MFP grants (0/1)
Proportion of population age 85 and over	1.566 (21.70)
Unemployment rate	0.042 (0.090)
Disability prevalence	-0.063 (0.080)
Nursing home beds	0.006 (0.007)
Housing price index	0.005 (0.339)
Medicare spending (in '0000s)	1.323 (0.797)
N=	51

Notes: ** p<0.01 * p<0.05 †p<0.1. Coefficients from a linear probability model where the dependent variable indicates receiving an MFP grant and data on control variables for pre-policy period (2007).

Appendix C

The data used in Chapter 4 are part of the North Carolina Retirement Transitions Study-Active Workers (NCRTS-A). These data were gathered as part of a larger project, “Challenges to Retirement Readiness in the North Carolina Public Sector Workforce,” funded by Sloan Foundation Grant Number 2013-10-20. This appendix describes the sample used in the analysis presented in Chapter 4. For more information about the full project, please see the website: <http://go.ncsu.edu/publicsectorretirement>.

Sample construction

The target survey population is workers that were ages 50-64, actively employment in March 2014, and have valid 2013 salary information indicating an active membership (N=138,790). Those with an email address were eligible for the email sample (N= 82,503), while the remaining workers were eligible for the print survey (N = 56,287). We sent a survey to the final target population of 13,884 (8,293 and 5,591 surveys sent for the email and print sample, respectively). As an incentive to complete the survey, we advertised that participants could enter into a drawing to win a free iPad. We received 2,480 responses (1,953 and 527 for email and print, respectively) for an overall response rate of about 18 percent. When including only those with valid survey responses to the main demographic characteristics (marital status, education, and race), there are 1808 observations. The final sample after restricting to non-missing responses for own and spouse’s health included 1298 observations. The Retirement System provided us with administrative data on the full sample of 2014 active workers as of April 2016.

Years of service calculations

There are several types of service that could be important in our analysis. First, there is membership service, which should approximate the actual tenure of the employee minus any

transferred or withdrawn service. We use membership service for our measure of job tenure and for calculating age-at-hire. However, to be eligible for retirement benefits, individuals may also have purchased non-contributory (e.g., sick leave and vacation time) service. To account for these latter types of service for all employees, we include an imputed amount of purchased service. The imputation method isolated the group of individuals in the 2014 cohort who did ultimately retire by March 2016. Of those, we calculated the actual service purchased at retirement. Those values were collapsed into cell-specific means by gender, salary (low/high), retirement system (TSERS/LGERS), and nine age-at-hire categories. Then, cell-specific imputed purchased years of service is added for the full 2014 cohort to create “projected years of service.” This method gives a more accurate measure of what benefits a worker can qualify for. Purchased service generally includes unused vacation time and sick leave. The values range from 1 week to 3.1 years. The average imputed purchased service is slightly over a year for the 20-29 age-at-hire group and approximately 10.5 months for the 30-39 age-at-hire group. .

Our sample is restricted to those without any withdrawn service or breaks in service. This is necessary for us to accurately determine age-at-hire and plan benefit rules. Individuals who have service with multiple retirement systems, that is both TSERS and LGERS can transfer service to either retirement system at the time of claiming benefits. Hence, we restrict our attention to individuals with membership in a single retirement system. We also exclude law enforcement officers and any people with service in non-reciprocity retirement systems. We also exclude a small number of workers hired prior to age 22 and those hired age 50 or later.