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THE IMPACT OF MEDICARE PART D ON MORTALITY AND FINANCIAL STABILITY

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THE IMPACT OF MEDICARE PART D ON MORTALITY AND FINANCIAL STABILITY

DISSERTATION

A dissertation submitted in partial fulfillment of the
requirements for the degree of Doctor of Philosophy in the
College of Business and Economics
at the University of Kentucky

By

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ABSTRACT OF DISSERTATION

THE IMPACT OF MEDICARE PART D ON MORTALITY AND FINANCIAL STABILITY

Using the Health and Retirement Study Panel core files from 1996 to 2014, I analyze how Medicare Part D impacted access to prescription drug coverage by various demographic factors such as race, gender, and income. In Chapter 1, I find the highest take-up rates for those who were white, female, and with higher incomes. However, increases in coverage were high across the board, such that Medicare Part D also improved drug insurance coverage for those who were black, male, and with lower income. Thus, although Medicare Part D did increase prescription drug insurance coverage for seniors across the board, I also find potential for improvement in enrollment for difficult-to-reach groups.

Next, Chapter 2 examines the impact of Medicare Part D on mortality. Although I do not find an impact on the life expectancy of respondents as a whole, I do find a significant positive effect for black respondents, indicating that Medicare Part D may have mattered more for disadvantaged groups. The largest impact is for black men, who have an additional 9 percentage point chance of living to age 73 for an additional 8 years of coverage (significant at the 5% level). When looking only at cardiovascular mortality, which is more likely to be influenced by drug coverage, I find improvements in life expectancy for the total population, with stronger effects for minorities and men. Overall, my findings suggest that Medicare Part D did move the needle on its goal: to improve the health of those who, without government intervention, had the most difficulty paying for prescription drugs.

Chapter 3 looks at the impact of Medicare Part D prescription drug coverage on cost-related medication adherence, food insecurity, and finances among seniors. It would be reasonable to assume that Medicare Part D, which led to near-universal drug coverage among senior citizens, could allow seniors to shift money previously spent on drug expenditures to other areas. The strongest effect of Medicare Part D is on cost-related medication nonadherence, leading to a 21% decrease for an additional 8 years of

Medicare Part D coverage. The impact is even stronger for the black male population (30%). I fail to reject the null hypothesis that Medicare Part D did not reduce food insecurity or household debt. Overall, Medicare Part D appears to have improved the financial stability of seniors.

KEYWORDS: Medicare Part D; Health Insurance; Life Expectancy; Racial Disparities

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THE IMPACT OF MEDICARE PART D ON MORTALITY AND FINANCIAL STABILITY

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CHAPTER 1. DID MEDICARE PART D IMPROVE RACIAL DISPARITIES IN HEALTHCARE?

1.1 Introduction

The Medicare Modernization Act of 2003 created Medicare Part D in order to alleviate the burden of drug expenditures on the elderly population. During the original creation of Medicare in 1965, an outpatient prescription drug benefit in Part B was considered and dropped because of fears of high costs, as well as oppositional lobbying from the American Medical Association (Oliver et al. 2004). Instead, public hospital drug provision programs aided the less well-off. However, as drug costs became an increasing share of public expenditures, these programs were strained to keep up (Flaer et al. 2008). In the 1990s and early 2000s, prescription drug expenditures grew twice as rapidly as all other health care spending (Duggan 2005). Furthermore, Duggan and Morton (2010) found that three years prior to Part D in 2003, seniors paid about $1,789 on drugs per year, with more than half of this spending out-of-pocket and just 7.8 percent covered by Medicare.

Utilization of drugs was also on the rise. Schur (2004) reported that "Between 1977 and 1998, the proportion of Americans taking at least one prescription rose from 58 to 66 percent and the average number of prescriptions per person more than doubled." Papers such as Poisal and Murray (2001) highlighted how Medicare beneficiaries without drug coverage reported less drug use and how out-of-pocket spending on drugs had increased for all seniors. According to Safran et al. (2002), before Part D 23% of seniors reported spending more than $100 per month on prescription drugs. Furthermore, among seniors without drug coverage, 43% spent more than $100 monthly. Rising drug costs for seniors due to medical advancement drove the creation of Part D. The primary purpose of

Medicare Part D was to provide universal access to drugs for seniors who needed them (Neuman et al. 2009).

Policymakers intended Medicare Part D to reduce disparities between beneficiaries of different income levels (Poisal and Murray 2001) as well as discrepancies between drug coverage across states (Safran et al. 2002). In a speech to the N.A.A.C.P., President Bush bragged of Medicare Part D's provisions to cover the costs of drugs for the poorest seniors (Stolberg 2006). However, those who opposed the bill such as Senator Barbara Mikulski (D-Maryland) argued that it was an inadequate benefit which would fail to control drug prices (Karl et al. 2003). Neuman et al. (2007) found that take-up of Part D was negatively correlated with being African-American, rural residence, and poverty, matching with my own findings below. Thus, focusing on how Medicare improved drug insurance coverage rates for the most disadvantaged groups is an important criterion to assess the program's effectiveness.

After 2006, individuals had the option of retaining their existing coverage or purchasing a Part D drug plan separately or through Medicare Advantage/HMO. For those who could not afford any plan, the low-income subsidy covered part or all of their insurance. For Medicare Part D to be as efficient as possible in terms of improving health at the lowest cost, take-up of Part D plans would need to be dominated by those who previously did not have coverage, not those switching from existing plans to something cheaper. However, Abaluck and Gruber (2011) find that seniors did not always pick the plans which maximized their welfare.

As shown in Figure 1.1, Medicare Part D increased prescription drug coverage among seniors by almost 15%, from around 75% to 90%. This could be considered close

to universal coverage, since those who did not take-up coverage because of good health dominated those who did not take-up (Levy and Weir 2010).

My contribution is to focus in particular on the racial gap in healthcare between black and white Americans, and also to assess to what extent Medicare Part D was effective at reaching those who needed it the most.

1.2 Literature Review

Levy and Weir (2010) look at the impact of Medicare Part D shortly after its inception. Like my own paper, they use the Health and Retirement Survey. They estimate that 50%–60% of seniors without drug coverage took up Part D coverage in 2006, increasing total prescription drug coverage by 17%. Thus, coverage rose to 93% of seniors. Similarly, Heiss et al. (2010) and Neuman et al. (2009) find 90% coverage rates after Medicare Part D. These results are very similar to mine: I found prescription drug coverage among seniors jumped from 76.5% in 2004 to 90% in 2006. This would imply about 15% of seniors gained coverage.

Levy and Weir (2010) also suggest that those seniors who did not take up coverage were predominantly those who did not have an immediate use for it. The majority of those without coverage in 2006 reported they did not use prescription drugs and had low out-of-pocket medical expenses overall. Levy and Weir find little evidence of crowd-out between 2004 and 2006. Finally, Levy and Weir do not find any evidence of less take-up among the poor.

1.2.1 Demographic Factors Impacting Drug Coverage

Whether or not an individual has can afford prescription drugs is strongly correlated with race, income, education, health, and other demographic factors. Klein et al. (2004) identify senior citizens prior to Part D who reported a delay in taking medication due to cost: they tended to be low income, with Medicare coverage only, have high out-of-pocket prescription costs, in poor health, and African-American. Similarly, Klein, Turvey, and Wallace (2004) find that the elderly most likely to delay prescription medication as a result of cost are those with Medicare coverage only, low income, poor health, African-American race, and age 65–80. Gellad, Haas, and Safran (2003) likewise report that blacks and Hispanics were more likely than whites to not take medication for cost-related reasons. Saver et al. (2004) also find that low-income Americans are more likely to have difficulty affording medications.

Looking at drug coverage for the under age 65 group, the Commonwealth fund study Schur, Doty, and Berk (2004) find that nonelderly adults with health insurance but no drug coverage were at risk for high out-of-pocket costs, a form of underinsurance. They estimate that 9 percent of the adult population under age 65 in 2001 had health insurance but lacked prescription drug coverage. (Unlike my results, this paper looks at younger adults.) In addition, they find only 63% of seniors had insurance which included prescription drug coverage before Medicare Part D. The study suggested that lacking coverage was a stronger problem among the elderly than the nonelderly.

Another Commonwealth fund study by Morgan and Kennedy (2010) looks at demographic factors related to prescription drug usage and access across seven countries. They find that in the United States there was little difference in prescription drug usage

between those with below-average income and those with average income, unlike five of the other countries. Because the poor are generally less healthy, this suggests less access to drugs among those with lower incomes. Americans with lower incomes are also more likely to report having skipped using drugs because of prohibitive costs.

Looking only at those who lacked coverage before 2006, Levy and Weir (2010) find that seniors who enrolled in Medicare Part D were as sicker, more likely to use prescription drugs, and had higher out-of-pocket spending on drugs in 2004. Use of drugs drove take-up. However, eligibility for the Low-Income Subsidy had no effect, suggesting this benefit could be better-publicized. Those who gained Part D insurance were also more likely to be young-elderly and slightly more likely to be married (the latter especially for men). Interestingly, education, homeownership, income, and assets did not have any significance.

After Part D, Levy and Weir (2010) concluded there was no longer a significant differential between the most advantaged and less-advantaged groups in education and income. However, because take-up of Part D was high for all racial and ethnic groups, although the probability of being uninsured dropped across all groups, racial and ethnic minorities had lower rates of coverage than non-Hispanic whites. Higher rates of Medicaid coverage for minorities in 2004 meant that non-Hispanic whites were in fact more likely to lack drug coverage before Part D, and thus experienced more gains in coverage from the program.

Other studies report vulnerable groups being less likely to enroll to a greater extent than Levy and Weir. Maciejewski et al. (2010) find that in 2006, of Medicare beneficiaries without prior drug coverage, 44 percent enrolled in Part D. Enrollment was

correlated with younger age (65–74), female, non-Hispanic white, married or widowed, and self-reported health conditions. They also find that those with incomes less than $50,000 were less likely to enroll. They conclude that initial enrollment shortly after the rollout of Medicare Part D was low.

Specifically looking at the impact of Part D on drug coverage, Neuman et al. (2007) find that those seniors still without drug coverage in 2006 fell into two groups: those in relatively good health and those potentially difficult to reach. The "difficult to reach" sociodemographic characteristics associated with no prescription drug coverage were: age 75 and older, African American, income at or below 150 percent of poverty, no education beyond high school, and rural residence. However, at the same time, they find Part D enrollment rates were higher among seniors with low incomes, racial and ethnic minorities, women, seniors taking prescription medications. Neuman et al. attributes this to the autoenrollment of those dual eligible for Medicare and Medicaid into Part D plans.[1] Furthermore, they find that out-of-pocket spending on drugs and rates of medicate nonadherence full much more for those enrolled in the low-income subsidy. This suggests that Part D improved usage of prescribed medicine for low-income beneficiaries who previously relied on Medicaid drug coverage which covered less of their costs. Finally, Neuman et al. report that only half of those eligible were aware of the low-income subsidy (despite being automatically enrolled in it), and even lower awareness rates were reported by African American and Hispanic seniors.

[1] Those dual eligible for Medicare and Medicaid are defined as those both enrolled in Medicare Part A and/or Part B and enrolled in either full coverage Medicaid or one of Medicaid's Medicare Savings Programs. Although all seniors on Medicaid were automatically enrolled in Part D, a minority still used Medicaid primarily to cover the costs of their drugs. Some of these may be seniors who were unaware of the low-income subsidy despite automatic enrollment.

Heiss et al. (2010) find healthy individuals less likely to enroll in Part D, and more likely to remain uninsured overall. Finally, Mahmoudi and Jensen (2014) find that although Part D reduced Hispanic/white disparities in annual prescription drug spending, it increased the African American/white disparity. If these groups may have found the complex enrollment process for Part D to be confusing, this suggests Medicare Part D could improve outreach.

There is ample literature suggesting that Medicare beneficiaries do not always choose the best possible Part D plan. Plans and their benefits change every year, making it hard for seniors to consistently stay in the best possible plan. Abaluck and Gruber (2011) find participants in Part D plans valued lower plan premiums more than expected out-of-pocket costs and picked plans with financial characteristics such as donut hole coverage even when not relevant to their own situation. In the end, they calculate a loss of 27 percent of patient welfare from such choices. In addition, Ericson (2014) discovers that consumers had inertia in switching plans. This led older plans to have 10 percent higher premiums relative to new plans. Zhou and Zhang (2012) find only 5.2 percent of Medicare Part D beneficiaries are in the cheapest plan and beneficiaries often overprotected themselves by paying higher premiums for plan features that they did not need. Similarly, Hsu et al. (2008) find that beneficiaries had limited knowledge of their plan, and this led to greater financial burden. Finally, Heiss et al. (2013) discover that fewer than 25% of individuals enrolled in plans as good as the least cost plan specified by the Plan Finder tool made available to seniors by the Medicare administration, and that consumers on average spend in excess about $300 per year. The confusing nature of Part

D offers an explanation for why take-up might be lower among the groups who theoretically would be expected to have more need for prescription drugs.

1.2.2 Total Health Insurance Coverage

The determinants of health insurance coverage are similar to the determinants of prescription drug coverage. The CDC's "Summary Health Statistics for U.S. Adults: National Health Interview Survey, 2012" (2014) find that those with good health were more likely to have private insurance whereas those with poor health were more likely to have public or no insurance. Women and seniors were more likely to have coverage than men or the young. Another CDC study by Martinez and Cohen (2013) find that Hispanics are the least likely to have insurance, with a quarter uninsured. They also find that men were less likely to have insurance than woman and the age group 25-34 was the least likely group to have insurance. Those married, employed, and having more than a high school education were more likely to have insurance coverage. My own results looking at seniors find that health coverage hovers around 99%, near-universal.[2] This is due to Medicare offering health insurance to everyone over age 65.

1.3 Data

My data set is the Health and Retirement Study (HRS). This longitudinal panel study represents a sample of approximately 20,000 elderly and near-elderly Americans surveyed every two years. The original HRS cohort was born 1931-41 and first interviewed at the ages of 51-61. In 1998, the HRS merged with the Asset and Health

[2] Table 1.1 contains the exact numbers for health insurance among the elderly for each year.

Dynamics Among the Oldest Old (AHEAD), which included U.S. seniors aged 70 and above, from the birth year cohorts 1890–1923. At the same time, two new cohorts were enrolled: seniors born 1924–30 and 1942–47. With subsequent cohorts added every six years, the HRS fully represents the population of U.S. seniors over age 50.

Sonnega et al. (2014) look at the composition of the Health and Retirement Study cohort, and find a representative rate of minority participation due to oversampling of African-American and Hispanic households and interviews conducted in both English and Spanish. Response rates are consistently between 80 and 90 percent. My final data set covers 1996 to 2014, and contains 35,025 observations. Individual years have between 4,000-8,000 observations, with the number of observations trending lower for earlier years.

1.3.1 Variables of Interest

Chapter 1 examines the impact of the rollout of Medicare Part D on drug coverage rates among seniors by demographic factors. In order to create my variable for prescription drug coverage, I used a series of questions asked by the HRS, linked in a chain, about health insurance and prescription drug coverage. In year 2006 only, several extra questions inquire about why an individual made the decision to enroll or not in Part D. For more details on how this variable was constructed, see Appendix A. My variables for health status, marriage, income and assets are all collected at age 64—meaning, the answer given when each individual was age 64.[3]

[3] For those who answered the survey at an odd year of age, the data categories at age 64 were taken at age 65 instead.

1.4 Summary Statistics

1.4.1 Elderly Drug Coverage

Table 1.1 compares my findings in the HRS on total health insurance coverage rates of seniors to those found using the CPS. Both results are extremely similar. Across all years, health insurance rates among the over 65 age group remain around 98-99% in both the HRS and the CPS. This is as expected, since Medicare offers insurance to all seniors.[4]

Then I compare prescription drug coverage rates of seniors. I used two different outside sources. Table 1.2 uses the Medicare Current Beneficiary Survey in early years, the HRS in middle years, and the Kaiser Foundation in later years, then compares with the Medical Expenditure Panel Survey. Finally, Table 1.3 has my own results from the HRS.[5] I find similar results in all tables. Prior to the rollout of Medicare Part D, drug coverage rates for seniors hovered between 71-76%. However, in 2006 this jumped up to around 90% and remained in that range ever since. This suggest that Medicare Part D led to about a 15 percentage point increase in prescription drug coverage among seniors (Figure 1.1).

Other sources support about a 90% rate of prescription drug coverage for seniors post-Part D. Levy and Weir (2010) also used the HRS to look at take-up of Medicare Part D, so their numbers should be most similar to mine. They find at 76% drug coverage rate among seniors in 2004 and a jump to 93% in 2006. The slightly higher findings of Levy

[4] Tiny variations may be due to the fact that I use birth year in the HRS to calculate age, with a slight margin of error depending on the month when someone was born. Also, the CPS may include some 64-year-olds, leading to very slightly lower numbers.

[5] I use a slightly different methodology for calculating drug coverage from 1996-2004, which is discussed in Appendix A.

and Weir in coverage is likely due to differences in methodology. Of people who use prescription drugs regularly, the HRS asks, "Are your drugs costs completely, mostly, or partly covered?" For those who did not report drug coverage from other sources, I did not count them as covered if they only reported mostly/partial coverage, since these people likely only received small discounts to the cost of drugs through prescription assistance programs. However, if I had counted these individuals as covered, then I would have found the exact same 93% as Levy and Weir.

Also supporting the 90% estimate, Donohue (2014) find that 10% of seniors lacked drug coverage in 2013. Heiss et al. (2010) report Medicare Part D hit its target of 90% coverage. In addition, according to Neuman et al. (2009) approximately 90% of all Medicare beneficiaries had prescription-drug coverage by June 2006.

> Next, I examine drug coverage among the near-elderly, those age 55-64. Using the Medical Expenditure Panel Survey,[6] I find that in 2004, among age 45-64, 74.1% of the population had a prescription medication expense, and 91.9% among the over 65 age group. In Table 1.3, I find that for the near-elderly (55-64), drug coverage lingered around 75%, increasing slightly over time. This intuitively makes sense, because before Part D the elderly would not have a significant advantage in obtaining drug coverage. Naturally the near-elderly had no change from Medicare Part D, which only applied to those over age 65. Thus, the near-elderly had a disadvantage in obtaining drug coverage relative to the elderly after the roll-out of Part D in 2006.

[6] The MEPS also contains a question asking if a private insurance plan covers prescription drugs. For 2004, I found that 60.21% of near-elderly (54-65) reported having prescription drug coverage by a private plan. For 2002, I found that 61.61% of near-elderly reported having prescription drug coverage by a private plan and 63.31% in 2000. The question was not asked in MEPS prior to 2000.

1.4.2 Landscape Prior to Medicare Part D—How the Elderly Obtained Drug Coverage Before and After Part D

Before Medicare Part D, elderly Americans could obtain prescription drug coverage through private plans, certain types of Medicare including Medigap and HMOs, Medicaid, and/or long-term care insurance. I find private plans to be the largest category pre-2006, around 40% in 2004, with Medicare HMOs/Medicare Advantage the largest source of public coverage.

After the rollout of Medicare Part D in 2006, anyone eligible for Medicare—that is to say, U.S. citizens who have reached age 65—could sign up for a Part D plan.[7] Joining Part D is voluntary, although Medicaid recipients with a drug plan were required to switch over. The enrollment period starts three months before the month in which an individual turns 65 and runs seven months. There is a late enrollment penalty for not signing up during enrollment, except for those currently with better coverage than Medicare Part D, who may delay enrolling until their coverage ends. Every year has an open enrollment period wherein seniors may change to a different Part D plan. Medicare Part D plans have four standard parts: the initial deductible (typically $400, but may start at first dollar coverage); co-insurance or medication co-payment; the coverage gap or donut hole (where beneficiaries pay 100% of costs unless the plan provides coverage for

[7] Permanent residents who are not citizens can purchase Part D plans if they have worked in the U.S. for at least 40 quarters and are above the age of 65. Immigrants who are permanently residents for 5 years and have resided continuously in the U.S. for that duration also have the option to purchase Medicare coverage from the U.S. government, and those who purchase Part A, Part B, or both then also have the option to purchase Part D plans.

this hole); and catastrophic coverage (which triggers when more than $4,950 has been spent on prescription medications).

In 2006, Medicare beneficiaries generally fell into four categories based on their prior coverage. Those who already had coverage better than Part D, usually private coverage, often kept their current plans. Medicaid-covered Medicare beneficiaries (aka dual eligible) were automatically enrolled in Part D.[8] Medicare Advantage (MA) plans/Medicare HMOs were required to offer drug coverage if they didn't already. Those with privately purchased prescription drug insurance, Medigap, or no coverage could decide if they wanted to enroll in Part D and choose a plan.

Medicare Part D plan costs vary by income level. Seniors with higher incomes pay a surcharge for Part D drug coverage on top of their plan premiums. For those with lower incomes and assets, Medicare Part D has a means-tested subsidy to help cover premiums, deductibles and copayments. Low-income subsidy recipients are automatically enrolled in Medicare Part D, defaulted randomly into a set of plans below a price benchmark. They are also automatically switched if their plan moves to above the benchmark the next year. According to Ericson (2014), such automatically enrolled recipients are half the market and face substantial inertia. This automatic enrollment implies that drug coverage should be higher among those with lower income and assets after Part D.

Looking at type of drug coverage by demographic factors post part-D, of the age 65 and older group, 24% were covered by Part D, 20% through a Medicare HMO or MA

[8] Those in my sample who reported having Medicaid drug coverage would be those who answered in the survey that their drugs were covered by Medicaid. Although all seniors in Medicaid were automatically enrolled in Part D, they still had the option of continuing to use Medicaid to cover the costs of their prescription drugs. Figure 1.2 reports the primary method used to pay for drugs.

plan, and 34% through a private plan (Figure 1.2). Coverage steadily increased with assets and income. In addition, for seniors, coverage by health was lowest for those who reported excellent health, peaked at good health, and decreased with poor health. This is likely due to the correlation between poor health and poverty.

Looking at the contrast between public and private coverage before and after Part D, I find private drug insurance fell by about 4 percentage points in 2006. By 2014, seniors with private drug coverage had fallen by 12 percentage points relative to 2004. [9] The change seems to be driven by people who enrolled in Medicare Part D or a Medicare Advantage/HMO plan with drug coverage. Since the reason for switching coverage was not asked in the HRS, it is difficult to determine how much of the decline in employer-sponsored drug insurance can be attributed to crowd-out as opposed to general trends of falling employer-provided insurance over time. According to Strumpf (2010), half of all large employers in the U.S. who previously offered retiree health insurance dropped this coverage over the past two decades. Hence Medicare Part D could have been an important source of coverage for those who lost their employer-sponsored drug insurance.

Also using the HRS, Levy and Weir (2010) argue there was not very much crowd-out between 2004 and 2006, pointing out that private coverage also declined between 2002-2004, which I also find. However, Engelhardt and Gruber (2010) find an 80% decline private prescription drug insurance after Part D, and Lichtenberg and Sun (2007) find 72% crowd-out in number of prescriptions paid for by the government.

[9] This is defined as the percentage point decrease in seniors covered by employer-sponsored, Medigap, or military drug coverage. Although military coverage is a form of public coverage, it was lumped in with privately-purchased Medigap plans in some survey years. As a result, this is a somewhat imprecise estimate of the decline in private drug insurance over time.

Overall, Part D represented a significant shift from private coverage of drug expenditures to public coverage, as well as an increase in total coverage overall.

1.4.3 Coverage by Income and Assets

Next, I look at the impact of Part D on drug coverage by income and assets categories. Mean income across the entire sample, all years, was $54,566. Median income was $35,360. Minimum income was zero and maximum was $5,084,600. My sample in the HRS ages over time, which leads to significant changes in average sample income over time. For a better basis of comparison, I compare income and assets at age 64 for each respondent.[10] I create my income categories by dividing my sample into four income groups.[11] My categories are as follows: "$0,000-$12,000"; "$12,000-$30,000"; "$30,000-$100,000"; and "Greater than 100,000." Table 1.4 shows the distributions of my sample across these categories.

To measure assets, again I examine age 64 for each observation. I create bins for assets using census data on quintiles of the over age 65 group.[12] The categories I chose are based off census data on median net worth of households by net worth quintile and age of householder. My categories are "< $7,263"; "$7,263-68,839"; "$68,839-205,985"; "205,985-630,754"; and "> $630,754." The distribution is shown in Table 1.5. For my sample, the mean assets at 64 was $355,487 and the median was $139,000.

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[10] Since the HRS surveys every 2 years, in for those with birth years in odd years this is age 65.
[11] To calculate income, I used the sum of all income in a household (only including respondent and spouse), reported in nominal dollars. The HRS imputed missing components of income.
[12] I used total household assets, also reported in nominal dollars. This is calculated as the sum of all wealth components (excluding second home) minus debt. As with income, the HRS imputes missing assets.

In addition, I look at how drug coverage changed by income and assets before and after Medicare Part D. In 2004, those in the poorest category of household income actually had a slightly higher rate of prescription drug coverage (by about 4%). In 2006, drug coverage rose across the board for all income categories, but increased the most for those with incomes over $100,000 and assets over $200,000. The poorest income category now had a lower drug insurance coverage rate than the richest group. Levy and Weir (2010) also found that education, homeownership status, and income and assets had no significant effect on take-up or on the probability of not having drug coverage, and that the Low Income Subsidy had low take-up. They found that prior to 2004, Medicaid actually made disadvantaged groups more likely to have drug coverage. A similar pattern is evident with assets, where gains in coverage were greater for the upper quintiles than the lowest quintile. Although Part D improved coverage for all income and asset groups, the gains seem to be greater for those who were already wealthier, indicating a potential for improvement if the program's goal was to extend coverage to those who were least able to afford it on their own.

The different increases in coverage suggests different price sensitivity to the price change for drug insurance. Using the near-elderly as a control group, Ketcham and Simon (2008) find that from 2005-2007, Part D reduced the daily cost medication for seniors by 21.7%. They also calculate that use of prescription drugs rose by 4.7%, hence suggesting a price elasticity of demand of -0.22. Based on an increase in the number of elderly filling any prescription, they suggest that the increase in utilization came from both those who previously had no coverage and those who switched to Part D. This indicates that Part D lowered drug costs for many seniors, supported by Yin et al. (2008) and Lichtenberg and

Sun (2007) both finding out-of-pocket drug costs for seniors fell after Part D, by 13.1 and 18.4 percent respectively. Finally, Duggan and Morton (2010) find that for drugs with significant competition, the creation of Part D lowered their prices, as well as decreasing total drug costs for enrollees previously uninsured. Furthermore, they also find that insured seniors are more price elastic, a counter-intuitive result. The cause may be that Medicare Advantage drug plans often include formulary (a list of prescription drugs that are covered by a specific health care plan) and other mechanisms to ensure enrollees have to pay more for more expensive drugs. My own findings contribute to this literature by suggesting that the price elasticity of seniors may also vary across demographics and income level. The goal of my next section is to examine how drug coverage changed based on demographic factors, particularly race.

1.5 Results

1.5.1 Theoretical Predictions

The previous section shows how the landscape for prescription drug coverage for seniors changed after the roll-out of Medicare Part D. This section focuses on the impact of demographic factors, asking if Medicare Part D expanded drug coverage to minorities, the less-educated, and those with lower incomes—groups with less ability to afford coverage without government intervention. The 15% increase in coverage demonstrated in the last section would be expected to disproportionately benefit disadvantaged groups who could not afford coverage prior to turning age 65. If so, this would provide evidence that Medicare Part D helped make prescription drug coverage available across all seniors.

However, looking at the literature on take-up of Medicare Part D, it is unclear if Medicare Part D successfully reached the groups who previously had lower drug coverage. This poses a different question about the efficiency of Part D. However, drug coverage did increase for all groups post-2006. Levy and Weir (2010) argued that the complexity of the menu of options of Part D plans could potentially discourage enrollment, citing how take-up of social benefits is especially low for the elderly.

1.5.2 Part D's Take-up by Demographic Factors

First, I divided seniors into three groups based on birth year: 1928-1932, 1933-1937, and 1938-1941. I found that the younger cohorts had higher coverage before Part D than the oldest one, by about 3-5%. However, rates of coverage became similar (around 93%) after Part D's rollout. If older seniors needed coverage more, then Part D may have been of greater aid to them.

Next, I examined drug coverage by various demographic factors for the elderly (those over age 65) pre and post 2006. The goal was to see to how the impact of Medicare Part D differed across seniors belonging to different demographic groups. This is important as one of the stated purposes of the program was to smooth out differences in coverage across seniors (Poisal and Murray 2001, Safran et al. 2002, Stolberg 2006).

Table 1.6 shows a huge change before and after Medicare Part D, raising mean drug coverage rate in every single category. Prior to Part D, minorities had a higher rate of coverage than the white non-Hispanic population, which can be attributed to greater coverage by Medicaid (Levy and Weir 2010). Those in worse health had a higher take-up rate, except for the absolutely worst category. Marriage and education increased take-up. Although groups which previously had lower drug coverage rates had higher take-up,

after Part D there was little difference across all groups of seniors in rates of prescription drug insurance coverage.

Everyone benefitted from Part D. However, those Hispanic, black, poorer, and less educated all had lower take-up rates. These groups already had higher coverage before 2006, so afterwards prescription drug insurance looked very similar across race. The difference between the black and white population disappeared, whereas the Hispanic population had slightly lower coverage rates after Part D. However, even though the gap between the Hispanic and the white population was one of the largest after Part D, the difference was less than 3 percentage points. Overall, Part D decreased the differences in drug coverage rates across demographics.

As mentioned in my literature review, Levy and Weir (2010), Maciejewski et al. (2010), Neuman et al. (2007), and Mahmoudi and Jensen (2014) all find Part D had difficulty reaching certain disadvantaged groups. Although drug coverage increased for all groups post-2006, disparities by race and income did not disappear; in some cases, they even find increased disparities.

My own results agree with Levy and Weir (2010) that take-up was higher among the white population. Although all groups benefited from Part D, it is not clear from Table 1.6 that disadvantaged groups benefitted more. The one exception to this is men versus women: men, who previously had a slightly higher coverage rate, had a much lower coverage rate than women after Part D (although again, mean coverage rates increased for both groups.) These results suggest that Part D may not have reached certain disadvantaged groups. However, they still show huge across-the-board increases in drug coverage.

Table 1.7 looks at types of drug coverage for various respondents by demographic factors prior to Medicare Part D. The sample is limited to those who were at least 65 in 2004. I find the largest gap in descriptive characteristics to be between those who have coverage through employers and those who have Medicaid. Those with Medicaid are the least well-educated, have the lowest income and assets, are more likely to be black or Hispanic, are less likely to have a high school degree and have a near-zero chance of having a college degree. They are more likely to be female but less likely to be married. Those with Medicaid coverage had the lowest income and assets and those with employer coverage had the highest. Given that Medicaid is means-targeted, this is as expected.

Table 1.8 limits the sample to respondents without prescription drug coverage in 2004 and examines their demographic characteristics as a function of what drug coverage they obtained in 2006. I focused my analysis on those who obtained Part D or remained without coverage, because these had the largest sample size and also provided the results most relevant to my research. I found that demographic characteristics had little impact on drug coverage rates after Part D. Women were more likely to sign up. However, education, income and assets did not have any impact. According to Levy and Weir (2010), the predominant determinants for signing up for Part D were poor health, using prescription drugs, and higher out-of-pocket spending in 2004 relative to those who remained without coverage.

Next, I use these demographics factors to predict prescription drug coverage in a random effects model. My equation is:

$$\text{Drug Coverage}_{im} = \beta_0 + \beta_1 \text{Age} + \beta_{2\text{-}4}\,\text{Self-Reported Health} + \beta_{5\text{-}8}\,\text{Income} + \beta_{9\text{-}12}\,\text{Assets} + \beta_{13}\,\text{Marriage} + \beta_{14}\,\text{Gender} + \beta_{16\text{-}17}\,\text{Education} + \beta_{18\text{-}21}\,\text{Race} + \beta_{22}\,\text{Retired} + \varepsilon \qquad (1.1)$$

Table 1.9 shows the effect of various demographic factors on probability of having prescription drug coverage, using random effects. I examine the elderly before and after Part D to see if the demographic factors predicting prescription drug coverage changed.

My time-varying variables are prescription drug coverage (dummy),[13] age, dummies for self-reported health, income and assets category dummies, dummy for married, and dummy for retired. My time-invariant variables are dummies for race,[14] gender, and education.[15]

My most important finding is that before Part D, being a racial minority was correlated with being more likely to have drug coverage, but after Part D, the white population was more likely to have coverage. The coefficient for the black population went from being 0.04 before Part D to being less likely to have coverage with a coefficient of -0.01. The effect was even stronger for the Hispanic non-white population, who went from a coefficient of 0.12, indicating being more likely to have drug coverage, to -0.01. However, after Part D the impact became insignificant for both groups.

In other words, Medicare Part D take-up appears to be lower among disadvantaged groups. This is not to say that it decreased coverage for minorities, only that the program increased coverage more for whites, who previously had lower coverage rates. Similarly, I also found that having lower assets was previously correlated with higher rates of coverage (likely because impoverished seniors were more likely to be in

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[13] A dummy for health insurance was dropped due to nearly all of my sample having health insurance.
[14] Race has five categories: White Non-Hispanic, Black Non-Hispanic, Other Non-Hispanic, Hispanic Non-White, and Hispanic White.
[15] Nine categories for education were used in my regression. In Table 1.8, I include only a dummy for College Degree (4 years or more) and High School Graduate (not including those with additional education.)

worse health and thus need to use prescription drugs), but after Part D the correlation flipped and higher assets were correlated with being more likely to have coverage. The effect of income remained the same, but assets may be a better measure of the wealth of seniors since many over the age of 65 would be retired.

Education was also positively and significantly correlated with coverage both before and after. Similar to my means, I found that women disproportionately benefited from Part D, switching from being less likely to have coverage to being more likely. Marriage also became positively correlated with coverage for those eligible for Part D. Age had nearly no impact and the effect of self-reported health status was also largely insignificant. Being retired had a negative impact on prescription drug coverage rates, suggesting some seniors lost employer-provided drug insurance after retirement. These results are all in line with what I expected based on my description statistics.

1.6 Conclusions

My results suggest that Medicare Part D increased access to prescription drug care across all demographic categories, but not to the extent expected. Minorities were actually more likely than whites to have coverage before Medicare Part D. This flipped after the rollout of Medicare Part D. Although coverage increased for all groups across all demographic factors, it increased more for those who were white non-Hispanic, as well was those with higher income and assets, those with more education, those who were married, and women. This ties in with literature suggesting that take up of the Part D Low-Income subsidy was low. My findings suggest a need to improve the targeting of Medicare Part D, particularly outreach towards lower income groups. This is important

because improving affordability of drugs among the less wealthy was a policy goal of Part D when it was first created a decade ago.

Table 1.1: Percent of Seniors with Health Insurance Coverage using Various Sources

	1996	1998	2000	2002	2004	2006
CPS	N/A	98.9	99.3	98.1	98.6	98.7
HRS (author's calculations)	98.5	99.2	99.4	99.4	99.1	99.0
HRS Sample Size	338	2,335	3,413	4,536	5,613	6,666

	2008	2010	2012
CPS	98.1	98	98.5
HRS (author's calculations)	99.2	99.1	99.0
HRS Sample Size	7,677	7,094	6,589

Source: Current Population Reports, Income, Poverty, and Health Insurance Coverage in the United States: 2012-1998.
HRS 1996-2012; Total observations: 35,025 (This includes numerous observations generated by the merges, particularly with the very large tracker file, which is why it is larger than any individual set of observations per year.)

Table 1.2: Percent of Seniors with Drug Coverage Using Outside Data

	1996	1998	2000	2002	2004	2006	2008	2010	2012
MCBS and others	73	76	N/A	74.2	76.2	92.9	90	90	90
MEPS	N/A	N/A	N/A	N/A	71.4	90	90	90	N/A

Source for row 1: 1996-1998 Medicare Current Beneficiary Survey
2004-2006 HRS, Levy and Weir (2010)
2008-2012 Kaiser Foundation
Source for row 2: MEPS, Engelhardt and Jonathan Gruber (2011)

Table 1.3: Percent of Sample with Drug Coverage

	1996	1998	2000	2002	2004	2006	2008	2010	2012	2014
Percent of Seniors	75.7	74.6	76.5	74.2	76.5	89.9	91.7	90.0	89.5	87.9
Sample Size	333	2,315	3,404	4,514	5,348	6,666	7,677	7,094	6,589	5,822
Percent of Near-Elderly	69.59	72.70	76.14	78.32	78.91	78.87	78.88	77.71	77.76	77.26
Sample Size	7,771	6,250	4,539	3,035	1,517	6,891	3,565	4,504	4,647	5,259

Source: My own calculations in the HRS
Total observations: 35,025

Table 1.4: Elderly Drug Coverage by Household Income

Household Income at Age 64-65	Percent of Sample	1998	2000	2002	2004	2006
$0-$12,000	14.88%	71.43%	71.84%	77.92%	78.61%	84.44%
$12,000-$30,000	27.33%	73.38%	76.56%	72.99%	75.08%	87.75%
$30,000-$100,000	46.02%	77.03%	83.08%	76.45%	77.70%	91.87%
>$100,000	11.77%	78.57%	82.11%	74.63%	72.07%	93.15%
Total	100%	70.94%	71.96%	72.94%	74.70%	89.14%
	2008	2010	2012	2014		
$0-$12,000	90.56%	88.96%	88.35%	86.70%		
$12,000-$30,000	92.36%	91.20%	90.43%	91.01%		
$30,000-$100,000	94.15%	92.97%	92.68%	93.45%		
>$100,000	96.14%	96.02%	94.78%	95.38%		
Total	92.99%	91.67%	91.48%	92.02%		

Note: "Total" coverage will not be the exact same as Figure 1.1 because not every individual had data for income and also because I altered my sample size prior to my main regressions. Elderly is defined as anyone over age 65.

Table 1.5: Elderly Drug Coverage by Household Assets

Household Assets At Age 64-65	Percent of Sample	2004	2006
< $7,263	8.86	80.05%	85.55%
$7,263-68,839	14.01	76.56%	90.06%
$68,839-205,985	19.25	78.71%	87.72%
205,985-630,754	18.31	76.09%	90.88%
> $630,754	39.56	72.54%	89.09%
All	100	74.70%	89.14%

Table 1.6: Mean Drug Coverage for Elderly Before and After Part D

Mean Percent of Sample With Prescription Drug Coverage	Age 65 and Older Pre-Part D (1996-2004)	Age 65 and Older, Post Part D (2006-2012)	Change	Percent Change
TOTAL SAMPLE MEAN	77%	89%	12%	16%
Dummy for Worst (Self-Reported) Health	75%	86%	12%	15%
Dummy for Second Worst Health	77%	90%	13%	18%
Dummy for Medium Health	78%	89%	11%	14%
Dummy for Second Best Health	78%	89%	11%	14%
Dummy for Best Health	77%	89%	12%	15%
Dummy for Married	77%	91%	14%	18%
Men	79%	88%	9%	11%
Women	76%	90%	14%	19%
White Non-Hispanic	76%	90%	14%	19%
Black Non-Hispanic	81%	91%	10%	12%
Other Non-Hispanic	87%	86%	-1%	-1%
Hispanic Non-White	86%	87%	1%	1%
Hispanic White	78%	87%	9%	11%
Black Men	82%	91%	9%	10%
Interaction for White and College	81%	93%	12%	15%
Dummy for High School Degree	76%	89%	13%	17%
Dummy for College Degree (at least 4 years)	82%	93%	11%	13%
Dummy for Retired	87%	84%	-3%	-3%
*Sample Size**	5,062	6,073		

*Sample size varies based on data availability, so this gives maximum sample.
Note: “College” includes those with a four year college degree or greater education. “High School” includes those who graduated high school, but did not get a four year college degree.

Table 1.7: Respondent Characteristics in 2004 by Type of Prescription Drug Coverage in 2004

	Employer	Medicaid	Medicare Advantage	Medigap	Other	None
Female	0.553	0.746	0.569	0.565	0.530	0.605
Married	0.636	0.237	0.572	0.617	0.512	0.562
White Non-Hispanic	0.854	0.395	0.722	0.896	0.702	0.837
Black Non-Hispanic	0.097	0.282	0.125	0.070	0.199	0.096
Hispanic (any race)	0.035	0.282	0.133	0.018	0.072	0.059
Education= High School	0.369	0.191	0.344	0.362	0.333	0.374
Education= College or Higher	0.234	0.023	0.168	0.233	0.141	0.142
Median Income (2004) if nonzero	18,000	6,520	10,000	10,450	9,000	10,000
Median Assets (2004)	242,000	800	177,000	269,500	99,425	186,000

Table 1.8: How much selection into Part D was there? Respondent with no coverage in 2004 by prescription drug insurance coverage in 2006

	Part D	None
Female	63.19%	60.90%
Married	58.26%	59.52%
White Non-Hispanic	84.83%	90.74%
Black Non-Hispanic	9.66%	6.57%
Hispanic (any race)	4.54%	2.16%
Education= High School	40.29%	39.27%
Education= College or Higher	14.30%	15.92%
Median Income (2004) if nonzero	9,857.5	10,000
Median Assets (2004)	174,500	210,500
Sample Size	1,035	1,156

Sample = respondents with no prescription drug coverage in 2004

Table 1.9: Two Random Effects Regressions of Demographic Factors Against Prescription Drug Coverage, Before and After Part D.

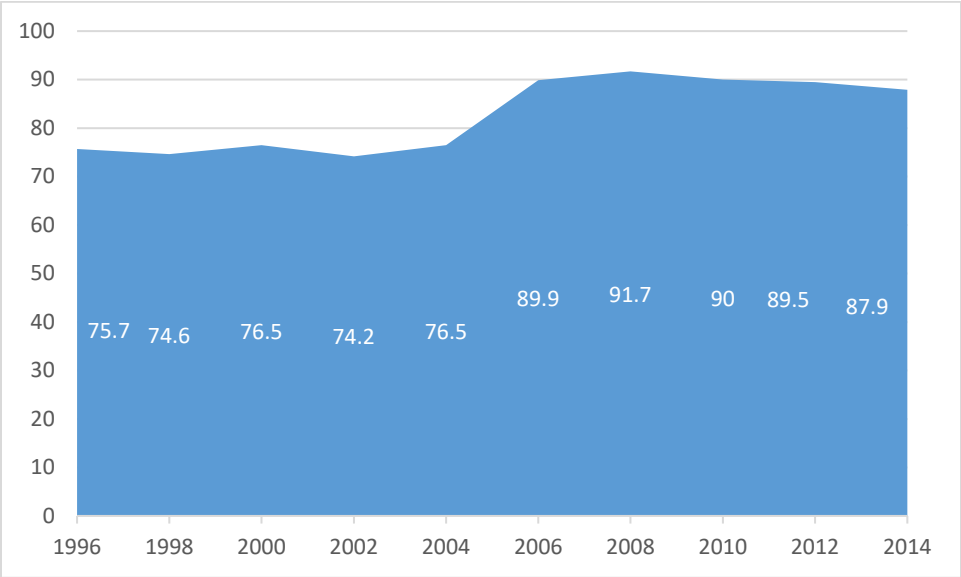
Prescription Drug Coverage (Dummy)	**Elderly Pre-Part D (1996-2004)**	**Elderly Post-Part D (2006-2012)**
	Coefficient	**Coefficient**
Age	-0.01***	0.00
Dummy for Worst (Self-Reported) Health	-0.02	-0.04***
Dummy for Second Worst Health	0.01	-0.01*
Dummy for Medium Health	0.00	0.00
Dummy for Second Best Health	0.02	0.01
Income Under $12000 (Dummy)	-0.06***	-0.04***
Income $12000-$30000 (Dummy)	-0.05***	-0.03**
Income $30000-$100000 (Dummy)	0.01	-0.01
Assets Dummy for First Category	0.07***	-0.03***
Assets Dummy for Second Category	0.03*	-0.03***
Assets Dummy for Third Category	0.04***	-0.02**
Assets Dummy for Fourth Category	0.04***	-0.02**
Dummy for Marriage	-0.01	0.02***
Dummy for Gender (Woman)	-0.04***	0.02***
Dummy for High School Degree	0.05***	0.03***

Table 1.9 (continued)

Dummy for College Degree (at least 4 years)	0.10***	0.05***
Dummy for White Non-Hispanic	-0.01	0.02**
Dummy for Black Non-Hispanic	0.04*	-0.01
Dummy for Other Non-Hispanic	0.04	-0.01
Dummy for Hispanic Not White	0.12***	-0.01
Dummy for Retired	0.04***	-0.05***
Number of Observations	13513	23472
Number of Groups	5853	6710

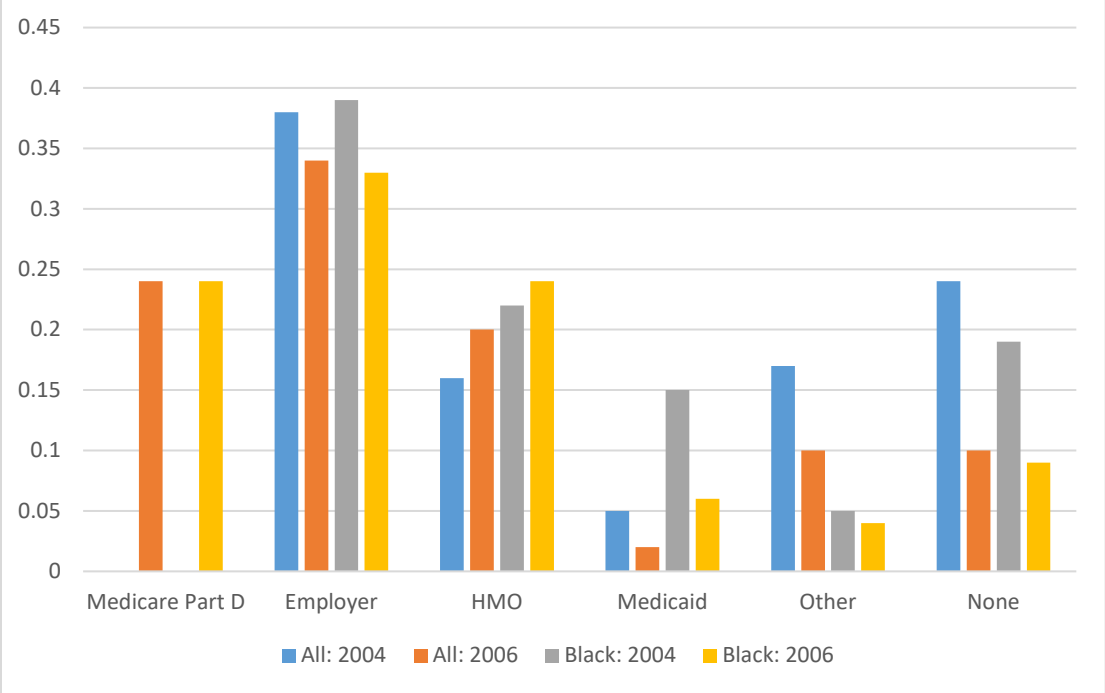
Note: *** p<0.01, ** p<0.05, *p<0.1

Figure 1.1: Percent of Seniors (Over Age 65) With Drug Coverage



Source: HRS, 1996-2014

Figure 1.2: Categories of Drug Coverage



CHAPTER 2. DOES MEDICARE PART D EXTEND LIVES—MEDICARE PART D AND MORTALITY

2.1 Introduction

A decade after the creation of Medicare Part D, now is the perfect time to revisit its impact on the health of seniors. Chapter 2 examines the effects of Medicare Part D's prescription drug coverage on life expectancy.

Medicare Part D was introduced in January 2006, with the policy goal of reducing the burden of drug expenditures on the elderly population. Safran et al. (2002) reports that prior to Medicare Part D, 23% of seniors reported spending more than $100 per month on prescription drugs, and among seniors without drug coverage, 43% spent more than $100 monthly. Rising drug costs for seniors due to medical advancement drove the creation of Part D. According to Duggan (2005), prescription drug expenditures grew twice as rapidly as all other health care spending in the 1990s. By 2003, the average senior paid about $1,789 on drugs per year, with more than half of drug spending out-of-pocket and only 7.8% covered by Medicare (Duggan and Morton 2010). In Medicare Modernization Act of 2003, policymakers created Medicare Part D partly with the intent to reduce disparities between beneficiaries of different income levels (Poisal and Murray 2001). The law included a subsidy for large employers to discourage them from eliminating private prescription coverage for their retired workers and prohibited the government from negotiating discounts with drug companies or establishing a formulary[16] (a key goal of pharmaceutical lobbyists.)[17]

[16] However, Medicare Advantage/HMO plans may establish a formulary.

[17] The act also included several non-drug-related provisions, including mandating a six-city trial of a partly privatized Medicare system (by 2010), giving an extra $25 billion to rural hospitals, and adding a pretax health savings account for working people.

Seniors can purchase a Part D drug plan, purchase a private Medicare Advantage or HMO plan which includes drug coverage, or retain their existing coverage. As of 2018, 43 million individuals in the U.S. are covered by Part D.[18] The cost is projected by the Congressional Budget Office to reach $99 billion or 15% of Medicare spending in 2019, increasing with the aging of the population. For those who enrolled in stand-alone Part D plans, there is a base monthly premium of $35.02,[19] a maximum annual deductible of $415, and a copay of a flat fee or 25% of generic drug costs and 37% of brand-name drug costs up to $5,100. The national average monthly bid for a Part D plan in 2018 was $57.93 and the average deductible was $243.55 for stand-alone Part D plans and $160.49 for Medicare Advantage plans. About three-quarters of financing for Part D comes from general revenues, with around three-twentieths from beneficiary premiums and a tenth from state contributions. Individuals below 150% of the federal poverty line and with modest assets are eligible for the Low-Income Subsidy, which pays for all of their premiums and deductible, but not their copays. Seniors between 135-150% of the federal poverty line receive Extra Help subsidies, which pay a percentage of their premium and deductible. Nearly half of all black beneficiaries and a third of Hispanic beneficiaries receive the Low-Income Subsidy, compared to about 17% of white beneficiaries. Those with income above $85,000[20] pay an income-related monthly adjustment amount in addition to their plan premiums. This amount starts at $12.40 a month and increases based on income to a maximum of $77.40 a month for those individuals with income of $500,000 above or married couples with income of $750,000 or above (SSA 2019).

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[18] This includes employer-only group plans. “The Medicare Part D Prescription Drug Benefit: Fact Sheet” (2017) and “An Overview of the Medicare Part D Prescription Drug Benefit” (2018).
[19] Or $33.19 as of 2019.
[20] As of 2019, this is based on yearly income reported to the IRS in 2017, two years previously.

Part D was the largest expansion of Medicare in the program's history. Analyzing the effectiveness of such a large program is important.[21] Furthermore, it is worth considering whether a program that offered drug plans to all seniors managed to reach the portion of the population with the greatest need—those with low incomes, those without prior coverage, and those with a need for prescription drugs. However, there is an enormous selection bias issue in comparing those who took up Part D in 2006 to those who didn't, because seniors in good health were less likely to take up drug insurance after the expansion. Also, since Part D is a relatively recent program, it is difficult to capture its impact on total lifespans.

Medicare Part D had an instant effect on drug coverage. Rates of prescription drug coverage for seniors before Part D were already relatively high, around 75%.[22] However, in 2006, the rollout if Medicare Part D increased coverage to 90%. According to Levy and Weir (2010), those in good health (who presumably had less need for coverage) dominated those who did not take-up. From a policy standpoint, this indicates there might not be much gain to trying to push coverage all the way up to 100%, if most of those currently without do not use drugs. Instead of increasing enrollment, media activism tends to focus more costs for seniors from coverage gaps in Part D and concerns that those who do not enroll may face a late penalty if they need coverage later (Singletary 2003, Andrews 2019).

A 15% increase in drug coverage among seniors would be expected to affect health outcomes, even life expectancy. In the diverse literature surrounding Medicare

[21] Later, I will look at the impact of Part D on black men in particular. Based on the percent of the elderly population which is both black and male, I roughly estimate their share of Medicare Part D in 2018 to be 3.3% of spending, or 3.3 billion dollars.
[22] See Figure 1.1.

Part D, my contribution is to focus on the relationship between life expectancy and Part D coverage by race. This an important policy area given the ongoing issue of discrepancies in access to healthcare and health outcomes between black and white Americans.

There may be reasons to expect a differential impact for particular demographic groups. For example, Finkelstein and McKnight (2007) study the impact of Medicare in 1965 on mortality. They find no change in overall elderly mortality. However, they do find the introduction of Medicare to be associated with a decline in non-white elderly pneumonia-related mortality rates. Currie and Gruber (1996) also find black children exhibited a much larger decline in mortality than white children due to Medicaid. Thus, even when overall mortality is not affected, certain groups with relatively less access to care may see improvement.

If Medicare Part D removed the differential in prescription drug coverage by race and gender, then we could see a shift in life expectancy among these groups. My findings in Chapter 1 suggest that after Medicare Part D, all elderly demographic groups had similar drug coverage rates. The program itself was designed to offer universal coverage to everyone, and part of the rationale was seniors experiencing increasing difficulty affording drugs. My contribution is to examine Medicare Part D based on a new outcome, life expectancy, focusing on the differential impact between black and white Americans. Unlike previous studies, which focused on changes in mortality at age 66, I examine more advanced ages. In addition, I estimate the value of lives saved compared to the costs of the program. My results are suggestive that Medicare Part D had no impact on mortality for the white population, but increased the probability of living to age 73 (conditional on living to age 65) by 9 percentage points for black men.

2.2 Literature Review

Other studies looking at the impact of Medicare Part D on coverage rates find similar results to my 15 percentage point increase in coverage (Figure 1.1). Levy and Weir (2010) also use the Health and Retirement Study to look at take-up rates of prescription drug coverage among the elderly. Among those without drug coverage in 2004, 50%–60% took up Part D coverage in 2006. The rollout of Part D had a large effect on drug coverage of senior citizens: 24% were without prescription drug coverage in 2004, and this shrank to 7% in 2006.[23]

Levy and Weir find the most important factor in the decision of seniors to enroll in Part D is use of prescription drugs—the majority of those who remained without coverage reported they did not use prescription drugs and had low out-of-pocket medical expenses. Surprisingly, Levy and Weir find no difference in take-up with respect to economic status. Generally, they find individuals kept existing drug coverage and take-up of Part D was driven by those without coverage. However, many beneficiaries were unaware of the SSA "Extra Help" subsidy and its eligibility requirements. In contrast, Engelhardt and Gruber (2010) find that Part D resulted in 80% crowd-out of both prescription drug insurance coverage and prescription drug expenditures of those 65 and older.

Donohue (2014), Heiss et al. (2010), and Neuman et al. (2009) all also find prescription drug coverage rates among seniors of about 90% after Part D. By January 30,

[23] This result is very similar to mine, although I found 90% coverage of seniors in 2006 relative to their 93%. This difference can be explained by how we counted those individuals who reported having partial drug coverage, a number of respondents too small to affect my regression results.

2007, about 24 million individuals were receiving prescription drug coverage through Medicare Part D (PDPs and MA-PDs combined), according to CMS.

2.2.1 Importance of Prescription Drugs to Health of Elderly

Mortality is the most extreme health outcome. Part D has been found to improve overall health according to studies cited later in this section, which found decreases in medication nonadherence, hospitalizations, and emergency room care. We might reasonably expect such a large increase in drug coverage could impact life expectancy, the most important health outcome of all.

Dunn and Shapiro (2017) look at a similar research question: if Medicare Part D impacted cardiovascular-related mortality. They argue that with nearly half of drug expenditures spent on treatments to prevent cardiovascular-related deaths, and heart disease the leading cause of death in the United States, there is a strong reason to believe that a program which expands drug coverage could impact mortality in immediate ways. Using variation in drug coverage across counties before the rollout, they find mortality dropped significantly in those counties most affected by Part D, to the extent that 7,000 to 26,000 more individuals were alive in mid-2007 because of the Part D implementation in 2006. This raises an interesting question which my research addresses: whether the same effect exists in microdata. By using the Health and Retirement Survey, I obtain detailed information on the demographics, income/assets, and health status of survey respondents. Comparatively, my paper looks at all causes of death and includes the entire United States instead of a select 169 counties.

In addition, Huh and Reif (2017) also conclude Medicare Part D reduced elderly mortality. Using confidential mortality data from the National Vital Statistics System of

the National Center for Health Statistics for the years 2001-2008, they find a reduction of mortality at age 66 by 2.2% annually, primarily driven by cardiovascular mortality. They used a differences-in-differences to compare mortality rates among the near-elderly and young-elderly. However, my research looks at mortality in later years (age 73) and uses more detailed demographics data.

A few other papers have looked at Medicare spending and life expectancy, though none have specifically looked at Medicare Part D. Lubitz et al. (2003) find that elderly with longer life expectancy had similar cumulative health care expenditures until death compared to those in poorer health, thus indicating that increased longevity does not necessarily lead to greater health expenditures. Similarly, Lubitz et al. (1995) find that lifetime Medicare payments were not substantially affected by longevity. Looking at the big picture, Chetty et al. (2016) shows increases in life expectancy in the U.S. of up to two years over the last ten years, highly correlated with health behaviors.

Previous findings suggest Medicare Part D had a positive effect on other health outcomes besides mortality. Afendulis et al. (2011) find after the introduction of Part D benefits, seniors' hospitalization rates fell. Also, Hsu et al. (2006) find that a cap on drug benefits led to unfavorable clinical outcomes and an increase in emergency department care. Stuart et al. (2013) analyze medication adherence among seniors with myocardial infarction and find improvements in adherence post Part D. Jung et al. (2014) and Donohue et al. (2010) find similar results for heart disease medication compliance. Dall et al. (2013) find that Part D led to a decline in congestive heart failure among seniors. Finally, Zhang et al. (2010) finds that after Part D, medication adherence increased for seniors across the board, with the greatest improvement for those who previously lacked

drug coverage. In general, it appears Part D helped improve the health of seniors, suggesting it may have had an impact on life expectancy.

2.2.2 Demographic Factors Impacting Drug Coverage

Health insurance coverage is strongly correlated with demographics such as race and gender, and prescription drug coverage is no exception. Looking at seniors without drug coverage before Part D, Levy and Weir (2010) find the uninsured are more likely to be in fair or poor health, slightly older, report more chronic health conditions, be less well-educated, and have lower income and assets. Looking at the characteristics of respondents without any drug coverage in 2004, as a function of what drug coverage they have in 2006, those who signed up for Part D were relatively younger and slightly more likely to be married than those who remained without coverage. The biggest factors determining who signed up were the group which was sicker, more likely to use prescription drugs, and had higher out-of-pocket spending on drugs in 2004. Thus, adverse selection proved to be a powerful factor driving take-up. Other characteristics such as cognitive ability, education, homeownership, income, assets, and eligibility for the Low-Income Subsidy did not have significance. However, unmarried men were less likely to sign up for Part D.

With respect to education and income, Levy and Weir find that prior to Part D, lower income and educated individuals had lower rates of coverage, whereas individuals in the highest education or income category were significantly less likely to lack coverage. After Part D, coverage increased for all groups, with gains for the lower income and education groups. Levy and Weir concluded Part D erased any difference in coverage rates between the most advantaged and least advantaged groups.

However, higher rates of Medicaid coverage for minorities in 2004 meant that non-Hispanic whites were in fact more likely to lack drug coverage before Part D. In addition, take-up of Part D was high for all racial and ethnic groups. Thus, although the probability of being uninsured dropped across all groups after Part D, racial and ethnic minorities have slightly lower rates of coverage than non-Hispanic whites.

Other studies also report minorities and the poor being less likely to enroll. Maciejewski et al. (2010) find that in 2006, of Medicare beneficiaries without prior drug coverage, 44 percent enrolled in Part D. Enrollment was correlated with younger age (65–74), female, non-Hispanic white, married or widowed, and self-reported health conditions. They also find that those with incomes less than $50,000 were less likely to enroll. They conclude that initial enrollment after the rollout of Medicare Part D was low.

Certain groups have always been more vulnerable to lacking drug coverage. Klein et al. (2004) and Klein, Turvey, and Wallace (2004) find that seniors who report cost-related medication nonadherence tended to be low income, with Medicare coverage only, high out-of-pocket prescription costs, in poor health, of older ages, and African American. Gellad, Haas, and Safran (2003) likewise report that minorities were more likely to not take prescribed medication because they could not afford it.

After Part D, Neuman et al. (2007) find seniors without drug coverage tended to be either in relatively good health or possess characteristics which would make them harder to reach: age 75 and older, African American, income at or below 150 percent of poverty, no education beyond high school, and rural residence. However, due to autoenrollment of dual eligibles[24] into Part D plans they also find Part D enrollment rates

[24] Those dual eligible for Medicare and Medicaid are defined as those enrolled in Medicare Part A and/or Part B and also enrolled in either full coverage Medicaid or one of Medicaid's Medicare Savings Programs.

were higher among seniors with low incomes, racial and ethnic minorities, women, seniors taking prescription medications. Heiss et al. (2010) also find healthy individuals less likely to enroll in Part D. Maciejewski et al. (2010) find that Part D enrollment was correlated with younger age (65–74), female, non-Hispanic white, married or widowed, and lower income. Although Mahmoudi and Jensen (2014) find that Part D reduced Hispanic/white disparities in annual prescription drug spending, it increased the African American/white disparity. A possible explanation is that these groups found to complex enrollment process for Part D to be confusing. This argues that Part D could have had better outreach towards the poor. However, despite prescription drug coverage rates increasing less for minorities, Chen et al. (2011) find that total out-of-pocket payments for drugs and probability of having unmet drug needs decreased the most for black seniors, followed by Hispanic seniors.

Medicare Part D increased prescription drug coverage, as well as spending and utilization, across the board. Thus, we have reason expect a potential impact on life expectancy, particularly on those groups less likely to be able to afford drugs prior to Part D.

2.2.3 Contribution

My contribution to the literature is to look at Medicare Part D's impact on probability of living to age 73, whereas Huh and Reif (2017) and Dunn and Shapiro

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The advantage to enrolling in both is greater breadth of healthcare coverage and lower out-of-pocket costs. Also, Medicaid provides many long-term care benefits and supports to allow persons to age at home which most Medicare does not cover except for a small portion of Medicare Advantage plans. Medicare is always the primary payer. Medicaid eligibility is based on income and asset limits and varies by state. The individual income limit for institutional/nursing home Medicaid and Medicaid's Home and Community Based Services (HCBS) is $2,313 per month and the asset limit is around $2,000 in 2019.

(2017) both focused on the immediate impact on the young-elderly (age 66).[25] Using a linear probability model instead of a differences-in-differences with near-elderly as a control allows me to capture the impact on mortality at older ages. With more years of data, I can capture more of the post-Part D effect. In addition, my methodology allows me to handle the censoring issue of not yet knowing the total lifespan of all elderly Americans. Because Medicare Part D was created in 2006, many recipients are still living, meaning we can't compare their lifespans to those who died before Part D was created. Instead, I look at probability of living to age 73, because I do know whether every member of my sample who reached at least age 65 by 2006 lived to age 73 in 2014, the last year of data currently available in the HRS. This allows me to create a dependent variable where I know for a fact whether every member of my sample lived to age 73 or not, instead of needing to impute future lifespans. I can also look at exactly how many months individuals lived after age 65 due to having data on month of death.

The Health and Retirement Survey is a rich data source with more details on demographics and health conditions than previous studies. This allows me to analyze how the impact of Medicare Part D on life expectancy was different by demographics, particularly race. This is extremely important as a policy issue due to the ongoing lifespan discrepancies between black and white Americans and the racial gap in healthcare quality.

[25] Huh and Reif (2017) used the near-elderly as a control group and thus used the young-elderly as a treatment group. Dun and Shapiro (2017) only had data to look at the impact of Part D one year after roll-out and thus focused on those age 66 as well.

2.3 Data

My research analyzes the link between Medicare Part D and mortality. I used the Health and Retirement Study (HRS) core files from 1996 to 2014, linked with death data from the HRS Tracker file, taken from the National Death Index (NDI) and the HRS Ancillary studies, and compiled by RAND. The earliest HRS cohort birth year cohort is 1890, with subsequent cohorts added every six years, to form a sample representative of the U.S. population over age 50. The longitudinal panel study represents a sample of approximately 20,000 elderly and near-elderly Americans surveyed every two years. Also, the HRS tracker file links with data on mortality from the National Death Index (collected by state vital statistics offices).

Sonnega et al. (2014) find a representative rate of minority participation and response rates consistently between 80 and 90 percent. My data set covers 1996 to 2014,[26] and contains 35,025 observations, or about 4,000-8,000 observations per year.

2.3.1 Variables of Interest

Chapter 2 examines the impact of Medicare Part D on life expectancy. Since Medicare Part D is a relatively recent program, created in 2006, we cannot yet know its impact on total lifespans. First, I limited my data set to only those who reached age 65, the youngest of whom turned 65 in 2006.[27] Hence my youngest birth year cohort would reach age 73 in 2014, assuming they lived that long. Those seniors who did not live to age 65 or those for who were too young to have lived to age 73 were dropped. Therefore,

[26] The first year of the HRS was in 1992, but data on drug coverage was not available until 1996.
[27] This may result in some observations being falsely dropped as some people born in 1940 would be 65 for a good part of 2006, but this is a small loss relative to the entire data set.

I was able to create a dummy variable for "lived until age 73, conditional on having lived to 65" that could be applied to my entire sample, handling the censoring problem caused by mortality.

Additionally, individuals in my sample experience differential coverage by Part D. Those who were 65 in 2006 were covered the entire period, all 8 years, until they reached 73. Those who turned 73 in 2006 were covered zero years from 65 to 73. This leaves seven groups with partial exposure to Medicare Part D in between. This allowed me to create an independent variable for amount of coverage age 65-73 by Medicare Part D. Using a linear probability model, I tested the effect of eligibility for Part D drug coverage on the probability of living to age 73. The goal of this methodology was to come up with a simple way to estimate the impact of Medicare Part D on life expectancy by looking at the part of the sample where censoring is not a problem.

I also dropped those with missing birth year and those with birth year 1930 and earlier, as these lacked data at age 64 because they were already older than 64 in 1996, my first year of data used. Finally, I dropped those elderly added to the sample who did not have data at age 64.

I interpret "Percent Covered," my independent variable of interest in the regressions, as being the percent of time that age 65-73 that an individual had Medicare Part D as an option (assuming they lived for the 8 years). This has nine possible values from 0-100%. Medicare Part D should have made coverage near-universally available to seniors. For this reason, "Percent Covered" represents the amount of time before reaching age 73 that drug coverage was available to a respondent. As previously mentioned, healthy seniors selected out of drug coverage, so instead I use whether seniors had the

option to take up Medicare Part D, which offered universal coverage. I expect that an additional eight years of prescription drug coverage at age 65 should have some effect on probability of living to age 73. The sign and significance of the variable "Percent Covered" tests this hypothesis.

The variable "Percent Covered" also captures increases in generosity of Medicare Part D. The original Medicare Modernization Act of 2003 included a gap in drug coverage between initial coverage and catastrophic coverage in order to reduce costs, colloquially known as the donut hole.[28] The Affordable Care Act of 2010 passed legislation to phase out this gap over a ten year period from 2011 to 2020[29] while also lowering the out-of-pocket amount necessary to qualify for catastrophic coverage. My data covers up to 2014. During this time period, the amount an enrollee had to pay out-of-pocket for branded drugs while in the coverage gap was 100% in 2010 and earlier, 50% in 2011-2012, and 47.5% in 2013-2014. For generic drugs, this went from 100% in 2010 to 72% in 2014. The out-of-pocket threshold for catastrophic coverage remained stable at $4,550 from 2010-2014 due to the ACA slowing its previous growth. The Kaiser Family Foundation (Cubanski et al. 2018) estimated that the average enrollee discount on brand-name medications as a result was $565 in 2011, valued in total at $2.2 billion. They also find that out-of-pocket costs for enrollees who reached the donut hole fell substantially between 2010-2011, but this trend reversed afterwards.

As a result, younger seniors in my sample should benefit from not only increased exposure to Medicare Part D, but also increasing generosity of the benefit over time. Those respondents with a higher value for "Percent Covered" are those born younger

[28] This gap does not apply to beneficiaries on the low-income subsidy.
[29] And later changed to 2019 by the Bipartisan Budget Act of 2018.

who experienced increasingly generous benefits as well as coverage over a longer period of time. Hence my results should be interpreted to capture not only exposure to Part D but also increasing benefits of Part D.

2.3.2 Generating Variables

All of my time-varying variables—self-reported health status, marriage, income and assets—are collected at age 64.[30] This is because I would expect health status, income, and assets to change across ages 65-73. In addition, I cannot collect data on these variables for those of my sample who died, so I collect the data while everyone is still alive. Income represents the sum of all income in a household (only including respondent and spouse, divided by two for couples so it's consistent for those not married). The log transformation on income is meant to deal with the highly positive skewness of income. Assets represents the net value of total wealth in a household (excluding second home), calculated as the sum of all wealth components less all debt. I also took the log of assets. My race categories are White,[31] Black Non-Hispanic, Other Non-Hispanic, and Hispanic Non-White. These are based off the race categories used in similar studies such as Levy and Weir (2010). The omitted category is Black Non-Hispanic. Education has eight categories, but for the sake of space only four-year college degree and high school degree is included in my tables.[32] No degree is the omitted category. Although data on state of residence exists in the HRS, it was masked for respondent confidentiality.

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[30] For those who answered the survey at an odd year of age, I rounded up; the categories were taken at age 65 instead.

[31] Which includes both white non-Hispanic and white Hispanic.

[32] The education categories are no degree, GED, high school diploma, two year college degree, four year college degree, master degree, professional degree, and degree unknown/some college.

One possible concern in my regression is whether the 2008-2009 recession might impact life expectancy. Year fixed effects were not an option unless I used panel data, which would cause its own problems by repeatedly counting those respondents who lived the longest. For this reason, I considered including a variable for whether or not a respondent was alive during the recession. However, I found that 93% of my sample was alive during the recession, so it would seem likely that any impact would affect the whole sample. This could possibly have a downward bias on my results. Thus, if I found a positive impact of Part D on life expectancy, this could be an underestimate of the true effects of Part D. However, since my key independent variable is a cohort effect not a time effect, I would expect the interference to be minimal.

I divided my sample into those alive at age 73 coded as one (including those who died at a later age), and those with a death age of younger than 73 coded as zero. The National Death Index (linked with the HRS) contains data on mortality for even those who dropped out of my sample. Hence, I was able to come up with a value for living to age 73 for every person in the sample.

As shown in Table 2.1, in total, I found that 83.2% of my sample lived to age 73, conditional on reaching age 65. Older cohorts were more likely to live to age 73, ranging from around 80% for those born in 1941 to 85% for those born in 1931. However, there was a great deal of fluctuation between years; this is likely because my sample sizes are relatively small (a little more than 1,000 observations per birth year).

It's possible that increasing life expectancy over time could influence my results. However, I would argue that because average life expectancy has been above age 73 for the entire period, the effect of my variable "percent of years covered by Part D" on

mortality at age 73 cannot be entirely attributed to improving technology over time. In the United States, life expectancy was 76 years in 2006 and 79 years in 2014. For black men, life expectancy increased from 70 years in 2006 to 72 years in 2014. The difference is stark. Hence, I would expect to find differences in the impact of Part D on mortality based on race.

To make sure my data matched general mortality patterns, I looked closely at the trend in death rates by age group in my sample, compared to what is found in the National Vital Statistics Life Tables. National life expectancy for those born in 1930 (my sample's earliest birth year) was actually below age 65. For total population in 2006, probability of living to age 73 conditional on living to age 65 was 85.87%. This had risen to 87.30% by 2014. My results also found numbers in the mid-eighty percent. For earlier years, I wasn't able to obtain data on probability of living to a given year, since the National Vital Statistics measured every five years: the closest available measurement was that probability of living to age 75 conditional on living to age 65 in 1996 was 75.78%. At a glance, this indicates that probability of living to age 73 increased more than three times as much from the eleven-year period of 1996 to 2006 than the nine-year period of 2006 to 2014. Thus, if I were to find a positive impact on probability of living to age 73 due to years of Part D coverage, this would probably not entirely be attributable to overall trends in life expectancy, since these trends were stronger for the years prior to Part D.

For black men in 2006, probability of living to age 73 conditional on living to age 65 was 75.17%, increasing to 78.84% by 2014. Though all groups saw improvements in life expectancy, blacks remained worse-off than whites. This indicates more room for

improvement in life expectancy among black men. For this reason, I would expect Medicare Part D to be more likely to impact mortality for the black population. I was not able to obtain data on probability of living to age 73 by race in earlier years.[33] Compared to the increase in probability of living to age 73 conditional on living to age 65 from the National Vital Statistics of 3.7% for black men from 2006 to 2014, my regression results below found black men experienced a nine percentage point increase in probability of living to age 73. My result is much larger than the overall national trend. Hence my findings cannot be entirely attributed to changes in lifespans over time.

Finally, because my key independent variable "Percent Covered" is a function of birthyear, in Table 2.2 I examine summary statistics by sample birth year. I do not find any changes in the racial or gender composition of my sample from birth years 1931-1941. Percent of my sample with only a high school degree and no higher education does not change over time, but those born in later years are more likely to have a four-year college degree, about an eight percentage point increase from birth years 1931 to 1941. In addition, I find evidence of an increasing trend over time towards higher income and assets (to the order of a 6 percentage point increase in seniors in the highest income category from birth years 1931 to 1941 and a 10 percentage point increase in the highest assets category). This could potentially have an upward bias on my results, but the effect of higher income and assets should be controlled for by including these as independent variables in my regression. Based on Table 2.2, I do not believe that I find any large differences across birth years which will influence my results.

[33] The National Vital Statistics published less-detailed tables in earlier years.

2.4 Summary Statistics

2.4.1 Changes in Elderly Drug Coverage

My findings suggest that Medicare Part D led to about a 15% increase in prescription drug coverage among seniors, from 76% to 90% (Figure 1.1).[34] Levy and Weir (2010), Donohue (2014), Heiss et al. (2010), and Neuman et al. (2009) support this 90% rate of prescription drug coverage for seniors post-Part D. For the near-elderly (55-64), drug coverage lingered around 70-80%, increasing over time. This intuitively makes sense, because before Part D the elderly would not have a significant advantage in obtaining drug coverage, although might still have slightly higher rates due to access to Medicare.

Before Medicare Part D, elderly Americans obtained prescription drug coverage through private plans, certain types of Medicare including Medigap and HMOs, Medicaid, and/or long-term care insurance. After Part D rolled out in January of 2006, seniors could enroll in a Part D plan or retain their existing coverage. Medicaid-covered Medicare beneficiaries (i.e. dual eligibles) were automatically enrolled in Part D and Medicare Advantage (MA) plans/Medicare HMOs were required to offer drug coverage if they didn't already. Medicare Part D plan costs vary by income level, charging more to seniors with higher income. For those with lower incomes and assets, Medicare Part D has a means-tested subsidy to help cover premiums, deductibles and copayments.

Mortality is an extreme outcome, and even if Medicare Part D did not move the needle there, it likely had other health effects. An increase in drug coverage of 15% is

[34] Across all years, health insurance rates among the over 65 age group remain around 98-99%. This is as expected, since Medicare offers insurance to all seniors.

large enough to suggest a possible change in life expectancy. The effect might be stronger for those demographic groups who previously reported difficulty paying for medications: minorities, the less-educated, and those with lower incomes.

2.5 Theoretical Predictions

2.5.1 Medicare Part D's Impact by Demographic Factors

Medicare Part D made prescription drug coverage significantly more available to all seniors. I would expect the 15% increase in coverage demonstrated in the last section to disproportionately benefit disadvantaged groups who could not afford coverage prior to turning age 65—minorities, the less-educated, and those with lower incomes.

However, my own results find that those who were more educated and with higher income/assets experienced greater gains in coverage rates after Part D. This poses a different question about the efficiency of Part D. However, drug coverage did increase for all groups post-2006. By race, take-up was virtually identical. As shown in Table 2.3, about 24% took up Part D plans for both the total population and the black population. Furthermore, about 10% remained without coverage for both groups.

Looking at mean drug coverage prior to Medicare Part D, the means are largely as expected: lower for the less educated, the non-white, and those with lower income/assets (Table 1.6). The largest gap is between Hispanic and non-Hispanic. The black population actually had slightly higher rates of coverage compared to the white population (likely due to those in worse health usually having higher health insurance coverage rates). Also using the HRS, Levy and Weir find that higher rates of Medicaid coverage for minorities in 2004 meant that non-Hispanic whites were, surprisingly, more likely to lack drug

coverage before Part D. Every group benefitted from Part D. However, since the black population already had slightly higher rates of coverage, this means they had less benefit from Part D.

As mentioned in previously, the literature is somewhat mixed on whether Part D reached all groups equally. Levy and Weir (2010) find that Part D "erased socioeconomic gradients in drug coverage among the elderly." Conversely, Maciejewski et al. (2010) and Neuman et al. find Part D had difficulty reaching certain disadvantaged groups. All of these studies find that drug coverage increased for all groups post-2006; the only question is to what extent racial disparities were erased.

My own results show huge across-the-board increases in drug coverage. We would expect these increases to impact health and perhaps mortality. In addition, the driving mechanism may be quality of coverage. Prior to Part D, minorities were more likely to be covered by Medicaid or "other" coverage (Table 2.3), which means that shifting to Part D plans may have represented an improvement in care. Women disproportionately benefited from Part D, switching from being less likely to have coverage to being more likely. Marriage also became positively correlated with coverage for those eligible for Part D.

2.5.2 Should Medicare Part D Impact Mortality?

Mortality is the most visible health outcome in any data set: unlike the HRS's measures of health, it does not rely on self-reported assessment of one's own condition. In the previous section, I have made an argument that drug coverage should have an impact on mortality, due to its importance in major causes of death such as heart attacks.

According to Dunn and Shapiro (2017), heart disease is the leading cause of death in the United States and about half of U.S. drug expenditures go towards treatments to prevent cardiovascular-related deaths. Huh and Reif (2017) found a significant increase in the utilization of drugs to treat heart disease after Part D, and that cardiovascular drugs were the largest category of drug expenditures and utilization by far, increasing by 25-30% after Part D rollout.

Interestingly, my results would have policy implications regardless of if I reject my null hypothesis. If Medicare Part D can be shown to have an impact on probability of living to age 73, this demonstrates that it had a clear impact on health outcomes of seniors, even extreme outcomes such as mortality. If Part D had a stronger impact on groups less likely to afford prescription drug coverage without government intervention, such as black men, this would serve to illustrate the benefits of the program. However, if Medicare Part D did not move the needle on life expectancy, even for groups that previously reported higher rates of cost-related medication nonadherence, then this implies that outreach of Medicare Part D may have been inefficient. The truth may also lie somewhere in the middle.

2.6 Main Results

2.6.1 Regressions

I used a linear probability model to estimate the impact of percent of years 65-73 potentially covered by Medicare Part D on probability of living to 73. I clustered my standard errors by birth year. My demographic variables were all measured at age 64-65. My equation is:

$$\text{Alive at } 73_{im} = \beta_0 + \beta_1 \text{Percent Covered} + \beta_{2\text{-}19} X_i + \varepsilon \quad (2.1)$$

As shown in Table 2.4, my results were insignificant for the variable of interest, percent of age 65-73 covered by the existence of Medicare Part D. The coefficient of interest was near zero and positive. I would expect exposure to Part D to increase life expectancy, which is line with my positive coefficient, but I fail to reject my null hypothesis. My R-squared was 0.0747.

Self-reporting better health had a positive and significant impact on life expectancy. Marriage and log-income were positive but insignificant, whereas assets had a positive significant effect.[35] As expected, being white had a positive impact on life expectancy and being Hispanic had a negative impact, but these results were insignificant. Schooling was near-zero and insignificant. Finally, being female had highly significant positive affect. These coincide with the factors I expected to have a positive effect on life expectancy.

Because the HRS includes data on month of death, an alternative methodology would be for me to look at each additional month lived past age 65 for each member of my sample. Thus, my dependent variable would be a range of values from 0 to 96 for number of months lived from age 65 to 73 (over an 8 year period). My sample contains 8,657 people who lived 96 months or longer (those alive past age 73) and 1,329 people who lived past age 65 but not to age 73. The average number of months lived is 89.5.

Table 2.4 also reports the results of running the same regression with months lived age 65-73 as the new dependent variable. As in the previous methodology, the coefficient of interest, percent of time covered by Medicare Part D, was near-zero and

[35] Although I experimented with including interaction terms for marriage and gender and income and employment, these proved insignificant so I did not include them in my final results.

insignificant.[36] None of the signs on the other independent variables changed noticeably.[37]

As mentioned previously, it may be that for my entire sample, the changes in probability of living to age 73 by birth year were minimal. Also, Part D would have had little effect on the 75% of the population who already had drug coverage. For this reason, in my next regressions, I focused on groups most likely to have a disproportionate impact from Medicare Part D.

Next, I stratified my results by gender and race. The life expectancy of black Americans is 3.4 years lower than white Americans as of 2014, leaving more room from improvement from Medicare Part D (Tavernise 2016). For men, U.S. life expectancy is 77 years for white men relative to 72 years for black men and has also improved less since 2006 (Measures of America 2014). Much of this is driven by disparities in income, and furthermore inequality in life expectancy across income has been increasing over time in the U.S. (Chetty et al. 2016). The black population also has significantly lower rates of upward mobility than the white population, primarily driven by different rates of wages and employment among men (Chetty et al. 2018). The ongoing racial gap in healthcare quality between black and white Americans make this a very important policy question.

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[36] The coefficient was -0.08, which would be interpreted as living 2 days less for an additional 8 years of Medicare Part D coverage. Although I would not expect the effect to be negative, it is so small, and completely insignificant, as to be disregarded.

[37] Oddly, a college degree shows an insignificant negative impact on probability of living to age 73. However, when I experimented with dropping variables, changing which category is omitted for education, and changing how degree was calculated, this finding did not prove robust.

Looking at a sample of only black men,[38] the impact of Medicare Part D becomes much more pronounced. I found an additional 9 percentage point chance of living to 73 for an additional 8 years of exposure. This coefficient was significant at the 5% level. The lower significance level may be the result of a smaller sample, only 403 observations. The results are shown in Table 2.5. My R-squared was 0.087. As expected, marriage and being in good health had significant positive impacts on life expectancy. Income, assets, and education were insignificant.[39]

As in the previous section, I also looked at months lived from age 65-73 for black men. I found an additional five months lived if fully covered by Medicare Part D, significant at the 10% level. The signs of the other independent variables remained similar. Both methodologies support a positive impact of Medicare Part D on life expectancy for black men. The second regression is likely to have a more precise coefficient due to measuring exactly how many months an individual lived after age 65. Given that black men are a group who previously reported greater difficulties in paying for prescription drugs, this result is suggestive that Medicare Part D helped improve health for male racial minorities. Overall, I am confident in the direction of the effect, which is consistent across regressions, more so than the magnitude.

I also examined the probability of living to age 71-66 for black men. Focusing on age 71, I found black men had an additional 8 percentage point chance of living to 71 for

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[38] Sample size of 403.

[39] College degree had an insignificant negative impact on probability of living to age 73. However, this impact was not robust to which category was omitted and different methods of calculating the education categories. Also, only 67 black men in my sample had a college degree (out of a sample of 403) so a small sample size could have potentially influenced my results.

an additional 8 years of coverage. This coefficient was significant at the 10% level (very near to the 5% level).

In Table 2.6, I examined the impact of eligibility for Part D coverage on black women, Hispanic women, Hispanic men, white women, and white men. For black women, I found a near-zero insignificant effect, indicating the impact of Medicare Part D on the black population is being entirely driven by men. Percent of time covered by Part D had a positive effect on probability of living to age 73 for Hispanic men, although the coefficient was small and insignificant. However, for Hispanic women and white women, the impact was actually very slightly negative and insignificant. For women, the impact of Part D is similar to the near-zero coefficients I find for the total population. The impact for white men was positive but near-zero and insignificant. Overall, this indicates that Part D coverage mattered more for men. This may reflect that men are more likely to die before age 73. The impact was only significant and substantial in size for men in racial minorities. Finally, those who reported having no prescription drug coverage in 2004 had an insignificant positive correlation with probability of living to age 73.

I also analyzed the probably of living to ages 66-73 for my whole sample, and for black men in particular. For the total sample, the results were insignificant every year except age 66, where I found a tiny positive effect (Table 2.7). This is interesting because Huh and Reif (2017) also looked at age 66 (using the near-elderly as a control) and found a positive impact on life expectancy. I hesitate to draw strong conclusions. However, this could indicate that there was pent-up demand for prescription drug coverage among the near-elderly, giving them a brief boost in health when they first obtained access to Medicare. For example, Card et al. (2008) find that once elderly in the United States

become eligible for Medicare at age 65, they increase their use of medical services, including bypass surgery and joint replacement. This also ties in with the literature which suggests that Medicare Part D had a larger impact on cardiovascular mortality,[40] and which is also supported by my examinations of heart attack mortality later in this paper. Finally, having a larger impact on mortality in younger years argues against the effect being entirely due to increasing lifespans due to improving medical technology over time, as this would be more likely to impact later years.

For the black male population (Table 2.8) I consistently found a positive impact on life expectancy from ages 66-73, although the magnitude and the significance level changed. I would hesitate to draw conclusions about magnitudes because of the low significance levels of my regressions. Furthermore, significance levels change depending on which independent variables I include. However, Table 2.8 does give me confidence in the direction of the effect of Medicare Part D on black men, since it was robust across all regressions.

2.6.2 Cost-Benefit Analysis

Based on my findings for improvements in life expectancy among black men, I attempted a rough cost-benefit analysis of Medicare Part D. First, I let value of one life-year saved be $100,000-$200,000. I chose not to use value of a statistical life saved because my regression allows me to be more specific, looking at each extra month of life. Intuitively, it would seem that value of a statistical year of life might vary based on quality of life and age, and thus each year would be worth less to those of an older age.

[40] The average age for a first attack is 66 for men and 70 for women (Woolston 2016).

However, economics studies do not tend to find that the elderly or those with chronic conditions are willing to pay less for an extra year of life (Aldy and Viscusi 2007, Alberini et al. 2004). The value of statistical year of life lived traditionally does not discount for age. I use a range for this value: $100,000 from Cutler (2004) to $200,000 from Alberini (2005). I'm able to obtain the most precise estimates by using my second regression finding: that black men live an extra 5 months for an additional 8 years of Medicare Part D coverage. Multiplied by $100,000-200,000, this generates a range of $41,667-$83,333. Based on the total black male elderly population in 2006, this becomes 729,000*[$41,667-$83,333] = $30.4-$60.8 billion. The total cost of Medicare Part D from 2006-2014 is $499 billion, adding together CBO costs for each year. Then if I multiply this by the percent of the elderly population which was black and male, I get the total cost for black male population as $16.5 billion. Given that $499 billion > $60.8 billion > $30.4 billion > $16.5 billion, my conclusion is that Medicare Part D was cost-effective for black men but not for the entire population.

This raises an issue of targeting, as I find benefits for the black population but not the population as a whole. Black men are only a small portion of the total elderly population, around 3.3% in 2006. However, there would likely be other health benefits from increased drug coverage besides mortality.[41] Also, Medicaid drug spending should

[41] My literature review finds that Medicare Part D led to decreases in medication nonadherence, hospitalizations and emergency room care. These health outcomes also deserve to be considered when assessing the program's effectiveness. For example, Dall et al. (2013) find upwards of $22.4 billion potential Medicare savings over 10 years due to reduced hospitalization from congestive heart failure due to increased medication adherence post Part D.

have fallen due to seniors shifting to Part D drug plans.[42] Thus, my estimate should be considered a lower bound for the benefits of Medicare Part D.

Additionally, I calculate that based on the increase of 9 percentage points in probability of living to age 73 for black men, this implies 65,610 lives saved as of 2014. This represents an important health gain for seniors in America.

There are several possible mechanisms through which Medicare Part D might impact life expectancy for black men but not the whole population of seniors. The improvements in probability of living to age 73 for black men were primarily driven by cardiovascular mortality, as discussed in my Additional Results section below. As previously mentioned, prior studies looking at the impact of Part D on mortality have also found heart disease to be the most important mechanism (Dunn and Shapiro, 2017, Huh and Reif, 2017). Black seniors are disproportionally likely to be affected by heart failure, particularly men. The prevalence starts at an earlier age, is more likely to be fatal, and has seen less improvement over time than the white population (Sharma et al. 2014). Also, age 73 is closer to the end of life for black men since their life expectancy in the U.S. is 72 years. For these reasons, I would expect to see a stronger effect of increased access to heart disease medication among the black population, starting at a younger death age. It is possible that once more years of data are available in the HRS, allowing me to look at probability of living to an age older than 73, there may be more of an impact on the white population (and for black women).

In addition, one mechanism through which the black population might be affected would be that three times as many black enrollees moved from Medicaid to Medicare

[42] McWilliams et al. (2011) find that after Part D, nondrug medical spending declined significantly for seniors with limited prior drug coverage, a category which includes Medicaid enrollees.

Part D as white enrollees—9% and 3% respectively (Table 2.3). Although Medicaid offers drug coverage, the quality varies wildly across states, many of which limit enrollees to generic drugs with higher copays for drugs on their non-approved list. States with more stringent Medicaid eligibility and limits on number of prescriptions filled per month also had higher rates of cost-related medication skipping (Safran et al. 2012). Prior to Part D, Cunningham (2005) found that a fifth of all Medicaid enrollees reported trouble paying for their prescription drugs. In addition, Miller et al. (2008) found that 10% of Medicaid enrollees reported spending more than 10% of their income on healthcare, and this was driven by prescription drug costs. If Medicaid was not an adequate source of drug coverage, we might expect to see health effects among seniors who switched to Part D post-2006. Neuman et al. (2007) find that out-of-pocket spending on drugs and rates of medicate nonadherence full much more for those Medicaid beneficiaries who were automatically enrolled in the low-income subsidy. After 2006, they find rates of out-of-pocket spending on drugs greater than $300 per month were significantly lower for low-income subsidy recipients (many of whom dual eligible previously covered by Medicaid drug coverage) than for other Part D enrollees even though lower income seniors reported greater usage of drugs. They also found higher rates of out-of-pocket spending among the near-poor not eligible for the low-income subsidy. Hence, Part D decreased costs more for low-income beneficiaries who previously relied on Medicaid drug coverage.

My own findings in the HRS suggest that the percent of the population who reported only having part of their drug costs covered as opposed to full coverage declined after Part D's rollout. Thus, the larger portion of black seniors switching from Medicaid

to Medicare Part D could also lead to great health effects among this population. All of these factors likely influenced my findings of improvements in life expectancy among black men.

2.6.3 Robustness Checks

I ran a series of regressions eliminating each of my independent variables. For my total population, no matter which variables I eliminated, my coefficient of interest was always statistically near-zero and insignificant.

Next, I focused particularly on my regression for black men. Eliminating the dummies for health, assets, marriage, and education had minimal effects on the regression. The coefficient remained in the 0.8-0.11 range, significant at the 10-15% level. The only real change came from removing the dummy for the natural log of income at age 64. Although the coefficient of interest remained about the same, it became insignificant. Given the well-documented correlation between race and income, it is not surprising that this variable in particular would have an impact on my regression.

For additional robustness checks, I also ran the same regression with a logistic probability model, and found that black men had 1.7 times greater odds of living to age 73, significant at the 5% level. (Again, the entire population was insignificant). Finally, I also used an interaction term of percent covered and black men and found a coefficient of 0.04, though it was insignificant. These results, reported in Table 2.9, indicate a positive impact of Part D on mortality for black men, regardless of the methodology used.

Another possible concern is that my results could contain a rebound effect, as described in Dunn and Shapiro (2017), who find that Medicare Part D improved the

survival of people with a chronic health condition immediately, which then caused the mortality rate to "rebound" in later years. To test whether this exists in my data, I ran a regression including only up to birth year 1938. I found an insignificant, near-zero coefficient, which makes a rebound effect less likely.

2.6.4 Placebo Test

One final potential issue with my regression results would be the possibility that my variable of interest is capturing improvements in life expectancy over time due to technological advancement, instead of the impact of Medicare Part D. My key independent variable, Percent Covered, is entirely based off respondent birth year. Thus, any other factors which might affect probability of living to age 73 for those born later would be wrapped up into the coefficient of this variable.

An omitted variable bias problem exists in separating out the effects of Part D as opposed to any other cohort trends which might impact life expectancy. The most obvious issue is that life expectancy is improving over time, so those born later would expect to live slightly longer. General macroeconomic trends such as recessions could affect respondents differently depending on how old they were when the event occurred. The same holds true for any other governmental change impacting health.

In order to test whether or not Percent Covered is picking up other trends in life expectancy over time, I used a placebo test. First, I created a new variable for Percent Covered as if Medicare Part D was created in 1997[43] instead of 2006. By creating a fake

[43] I picked 1997 so that my fake Medicare Part D exposure variable would have no overlap with the real Part D.

Medicare Part D nine years prior to the real one, I could then form a new Percent Covered variable using birth years 1925 to 1932. This did not overlap with the original Percent Covered variable used in my actual regression, which used birth years 1933 to 1941. In my new data set, I once again dropped everyone who did not live to at least age 65 or who was too young for me to know yet if they lived to age 73. Then I regressed the fake Percent Covered against probability of living to age 73, conditional on first living to age 65. The goal of this methodology was to test whether or not I still saw a positive impact for black men using my fake Medicare Part D. If I obtained a significant positive result, that would indicate that Medicare Part D had no actual impact on life expectancy and the effect I previously found was entirely due to increasing life expectancy for those born later in time. However, if I didn't obtain a positive coefficient, this would provide evidence that trends in life expectancy were not a problem in my regression, since life expectancy should have an overall positive trend across both periods of time.

In order to run my placebo test, I first needed to generate new values for my independent variables. Gender, education, and race are all time invariant and thus did not need to be recreated. I previously collected income, assets, marriage, and self-reported health at ages 64-65 for my sample. However, when looking at earlier birth years, many respondents were not surveyed until older than age 64-65 because they entered the sample at a later age. I defaulted to using 1996, my earliest available year of data, for those respondents. That said, since I am comparing income, assets, marriage, and self-reported health of respondents at different ages, these variables are all likely to be downwardly biased for those surveyed at more advanced ages.

For both the total population and black men, I found that my placebo Part D event had a significant negative effect on life expectancy. The negative effect was even larger for black men than for the total population, providing evidence that improvements in life expectancy over time did not cause the positive effect in my main results. If Percent Covered was only capturing technological improvements in health over time, I would have expected to see this no matter which set of birth years I looked at. Instead, I only find a positive impact for the birth year cohort affected by Medicare Part D.

For birth year cohort to have a negative impact on life expectancy in my placebo test was unexpected. Looking at my summary statistics, I noticed that in the very early birth years, life expectancy seems to briefly decline before flattening out over time. I attribute this largely to small sample sizes. This is likely connected to why I found a slight negative impact on life expectancy for younger birth year cohorts.

In conclusion, my regression passed the placebo test. Despite this, I cannot completely rule out the possibility of general macroeconomic trends or other factors influencing health over time affecting my regression results, since these could have been different from 1997-2005 than 2006-2014. For this reason, I am still more confident in the direction of my regression results (a positive effect for black men) than in the magnitudes of my coefficients.

2.7 Additional Results

Having examined the impact of Medicare Part D on mortality, next I focus on the impact on mortality by cause of death. Previous literature has particularly looked at the impact of Part D on heart attacks, arguing that cardiovascular mortality is a logical

measure to use because of its prevalence as a cause of death and because heart conditions are commonly treated through prescription drugs.

For example, Dunn and Shapiro (2017) also look at if Medicare Part D decreased cardiovascular-related mortality. As mentioned above, they argue that access to heart attack medication could have an immediate impact on mortality due to heart disease being the leading cause of death among the elderly, including the young-elderly as heart attacks tend to strike at a younger age than other age-related ailments.[44] Using a microsimulation approach and including elderly with diabetes as well as cardiovascular disease, Semilla et al. (2015) calculate that since the implementation of Part D, about 200,000 Medicare enrollees have lived at least one year longer, with an average increase in longevity of 3.3 years. Finally, Briesacher et al. (2015) estimated a 1% found a decline in elderly mortality due to Part D, but their result is not statistically significant. These findings are generally consistent with others looking at the effect of Part D on life expectancy.

Papers examining cardiovascular mortality such as Dunn and Shapiro (2017) have argued that heart disease-related drug expenditures increased by a significant enough margin that Medicare Part D should have had an impact on life expectancy. An alternate strategy used is to compare mortality rates of the older than 65 group to the population aged 55-64. Another paper using the HRS, O'Rand and Hamil-Luker (2005), used a modified pseudo-variables approach, by estimating binary logistic regression models in which the likelihood of having a heart attack in each survey year is predicted by health status, age, education, race, marital status, and income in the previous year. Beckett

[44] Woolston 2016 finds the average age for a first heart attack is 66 for men.

(2000) used a similar method with the National Health and Nutrition Examination Survey.

In 2016, the cost of cardiovascular disease in the U.S. was about $555 billion, or $1 of every $6 spent on health care in the U.S. The cost is projected to reach $1.1 trillion by 2035 (American Heart Association 2017). Looking at the impact of Part D on cardiovascular drug costs for seniors on dialysis, Frankenfield et al. (2012) found that mean out-of-pocket monthly costs for cardiovascular medications were $49.59, reduced to $3.44 for seniors with the low-income subsidy and $49.59 for other Part D seniors. However, mean total costs for patients using the low-income subsidy were actually higher, $124.02 per month relative to $110.32. These costs represented 21.9% of total drug costs for seniors with the low-income subsidy and 30.7% for those without. In addition, the costs of the most commonly used cardiovascular medications for seniors have been rising over time (Watanabe et al. 2018). Finally, greater out-of-pocket costs for heart disease medication is associated with reductions in utilization, with lower adherence rates for non-whites (Holmes et al. 2010, Karaca-Mandic et al. 2013).

The Health and Retirement study includes a variable on cause of death. Cardiovascular mortality is grouped together under cause of death as “Heart, circulatory and blood conditions.” Respondents can have up to two causes of death. As Table 2.11 below shows, heart conditions represent a little more than a third of all deaths across all years. Note that this table only includes the primary cause of death, not the secondary one. Otherwise the totals would not add up to 100%.

Examining the percent of the entire sample who died of a heart condition by year, I found that as many as 40% of all deaths in the HRS sample had heart conditions listed

as a cause of death (Table 2.12).[45] In both tables, heart conditions stand out as the leading cause of mortality in my sample. This is expected since heart disease is the top cause of death in the United States.

Table 2.12 shows a decline in percent of deaths due to heart conditions post Medicare Part D, although it starts in 2008, not 2006. The share of cardiovascular-related deaths shifts from the low 40 percentile to the high 30 percentile and continues declining over time, with 2014 having the lowest number at 33%. Since this looks at percent of deaths, not number of deaths, this indicates that Part D may have had more impact on heart conditions compared to other causes of death.

Next, I look at the percent of deaths caused by heart, circulatory and blood conditions among only men. The overall percent of deaths caused by heart conditions seems to be slightly lower for men. The literature suggests cardiovascular mortality is higher among non-senior men, but women steeply increase in risk at around 60 years of age to eventually overtake men (Mikkola et al. 2013). Since the HRS looks at an elderly population, then I would expect men to have a smaller percent of deaths due to heart disease deaths than women. Men also show a decline in heart attack mortality after Medicare Part D, although a smaller decrease in terms of percentages.[46]

Finally, I looked at heart disease among black respondents. The sample sizes were small enough to label my results suspect: only 60-100 deaths per year. This is likely why the percentages do not show a clear pattern over time. As a result, it is difficult to draw any conclusions about the impact of Medicare Part D. However, looking at all years

[45] This number is higher than in Table 2.9 because it includes those who listed heart conditions as a secondary cause of death and another cause as a primary cause of death. Using this methodology, the totals for causes of death would be higher than 100% since about a third of the deceased had two causes of death.
[46] Possibly connected to my earlier findings that Medicare Part D take-up was higher among women.

(where the sample size would be largest) it appears that cardiovascular mortality was slightly higher as a share of death among the black population, which would fit the literature about lack of healthcare access and disease prevalence among minorities. Since Table 2.12 looks at share of deaths, not number of deaths, and lack of care could affect many causes of deaths, the higher rates of heart disease among the black population relative to the white population may be underestimated.

Next, I examined the impact of Medicare Part D on cardiovascular mortality. I used the same method as my previous regressions on Medicare Part D and mortality. The dependent variable is a dummy variable, with 1 representing a cardiovascular cause of death and 0 otherwise.[47] "Percent Covered," my independent variable of interest in the regressions, is the percent of time that age 65-73 that an individual could have taken up Medicare Part D if they chose to. I would expect a negative coefficient as Medicare Part D should decrease the probability of seniors dying from heart conditions.

As expected, Medicare Part D coverage was negatively correlated with dying of a heart attack (see Table 2.13). I found 8 percentage points less of a chance of dying from a heart condition for an additional 8 years of coverage, significant at the 1% level. This result matches my expectations and what others have found concerning the impact of additional drug coverage on cardiovascular mortality.

There is a potential selection bias issue because my sample is aging over time. Also, heart death disease rate has naturally dropped over time due to improving health technology. Finally, not all heart attack mortality can be captured prior to age 73. For this

[47] I counted those with heart conditions as a secondary cause of death also as 1. Those who died but did not list heart attack as a primary or secondary cause of death were coded as 0 along with those still alive at age 73.

reason, it is difficult to draw strong conclusions (particularly about the magnitudes of the impact).

Next, I focused my regression on black men. In Table 2.14, I found black men had an 11 percentage points less of a chance of dying from a heart condition for an additional 8 years of coverage. This was significant at the 1% level. Intuitively and based on my summary statistics, the impact of Part D should be stronger for black men. This also matches my findings for overall mortality.

Examining only black respondents, I also found a significant negative correlation, showing stronger improvements in cardiovascular mortality than total mortality. For every demographic group, Medicare Part D led to a decrease in cardiovascular mortality. However, the negative correlation is the largest for black men. This matches my already existing findings that Medicare Part D helped expand coverage and improve health for groups who previously reported difficulty paying for prescription drugs and higher rates of cost-related medication nonadherence.

2.7.1 Cox Proportional Hazards Model

This section uses a Cox Proportional Hazards Model to look at the impact of Medicare Part D on mortality. I chose not to use this methodology in my initial analysis because I had a simpler strategy for handling the censoring issue which did not require me to make assumptions about the lifespans of those respondents still living. However, there is value in comparing the two methods to see if the results are similar as a robustness check.

I estimated the hazard ratio for mortality before and after 2006 (when Medicare Part D was established), adjusting for risk factors such as age, race, sex, income, and assets.[48] I also examined cardiovascular mortality in particular.

For any study, a serious problem in examining the impact of Medicare Part D is that after death, individuals no longer have an effect on overall group health conditions or drug expenditures. Thus, a higher mortality rate could falsely lead to an appearance of improving health. Prior to Medicare Part D, it may very well be that fewer seniors reported worsening heart conditions if mortality due to heart conditions improved after Part D. Other studies examining health outcomes of the elderly have handled similar issues. One method is to lump various health outcomes together, including morality, and create categories based on degrees of severity. Waheed et al. (2015) uses this method when looking at cardiovascular outcomes in the elderly population: by including mortality in their risk classification system they make sure to capture any censoring impact. Also, Shih (2002) suggests conducting sensitivity analyses on different scenarios concerning those who drop out of clinical trials, possibly due to mortality. Wu and Bailey (1988) and Klein and Moeschberger (2005) discuss many different conceptual models that can be used in cases of right censoring caused by mortality. Finally, Lunn and McNeil (1995) recommend that in cases of competing risks in survival analysis, the Cox Proportional Hazards Model should use a data duplication method.

The goal of the Cox Proportional Hazards Model is to deal with this selection bias issue in examining the impact of Medicare Part D on mortality. In a Cox Proportional Hazards Model, this problem is called random censoring. The analysis includes an

[48] Using the same independent variables as in my main regression.

indicator variable if the observation is terminated by death and a likelihood function for censored data.

Mortality poses the largest problem for studies without death data, which may not even be able to distinguish between members of the sample who dropped out or died. Since I have data on mortality, I can include this as an outcome. My Cox Proportional Hazards Model uses right censoring techniques.

In Table 2.15, the model uses death as the "failure" event. This time, I look at total lifespan instead of probability of living to age 73. The advantage to using a Cox Proportional Hazards Model is that it allows me to examine total lifespans. This also allows me to use my entire data set instead of dropping those who would not have lived to at least age 73 in 2014. Once again, percent of years covered by Medicare is my key independent variable to better serve as a robustness check. Table 2.15 looks at the impact of Part D on the total population. The log-likelihood is -13118.444 and the overall model is significant. I find a positive effect of an additional 8 years of Medicare Part D coverage on last age reached, to the order of a 9% lower chance of dying. However, the hazard ratio is insignificant. I expected that Medicare Part D should decrease the hazard rate of dying. Not surprisingly, I also find women, those married, and those with greater income, those in better health, and those with more education have longer lifespans. It is interesting that I find a positive effect on the whole population using a Cox Proportional Hazards Model, but not using a linear probability model. However, the Cox Proportional Hazards Model result is insignificant and there is a possibility of censoring issues. The Cox Proportional Hazards Model attempts to use right-censoring techniques to calculate the total lifespans of those members of my sample who have not died yet, but there could

still be upward bias in my result, making it look like people are living longer in later years when actually there hasn't yet been time to discover their total lifespan. Comparatively, the linear probability model uses a dependent variable where I know for a fact if every member of my sample lived to age 73 or not. This is likely to be the more accurate result.

As in my previous section using the linear probability model, next I stratify my results by race and gender. In Table 2.16, I find that percent of years covered by Medicare Part D results in a 30% lower probability of dying for the black male population. Again, this result is insignificant.

Using the Cox Proportional Hazards Model, my results support my hypothesis that Part D had a positive impact on life expectancy.

2.8 Conclusions

Looking at the relationship between living to age 73 and percent of the 65-73 age range potentially covered by Medicare Part D, I obtained insignificant, near zero results for the total population. However, focusing on the groups most likely to be affected by Part D, I found that percent of time covered by Part D had a significant positive effect on life expectancy. The greatest effect was for black men, with a weaker correlation for all black respondents and those who reported no prescription drug coverage in 2004 (prior to Part D). These results suggest that Medicare Part D improved access to prescription drugs, even improving health enough to impact life expectancy. For historically disadvantage groups, this was a hugely important health gain.

My findings indicate that for certain demographics groups which tend to be poorer and disadvantaged, Medicare Part D had a positive impact on life expectancy. This is not to cast judgement on Medicare Part D as a good or bad program. However, it does appear to have moved the needle on its targeted goal: to improve the health of those who, without government intervention, had the least access to prescription drug coverage.

Table 2.1: Percent of Sample Still Alive at Age 73 by Birth Year

		1931	1932	1933	1934	1935	1936
Number Alive at 73		133	135	145	175	153	150
Total		744	764	685	777	790	782
Percent Alive at 73		84.8%	85.0%	82.5%	81.6%	83.8%	83.9%
		1937	**1938**	**1939**	**1940**	**1941**	**Total**
		174	184	226	207	222	2,118
		836	831	834	850	846	10,477
		82.8%	81.9%	78.7%	80.4%	79.2%	83.2%

Table 2.2: Demographics by Birth Year

	Birth Years 1931-1933 [49]	Birth Year 1934 [50]	Birth Year 1935 [51]	Birth Year 1936 [52]	Birth Year 1937 [53]	Birth Year 1938 [54]	Birth Year 1939 [55]	Birth Year 1940 [56]	Birth Year 1941 [57]
Percent of Sample White Non-Hispanic	71.6%	70.8%	70.4%	70.7%	70.6%	70.5%	67.5%	68.1%	71.0%
Percent of Sample Black Non-Hispanic	16.5%	17.5%	17.6%	17.6%	15.2%	15.9%	16.8%	16.0%	16.0%
Percent of Sample Other Non-Hispanic	1.9%	1.8%	2.5%	2.5%	2.2%	1.6%	2.5%	2.9%	2.0%
Percent of Sample Hispanic Non-White	3.1%	3.3%	2.5%	3.0%	3.7%	4.0%	4.6%	4.3%	3.3%
Percent of Sample Hispanic White	6.8%	6.6%	7.1%	6.2%	8.2%	8.0%	8.7%	8.7%	7.8%
Percent of Sample Female	53.4%	52.9%	50.7%	53.4%	54.1%	54.5%	52.0%	54.0%	53.6%
Percent of Sample Reporting Best Health at Age 64	15.0%	13.7%	12.4%	9.3%	10.7%	10.7%	10.6%	12.2%	11.5%

[49] Percent Covered = 0
[50] Percent Covered = 0.125
[51] Percent Covered = 0.25
[52] Percent Covered = 0.375
[53] Percent Covered = 0.5
[54] Percent Covered = 0.625
[55] Percent Covered = 0.75
[56] Percent Covered = 0.875
[57] Percent Covered = 1

Table 2.2 (continued)

Percent of Sample with Only High School Degree	34.1%	36.1%	34.2%	37.6%	36.2%	39.2%	33.4%	34.3%	36.1%
Percent of Sample with Only 4-year College Degree	33.4%	33.3%	35.0%	37.9%	34.1%	32.6%	39.3%	42.1%	41.2%
Percent of Sample with Income <$12,000	14.1%	14.9%	12.4%	11.0%	10.1%	10.2%	8.9%	9.5%	9.8%
Percent of Sample with Income $12,000-$30,000	25.1%	22.9%	22.2%	19.8%	22.2%	20.3%	19.8%	18.8%	15.7%
Percent of Sample with Income $30,000-$100,000	36.6%	35.4%	32.1%	40.0%	37.0%	36.3%	35.2%	35.7%	35.3%
Percent of Sample with Income >$100,000	6.6%	8.5%	9.6%	9.0%	8.8%	9.1%	10.3%	12.4%	13.1%
Percent of Sample with Assets < $7,263	10.6%	11.2%	11.9%	10.3%	10.2%	10.9%	9.5%	8.9%	10.5%
Percent of Sample with Assets $7,263-68,839	18.1%	17.4%	15.2%	13.3%	16.7%	12.4%	16.3%	14.2%	14.3%

Table 2.2 (continued)

Percent of Sample with Assets $68,839-205,985	24.2%	22.4%	23.8%	20.2%	20.6%	23.0%	20.4%	19.5%	17.6%
Percent of Sample with Assets 205,985-630,754	22.8%	20.7%	20.3%	23.1%	20.3%	18.9%	18.4%	21.3%	21.7%
Percent of Sample with Assets > $630,754	24.2%	28.3%	28.8%	33.0%	32.2%	34.8%	35.4%	36.1%	35.8%

Note: Sample size is 9,986. All data collected at ages 64-65.

Table 2.3: Categories of Drug Coverage Before and After Part D

	Medicare Part D	Employer	Medicare Advantage/ HMO	Medicaid	Other	None	Sample
All Seniors: 2004	--	38%	16%	5%	17%	24%	6,690
All Seniors: 2006	24%	34%	20%	2%	10%	10%	5,188
Black Seniors: 2004	--	39%	22%	15%	5%	19%	831
Black Seniors: 2006	24%	33%	24%	6%	4%	9%	590

Table 2.4: Impact of Part D Coverage on Living to Age 73

	Reported Alive at 73	**Months Alive from Age 65-73**
Percent Covered	0.003 (0.01)	-0.077 (0.39)
Health		
Dummy for Best (Self-Reported) Health at 64	0.310 (0.03)***	16.819 (2.49)***
Dummy for Second Best Health at 64	0.278 (0.03)***	15.771 (2.63)***
Dummy for Medium Health at 64	0.235 (0.04)***	13.238 (2.76)***
Dummy for Second Worst Health at 64	0.175 (0.04)***	10.329 (2.535)***
Finances		
Log Income at 64	0.009 (0.01)	0.492 (0.44)
Log Assets at 64	0.016 (0.00)***	0.957 (0.20)***
Demographics		
Marriage at 64	0.023 (0.02)	1.649 (1.12)
Dummy for White	0.006 (0.01)	0.049 (0.46)
Dummy for Other Non-Hispanic	0.023 (0.03)	0.384 (1.79)
Dummy for Hispanic Non-White	-0.002 (0.03)	-0.149 (1.69)
Dummy for Gender (Woman)	0.062 (0.01)***	3.275 (0.51)***
Dummy for High School Degree	0.012 (0.01)	0.0743 (0.54)
Dummy for College Degree (at least 4 years)	-0.006 (0.02)	-0.870 (0.88)
Sample Size	7,098	7,098

Note: *** p<0.01, ** p<0.05, *p<0.1
Worst health is the omitted category for health, and Black Non-Hispanic is the omitted category for race

Table 2.5: Impact of Part D Coverage on Probability of Living to Age 73 for Only Black Male Respondents

	Reported Alive at 73	**Months Alive from Age 65-73**
Percent Covered	0.094 (0.04)**	4.880 (2.53)*
Health		
Dummy for Best (Self-Reported) Health at 64	0.440 (0.11)***	27.692 (7.54)***
Dummy for Second Best Health at 64	0.325 (0.11)***	22.625 (7.98)***
Dummy for Medium Health at 64	0.302 (0.12)***	20.714 (8.74)***
Dummy for Second Worst Health at 64	0.260 (0.10)***	16.112 (7.72)**
Finances		
Log Income at 64	0.030 (0.03)	2.132 (1.34)
Log Assets at 64	0.016 (0.01)	0.733 (0.91)
Demographics		
Marriage at 64	0.153 (0.07)*	7.338 (3.47)*
Dummy for High School Degree	-0.080 (0.05)	-5.917 (3.02)*
Dummy for College Degree (at least 4 years)	-0.129 (0.10)	-3.890 (4.21)
Sample Size	403	403

Note: *** p<0.01, ** p<0.05, *p<0.1
Worst health is the omitted category for health

Table 2.6: Impact of Part D Coverage on Living to 73 For Respondents Across Race

	Reported Alive at 73: Black Women	**Reported Alive at 73: Hispanic Women**	**Reported Alive at 73: Hispanic Men**	**Reported Alive at 73: White Women**	**Reported Alive at 73: White Men**
Percent Covered	-0.002 (0.03)	-0.026 (0.20)	0.037 (0.23)	-0.026 (0.02)	0.009 (0.02)
Health					
Dummy for Best (Self-Reported) Health at 64	0.245 (0.07)***	0.287 (0.26)	0.243 (0.38)	0.257 (0.07)***	0.386 (0.06)***
Dummy for Second Best Health at 64	0.175 (0.08)**	0.354 (0.23)	0.162 (0.37)	0.252 (0.07)***	0.333 (0.06)***
Dummy for Medium Health at 64	0.106 (0.07)	0.188 (0.31)	0.161 (0.36)	0.209 (0.07)**	0.305 (0.06)***
Dummy for Second Worst Health at 64	0.053 (0.06)	0.178 (0.20)	-0.092 (0.27)	0.168 (0.06)**	0.214 (0.07)**
Finances					
Log Income at 64	0.018 (0.02)	0.116 (0.08)	-0.068 (0.11)	0.014 (0.01)*	0.019 (0.01)
Log Assets at 64	0.010 (0.01)	-0.022 (0.03)	0.026 (0.06)	0.014 (0.00)**	0.023 (0.01)***
Demographics					
Marriage at 64	0.035 (0.06)	0.500 (0.22)**	0.291 (0.49)	0.003 (0.03)	0.022 (0.03)
Dummy for High School Degree	0.001 (0.04)	0.066 (0.09)	0.114 (0.12)	0.041 (0.02)**	0.031 (0.02)
Dummy for College Degree (at least 4 years)	0.031 (0.06)	0.195 (1.11)*	0.187 (0.16)	0.024 (0.02)	-0.007 (0.03)
Sample Size	585	62	53	2,833	2,572

Note: *** p<0.01, ** p<0.05, *p<0.1
Worst health is the omitted category for health

Table 2.7: Impact of Part D Coverage on Living to 66-73

	Percent Covered Coefficient
Alive at 66	0.01 (0.00)**
Alive at 67	0.01 (0.00)
Alive at 68	-0.00 (0.00)
Alive at 69	0.00 (0.01)
Alive at 70	-0.00 (0.01)
Alive at 71	-0.01 (0.00)
Alive at 72	-0.01 (0.01)
Alive at 73	0.00 (0.01)

Note: *** p<0.01, ** p<0.05, *p<0.1. Sample size 7,098.

Table 2.8: Impact of Part D Coverage on Living to 66-73 for Only Black Men

	Percent Covered Coefficient
Alive at 66	0.01 (0.00)*
Alive at 67	0.03 (0.01)***
Alive at 68	0.01 (0.02)
Alive at 69	0.03 (0.03)
Alive at 70	0.04 (0.03)
Alive at 71	0.08 (0.04)*
Alive at 72	0.07 (0.04)*
Alive at 73	0.09 (0.04)**

Note: *** p<0.01, ** p<0.05, *p<0.1. Sample size 403.

Table 2.9: Alternative Specifications for Measuring the Impact of Part D Coverage on Probability of Living to 73 for Only Black Men

	Percent Covered Coefficient
Income Bins instead of log income (based on quintiles)	0.08 (0.04)*
Indicator of No Income included	0.09 (0.04)**
Interaction Variable of Percent Covered and Black Men	0.04 (0.01)
Logistic Probability Model	1.7 times greater odds of living to age 73**

Table 2.10: Placebo Test Looking at the Impact of Birth Year Cohort 1925 to 1930 on Probability of Living to Age 73

	Reported Alive at Age 73	**Reported Alive at Age 73 for Only Black Male Respondents**
Percent Covered	-0.126 (0.02)***	-0.245 (0.02)***
Health		
Dummy for Best (Self-Reported) Health	0.330 (0.03)***	0.401 (0.05)***
Dummy for Second Best Health	0.298 (0.03)***	0.341 (0.06)***
Dummy for Medium Health	0.263 (0.03)***	0.298 (0.07)***
Dummy for Second Worst Health	0.193 (0.03)***	0.248 (0.06)***
Finances		
Log Income	0.005 (0.00)	0.018 (0.02)
Log Assets	0.015 (0.00)***	0.020 (0.01)
Demographics		
Marriage	0.030 (0.01)***	0.019 (0.03)
Dummy for White	0.001 (0.01)	N/A
Dummy for Other Non-Hispanic	0.025 (0.02)	N/A
Dummy for Hispanic Non-White	-0.019 (0.03)	N/A
Dummy for High School Degree	0.001 (0.01)	0.051 (0.04)
Dummy for College Degree (at least 4 years)	-0.007 (0.01)	-0.120 (0.08)
Sample Size	8.869	544

Note: *** p<0.01, ** p<0.05, *p<0.1
Worst health is the omitted category for health

Table 2.11: Cause of Death Across All Years: Percent in Each Category

Cause of Death	Percent
Cancers and tumors; skin conditions	23.41%
Musculoskeletal system and connective tissue	1.09%
Heart, circulatory and blood conditions	36.36%
Allergies; hay fever; sinusitis; tonsillitis	11.02%
Endocrine, metabolic and nutritional conditions	3.50%
Digestive system (stomach, liver, gallbladder, kidney, bladder)	6.94%
Neurological and sensory conditions	1.93%
Reproductive system and prostate conditions	0.05%
Emotional and psychological conditions	0.32%
Miscellaneous	3.52%
Other symptoms	3.95%
Not A Health Condition	0.92%
None	0.39%
Other health condition	4.62%
DK (Don't Know); NA (Not Ascertained)	1.90%
RF (Refused)	0.08%

Table 2.12: Percent of Total Deaths Caused by Heart, Circulatory and Blood Conditions

	All Yrs.	1996	1998	2000	2002	2004
Percent of deaths caused by heart, circulatory and blood conditions	39.92%	34.19%	48.25%	43.84%	41.86%	42.05%
Men Only	37.01%	39.23%	37.04%	41.41%	41.81%	36.41%
Black Only	40.34%	36.54%	37.93%	44.62%	38.78%	47.62%
	2006	2008	2010	2012	2014	
Percent of deaths caused by heart, circulatory and blood conditions	41.04%	38.45%	37.70%	33.73%	32.77%	
Men Only	35.83%	40.25%	37.96%	33.33%	30.10%	
Black Only	40.54%	40.74%	38.24%	47.73%	32.63%	

Table 2.13: Impact of Part D Coverage on Cardiovascular Mortality at Age 73 for Total Population

Died of Heart Condition	**Coefficient**
Percent Covered	-0.077***
Dummy for Best (Self-Reported) Health at 64	-0.167***
Dummy for Second Best Health at 64	-0.147***
Dummy for Medium Health at 64	-0.104***
Dummy for Second Worst Health at 64	-0.078***
Income at 64	0
Assets Dummy for First Category at 64	0.064***
Assets Dummy for Second Category at 64	0.047***
Assets Dummy for Third Category at 64	0.025***
Assets Dummy for Fourth Category at 64	0.003
Marriage at 64	0.003
Dummy for Not Hispanic	0.030***
Dummy for Gender (Woman)	-0.044***
Dummy for High School Degree	-0.008
Dummy for College Degree (at least 4 years)	-0.011
Dummy for White	0.029**
Dummy for Black	0.047***
Constant	0.176
Sample Size	8,643

Note: *** p<0.01, ** p<0.05, *p<0.1

Table 2.14: Impact of Part D on Cardiovascular Mortality at Age 73 for Only Black Male Respondents

Died of Heart Condition	**Coefficient**
Percent Covered	-0.114***
Dummy for Best (Self-Reported) Health at 64	-0.163***
Dummy for Second Best Health at 64	-0.089**
Dummy for Medium Health at 64	-0.047
Dummy for Second Worst Health at 64	-0.073
Income at 64	0.000
Assets Dummy for First Category at 64	0.064
Assets Dummy for Second Category at 64	0.031
Assets Dummy for Third Category at 64	0.023
Assets Dummy for Fourth Category at 64	-0.015
Marriage at 64	-0.105*
Dummy for Not Hispanic	-0.275
Dummy for High School Degree	0.038
Dummy for College Degree (at least 4 years)	0.014
Constant	0.497
Sample Size	573

Note: *** p<0.01, ** p<0.05, *p<0.1

Table 2.15: Impact of Part D Coverage on Hazard Rate for Dying, Total Population

Total Lifespan	**Hazard Ratio**
Percent Covered	0.907
Dummy for Best (Self-Reported) Health at 64	0.214***
Dummy for Second Best Health at 64	0.270***
Dummy for Medium Health at 64	0.411***
Dummy for Second Worst Health at 64	0.568***
Log Income at 64	0.909***
Log Assets at 64	0.888***
Marriage at 64	0.624***
Dummy for Gender (Woman)	0.581***
Dummy for High School Degree	0.949
Dummy for College Degree (at least 4 years)	0.918
Dummy for White Non-Hispanic	1.134
Dummy for Other Non-Hispanic	0.696
Dummy for Hispanic Non-White	0.915
Dummy for Hispanic White	0.668
Sample Size	6,479

Note: *** p<0.01, ** p<0.05, *p<0.1

Table 2.16: Impact of Part D Coverage on Hazard Rate for Dying for Black Male Population

Total Lifespan	**Hazard Ratio**
Percent Covered Interacted with Black	0.703
Dummy for Best (Self-Reported) Health at 64	0.234***
Dummy for Second Best Health at 64	0.374***
Dummy for Medium Health at 64	0.466**
Dummy for Second Worst Health at 64	0.561*
Log Income at 64	0.911
Log Assets at 64	0.939
Marriage at 64	0.695
Dummy for High School Degree	1.367
Dummy for College Degree (at least 4 years)	1.342
Sample Size	403

Note: *** p<0.01, ** p<0.05, *p<0.1

CHAPTER 3. MEDICARE PART D AND FINANCIAL INSECURITY

3.1 Introduction

Medicare Part D was created by the Medicare Modernization Act of 2003, and rolled out in January 2006. This was the largest expansion of an entitlement program since Medicare itself. Rising drug costs for seniors due to medical advancement motivated the creation of Part D. Medicare Part D had an instant effect on drug coverage, increasing rates of prescription drug coverage among from around 75% to 90%.

This large increase in drug coverage among seniors had a positive impact on health outcomes, decreasing seniors' hospitalization rates (Afendulis et al. 2011), increasing medication adherence (Stuart et al. 2013, Jung et al. 2014, Donohue et al. 2010, Zhang et al. 2010), and decreasing congestive heart failure rates (Dall et al. 2013). Finally, Dunn and Shapiro (2017) and Huh and Reif (2017) both find that Medicare Part D improved mortality at age 66. Overall, Part D helped improve the health of seniors. However, previous literature has yet to examine if Medicare Part D could have benefitted seniors' financial stability.

Chapter 3 examines the impact of Medicare Part D on financial/food insecurity among elderly Americans. According to the AARP, approximately 9% of Americans over age 60 experience some form of food insecurity (Strickhouser et al. 2014). For black elderly, this reaches 24% and for Hispanic elderly, 20%. Food insecurity is also correlated with health problems, suggesting those who have high medical costs may struggle to afford food. In 1997, prior to Medicare Part D, approximately 8% to 16% of seniors have experienced food insecurity within a 6-month period (Wellman et al. 1997). Among the elderly, minorities are more likely to report financial difficulty acquiring food

(Klesges 2001). Previous research into health economics has found that when uninsured receive health insurance, this can allow them to switch expenditures previously spent on necessary health treatments to other important areas, such as food or debt repayment. The classic RAND health experiment found access to health insurance improved financial stability of the recipients by lowering medical debt. Health spending is often inelastic. Thus, even an individual whose health expenditures did not significantly change before or after receiving coverage might have benefited financially from health insurance, if they were able to switch spending from health to other important areas.

My paper is the first to examine the impact of Medicare Part D on financial stability. Previous literature has focused almost exclusively on the health effects of Medicare Part D. In addition, this is the first paper to examine the impact of Part D on financial stability by race.

3.2 Literature Review

Medicare Part D, which led to near-universal drug coverage among senior citizens, would be expected to improve their overall finances by allowing them to shift money previously spent on drug expenditures to other areas. As a group, Americans age 65 and older have higher rates of poverty. Papers such as Basu et al. (2010) and Millet et al. (2010) found that Medicare Part D reduced senior citizen's out-of-pocket drug expenditures. Presumably savings on health costs could be shifted to other areas. Lee (2013) describes how obtaining health insurance can impact food insecurity both directly and indirectly: directly through reduced healthcare costs and indirectly because those who are ill may not be able to work.

Looking at the relationship between food insecurity and cost-related medication nonadherence, Bengle et al. (2010) finds food-insecure older Americans are three times as likely to also report not purchasing medication for financial reasons. Adults with chronic diseases such as diabetes are more likely to also report food insufficiency (Nelson et al. 2001, Seligman et al. 2010). Public insurance, chronic illnesses, and minority status are all associated with both cost-related medication underuse and food insecurity (Berkowitz 2014). Bhargava et al. (2012) also finds food-insecure elderly are more likely to underutilize healthcare. Not surprisingly, there appears to be a tradeoff in spending between health and food. Neilsen et al. (2010) finds the probability of hunger for U.S. families increased when out-of-pocket medical expenditures increased. Interestingly, food security did not affect medical spending, indicating the latter to be more inelastic. Kersey et al. (1999) found emergency department patients had high rates of hunger. They reported making choices between buying food or medicine, and loss of food stamps was associated with not being able to afford medicine and self-reported worse health. The creation of Medicare did lower poverty rates among senior citizens. In fact, the near-elderly, those 60-65 who cannot yet access Medicare, tend to have higher rates of food insufficiency than older Americans (Rowley 2012).

I would expect any improvements in financial stability as a result of Part D to show up among lower-income elderly. Since demand for food and healthcare are both relatively inelastic, only those without money to afford both would experience a trade-off. Klein, Turvey, and Wallace (2004) find that the elderly most likely to delay prescription medication as a result of cost are: those with Medicare coverage only, low income, poor health, African-American race, and age 65–80. Gellad, Haas, and Safran

(2003) likewise report that blacks and Hispanics were more likely than whites to not take medication for cost-related reasons. Saver et al. (2004) also finds that low-income Americans are more likely to have difficulty affording medications.

Overall, it seems that little research has been done into the indirect effects of Medicare Part D on the finances and food security of the elderly, making this a rich field for research.

Despite improvements in health and coverage as a result of Medicare Part D, Chapter 1 found that gains were not as large among minorities and those with lower incomes. Seniors reported the enrollment process to be confusing, and it could be more difficult for those in a lower income bracket. There is ample evidence that Medicare beneficiaries do not always choose the best possible Part D plan. Anecdotally, the many different Part D plans are difficult to understand and their benefits change every year, making it hard for seniors to consistently stay in the best possible plan. Abaluck and Gruber (2011), Ericson (2014), and Zhou and Zhang (2012) all find losses in patient welfare due to seniors choosing more expensive plans less-suited to their needs.

The creation of Medicare Part D in 2006 was inspired by concerns over lack of access to medication among the elderly population. According to Soumerai et al. (2006), prior to Part D, rates of medication non-adherence due to prohibitive costs were highest among those with disabilities, poor health, multiple morbidities, and limited drug coverage. In total, among Medicare enrollees, 29% of the disabled and 13% of the elderly beneficiaries report not taking prescribed medications due to cost. Those who restrict their medications due to cost have worst self-reported health and higher rates of angina, nonfatal heart attacks, and strokes (Heisler et al. 2004).

Medication nonadherence is a serious issue in U.S. healthcare, estimated to cost about $396 to $792 million per year as a result of additional healthcare utilization (Munger et al. 2007). Looking across thirty-nine articles, Lacro et al. (2002) find that the factors most associated with medication nonadherence are "poor insight, negative attitude or subjective response toward medication, previous nonadherence, substance abuse, shorter illness duration, inadequate discharge planning or aftercare environment, and poorer therapeutic alliance." Seniors with lower incomes might be more at-risk for factors such as substance abuse or negative attitudes towards healthcare providers. Munger et al. 2007 find that elderly patients and women are more likely to exhibit medication nonadherence for antihypertensive medication. In addition, African-American and Hispanic patients are more likely to not take their prescribed medication, even controlling for socioeconomic status, health insurance coverage, health status, and health risk behaviors. Munger et al. 2007 attribute the difference to language proficiency, cultural beliefs, and attitudes toward healthcare. Medication nonadherence leads to a broad range of adverse outcomes, including cardiovascular hospitalization and revascularization procedures (Ho et al. 2008).

Madden et al. (2009) was the first study to use longitudinal data to examine changes in cost-related medication nonadherence after Medicare Part D. Their paper also looked at look at spending on basic needs (e.g., food) using the Medicare Current Beneficiary Survey. Changes in the dependent variables between 2005 and 2006 (before and after Medicare Part D implementation) were compared with changes between 2004 and 2005. Madden et al. used full population analyses to avoid selection biases due to greater Part D enrollment among sicker and poorer beneficiaries.

Using odds ratios of cost-related medication nonadherence (CRN) and basic needs, Madden et al. (2009) found significant decreases in the odds of CRN and increases in spending on basic needs after Medicare Part D. Examining subgroups, they also found significant decreases in CRN among lower-income beneficiaries. Overall, the implementation of Part D was associated with modest but significant decreases in the prevalence of CRN. In absolute terms, prevalence of CRN decreased by 2.6 percentage points, and spending less on basic needs by 3.5 percentage points. This suggests that Medicare Part D did loosen constraints on finances for seniors, leading to more spending on basic needs.

In 2011, nearly one in every seven Americas, or forty-seven million people, are enrolled in the Supplemental Nutrition Assistance Program (SNAP). This number has risen over time due to the Great Recession and the 2002 and 2008 Farm Acts. The United States differs from many first-world countries in relying on food stamps instead of cash transfers to feed impoverished families (Poppendieck 2014). However, the impact of food stamps on food insecurity can be difficult to calculate due to the tendency of recipients to shift spending previously spent on food into other categories (Gibson-Davis and Foster 2006, Yen et al. 2008). In addition, more needy households select into SNAP (Gregory et al. 2013). Nord and Golla (2009) circumvent this issue by examining the same households before and after receiving SNAP benefits, and find about a one-third reduction in the prevalence of food insecurity. Similarly, Ratcliffe et al. (2011) find that receiving SNAP benefits reduces the likelihood of being food insecure by roughly 30% and the likelihood of being very food insecure by 20%. Comparing to low-income households with incomes slightly above SNAP eligibility, Nord and Prell (2011) find that

the SNAP expansions of 2008-2009 decreased food insecurity by 2.2 percentage points. Recent papers with new methodologies have found that SNAP decreases food insecurity, but previously researchers frequently found that SNAP benefits were associated with greater food insecurity due to selection bias issues; looking at means, SNAP eligibility tends to be correlated with hunger (Gregory et al. 2013). For this reason, I use caution in my interpretation of my summary statistics.

3.2.1 Differential Impact by Demographic Factors

One of the focuses of Chapter 3 is to examine if the impact of Medicare Part D on financial stability differed by race and gender. My findings in Chapter 2 and Levy and Weir (2010) suggest that after Part D, coverage increased for all groups, erasing the differential between the most advantaged and less-advantaged groups. However, because of higher rates of Medicaid drug coverage among the poor and minorities, these groups were more likely than non-Hispanic whites to have coverage before Part D, so their gains were relatively smaller. Other studies including Maciejewski et al. (2010) also support that take-up rates were lower among black and Hispanic seniors and those with lower incomes. Still, Medicare Part D increased prescription drug coverage, spending, and utilization for all groups. Despite lower take-up rates, black seniors may have experienced greater increases in their quality of prescription drug coverage. After Part D, 9% of black seniors switched from Medicaid coverage to Part D plans.[58] Theoretically,

[58] As discussed in Chapter 1, although Medicaid offers drug coverage, the quality varies wildly across states. Many states which limit seniors to generic drugs with higher copays for drugs on their non-approved list. States with more stringent Medicaid eligibility and limits on number of prescriptions filled per month also had higher rates of cost-related medication skipping (Safran et al. 2002). Prior to Part D, Cunningham (2005) found that a fifth of all Medicaid enrollees reported trouble paying for their prescription drugs. In addition, Miller et al. (2008) found that 10% of Medicaid enrollees reported spending more than 10% of their income on healthcare, and this was driven by prescription drug costs.

obtaining superior prescription drug insurance through Medicare Part D instead of Medicaid might allow beneficiaries who previously struggled to pay for life-saving drugs to become more financially stable overall. This could allow seniors to shift spending into food and debt.

3.2.2 Contribution

My contribution to the literature is to look at Medicare Part D's impact on food insecurity and financial stability. Previous papers have focused on the health effects of Part D, ranging from medication utilization and spending to various health conditions. This is the first paper to look at whether obtaining health insurance allowed seniors to shift spending into food or debt over the long-run. Madden et al. (2009) examined changes in cost-related medication nonadherence and basic needs shortly after Medicare Part D, but their analysis was limited in scope due to their most recent data being available in 2008, directly after Part D was created in 2006. It would be worthwhile to analyze if the spillover effects might have been stronger the longer Part D was in effect. Also, Madden et al. (2009) only had the data to look at one category of basic needs spending, whereas I look at food insecurity and household debt separately.

My sample contains data from 1996 to 2014. In addition, the Health and Retirement Survey has detailed information on demographics, allowing me to analyze how the impact of Part D differed by race and gender.

Chapter 1 looked at the take-up rates of Part D by race, and found similar coverage rates across all groups after 2006. One of the largest differences between white and black seniors was that three times as many black seniors moved from Medicaid to Part D. In Chapter 2, I found a positive impact on life expectancy for black male seniors

but not for the entire population. My findings in Chapter 1 suggested that one of the mechanisms may have been an improvement in quality of drug coverage for black men who moved out of Medicaid into Part D plans. By examining the impact of Part D by race, I hope to test whether there is a greater decline in cost-related medication non-adherence for black men, which would provide evidence that quality of coverage improved more for this group.

3.3 Data

I use the Health and Retirement Study Panel core files from 1996 to 2014 to examine the impact of Medicare Part D on financial insecurity for seniors.[59] I examine several measures of financial stability, including cost-related medication nonadherence, debt, and food insecurity. I compare these before and after the rollout of Medicare Part D, using odds ratios in a manner similar to Madden et al. (2009) and risk ratios using a Cox Proportional Hazards Model. The purpose of this approach is to estimate the change in financial outcomes after Part D, controlling for historical year-to-year changes and using the total population to avoid selection bias due to those in worst health being more likely to take up Part D.

The HRS sample size is approximately 20,000, with response rates consistently between 80 and 90 percent. As in Chapter 2, I dropped individuals from my sample with missing birth year or without data at age 64. Next, I dropped those individuals who were too young to have lived to at least age 73 in 2014, since my goal is to examine probability of an adverse event occurring between ages 65 to 73.

[59] Here "elderly" is defined as age 65 and older.

3.3.1 Identification

My dependent variables are cost-related medication nonadherence, food insecurity, and household debt. My key independent variable is percent of time potentially covered by Part D from ages 65 to 73. I do not use which seniors took up Medicare Part D as my key independent variable because of the selection bias issue. Levy and Weir (2010) find that seniors who were healthy and who didn't use prescription drugs were less likely to take up drug insurance after the expansion. Because Medicare Part D offered close to universal coverage to seniors, I use eligibility for Part D rather than who actually took it up as my independent variable. Similarly to Madden et al. (2009), I analyze the total population of U.S. seniors to find the effects of Part D. I do not want to use seniors who did not take up Part D because they did not use drugs as a control group.

As in Chapter 2, I create my key independent variable based on percent of time ages 65 to 73 an individual was eligible for Part D, because I can collect data at age 73 for my entire sample. Those who turned 65 in 2006 were covered the entire period, all 8 years, until they reached 73. Those who turned 73 in 2006 were covered zero years from 65 to 73, and so forth. This leaves seven groups with partial coverage by Medicare Part D in between, or nine categories total for percent of time age 65-73 an individual could have taken up Medicare Part D if they desired (and assuming they lived until 73).[60] The

[60] This variable also captures increases in generosity in Part D over time, which seniors born later would have benefitted more from.

sign and significance of "Percent Covered" tests whether or not Part D had an impact on cost-related medication nonadherence, food insecurity, and debt among seniors.

3.3.2 Generating Variables

Health status, marriage, income and assets are all collected at age 64.[61] Income represents the sum of all income in a household.[62] Assets represents the net value of total wealth in a household. Both have been log transformed because of their highly positive skew. My race categories are White[63], Black Non-Hispanic, Other Non-Hispanic, and Hispanic Non-White. Education has eight categories, but for the sake of space only four-year college degree and high school degree is included in my tables.[64] I considered including a variable for whether or not a respondent was alive during the recession,[65] but did not because 93% of my sample was alive during the recession. The Great Recession could possibly have a downward bias on my results, making the impact of Part D seem smaller.

3.4 Summary Statistics

There are two yes/no questions in the HRS which address food insecurity: "Did you (or other family members who were living here) receive government food stamps at any time in the last two years?" and "In the last two years, have you always had enough money to buy the food you need?" For cost-related medication nonadherence, the HRS

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[61] For those who answered the survey at an odd year of age, I rounded up. For these individuals, the data categories at age 64 were taken at age 65 instead.
[62] Only including respondent and spouse, divided by two for couples so it's consistent for those not married.
[63] Which includes both white non-Hispanic and White Hispanic.
[64] The education categories are no degree, GED, high school diploma, two year college degree, four year college degree, master degree, professional degree, and degree unknown/some college.
[65] Year fixed effects could not be used in non-panel data.

asks: “At any time in the last two years have you ended up taking less medication than was prescribed for you because of the cost?” For my summary statistics, I examine how the answers to these questions compare before and after Medicare Part D. The question on cost-related medication nonadherence was only asked from 2002 onward, so data is not available in earlier years.

Because the HRS’s survey questions ask about “the last two years,” I would expect the full impact of Medicare Part D to show up in 2008, two years after the program was created. (Some effect of prescription drug coverage might still show up in 2006, so the most accurate before-after comparison would be 2004 to 2008.) Figures 3.1, 3.2, and 3.3 show unadjusted prevalence rates for cost-related medication nonadherence, usage of food stamps, and food insecurity, with bars to represent the 95% confidence interval. This methodology is the same as that used in Madden et al. (2009) in order to examine the impact of Part D on basic needs spending.[66]

Looking at unadjusted prevalence rates, I find that 7.2% of seniors reported cost-related medication nonadherence in 2006.[67] In 2008, after Medicare Part D took effect over the last two years, this fell to 6.2%. The difference was large enough to be (barely) outside the 95% confidence interval of the previous year. The rates fluctuated from 2002-2014[68] between six to seven percent, though on average remaining lower than the average before Part D. Note that prior to Medicare Part D, cost-related medication nonadherence was rising, indicating that the decrease made by Medicare Part D might be understated in my summary statistics because there was previously a trend pushing the numbers upward.

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[66] The HRS is replenished with younger seniors over time, so overall aging of the sample is not a concern. However, these summary statistics could be influenced by economic conditions over time.
[67] In other words, these seniors took less medication than prescribed sometime in the last two years.
[68] The question about cost-related medication nonadherence was first added to the HRS in 2002.

Overall, Figure 3.1 suggests that Medicare Part D decreased the number of seniors who did not take prescribed medication for financial reasons, which would be an expected consequence of expanding access to prescription drug insurance.

Figure 3.2 looks at whether the respondent or any family member received food stamps in the last two years (aka since the previous wave). Here, it is not clear what the effect of Part D was. The percent of elderly respondents who used SNAP increased from 2004 to 2008 from 4.4% to 5.2%. This change is small enough to almost be within the 95% confidence interval. We would expect Medicare Part D to improve the finances of seniors and thus decrease enrollment for food stamps, the opposite of my finding. However, other factors impacted SNAP during this time period. First, the Farm Bill of 2002 (aka the Food Security and Rural Investment Act of 2002) reauthorized the food stamp program. This expanded eligibility by adjusting the standard deduction to vary by household size and be indexed for inflation; providing states with options to simplify the program; and eliminating the cost neutrality requirement for electronic benefit transfer systems. According to the USDA, "Food stamp participation increased from about 17.2 million in fiscal year 2000 to 26 million people in July 2006." This impact is clearly seen in Figure 3.2, showing an increase in food stamp usage leading up to 2006. Similarly, the Farm Bill of 2008 also expanded the food stamp program, changing its name to SNAP and expanding eligibility. Finally, the American Recovery and Reinvestment Act of 2009 increased SNAP benefit levels and expanded SNAP eligibility for jobless adults without children. Seniors in particular would likely be affected due to higher rates of poverty among the elderly. Once again, Figure 3.2 shows a sharp increase in usage of food stamps after this new law. However, this change shouldn't necessarily be taken as an increase in

hunger, since it could have been driven by changes in eligibility for the program. For this reason, it is difficult to use my summary statistics to look at the impact of Medicare Part D on food stamps, because too many other changes in SNAP occurred around this time period.

In Figure 3.3, I examined the question "In the last two years, have you always had enough money to buy the food you need?" Seniors who did not always have enough money to buy food rose from 3.9% in 2002 to 5.4% in 2004. Then it dropped to 4.5% in 2006, going back to 5.2% in 2008. There is some indication here that food insecurity was increasing before Part D and that the program may have halted or at least decreased the magnitude of the increase. However, food insecurity fluctuated over the period from 1996-2014, and the changes around 2006 were no greater than unexplained changes in other years.[69] Once again, it is difficult to separate what the impact of the changes in food stamp eligibility during this time period might have been from a possible, likely lesser, impact from Medicare Part D. A more telling measure will be to actually look at risk ratios before and after Part D.

Finally, Figures 3.4 and 3.5 look at the trends in cost-related medication nonadherence and food security for black seniors. I find that black seniors had rates of cost-related medication nonadherence around 9-11%, about 5 percentage points higher than for the total population of seniors. There was no difference in the trends over time: for both groups, cost-related medication nonadherence decreased after 2006. In Figure 3.5, black seniors reported rates of food insecurity around 10-16%, about 6-7 percentage

[69] My sample sizes were from 10,000-14,000 per year, tending to increase over time. The exception was 1996, where sample sizes were around 1,000. This year also shows greater fluctuations likely due to the smaller sample size.

points higher than the total population of seniors. Again, I see no difference in trends for black seniors, who also had increasing rates of food insecurity starting before Part D.

I compare my results to the trends in food insecurity found by the USDA's Economic Research Service (Figure 3.6). For the total U.S. population, food insecurity rates among households increased pre-Part D from 10.5% in 2000 to 12.0% in 2004. After a slight dip from 2005-2007, percent of food insecure households increased in 2008 up to 14.6, and declined to 14.0% in 2014, a downward trend which has been continuing in the most recent data.

Looking at food insecurity rates among the elderly, I turn to data from the Current Population Survey (CPS), compiled by Ziliak and Gundersen (2018). Figure 3.7 shows trends in food insecurity for Americans ages 60 and older, examining separately marginal food insecurity, food insecurity, and very low food security.[70] These measures are created based on eighteen questions asking about difficulty affording food in the Food Security Supplement (FSS), where marginal food insecurity is defined as one or more affirmative responses, food insecurity is defined as three or more affirmative responses, and very low food security is defined as eight or more affirmative responses in households with children or six or more affirmative responses in households without. In 2016, Ziliak and Gundersen (2018) found that 13.6% of those over age 60 were marginally food insecure (8.6 million seniors), 7.7% were food insecure (4.9 million seniors), and 2.9% were very low food secure (1.8 million seniors). They find higher rates of food insecurity than my own summary statistics, which found rates around 5%. There are two possible reasons. First, Ziliak and Gundersen (2018) looked at Americans over age 60 and I looked at those

[70] This figure was taken from Ziliak and Gundersen (2018) with permission from the authors.

over age 65, and they find that younger seniors are more likely to report food insecurity. Secondly, I rely on only one question in the HRS to calculate food insecurity whereas they use eighteen questions in the Food Security Supplement.

Figure 3.7 shows trends in food insecurity over time for Americans over age 60, both as a percent of households and in millions of seniors. Ziliak and Gundersen (2018) show that across all three measures, food insecurity has been increasing since 2001 (a 45% increase in food insecurity from 2001 to 2016). The number of food insecure seniors rose by 113%, although this also reflects increases in the population of seniors. From 2014 to 2016, there has been a slight decline in food insecurity. Ziliak and Gundersen (2018) report the highest food insecurity rates among seniors living in states in the South and Southwest, seniors with lower incomes, seniors aged 60-69, black seniors, and Hispanic seniors. Compared to my own summary statistics in the HRS, I also find that food insecurity has been increasing over time. My findings show more variation across years and less statistical significance, which may reflect smaller sample sizes. As a result of increasing food insecurity rates among seniors over the last decade, my findings could possible underestimate the impact of Part D, if Part D helped curb an existing trend of rising food insecurity.

Next, I focus on debt. The HRS asks if a household had any debt and amount of household debt. I find that probability of having any debt among seniors rose steadily over time from 1996-2014. There's no evidence of a decline post-2006. Looking at amount of household debt, again debt has been increasing over time, and this trend did not appear to change after Medicare Part D. For debt at age 73 in particular, 72% of seniors reported having no debt. The smallest amount of household debt was $1 and the

greatest was $2 million. Among those seniors who reported debt at age 73, the average amount was $48,000 and the median was $2,000.

Overall, my summary statistics find some evidence of Medicare Part D reducing the number of respondents who did not take medication for monetary reasons. However, I do not find any evidence of it impacting food security or debt. Food security and debt could potentially be influenced by many other factors, so it is difficult to predict the effect of Part D from looking at summary statistics.

3.5 Theoretical Predictions

Previous literature found that Medicare Part D decreased seniors' out-of-pocket spending on drugs (Basu et al. 2010 and Millet et al. 2010). Thus, my hypothesis is that Medicare Part D, which led to a 15% increase in drug coverage among seniors, would allow seniors to increase their spending in other essential areas such as housing, food, and debt. In addition, I expect Medicare Part D to have a stronger impact on those demographic groups with the most need for health/drug insurance. Prior to Part D, the black population of seniors was more likely to have drug coverage through sources like Medicaid or "other" coverage, which required more spending out-of-pocket (as discussed in the literature above). Thus, I test whether these groups could have experienced a greater effect from Part D.

3.6 Results

First, I compare odds ratios before and after the rollout of Medicare Part D. I examine the mean rate of medication nonadherence and financial/food insecurity incurred by seniors to determine the incremental difference attributable to access to prescription

drug insurance. Then I analyze the hazard rates for experiencing medication nonadherence, food insecurity, and debt using a Cox Proportional Hazards Model.

My results in Figure 3.8 show the ratio of odds ratios for the categories described above. I compare 2002-2004 to 2006-2008 because the HRS asks about CRN/food insecurity every two years, so the impact of Medicare Part D would not show up in full until 2008. For cost-related medication nonadherence, the ratio of odds ratios before and after Medicare Part D was 0.84. Therefore, between the periods of 2002-2004 and 2006-2008 there was a significant decrease in the number of elderly respondents who reported failing to take medication due to financial constraints. Next, comparing 2002-2004 to 2012-2014, the ratio of odds ratios was 0.79, an even greater decline. It's possible that the 2007 recession caused the improvement in seniors taking medications due to Part D to be smaller in earlier years. Thus my calculations for 2012-2014 would reflect more of the true improvements due to Medicare Part D.

The ratio of odds ratios for usage of food stamps from 2002-2004 to 2006-2008 was 0.53, indicating an increase in food stamp usage. This is the opposite of what I would expect, although as mentioned in the last section, it is difficult to separate out the impact of Medicare Part D from several reforms of SNAP carried out during this time period.[71] In order to avoid this issue, next I looked at the ratio of odds ratios for usage of food stamps from 2004-2006 to 2006-2008. By starting my analysis two years later, I intended to compare odds ratios from only time periods after the SNAP expansion. I found 0.63, which still indicates an increase in food stamp usage. This suggests the increase in food stamp usage over time can also partly be attributed to pre-existing trends.

[71] Cost-Related Medication Adherence, discussed above, would both be more likely to be influence by Part D and less likely to be influence by SNAP expansions.

By 2012-2014, the ratio of odds ratios was 0.37, indicating an even greater increase in food stamp usage. Both the Great Recession and increases in SNAP eligibility could lead to more seniors using food stamps.

For food insecurity, the ratio of odds ratios was 1.05 for comparting 2002-2004 to 2006-2008 and 1.03 for 2012-2014, finding little change over time at all. For amount of household debt, the odds ratios were 0.83 and 0.54 respectively, suggesting an increase in debt over time, the opposite of the hypothetical impact of Medicare Part D. Part D clearly did not decrease food insecurity or household debt in the aggregate as these show trends of increasing over time. It remains to be seen if Part D affected the hazard rates.

Overall, my results are similar to my summary statistics: I find clear evidence that Medicare Part D improved cost-related medication nonadherence, but it is more difficult to find an impact on food security or financial security.

Next, I examine risk ratios, using a Cox Proportional Hazards Model and adjusting for various demographic categories (Table 3.1). I estimate the hazard ratio for medication non-adherence, food insecurity, and household debt, adjusting for risk factors such as age, race, sex, income, and assets.

Using a Cox Proportional Hazards Model allows me to examine the incidence or hazard rate of an adverse event occurring—in other words, the number of new cases per population per unit of time. The hazard function represents the probability that if an individual survives to time t, they will experience the adverse event. In contrast, a logistic regression would consider proportion of new cases that develop in a given time period, i.e. the cumulative incidence. A logistic regression estimates the odds ratio and a Cox Proportional Hazards Model estimates the hazard ratio. As shown in my summary

statistics, food stamp usage and debt among seniors is increasing over time, likely influenced by the Great Recession.[72] By looking instead at hazard rates of experiencing food insecurity and debt, this allows me to examine how Part D impacted the probability of a new adverse event occurring instead of total frequency of such events, which better allows me to separate out the effects of SNAP expansions and the recession. Variables on income and assets also help capture SNAP eligibility. Although the recession may still have some effect on my results, if anything it would lead me to underestimate the benefits of Part D for seniors.

Finally, there is a censoring issue due members of my sample dying, another reason to use survival analysis. The Cox Proportional Hazards Model includes an indicator variable if the observation is terminated by death and a likelihood function for censored data, in order to handle the random censoring problem of seniors leaving the sample due to mortality.

For my first Cox Proportional Hazards Model, the failure event is any instance of respondent failing to take medication for the reason of not having enough money from ages 65 to 73. I compare this to the percent of time age 65 to 73 an individual was potentially covered by Part D. Since the failure event is cost-related medication nonadherence, a hazard ratio of less than one implies the variable led to a decrease in cost-related medication nonadherence.[73]

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[72] Figure 3.8 shows the ratio of odds ratios. The increase in food stamp usage and debt over this time period is likely driven by SNAP expansions and the Great Recession. It would be difficult to separate out the impact of this macroeconomic event using a logistic regression, which uses odd ratios. This is a reason to instead use a Cox Proportional Hazards Model.

[73] I also tested using a shared frailty model to account for similarities between seniors who shared a household. Respondents might be more likely to report cost-related medication nonadherence if another respondent from the same household reported cost-related medication nonadherence. However, I found this did not affect my results. The same was also true for probability of reporting food insecurity and household debt.

I control for various demographic factors: self-reported health, log of income, log of assets, marriage, gender, education, and race. These variables were all reported at age 64-65. My variable of interest is the exposure of the respondent to Medicare Part D, captured by the variable Percent Covered. I interpret "Percent Covered," my independent variable of interest in the regressions, as being the percent of time that age 65-73 that an individual had Medicare Part D as an option (assuming they lived for the 8 years). As previously mentioned, healthy seniors selected out of drug coverage, so instead whether seniors had access to Medicare Part D, which offered universal coverage, is a more accurate reflection of accessibility of care to use as an independent variable. My dependent variable, cost-related medication nonadherence, represents whether a senior did not take prescribed medicine due to not being able to afford it from ages 65 to 73. Hence, I'm testing the impact of percent of time potentially covered by Part D ages 65-73 on risk of cost-related medication nonadherence from ages 65-73.

I find that Medicare Part D led to a decrease in cost-related medication nonadherence on the order of a 21% decrease for an additional 8 years of Medicare Part D coverage, significant at the 1% level (Table 3.1).[74] It is intuitive that Part D, a program offering prescription drug insurance, should reduce the number of seniors who failed to take prescribed medicine because they could not afford it.

Being in worst possible health made it less likely someone would not take medication. The sign of this coefficient could be rationalized either direction; on the one hand, people in worst health tend to be poorer so they would be more likely to skip medication, but on the other hand, people in worst health might have a very inelastic

[74] The question on cost-related medication nonadherence was first asked in 2002, making my sample size smaller for Table 3.1 than in Tables 3.2 and 3.3.

demand for medication since not taking it could be fatal. My regression points to the latter case. Being white and female both decreased cost-related medication nonadherence, whereas being black or Hispanic increased it. Education, income and assets proved insignificant, although a 4-year college degree decreased cost-related medication nonadherence at the 10% level.

Focusing on black men in particular, Medicare Part D had an even strong effect: a 30% decrease in probability of cost-related medication nonadherence for an additional 8 years of potential Part D coverage, significant at the 5% level.[75] I expected that Part D might have a greater impact for populations who previously had less access to prescription drugs. As mentioned in my literature review, the effect for the black population may have been at least partially driven by movement from Medicaid to Medicare Part D, which offered more comprehensive drug coverage, making enrollees less likely to need to skip medications. My other independent variables are similar to the whole population, with assets, education, and being in worse health all decreasing the probability of failing to take medication.

Next, I examine the Hispanic population. Here, I find a 20% decrease in the probability of cost-related medication nonadherence from ages 65 to 73 for an additional 8 years of Medicare Part D coverage. However, this effect was not significant.[76] Overall, Part D improved cost-related medication nonadherence for the whole population, with a greater impact for minorities.

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[75] Black women show little difference from the total population, hence why black men were picked for Table 3.1.

[76] The Hispanic population of seniors was too small to separate into males and females. The small sample size also led to lower significance levels and several variables being eliminated.

In Table 3.2, I look at the impact of Medicare Part D on probability of being food insecure. The dependent variable for food insecure equals one if an individual reported being food insecure in one survey year between ages 65 to 73. Hence, I compare percent of time eligible for Part D from ages 65 to 73 to probability of being food insecure from ages 65 to 73. I find that Medicare Part D led to a 3% decrease in food insecurity for an additional 8 years of Medicare Part D coverage, although this was not significant. The other independent variables remained similar to last regression, with the exception that being in worst health increased the probability of being food insecure. In addition, I found an even stronger effect on the black male population, a 7% decrease in probability of reporting food insecurity for an additional 8 years of Medicare Part D coverage. This was also insignificant. The greatest impact is for the Hispanic population, with a 14% decrease in food insecurity for an additional 8 years of Medicare Part D coverage, also insignificant. Although my significance levels are low, these results suggest that Part D coverage could have improved food security among seniors, with an even stronger affect for those demographic groups who previously had higher out-of-pocket costs for drugs.[77]

Compared to my odds ratios, my hazard ratios are less affected by the changes in SNAP eligibility because I'm able to separate out numerous independent variables (such as income and assets) which would affect eligibility for food stamps. Also, if changes in

[77] In addition, I also looked at the impact of Medicare Part D on the probability of reporting food insecurity from ages 65-73 for two years, for three years, and so forth. (The Cox Proportional Hazard Model only allows for binary failure events, hence why I looked at multiple food insecurities separately.) I consistently found that Medicare Part D increased the probability of being food insecure by about 2-5%. There was no evidence that the effect was larger or smaller based on how many times being food insecure occurred. (In other words, Part D did not affect those who were more frequently food insecure more or less). Those who reported food insecurity five or more times were not frequent enough in number to estimate their hazard rates. Consistently, the black and Hispanic population experienced a greater effect, ranging from 3-30%. A final option would be to examine the impact of food insecurity in a panel data set using a shared frailty model to account for correlation between the same respondent across years. However, I found there was not enough variation in my failure event using this methodology for the model to run successfully.

SNAP or the Great Recession were affecting my results, then I would expect to see food insecurity increasing instead of declining, as shown in Figures 3.6-3.8. If anything, this could make the effect of Part D seem smaller in Table 3.2 than it actually is. Because my summary statistics show food insecurity increasing rather than declining over time, this suggests that my estimate of a 3% decrease in food insecurity among all seniors for an additional 8 years of Medicare Part D coverage may be a lower bound and the true effect may be even larger. In addition, my key independent variable, Percent Covered, is a cohort effect not a time effect, making it less affected by policy changes in particular years. Finally, in order to test if my results were affected by general trends over time, I conduct a placebo test in my robustness checks below.

Looking at the impact of Medicare Part D on household debt (Table 3.3), I use presence of household debt at age 73.[78] I find that Medicare Part D led to a decrease in household debt on the order of a 9% decrease for an additional 8 years of Medicare Part D coverage, significant at the 15% level. In addition, I found an even stronger effect on the black population, a 12% decrease in debt for an additional 8 years of Medicare Part D coverage.[79] This effect was insignificant, so I hesitate to draw strong conclusions. These results are suggestive that Part D reduced household debt.

3.7 Robustness Checks

Because my key independent variable, Percent Covered, was created using birth year, it could potentially capture any other cohort effects which might impact cost-related

[78] For those deceased, I look at debt in the last year alive.

[79] Here, I look at the whole black population because black women actually saw a slightly larger effect instead of the impact being driven entirely by black men as in the previous two tables. Also, looking at the total black population increases my sample size—debt had more missing data. For the same reason, I do not have a large enough sample size to examine the Hispanic population.

medication nonadherence, food insecurity, and household debt. Trends in these variables over time could influence my results, including the recession and changes in SNAP eligibility as discussed above.

In order to test the robustness of my findings, I ran a placebo test. My dependent variable was a new version of Percent Covered created as if Medicare Part D rolled out in 1997 instead of 2006. This allowed me to test if trends over time could potentially be influencing my results in Tables 3.1-3.3. I was only able to run this regression on food insecurity and household debt, because the question on cost-related medication nonadherence was first created in 2002.

As shown in Table 3.4, my fake Medicare Part D coverage actually increased the probability of food insecurity. This implies food insecurity among seniors may have been increasing over time prior to Part D. Hence, my findings in Table 3.2 (that Medicare Part D reduced food insecurity) could underestimate the true impact of Part D. Furthermore, this suggests that changes over time should not be a problem for this set of results.

However, I find that the fake Medicare Part D decreased probability of household debt, which suggests a trend of debt decreasing for birth year cohorts over time. (In fact, the impact of the fake Medicare Part D was greater than the true Medicare Part D). Hence, I cannot say if my results in Table 3.3 are due to Medicare Part D or overall trends in time. Overall, the placebo test suggests that my results are robust for food insecurity, but not for household debt.

Additionally, I tested the impact of Percent Covered on food insecurity using a logistic regression. However, here I found that percent of time eligible for Part D appeared to be increasing rather than decreasing food security. This is likely capturing the

trend of increasing food insecurity over time among seniors, as shown in my summary statistics. As discussed earlier, I used a Cox Proportional Hazards Model because it estimates the probability an individual does not experience an adverse event over a time period as opposed to a logistic regression which looks at the cumulative incidence of the adverse event, and thus a Cox Proportional Hazards Model would be more deft at separating out the impacts of trends in food insecurity over time. Thus, it is not completely surprising that the logistic regression had different results for the impact of Part D. However, since my results in my logistic regression do not support an impact of Part D on food insecurity, this robustness check failed.

As a final robustness check, I examined the impact of Medicare Part D on probability of cost-related medication nonadherence for only those who took up Medicare Part D in 2006. Note that the selection bias issue could work in either direction for this sample, since those who took up Medicare Part D tended to have higher income/assets but also be in worse health and more likely to report prescription drug use. Here, the impact of Medicare Part D was even stronger (24% decrease for the total population and a 30% decrease for black men), providing additional evidence that Medicare Part D served its intended purpose in decreasing seniors who could not afford to take prescribed medicine.

3.8 Conclusions

Overall, I find evidence that Medicare Part D reduced cost-related medication nonadherence, with a greater impact for racial minorities. The strongest impact was on cost-related medication nonadherence. This suggests that Medicare Part D did fulfil its primary purpose by reducing the number of seniors who failed to take medication

because they could not afford them. In addition, I find a stronger impact for black men, which is also the group which experienced improvements in mortality in Chapter 2. Although my significance levels are low, I find some evidence that Medicare Part D may have had spillover positive effects by allowing seniors to shift out-of-pocket spending on medication to instead spending on food as a result of obtaining better health insurance. The impact was even stronger among minorities, with the greatest improvements for black men and Hispanic seniors. My results pass a placebo test for food insecurity, but not for household debt. I hesitate to draw strong conclusions because my findings on food insecurity were not significant and also did not appear robust in a logistic regression. In addition, it is difficult to separate the impact of SNAP expansions during this time period. However, this suggests a potential for further research into whether Medicare Part D had even greater benefits than previously realized, improving food security among seniors in addition to increasing access to life-saving medication.

Table 3.1: Impact of Part D Coverage on Hazard Rate for Cost-related Medication Nonadherence

	Hazard Ratio— Total Pop.	**Hazard Ratio— Black Men**	**Hazard Ratio— Hispanic Pop.**
Percent Covered	0.787***	0.702**	0.804
Dummy for Best (Self-Reported) Health at 64	1.232***	1.356	Omitted
Dummy for Second Best Health at 64	1.114*	1.307	1.386*
Dummy for Medium Health at 64	0.930	1.050	1.433*
Dummy for Second Worst Health at 64	0.971	1.082	0.924
Log Income at 64	1.017	0.984	0.655***
Log Assets at 64	1.001	0.941*	1.315***
Marriage at 64	1.100	1.591	Omitted
Dummy for Gender (Woman)	0.907***	N/A	1.238
Dummy for High School Degree	0.953	0.954	Omitted
Dummy for College Degree (at least 4 years)	0.874*	0.432***	Omitted
Dummy for White	0.963	N/A	N/A
Dummy for Other Non-Hispanic	1.018	N/A	N/A
Dummy for Hispanic Non-White	1.391***	N/A	N/A
Sample Size	1174	66	20

Note: *** p<0.01, ** p<0.05, *p<0.1
Several variables in the regression on the Hispanic population are omitted due to small sample size

Table 3.2: Impact of Part D Coverage on Hazard Rate for Food Insecurity

	Hazard Ratio— Total Pop.	**Hazard Ratio— Black Men**	**Hazard Ratio— Hispanic Pop.**
Percent Covered	0.974	0.934	0.865
Dummy for Best (Self-Reported) Health at 64	0.812***	0.448***	0.796
Dummy for Second Best Health at 64	0.824***	0.549***	0.715
Dummy for Medium Health at 64	0.850***	0.460***	0.737
Dummy for Second Worst Health at 64	0.884***	0.491***	0.961
Log Income at 64	0.947***	0.926**	1.066
Log Assets at 64	0.970***	0.968	0.965
Marriage at 64	1.030	0.739	0.526**
Dummy for Gender (Woman)	1.022	N/A	Omitted
Dummy for High School Degree	0.944***	0.918	0.888
Dummy for College Degree (at least 4 years)	0.962	0.951	0.772
Dummy for White	0.906***	N/A	N/A
Dummy for Other Non-Hispanic	1.014	N/A	N/A
Dummy for Hispanic Non-White	0.875*	N/A	N/A
Sample Size	6943	393	111

Note: *** p<0.01, ** p<0.05, *p<0.1

Table 3.3: Impact of Part D Coverage on Hazard Rate for Household Debt

	Hazard Ratio— Total Pop.	**Hazard Ratio— Black Pop.**
Percent Covered	0.909	0.881
Dummy for Best (Self-Reported) Health at 64	1.182	0.877
Dummy for Second Best Health at 64	1.249*	1.098
Dummy for Medium Health at 64	1.138	0.985
Dummy for Second Worst Health at 64	1.130	1.034
Log Income at 64	0.833***	0.818***
Log Assets at 64	0.958**	0.973
Marriage at 64	1.375***	1.446*
Dummy for Gender (Woman)	1.064	N/A
Dummy for High School Degree	0.946	0.983
Dummy for College Degree (at least 4 years)	0.884	0.996
Dummy for White	1.054	N/A
Dummy for Other Non-Hispanic	0.974	N/A
Dummy for Hispanic Non-White	0.784	N/A
Sample Size	1841	345

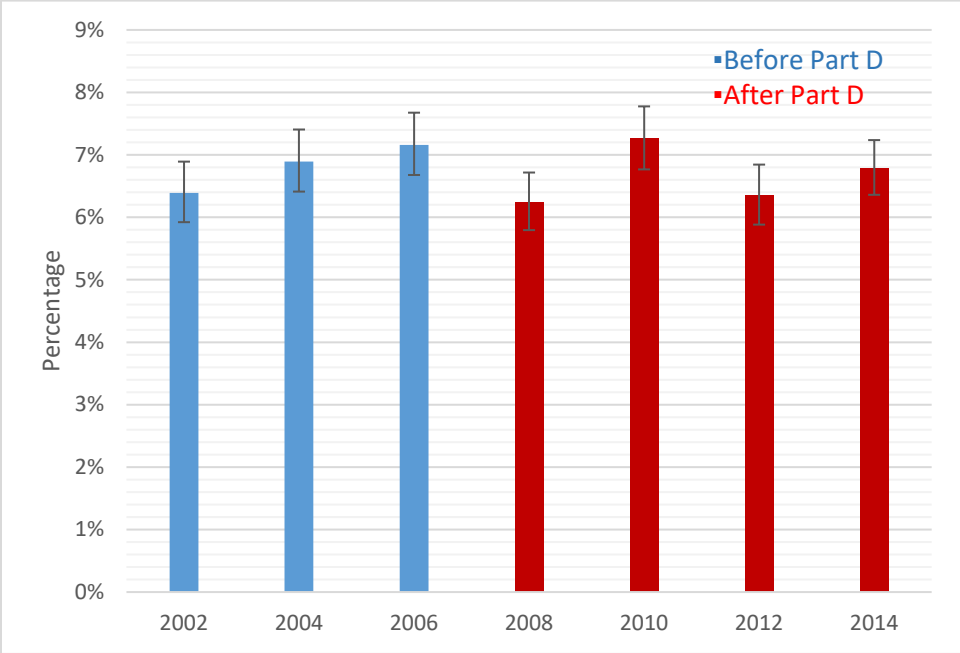
Note: *** p<0.01, ** p<0.05, *p<0.1

Table 3.4: Placebo Test on Total Population

	Hazard Ratio—Food Insecurity	**Hazard Ratio—Household Debt**
Percent Covered	1.772***	0.509***
Dummy for Best (Self-Reported) Health at 64	0.857***	1.123
Dummy for Second Best Health at 64	1.022	1.184
Dummy for Medium Health at 64	0.970	1.085
Dummy for Second Worst Health at 64	0.992	1.071
Log Income at 64	1.040***	0.828***
Log Assets at 64	0.982**	0.964**
Marriage at 64	0.933***	0.951
Dummy for Gender (Woman)	0.987	1.070
Dummy for High School Degree	0.962	0.939
Dummy for College Degree (at least 4 years)	0.922**	0.859*
Dummy for White	0.919***	1.033
Dummy for Other Non-Hispanic	1.058	0.979
Dummy for Hispanic Non-White	1.136	0.820
Sample Size	6598	2089

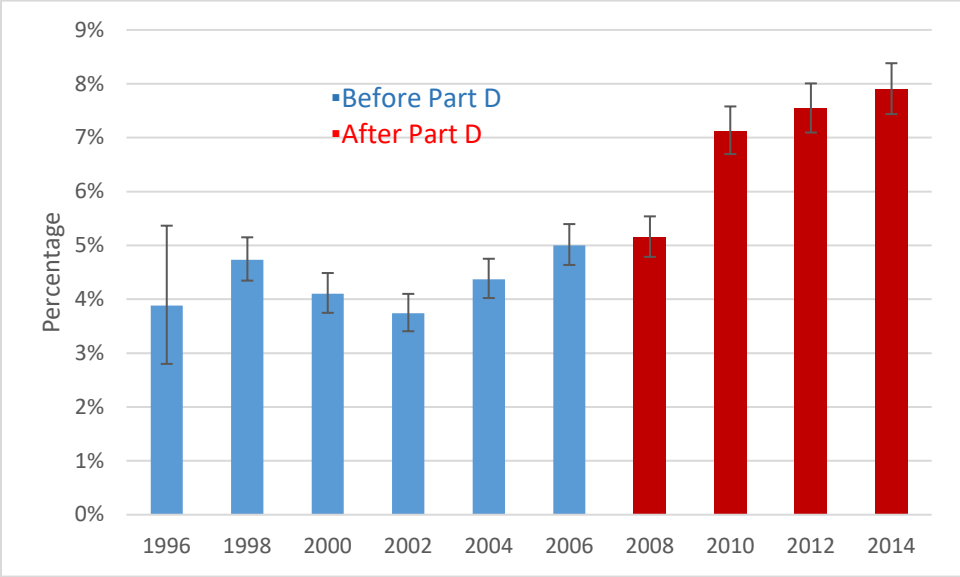
Note: *** p<0.01, ** p<0.05, *p<0.1

Figure 3.1: Unadjusted Prevalence Rates of Cost-related Medication Nonadherence (in Last Two Years) Among Seniors, 2002-2014



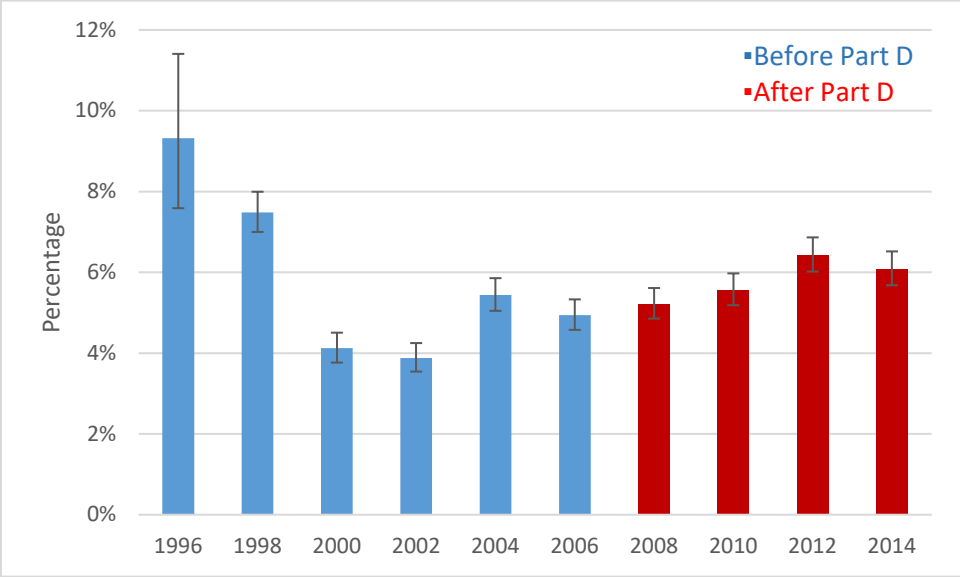
Note: Bars represent 95% confidence intervals
Sample Sizes: 10,000-12,000, varying by year

Figure 3.2: Unadjusted Prevalence Rates of Food Stamp Usage (in Last Two Years) Among Seniors, 1998-2014



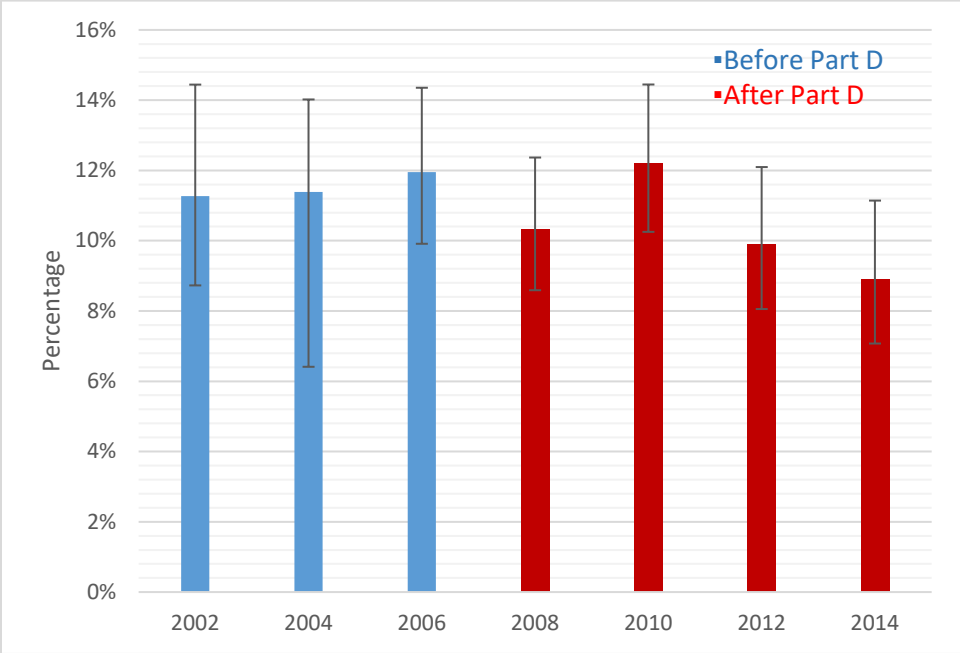
Note: Bars represent 95% confidence intervals
Sample Sizes: 1,000-14,000, varying by year

Figure 3.3: Unadjusted Prevalence Rates of Food Insecurity (Did Not Have Enough Money to Buy Food in Last Two Years) Among Seniors, 1996-2014



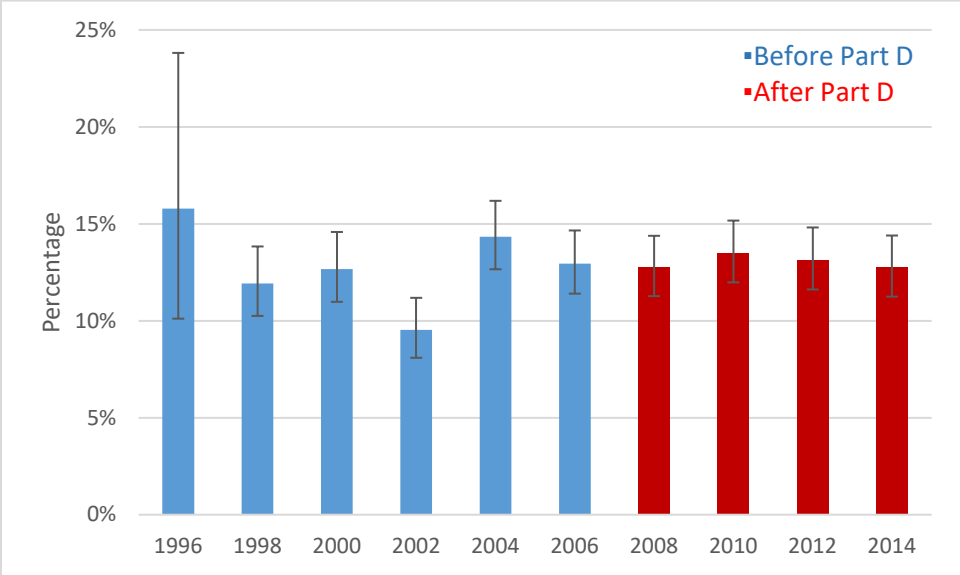
Note: Bars represent 95% confidence intervals
Sample Sizes: 1,000-14,000, varying by year

Figure 3.4: Unadjusted Prevalence Rates of Cost-related Medication Nonadherence (in Last Two Years) Among Black Seniors, 2002-2014



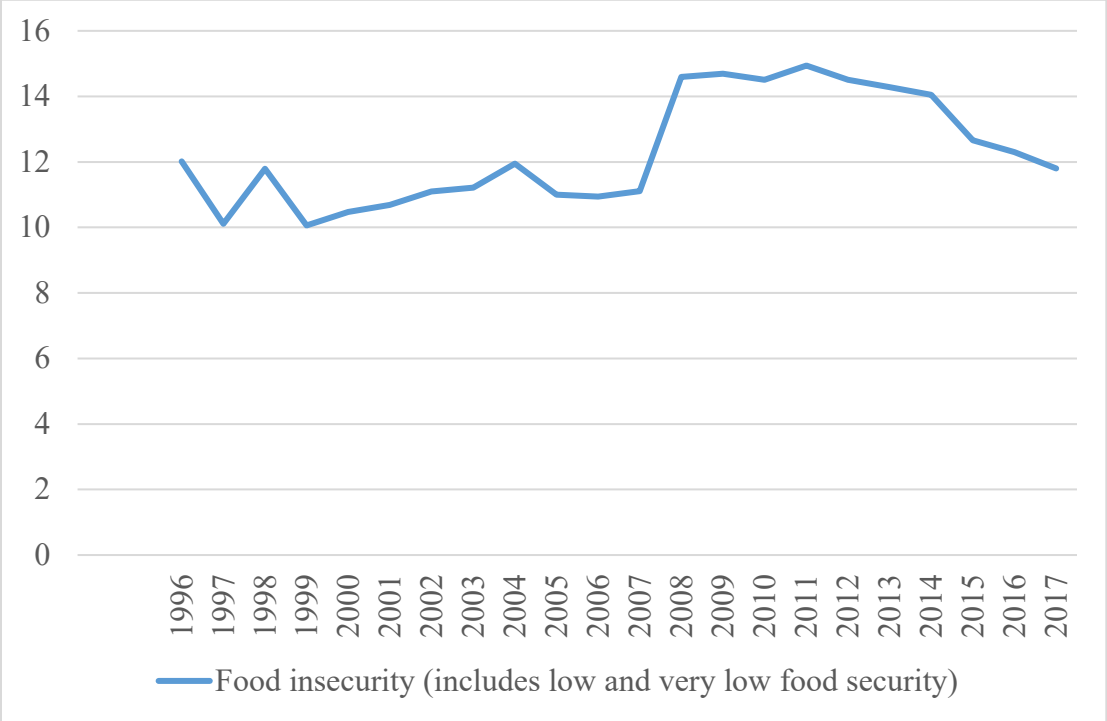
Note: Bars represent 95% confidence intervals
Sample Sizes: 300-1,000 varying by year

Figure 3.5: Unadjusted Prevalence Rates of Food Insecurity (Did Not Have Enough Money to Buy Food in Last Two Years) Among Black Seniors, 1996-2014



Note: Bars represent 95% confidence intervals. No observations were available in 1996. Sample Sizes: 100-2,000 varying by year

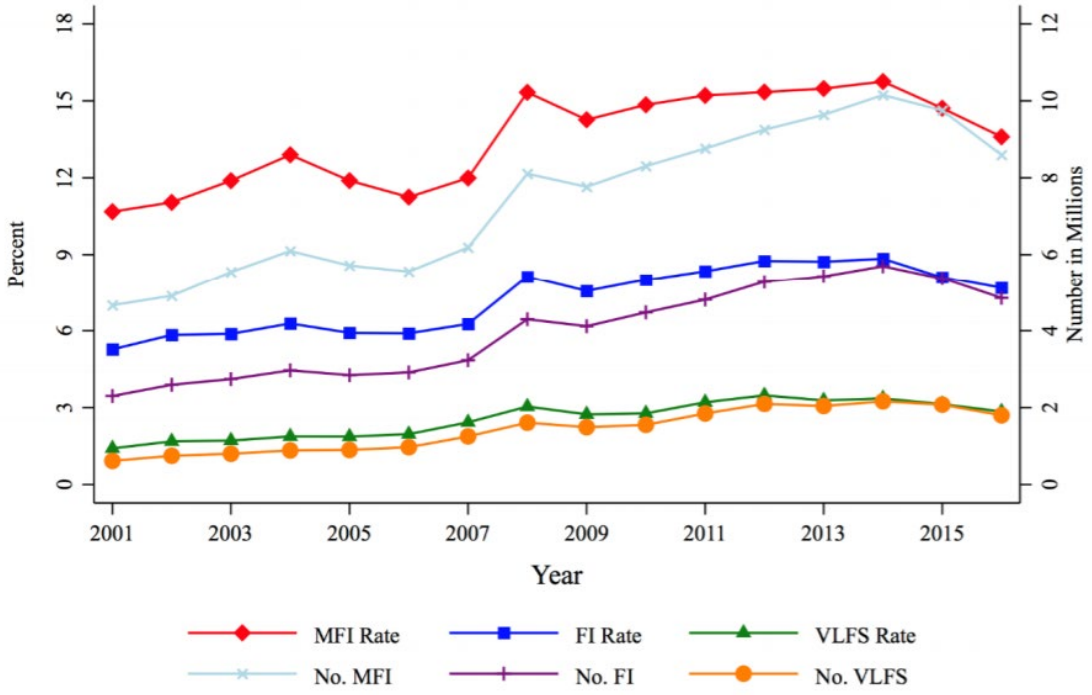
Figure 3.6: Trends in Food Insecurity for Total U.S. Population



Source: USDA, Economic Research Service, using data from the Current Population Survey Food Security Supplement. Based on data published in Coleman-Jensen et al. (2018).

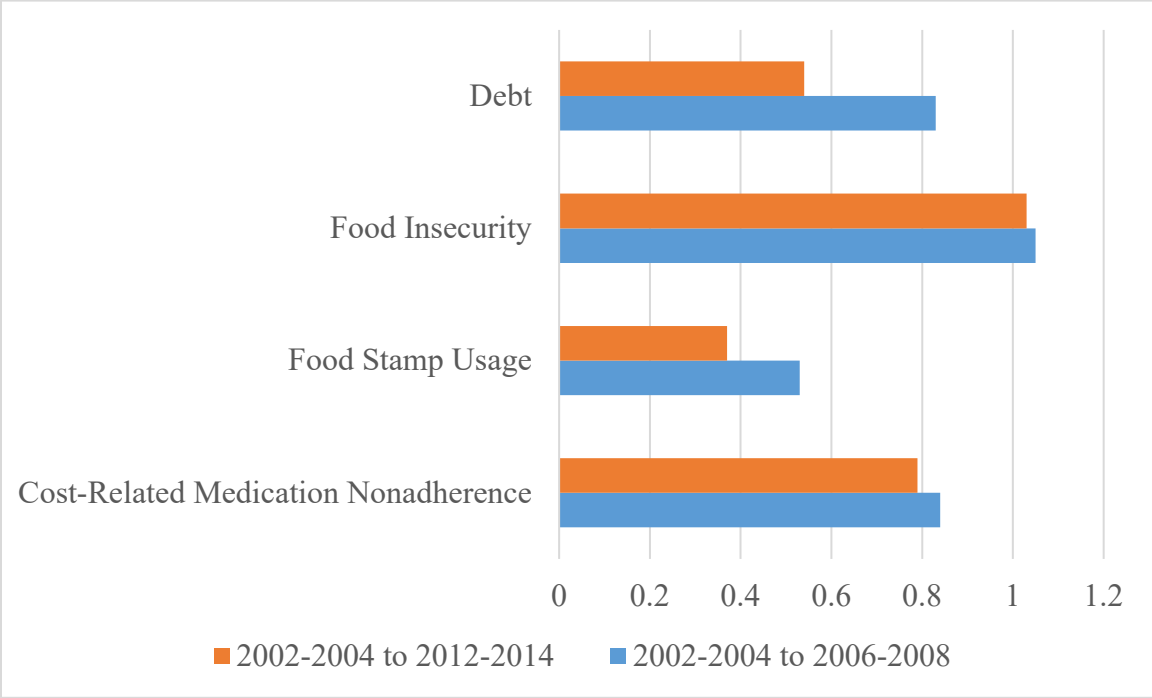
Notes: Prevalence rates for 1996 and 1997 were adjusted for the estimated effects of differences in data collection screening protocols used in those years. Food-insecure households include those with low food security and very low food security. Food insecure is defined as "at times during the year, these households were uncertain of having, or unable to acquire, enough food to meet the needs of all their members because they had insufficient money or other resources for food"; low food security is defined as "these food-insecure households obtained enough food to avoid substantially disrupting their eating patterns or reducing food intake by using a variety of coping strategies, such as eating less varied diets, participating in Federal food assistance programs, or getting emergency food from community food pantries"; and very low food security is defined as "in these food-insecure households, normal eating patterns of one or more household members were disrupted and food intake was reduced at times during the year because they had insufficient money or other resources for food."

Figure 3.7: Trends in Food Insecurity Among Senior Americans (Over Age 60)



Source: Ziliak and Gundersen (2018), used with permission from the authors. Data from the Current Population Survey (CPS), Food Security Supplement (FSS).
Notes: MFI Rate looks at percent of households reporting marginal food insecurity, FI Rate looks at percent of households reporting food insecurity, and VLFS Rate looks at percent of households reporting very low food security. No. MFI looks at the number of seniors in millions reporting marginal food insecurity, No. FI looks the number of seniors in millions reporting food insecurity, and No. VLFS looks the number of seniors in millions reporting very low food security. Marginal food insecurity is defined as one or more affirmative responses out of eighteen questions asking about difficulty affording food, food insecurity is defined as three or more affirmative responses, and very low food security is defined as eight or more affirmative responses in households with children or six or more affirmative responses in households without.

Figure 3.8: Ratio of Odds Ratios for the Financial Security of Seniors Before and After Medicare Part D



APPENDIX A: CHAPTER 1 APPENDIX

In order to create my variable for prescription drug coverage, I used a series of questions asked by the HRS about respondents' health insurance and prescription drug coverage. The survey uses the following pattern: first, asking if the respondent has a given type of health insurance, and then if that type of insurance has drug coverage or not. For years 2006-2014, the respondent is asked if they have drug coverage through an HMO/a Medicare Advantage Plan, Medicare Part D, "other" public source, or a private plan.

Because the question on drug coverage was only asked of people who first said they had some type of insurance, I defaulted to coding everyone who did not answer the questions as "zero" for no drug coverage. Here, I'm making the reasonable assumption that people who do not have health insurance also do not have prescription drug coverage. This allows me to obtain information on coverage for the entire sample.

One additional question concerning drug coverage was asked only of people who said "yes" to taking one of the following medications in a previous section on health: Blood pressure HBP meds; diabetes meds or insulin, heart attack angina meds or heart failure meds; stroke meds; and/or psychiatric meds. These people were asked first if they regularly took prescription medications, and second if their medications were completely covered by health insurance, mostly covered, only partially covered, or not covered at all by insurance. Most people answering this question were already asked about drug coverage when they were asked about insurance. However, a small portion of the uninsured (about four hundred) still reported having part of their drug costs covered despite not having insurance. These were likely to only have a small portion of their costs

covered through some type of drug discount program. Most minor programs that help the uninsured with medications do not greatly defray total costs. Thus, I only counted them as having coverage if they reported that all drug costs were covered, leaving those with only partial coverage and no insurance as not being covered. Those with partial drug coverage are too small in number to impact regression results.

In years 1996-2004, fewer questions were asked concerning drug coverage. Respondents were asked if they had coverage from Medicare, an HMO, Medigap, or a private plan. The respondents who reported using prescription medications were still asked if they regularly took prescription medications and if their medications were completely covered by health insurance, partly covered, or not covered. Once again, I counted only those completely covered as having prescription drug coverage.

Health insurance is constructed using the same variable tree. In the earlier years there is one question asking about health insurance, asking every respondent if they had it or not. In the later years I was able to obtain information on type of health insurance as well. Again, I defaulted to coding missing as zero because each health insurance question is asked only of those who don't have the previous kind of health insurance.

REFERENCES: FOR CHAPTER 1

Abaluck, Jason and Jonathan Gruber. 2011. "Choice Inconsistencies among the Elderly: Evidence from Plan Choice in the Medicare Part D Program." *The American Economic Review*. 101(4): 1180-1210.

Adams A.S., S.B. Soumerai, D. Ross-Degnan. 2001. "Use of Antihypertensive Drugs by Medicare Enrollees: Does Type of Drug Coverage Matter?" *Health Affairs (Millwood)*. 20(1): 276-86. < https://www.ncbi.nlm.nih.gov/pubmed/11194852>.

Afendulis, Christopher C., Yulei He, Alan M. Zaslavsky and Michael E. Chernew. 2011. "The Impact of Medicare Part D on Hospitalization Rates." *Health Services Research*. 46(4): 1022–1038. <http://onlinelibrary.wiley.com/doi/10.1111/j.1475-6773.2011.01244.x/abstract>.

Arias, Elizabeth. 2015. "United States Life Tables, 2011." *National Vital Statistics Reports*. 64(11). <http://www.cdc.gov/nchs/data/nvsr/nvsr64/nvsr64_11.pdf>.

---. 2010. "United States Life Tables, 2006." *National Vital Statistics Reports*. 58(21). <http://www.cdc.gov/nchs/data/nvsr/nvsr58/nvsr58_21.pdf>.

Beckett, Megan. 2000. "Converging Health Inequalities in Later Life-An Artifact of Mortality Selection?" *Journal of Health and Social Behavior*. 41(1): 106-119.

Brennan, Niall. 2000. "Health Insurance Coverage of the Near Elderly." *New Federalism National Survey of America's Families: An Urban Institute Program to Assess Changing Social Policies*. Series B, No. B-21. <http://www.urban.org/sites/default/files/alfresco/publication-pdfs/309612-Health-Insurance-Coverage-of-the-Near-Elderly.PDF>.

Briesacher, B.A., J.M. Madden. F. Zhang F, et al. 2015. "Did Medicare Part D affect national trends in health outcomes or hospitalizations? a time-series analysis." *Ann Intern Med*. 162(12): 825-833.

Chetty, Raj, Michael Stepner, Sarah Abraham, Shelby Lin, Benjamin Scuderi, Nicholas Turner, Augustin Bergeron, David Cutler. 2016. "Association Between Income and Life Expectancy in the United States, 2001-2014." *The Journal of the American Medical Association*. Published online April 10, 2016. <http://jama.jamanetwork.com/article.aspx?articleid=2513561>.

Congressional Budget Office. 2014. "Competition and the Cost of Medicare's Prescription Drug Program." <https://www.cbo.gov/publication/45552>.

---. 2016. "Medicare Baseline, March 2015." <https://www.cbo.gov/sites/default/files/51302-2016-03-Medicare.pdf>.

The Council of State Governments' Summation Report. 2001. "Prescription drug coverage for seniors." *Health Policy Forum*. <http://www.csg.org/knowledgecenter/docs/Conf0112HPFRxForSeniors.pdf>.

Currie, Janet and Jonathan Gruber. 1996. "Health Insurance Eligibility, Utilization of Medical care, and Child Health." *The Quarterly Journal of Economics*. 111(2): 431-466. <http://qje.oxfordjournals.org/content/111/2/431.short>.

DeNavas-Walt, Carmen, Bernadette D. Proctor, and Jessica C. Smith. 2013. "Income, Poverty, and Health Insurance Coverage in the United States: 2012." *Current Population Reports*. <https://www.census.gov/prod/2013pubs/p60-245.pdf>.

Donohue, Julia M. 2014. "The Impact and Evolution of Medicare Part D." *The New England Journal of Medicine*. 371: 693-695. <http://www.nejm.org/doi/full/10.1056/NEJMp1402471>.

Duggan, Mark. 2005. "Do New Prescription Drugs Pay for Themselves? The Case of Second-Generation Antipsychotics." *Journal of Health Economics*. 1-31.

Duggan, Mark and Fiona Scott Morton. 2010. "The Effect of Medicare Part D on Pharmaceutical Prices and Utilization." *American Economic Review*. 100(1): 590-607.

Dunn, Abe and Adam Hale Shapiro. 2015. "Does Medicare Part D Save Lives?" *Federal Reserve Bank of San Francisco Working Paper*. <http://www.frbsf.org/economic-research/files/wp2015-04.pdf>.

Engelhardt, Gary and Jonathan Gruber. 2011. "Medicare Part D and the Financial Protection of the Elderly." *American Economic Journal: Economic Policy*. 3(4): 77-102. <https://www.aeaweb.org/articles?id=10.1257/pol.3.4.77>.

Ericson, Keith. 2014. "Consumer Inertia and Firm Pricing in the Medicare Part D Prescription Drug Insurance Exchange." *American Economic Journal: Economic Policy*. 6(1): 38-64.

Federman, Alex D., Alyce S. Adams, Dennis Ross-Degnan, Stephen B. Soumerai, and John Z. Ayanian. 2001. "Supplemental Insurance and Use of Effective Cardiovascular Drugs Among Elderly Medicare Beneficiaries With Coronary Heart Disease." *The Journal of the American Medical Association*. 286(14): 1732-1739. <http://jamanetwork.com/journals/jama/fullarticle/194275>.

Flaer, Paul J. and Mustafa Z. Younis. 2008. "Medicare Part D: Access, Efficiency, and Costs." *Public Health Rep*. 123(2): 110. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2239341/>.

Finkelstein, Amy and Robin McKnight. 2007. "What did Medicare do? The initial impact of Medicare on mortality and out of pocket medical spending." *Journal of Public Economics*. 92(7): 1644–1668.

Gellad, W.F., J.S. Haas, and D.G. Safran. 2007. “Race/ethnicity and nonadherence to prescription medications among seniors: results of a national study.” *Journal of General Internal Medicine*. 22(11): 1572-8. <https://www.ncbi.nlm.nih.gov/pubmed/17882499>.

Goulding, Margie R. 2005. “Trends in Prescribed Medication Use and Spending by Older Americans, 1992-2001.” *CDC: Aging Trends No. 5*. <https://www.cdc.gov/nchs/data/ahcd/agingtrends/05medicine.pdf>.

Hamil-Luker, Jenifer and Angela M. O’Rand. 2007. “Gender Differences in the Link between Childhood Socioeconomic Conditions and Heart Attack Risk in Adulthood.” *Demography*. 44(1): 137-158.

Heisler, M., K.M. Langa, E.L. Eby, A.M. Fendrick, M.U. Kabeto, and J.D. Piette. 2004. “The Health Effects of Restricting Prescription Medication Use Because of Cost.” *Medical Care*. 42(7): 626-34. < https://www.ncbi.nlm.nih.gov/pubmed/15213486>.

Heiss, Florian, Adam Leive, Daniel McFadden, and Joachim Winter. 2013. “Plan selection in Medicare Part D: Evidence from administrative data.” *Journal of Health Economics*. 32(6): 1325–1344. <http://www.sciencedirect.com/science/article/pii/S0167629613000921>.

Heiss, Florian, Daniel McFadden, and Joachim Winter. 2010. “Mind the Gap! Consumer Perceptions and Choices of Medicare Part D Prescription Drug Plans.” *Research Findings in the Economics of Aging*, David A. Wise, ed. University of Chicago Press: 413-481. <http://www.nber.org/chapters/c8214>.

Holohan, John. 2004. “Health Insurance Coverage of the Near Elderly.” *The Kaiser Commission on Medicaid and the Uninsured*. <https://kaiserfamilyfoundation.files.wordpress.com/2013/01/health-insurance-coverage-of-the-near-elderly-report.pdf>

Hsu, John, Vicki Fung, Mary Price, Jie Huang, Richard Brand, Rita Hui, Bruce Fireman, Joseph P. Newhouse. 2008. “Medicare Beneficiaries' Knowledge of Part D Prescription Drug Program Benefits and Responses to Drug Costs.” *The Journal of the American Medical Association*. 299(16): 1929-1936. <http://jama.jamanetwork.com/article.aspx?articleid=181814>.

---, Mary Price, Jie Huang, Richard Brand, Vicki Fung, Rita Hui, Bruce Fireman, Joseph P. Newhouse, and Joseph V. Selby. 2006. “Unintended Consequences of Caps on Medicare Drug Benefits.” *The New England Journal of Medicine*. 354: 2349-2359. <http://www.nejm.org/doi/full/10.1056/NEJMsa054436>.

Huh, Jason and Julian Reif. 2017. “Did Medicare Part D Reduce Mortality?” *Journal of Health Economics.* 53: 17-37.

Jackson, J. Elizabeth, Mark P. Doescher, Barry G. Saver, and Paul Fishman. 2004. "Prescription Drug Coverage, Health, and Medication Acquisition Among Seniors With One or More Chronic Conditions." *Medical Care*. 42(11): 1056-1065. < http://journals.lww.com/lww-medicalcare/Abstract/2004/11000/Prescription_Drug_Coverage,_Health,_and_Medication.4.aspx>.

Karl, Jonathan, John King, Kathleen Koch, Louise Schiavone, Suzanne Malveaux and Ted Barrett. 2003. "Senate passes Medicare bill." *CNN*. November 25, 2003. Accessed June 7, 2019. <http://www.cnn.com/2003/ALLPOLITICS/11/25/elec04.medicare/index.html>.

Ketcham, Jonathan D. and Kosali Simon. 2008. "Medicare Part D's Effects on Elderly Drug Costs and Utilization." *NBER Working Papers 14326, National Bureau of Economic Research, Inc.* <https://www.nber.org/papers/w14326>.

Klein, Dawn, Carolyn Turvey, and Robert Wallace. 2004. "Elders Who Delay Medication Because of Cost: Health Insurance, Demographic, Health, and Financial Correlates." *The Gerontologist*. 44(6): 779-787. <http://gerontologist.oxfordjournals.org/content/44/6/779.short>.

Klein, John P. and Melvin L. Moeschberger. 2005. *Survival Analysis: Techniques for Censored and Truncated Data*. Berlin: Springer Science & Business Media.

Levy, Helen and David R. Weir. 2010. "Take-up of Medicare Part D: Results From the Health and Retirement Study." *The Journals of Gerontology, Series B, Psychological Sciences and Social Sciences.* 65B(4): 492–501. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4208729/>.

Lichtenberg, Frank R. and Shawn X. Sun. 2007. "The Impact of Medicare Part D on Prescription Drug Use by the Elderly." *Health Affairs*. 26(6): 1735-1744. <http://content.healthaffairs.org/content/26/6/1735.short>.

Lubitz, James, James Beebe, and Colin Baker. 1995. "Longevity and Medicare Expenditures." *The New England Journal of Medicine*. 332: 999-1003. <http://www.nejm.org/doi/full/10.1056/NEJM199504133321506>.

---, Liming Cai, Ellen Kramarow, and Harold Lentzner. 2003. "Health, Life Expectancy, and Health Care Spending among the Elderly." *The New England Journal of Medicine*. 349: 1048-1055. <http://www.nejm.org/doi/full/10.1056/NEJMsa020614>.

Lunn, Mary and Don McNeil. 1995. "Applying Cox Regression to Competing Risks." *Biometrics*. 51(2): 524-532. < http://www.jstor.org/stable/2532940>.

Maciejewski, Matthew L., Joel F. Farley, Richard A. Hansen, David Wei, and Jeffrey S. Harman. 2010. "Part D Plan Enrollment by Uninsured Medicare Beneficiaries." *Medical Care*. 48(2): 183-186. < http://journals.lww.com/lww-

medicalcare/Abstract/2010/02000/Part_D_Plan_Enrollment_by_Uninsured_Medicare.14.aspx>.

Mahmoudi, E. and G.A. Jensen. 2014. "Has Medicare Part D reduced racial/ethnic disparities in prescription drug use and spending?" *Health Services Research*. 49(2): 502-25. <https://www.ncbi.nlm.nih.gov/pubmed/24102408>.

March Current Population Survey 2012. "The Older Population in the United States: 2012." Accessed April 5 2016. <https://www.census.gov/population/age/data/2012.html>.

Martinez, Michael E. and Robin A. Cohen. 2013. "Health Insurance Coverage: Early Release of Estimates From the National Health Interview Survey, January–September 2012." *Centers for Disease Control and Prevention*. <http://www.cdc.gov/nchs/data/nhis/earlyrelease/insur201303.pdf>.

McWilliams, J. Michael, Alan M. Zaslavsky, Ellen Meara and John Z. Ayanian. 2004. "Health Insurance Coverage And Mortality Among The Near-Elderly." *Health Affairs*. 23(4): 223-233. <http://content.healthaffairs.org/content/23/4/223.full>.

"The Medicare Part D Prescription Drug Benefit: Fact Sheet." 2017. *The Henry J. Kaiser Family Foundation.* October 2 2017. Accessed November 20 2017. <https://www.kff.org/medicare/fact-sheet/the-medicare-prescription-drug-benefit-fact-sheet/>.

Morgan, Steve and Jae Kennedy. 2010. "Prescription Drug Accessibility and Affordability in the United States and Abroad." Commonwealth Fund, pub. 1408, Vol. 89. <http://www.commonwealthfund.org/~/media/Files/Publications/Issue%20Brief/2010/Jun/1408_Morgan_Prescription_drug_accessibility_US_intl_ib.pdf>.

Neuman, Patricia, and Juliette Cubanski. 2009. "Medicare Part D Update — Lessons Learned and Unfinished Business." *The New England Journal of Medicine*. 361: 406-414. <http://www.nejm.org/doi/full/10.1056/NEJMhpr0809949>.

Neuman, Patricia, Strollo, Michelle, Guterman, Stuart, Rogers, William, Li, Angela, Mae C. Rodday, Angie, and Gelb Safran, Dana. 2007. "Medicare Prescription Drug Benefit Progress Report: Findings From A 2006 National Survey Of Seniors." *Health Affairs (Project Hope).* 26: w630-43. <10.1377/hlthaff.26.5.w630.>

Oliver, Thomas R., Philip R. Lee, and Helene L. Lipton. 2004. "A Political History of Medicare and Prescription Drug Coverage." *Milbank Q*. 82(2): 283–354. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2690175/>.

O'Rand, Angela M. and Jenifer Hamil-Luker. 2005. "Processes of Cumulative Adversity: Childhood Disadvantage and Increased Risk of Heart Attack Across the Life Course." *The Journals of Gerontology*. Series B, Volume 60, Issue Special_Issue_2: S117–S124.

Poisal, John A. and Lauren Murray. 2001. “Growing Differences Between Medicare Beneficiaries With And Without Drug Coverage.” *Health Affairs*. 20(2): 74-85. <http://content.healthaffairs.org/content/20/2/74.short>.

Safran, Dana Gelb, Patricia Neuman, Cathy Schoen, Jana E. Montgomery, Wenjun Li, Ira B. Wilson, Michelle S. Kitchman, Andrea E. Bowen, and William H. Rogers. 2002. “Prescription Drug Coverage And Seniors: How Well Are States Closing The Gap?” *Health Affairs*. 21(Suppl1). <https://www.healthaffairs.org/doi/full/10.1377/hlthaff.w2.253>.

Saver, B.G., M.P. Doescher, J.E. Jackson, P. Fishman. 2004. “Seniors with chronic health conditions and prescription drugs: benefits, wealth, and health.” *Value Health*. 7(2):133-43. < https://www.ncbi.nlm.nih.gov/pubmed/15164803>.

Schur, Claudia L., Michelle M. Doty, and Marc L. Berk. 2004. “Lack of Prescription Coverage Among the Under 65: A Symptom of Underinsurance.” Commonwealth Fund Issue Brief. < http://www.commonwealthfund.org/~/media/files/publications/issue-brief/2004/feb/lack-of-prescription-coverage-among-the-under-65--a-symptom-of-underinsurance/schur_under65-pdf.pdf>.

Semilla, April P., Fang Chen, and Timothy M. Dall. 2015. “Reductions in Mortality Among Medicare Beneficiaries Following the Implementation of Medicare Part D.” *Am J Manag Care*. 21(9 Suppl): s165-71.

Shih, Weichung Joseph. 2002. “Problems in dealing with missing data and informative censoring in clinical trials.” *Current Controlled Trials in Cardiovascular Medicine.* 3:4. <http://www.biomedcentral.com/1468-6708/3/4>.

Sonnega, Amanda, Jessica D. Faul, Mary Beth Ofstedal, Kenneth M. Langa, John W.R. Phillips, and David R Weir. 2014. “Cohort Profile: the Health and Retirement Study (HRS).” *International Journal of Epidemiology*. 43(2): 576-585. <http://ije.oxfordjournals.org/content/43/2/576.full>.

Stolberg, Sheryl Gay. 2006. “In Speech to N.A.A.C.P., Bush Offers Reconciliation.” *The New York Times*. July 21, 2006. Accessed June 7, 2019. <https://www.nytimes.com/2006/07/21/washington/21bush.html>.

“Summary Health Statistics for U.S. Adults: National Health Interview Survey, 2012.” 2014. *Vital and Health Statistics*. 10(260). <http://www.cdc.gov/nchs/data/series/sr_10/sr10_260.pdf>.

Tavernise, Sabrina. 2016. “Black Americans See Gains in Life Expectancy.” May 8. *The New York Times.* A1. Accessed November 30 2017. <https://www.nytimes.com/2016/05/09/health/blacks-see-gains-in-life-expectancy.html>.

Waheed, Salman, Paulo H. M. Chaves, Julius M. Gardin and Jie Jane Cao. 2015. "Cardiovascular and Mortality Outcomes in the Elderly With Impaired Cardiac and Pulmonary Function: The Cardiovascular Health Study (CHS)." *Journal of the American Heart Association*. 4(12). <http://jaha.ahajournals.org/content/4/12/e002308.full>.

Woolston, Christopher. 2016. "What Are Your Odds of a Heart Attack?" February 28. *Health.com: Fitness, Nutrition, Tools, News, Health Magazine.* Accessed February 30 2018. <http://www.health.com/health/condition-article/0,,20188578,00.html>.

Wu, M.C. and K. Bailey. 1988. "Analysing changes in the presence of informative right censoring caused by death and withdrawal." *Statistical Medicine*. 7(1-2): 337-46. <https://www.ncbi.nlm.nih.gov/pubmed/3281208>.

Yin W, Basu A, Zhang JX, Rabbani A, Meltzer DO, Alexander GC. 2008. "The Effect of the Medicare Part D prescription benefit on drug utilization and expenditures." *Ann of Intern Med.* 148:169-177.

Zho, Chao and Yuting Zhang. 2012. "The Vast Majority Of Medicare Part D Beneficiaries Still Don't Choose The Cheapest Plans That Meet Their Medication Needs." *Journal of Health Affairs*. 31(10): 2259-2265. <http://content.healthaffairs.org/content/31/10/2259.short>.

REFERENCES: FOR CHAPTER 2

Abaluck, Jason and Jonathan Gruber. 2011. "Choice Inconsistencies among the Elderly: Evidence from Plan Choice in the Medicare Part D Program." *The American Economic Review*. 101(4): 1180-1210.

Adams A.S., S.B. Soumerai, D. Ross-Degnan. 2001. "Use of Antihypertensive Drugs by Medicare Enrollees: Does Type of Drug Coverage Matter?" *Health Affairs (Millwood)*. 20(1): 276-86. < https://www.ncbi.nlm.nih.gov/pubmed/11194852>.

Afendulis, Christopher C., Yulei He, Alan M. Zaslavsky and Michael E. Chernew. 2011. "The Impact of Medicare Part D on Hospitalization Rates." *Health Services Research*. 46(4): 1022–1038. <http://onlinelibrary.wiley.com/doi/10.1111/j.1475-6773.2011.01244.x/abstract>.

Alberini, Anna. 2005. "What Is a Life Worth? Robustness of VSL Values from Contingent Valuation Surveys." *Risk analysis: an official publication of the Society for Risk Analysis*. 25: 783-800. 10.1111/j.1539-6924.2005.00646.x.

Alberini, Anna, Maureen Cropper, Alan Krupnick, and Nathalie B. Simon. 2004. "Does the value of a statistical life vary with age and health status? Evidence from the US and Canada." *Journal of Environmental Economics and Management*. 48(1): 769-792.

Aldy, Joseph E. and W. Kip Viscusi. 2007. "Age Differences in the Value of Statistical Life: Revealed Preference Evidence." *Review of Environmental Economics and Policy*. 1(2): 241–260.

American Heart Association. 2017. "Cardiovascular Disease: A Costly Burden For America — Projections Through 2035." Accessed July 22 2019. <https://healthmetrics.heart.org/wp-content/uploads/2017/10/Cardiovascular-Disease-A-Costly-Burden.pdf>.

Andrews, Michelle. 2019. "Medicare's uncapped drug costs still bite into budgets." *The Philadelphia Inquirer*. Accessed April 5 2019. <https://www.philly.com/health/medicare-uncapped-drug-costs-still-bite-into-budgets-20190331.html>.

Arias, Elizabeth. 2015. "United States Life Tables, 2011." *National Vital Statistics Reports*. 64(11). <http://www.cdc.gov/nchs/data/nvsr/nvsr64/nvsr64_11.pdf>.

---. 2010. "United States Life Tables, 2006." *National Vital Statistics Reports*. 58(21). <http://www.cdc.gov/nchs/data/nvsr/nvsr58/nvsr58_21.pdf>.

Beckett, Megan. 2000. "Converging Health Inequalities in Later Life-An Artifact of Mortality Selection?" *Journal of Health and Social Behavior*. 41(1): 106-119.

Brennan, Niall. 2000. “Health Insurance Coverage of the Near Elderly.” *New Federalism National Survey of America’s Families: An Urban Institute Program to Assess Changing Social Policies*. Series B, No. B-21. <http://www.urban.org/sites/default/files/alfresco/publication-pdfs/309612-Health-Insurance-Coverage-of-the-Near-Elderly.PDF>.

Briesacher, B.A., J.M. Madden. F. Zhang F, et al. 2015. “Did Medicare Part D affect national trends in health outcomes or hospitalizations? a time-series analysis.” *Ann Intern Med*. 162(12): 825-833.

Card, David, Carlos Dobkin, and Nicole Maestas. 2008. “The Impact of Nearly Universal Insurance Coverage on Health Care Utilization: Evidence from Medicare.” *American Economic Review*. 98(5): 2242-58.

Chen, Jie, John A. Rizzo, and Alexander N. Ortega. 2011. “Racial and Ethnic Differences in Drug Expenditures and Access under Medicare Part D.” *Journal of Health Care for the Poor and Underserved*. 22(3): 1059. <https://muse.jhu.edu/article/447872/summary>.

Chetty, Raj, Nathaniel Hendren, Maggie R. Jones, and Sonya R. Porter. 2018. “Race and Economic Opportunity in the United States: An Intergenerational Perspective.” Equality of Opportunity Project. < http://www.equality-of-opportunity.org/assets/documents/race_paper.pdf>.

Chetty, Raj, Michael Stepner, Sarah Abraham, Shelby Lin, Benjamin Scuderi, Nicholas Turner, Augustin Bergeron, David Cutler. 2016. “Association Between Income and Life Expectancy in the United States, 2001-2014.” *The Journal of the American Medical Association*. Published online April 10, 2016. <http://jama.jamanetwork.com/article.aspx?articleid=2513561>.

Congressional Budget Office. 2014. “Competition and the Cost of Medicare’s Prescription Drug Program.” <https://www.cbo.gov/publication/45552>.

---. 2016. “Medicare Baseline, March 2015.” <https://www.cbo.gov/sites/default/files/51302-2016-03-Medicare.pdf>.

The Council of State Governments’ Summation Report. 2001. “Prescription drug coverage for seniors.” *Health Policy Forum*. <http://www.csg.org/knowledgecenter/docs/Conf0112HPFRxForSeniors.pdf>.

Cubanski, Juliette, Tricia Neuman, and Anthony Damico. 2018. “Closing the Medicare Part D Coverage Gap: Trends, Recent Changes, and What’s Ahead.” *The Henry J. Kaiser Family Foundation*. Accessed April 8 2019. <https://www.kff.org/medicare/issue-brief/closing-the-medicare-part-d-coverage-gap-trends-recent-changes-and-whats-ahead/>.

Cunningham, Peter J. 2005. “Medicaid Cost Containment And Access To Prescription Drugs.” *Health Affairs*. 24(3). <https://www.healthaffairs.org/doi/full/10.1377/hlthaff.24.3.780>.

Currie, Janet and Jonathan Gruber. 1996. “Health Insurance Eligibility, Utilization of Medical care, and Child Health.” *The Quarterly Journal of Economics*. 111(2): 431-466. <http://qje.oxfordjournals.org/content/111/2/431.short>.

Cutler, D. M. 2004. “Your money or your life: Strong medicine for America’s health care system.” Oxford University Press.

Dall, Timothy M., Tericke D. Blanchard, Paul D. Gallo, and April P. Semilla. 2013. “The economic impact of Medicare Part D on Congestive Heart Failure.” *The American Journal of Managed Care.* 19(6).

DeNavas-Walt, Carmen, Bernadette D. Proctor, and Jessica C. Smith. 2013. “Income, Poverty, and Health Insurance Coverage in the United States: 2012.” *Current Population Reports*. <https://www.census.gov/prod/2013pubs/p60-245.pdf>.

Donohue, Julia M. 2014. “The Impact and Evolution of Medicare Part D.” *The New England Journal of Medicine*. 371: 693-695. <http://www.nejm.org/doi/full/10.1056/NEJMp1402471>.

Donohue, Julie M., Yuting Zhang, Judith R.Lave, Walid F. Gellad, Aiju Men, Subashan Perera, and Joseph T. Hanlon. “The Medicare drug benefit (Part D) and treatment of heart failure in older adults.” 2010. *American Heart Journal*. 160(1): 159-165.

Duggan, Mark. 2005. “Do New Prescription Drugs Pay for Themselves? The Case of Second-Generation Antipsychotics.” *Journal of Health Economics*. 1-31.

Duggan, Mark and Fiona Scott Morton. 2010. “The Effect of Medicare Part D on Pharmaceutical Prices and Utilization.” *American Economic Review*. 100(1): 590-607.

Dunn, Abe and Adam Hale Shapiro. 2017. “Does Medicare Part D Save Lives?” *American Journal of Health Economics.* 1-48.

Engelhardt, Gary and Jonathan Gruber. 2010. “Medicare Part D and the Financial Protection of the Elderly.” *American Economic Journal: Economic Policy*. 3(4): 77-102. <https://www.aeaweb.org/articles?id=10.1257/pol.3.4.77>.

Ericson, Keith. 2014. “Consumer Inertia and Firm Pricing in the Medicare Part D Prescription Drug Insurance Exchange.” *American Economic Journal: Economic Policy*. 6(1): 38-64.

“Explaining Health Care Reform: Key Changes to the Medicare Part D Drug Benefit Coverage Gap.” 2010. The Henry J. Kaiser Family Foundation. Accessed April 8

2019. <https://www.kff.org/health-reform/issue-brief/explaining-health-care-reform-key-changes-to/>.

Federman, Alex D., Alyce S. Adams, Dennis Ross-Degnan, Stephen B. Soumerai, and John Z. Ayanian. 2001. "Supplemental Insurance and Use of Effective Cardiovascular Drugs Among Elderly Medicare Beneficiaries With Coronary Heart Disease." *The Journal of the American Medical Association*. 286(14): 1732-1739. <http://jamanetwork.com/journals/jama/fullarticle/194275>

Finkelstein, Amy and Robin McKnight. 2007. "What did Medicare do? The initial impact of Medicare on mortality and out of pocket medical spending." *Journal of Public Economics*. 92(7): 1644–1668.

Frankenfield DL, Weinhandl ED, Powers CA, Howell BL, Herzog CA, and St Peter WL. 2012. "Utilization and Costs of Cardiovascular Disease Medications in Dialysis Patients in Medicare Part D." *American Journal of Kidney Diseases*. 59(5): 670-681.

Gellad, W.F., J.S. Haas, and D.G. Safran. 2007. "Race/ethnicity and nonadherence to prescription medications among seniors: results of a national study." *Journal of General Internal Medicine*. 22(11): 1572-8. <https://www.ncbi.nlm.nih.gov/pubmed/17882499>.

Goulding, Margie R. 2005. "Trends in Prescribed Medication Use and Spending by Older Americans, 1992-2001." *CDC: Aging Trends No. 5*. <https://www.cdc.gov/nchs/data/ahcd/agingtrends/05medicine.pdf>.

Hamil-Luker, Jenifer and Angela M. O'Rand. 2007. "Gender Differences in the Link between Childhood Socioeconomic Conditions and Heart Attack Risk in Adulthood." *Demography*. 44(1): 137-158.

Heckman, James J. and Yona Rubinstein. 2001. "The Importance of Noncognitive Skills: Lessons from the GED Testing Program." *The American Economic Review*. 91(2): 145-149.

Heisler, M., K.M. Langa, E.L. Eby, A.M. Fendrick, M.U. Kabeto, and J.D. Piette. 2004. "The Health Effects of Restricting Prescription Medication Use Because of Cost." *Medical Care*. 42(7): 626-34. < https://www.ncbi.nlm.nih.gov/pubmed/15213486>.

Heiss, Florian, Adam Leive, Daniel McFadden, and Joachim Winter. 2013. "Plan selection in Medicare Part D: Evidence from administrative data." *Journal of Health Economics*. 32(6): 1325–1344. <http://www.sciencedirect.com/science/article/pii/S0167629613000921>.

Heiss, Florian, Daniel McFadden, and Joachim Winter. 2010. "Mind the Gap! Consumer Perceptions and Choices of Medicare Part D Prescription Drug Plans." *Research*

Findings in the Economics of Aging, David A. Wise, ed. University of Chicago Press: 413-481. <http://www.nber.org/chapters/c8214>.

Holmes, Holly M., Ruili Luo, Joseph T. Hanlon, Linda S. Elting, Maria Suarez-Almazor, and James S. Goodwin MD. 2012. "Ethnic Disparities in Adherence to Antihypertensive Medications of Medicare Part D Beneficiaries." *American Geriatrics Society*. 60(7): 1298-1303.

Holohan, John. 2004. "Health Insurance Coverage of the Near Elderly." *The Kaiser Commission on Medicaid and the Uninsured*. <https://kaiserfamilyfoundation.files.wordpress.com/2013/01/health-insurance-coverage-of-the-near-elderly-report.pdf>

Hsu, John, Vicki Fung, Mary Price, Jie Huang, Richard Brand, Rita Hui, Bruce Fireman, Joseph P. Newhouse. 2008. "Medicare Beneficiaries' Knowledge of Part D Prescription Drug Program Benefits and Responses to Drug Costs." *The Journal of the American Medical Association*. 299(16): 1929-1936. <http://jama.jamanetwork.com/article.aspx?articleid=181814>.

---, Mary Price, Jie Huang, Richard Brand, Vicki Fung, Rita Hui, Bruce Fireman, Joseph P. Newhouse, and Joseph V. Selby. 2006. "Unintended Consequences of Caps on Medicare Drug Benefits." *The New England Journal of Medicine*. 354: 2349-2359. <http://www.nejm.org/doi/full/10.1056/NEJMsa054436>.

Huh, Jason and Julian Reif. 2017. "Did Medicare Part D Reduce Mortality?" *Journal of Health Economics.* 53: 17-37.

Jackson, J. Elizabeth, Mark P. Doescher, Barry G. Saver, and Paul Fishman. 2004. "Prescription Drug Coverage, Health, and Medication Acquisition Among Seniors With One or More Chronic Conditions." *Medical Care*. 42(11): 1056-1065. < http://journals.lww.com/lww-medicalcare/Abstract/2004/11000/Prescription_Drug_Coverage,_Health,_and_Medication.4.aspx>.

Jung, Kyoungrae, Roger Feldman and A. Marshall McBean. 2014. "Nonlinear Pricing in Drug Benefits and Medication Use: The Case of Statin Compliance in Medicare Part D." *Health Services Research*. 49(3). <http://www.hsr.org/hsr/abstract.jsp?aid=4933846683>.

Karaca-Mandic, Pinar, Tami Swenson, Jean M. Abraham, and Robert L. Kane. 2013. "Association of Medicare Part D Medication Out-of-Pocket Costs with Utilization of Statin Medications." *Health Services Research*. 48(4): 1311-1333.

Ketcham, Jonathan D. and Kosali Simon. 2008. "Medicare Part D's Effects on Elderly Drug Costs and Utilization." *NBER Working Papers 14326, National Bureau of Economic Research, Inc.* <https://www.nber.org/papers/w14326>.

Klein, Dawn, Carolyn Turvey, and Robert Wallace. 2004. "Elders Who Delay Medication Because of Cost: Health Insurance, Demographic, Health, and Financial Correlates." *The Gerontologist*. 44(6): 779-787. <http://gerontologist.oxfordjournals.org/content/44/6/779.short>.

Klein, John P. and Melvin L. Moeschberger. 2005. *Survival Analysis: Techniques for Censored and Truncated Data*. Berlin: Springer Science & Business Media.

Levy, Helen and David R. Weir. 2010. "Take-up of Medicare Part D: Results From the Health and Retirement Study." *The Journals of Gerontology, Series B, Psychological Sciences and Social Sciences.* 65B(4): 492–501. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4208729/>.

Lichtenberg, Frank R. and Shawn X. Sun. 2007. "The Impact of Medicare Part D on Prescription Drug Use by the Elderly." *Health Affairs*. 26(6): 1735-1744. <http://content.healthaffairs.org/content/26/6/1735.short>.

Lubitz, James, James Beebe, and Colin Baker. 1995. "Longevity and Medicare Expenditures." *The New England Journal of Medicine*. 332: 999-1003. <http://www.nejm.org/doi/full/10.1056/NEJM199504133321506>.

---, Liming Cai, Ellen Kramarow, and Harold Lentzner. 2003. "Health, Life Expectancy, and Health Care Spending among the Elderly." *The New England Journal of Medicine*. 349: 1048-1055. <http://www.nejm.org/doi/full/10.1056/NEJMsa020614>.

Lunn, Mary and Don McNeil. 1995. "Applying Cox Regression to Competing Risks." *Biometrics*. 51(2): 524-532. < http://www.jstor.org/stable/2532940>.

Maciejewski, Matthew L., Joel F. Farley, Richard A. Hansen, David Wei, and Jeffrey S. Harman. 2010. "Part D Plan Enrollment by Uninsured Medicare Beneficiaries." *Medical Care*. 48(2): 183-186. < http://journals.lww.com/lww-medicalcare/Abstract/2010/02000/Part_D_Plan_Enrollment_by_Uninsured_Medicare.14.aspx>.

Mahmoudi, E. and G.A. Jensen. 2014. "Has Medicare Part D reduced racial/ethnic disparities in prescription drug use and spending?" *Health Services Research*. 49(2): 502-25. <https://www.ncbi.nlm.nih.gov/pubmed/24102408>.

March Current Population Survey 2012. "The Older Population in the United States: 2012." Accessed April 5 2016. <https://www.census.gov/population/age/data/2012.html>.

Martinez, Michael E. and Robin A. Cohen. 2013. "Health Insurance Coverage: Early Release of Estimates From the National Health Interview Survey, January–September 2012." *Centers for Disease Control and Prevention*. <http://www.cdc.gov/nchs/data/nhis/earlyrelease/insur201303.pdf>.

McWilliams, J. Michael, Alan M. Zaslavsky, and Haiden A. Huskamp. 2011. "Spending for Elderly Adults With Limited Prior Drug Coverage." *The Journal of the American Medical Association*. 306(4):402-9. <https://www.researchgate.net/publication/51523492_Implementation_of_Medicare_Part_D_and_Nondrug_Medical_Spending_for_Elderly_Adults_With_Limited_Prior_Drug_Coverage>.

McWilliams, J. Michael, Alan M. Zaslavsky, Ellen Meara and John Z. Ayanian. 2004. "Health Insurance Coverage And Mortality Among The Near-Elderly." *Health Affairs*. 23(4): 223-233. <http://content.healthaffairs.org/content/23/4/223.full>.

"Measures of America." 2014. World Life Expectancy. Accessed April 10 2019. <https://www.worldlifeexpectancy.com/>.

"The Medicare Part D Prescription Drug Benefit: Fact Sheet." 2017. *The Henry J. Kaiser Family Foundation.* October 2 2017. Accessed November 20 2017. <https://www.kff.org/medicare/fact-sheet/the-medicare-prescription-drug-benefit-fact-sheet/>.

"Medicare Premiums: Rules For Higher-Income Beneficiaries." 2019. *Social Security Administration*. Publication No. 05-10536. Accessed July 21 2019. <https://www.ssa.gov/pubs/EN-05-10536.pdf>.

Miller, G. Edward, Jessica S. Banthin and Thomas M. Selden. 2008. "Prescription Drug Expenditures and Prescription Drug Expenditures and Healthcare Burdens in the Medicaid Population Healthcare Burdens in the Medicaid Population." *Agency for Healthcare Research and Quality*. Accessed April 8 2019. <http://www.ehcca.com/presentations/uninscong2/banthin_2e.pdf>.

Morgan, Steve and Jae Kennedy. 2010. "Prescription Drug Accessibility and Affordability in the United States and Abroad." Commonwealth Fund, pub. 1408, Vol. 89. <http://www.commonwealthfund.org/~/media/Files/Publications/Issue%20Brief/2010/Jun/1408_Morgan_Prescription_drug_accessibility_US_intl_ib.pdf>.

Neuman, Patricia, and Juliette Cubanski. 2009. "Medicare Part D Update — Lessons Learned and Unfinished Business." *The New England Journal of Medicine*. 361: 406-414. <http://www.nejm.org/doi/full/10.1056/NEJMhpr0809949>.

Neuman, Patricia, Strollo, Michelle, Guterman, Stuart, Rogers, William, Li, Angela, Mae C. Rodday, Angie, and Gelb Safran, Dana. 2007. "Medicare Prescription Drug Benefit Progress Report: Findings From A 2006 National Survey Of Seniors." *Health Affairs (Project Hope).* 26: w630-43. <10.1377/hlthaff.26.5.w630.>

O'Rand, Angela M. and Jenifer Hamil-Luker. 2005. "Processes of Cumulative Adversity: Childhood Disadvantage and Increased Risk of Heart Attack Across the Life Course." *The Journals of Gerontology*. Series B, Volume 60, Issue Special_Issue_2: S117–S124.

"An Overview of the Medicare Part D Prescription Drug Benefit." 2018. The Henry J. Kaiser Family Foundation. October 12. Accessed April 5 2019. <https://www.kff.org/medicare/fact-sheet/an-overview-of-the-medicare-part-d-prescription-drug-benefit/>.

Peters, Kimberley D., Kenneth D. Kochanek, M.A., and Sherry L. Murphy. 1998. "Deaths: Final Data for 1996." National Vital Statistics Reports. 47(9). <https://www.cdc.gov/nchs/data/nvsr/nvsr47/nvs47_09.pdf>.

Poisal, John A. and Lauren Murray. 2001. "Growing Differences Between Medicare Beneficiaries With And Without Drug Coverage." *Health Affairs*. 20(2): 74-85. <http://content.healthaffairs.org/content/20/2/74.short>.

Safran, Dana Gelb, Patricia Neuman, Cathy Schoen, Jana E. Montgomery, Wenjun Li, Ira B. Wilson, Michelle S. Kitchman, Andrea E. Bowen, and William H. Rogers. 2002. "Prescription Drug Coverage And Seniors: How Well Are States Closing The Gap?" *Health Affairs*. 21(Suppl1). <https://www.healthaffairs.org/doi/full/10.1377/hlthaff.w2.253>.

Saver, B.G., M.P. Doescher, J.E. Jackson, P. Fishman. 2004. "Seniors with chronic health conditions and prescription drugs: benefits, wealth, and health." *Value Health*. 7(2):133-43. < https://www.ncbi.nlm.nih.gov/pubmed/15164803>.

Schur, Claudia L., Michelle M. Doty, and Marc L. Berk. 2004. "Lack of Prescription Coverage Among the Under 65: A Symptom of Underinsurance." Commonwealth Fund Issue Brief. <http://www.commonwealthfund.org/~/media/files/publications/issue-brief/2004/feb/lack-of-prescription-coverage-among-the-under-65--a-symptom-of-underinsurance/schur_under65-pdf.pdf>.

Semilla, April P., Fang Chen, and Timothy M. Dall. 2015. "Reductions in Mortality Among Medicare Beneficiaries Following the Implementation of Medicare Part D." *Am J Manag Care*. 21(9 Suppl): s165-71.

Sharma, Alok, Monica Colvin-Adams, and Clyde W. Yancy. 2014. "Heart failure in African Americans: Disparities can be overcome." Cleveland Clinic Journal of Medicine. 81(5): 301-311. <http://www.abcardio.org/wp-content/uploads/2016/11/Yancy_Colvin.pdf>.

Shih, Weichung Joseph. 2002. "Problems in dealing with missing data and informative censoring in clinical trials." *Current Controlled Trials in Cardiovascular Medicine.* 3:4. <http://www.biomedcentral.com/1468-6708/3/4>.

Singletary, Michelle. 2013. "The truth about paying the Medicare Part D penalty." *The Washington Post*. Accessed April 5, 2019. <https://www.washingtonpost.com/business/the-truth-about-paying-the-medicare-part-d-penalty/2013/10/31/93287a2e-3e91-11e3-b6a9-da62c264f40e_story.html?utm_term=.4bc2dcefe0bf>.

Sonnega, Amanda, Jessica D. Faul, Mary Beth Ofstedal, Kenneth M. Langa, John W.R. Phillips, and David R Weir. 2014. "Cohort Profile: the Health and Retirement Study (HRS)." *International Journal of Epidemiology*. 43(2): 576-585. <http://ije.oxfordjournals.org/content/43/2/576.full>.

Strumpf, Eric. 2010. "Employer-sponsored health insurance for early retirees: impacts on retirement, health, and health care." *International Journal of Health Care Finance and Economics*. 10(2): 105–147.

Stuart, Bruce, Amy Davidoff, Mujde Erten, Stephen S Gottlieb, Mingliang Dai, Thomas Shaffer, Ilene H Zuckerman, Linda Simoni-Wastila, Lynda Bryant-Comstock, and Rahul Shenolikar. 2013. "How Medicare Part D Benefit Phases Affect Adherence with Evidence-Based Medications Following Acute Myocardial Infarction." *Health Services Research*. 48(6 Pt 1): 1960–1977. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3876395/>.

"Summary Health Statistics for U.S. Adults: National Health Interview Survey, 2012." 2014. *Vital and Health Statistics*. 10(260). <http://www.cdc.gov/nchs/data/series/sr_10/sr10_260.pdf>.

Tavernise, Sabrina. 2016. "Black Americans See Gains in Life Expectancy." May 8. *The New York Times.* A1. Accessed November 30 2017. <https://www.nytimes.com/2016/05/09/health/blacks-see-gains-in-life-expectancy.html>.

Waheed, Salman, Paulo H. M. Chaves, Julius M. Gardin and Jie Jane Cao. 2015. "Cardiovascular and Mortality Outcomes in the Elderly With Impaired Cardiac and Pulmonary Function: The Cardiovascular Health Study (CHS)." *Journal of the American Heart Association*. 4(12). <http://jaha.ahajournals.org/content/4/12/e002308.full>.

Watanabe, Jonathan H., Diane L. Chau, Jan D. Hirsch. 2018. "Federal and Individual Spending on the 10 Costliest Medications in Medicare Part D from 2011 to 2015." *Journal of the American Geriatrics Society*. <DOI: 10.1111/jgs.15443>.

Woolston, Christopher. 2016. "What Are Your Odds of a Heart Attack?" February 28. *Health.com: Fitness, Nutrition, Tools, News, Health Magazine.* Accessed February 30 2018. <http://www.health.com/health/condition-article/0,,20188578,00.html>.

Wu, M.C. and K. Bailey. 1988. "Analysing changes in the presence of informative right censoring caused by death and withdrawal." *Statistical Medicine*. 7(1-2): 337-46. <https://www.ncbi.nlm.nih.gov/pubmed/3281208>.

Yin W, Basu A, Zhang JX, Rabbani A, Meltzer DO, Alexander GC. 2008. "The Effect of the Medicare Part D prescription benefit on drug utilization and expenditures." *Ann of Intern Med.* 148:169-177.

Zhang, Yuting, Julie M. Donohue, Judith R. Lave, and Walid F. Gellad. 2010. “The Impact of Medicare Part D on Medication Treatment of Hypertension.” *Health Services Research*. 46(1p1): 185-198. <https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1475-6773.2010.01183.x>.

Zhang, Yuting, Judith R. Lave, Julie M. Donohue, Michael A. Fischer, Michael E. Chernew and Joseph P. Newhouse. 2010. “The Impact of Medicare Part D on Medication Adherence Among Older Adults Enrolled in Medicare-Advantage Products.” *Medical Care*. 48(5): 409-417. <https://www.jstor.org/stable/27798467>.

Zho, Chao and Yuting Zhang. 2012. “The Vast Majority Of Medicare Part D Beneficiaries Still Don’t Choose The Cheapest Plans That Meet Their Medication Needs.” *Journal of Health Affairs*. 31(10): 2259-2265. <http://content.healthaffairs.org/content/31/10/2259.short>.

REFERENCES: FOR CHAPTER 3

Abaluck, Jason and Jonathan Gruber. 2011. "Choice Inconsistencies among the Elderly: Evidence from Plan Choice in the Medicare Part D Program." *The American Economic Review*. 101(4): 1180-1210.

Basu, Anirban, Wesley Yin, and G. Caleb Alexander. 2010. "Impact of Medicare Part D on Medicare/Medicaid Dual-Eligible Beneficiaries' Prescription Utilization and Expenditures." *Health Services Research*. 45(1). <http://www.hsr.org/hsr/abstract.jsp?aid=45315306365>.

Bengle, Rebecca, Stephanie Sinnett, Tommy Johnson, Mary Ann Johnson, Arvine Brown and Jung Sun Lee. 2010. "Food Insecurity Is Associated with Cost-related medication nonadherence in Community-Dwelling, Low-Income Older Adults in Georgia." *Journal of Nutrition For the Elderly*. 2: 170-191.

Berkowitz, Seth A., Hilary K. Seligman, and Niteesh K. Choudhry. 2014. "Treat or Eat: Food Insecurity, Cost-related Medication Underuse, and Unmet Needs." *The American Journal of Medicine*. 127(4): 303-310.

Bhargava, Vibha, Jung Sun Lee, Rahul Jain, Mary Ann Johnson, and Arvine Brown. 2012. "Food Insecurity Is Negatively Associated with Home Health and Out-of-Pocket Expenditures in Older Adults." *The Journal of Nutrition*. <http://jn.nutrition.org/content/early/2012/08/28/jn.112.163220.full.pdf>.

Coleman-Jensen, Alisha, Christian A. Gregory, and Matthew P. Rabbitt. 2018. "Food Security in the U.S.: Key Statistics & Graphics." *USDA, Economic Research Service*. Accessed July 22 2019. <https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/key-statistics-graphics.aspx#trends>.

Ericson, Keith. 2014. "Consumer Inertia and Firm Pricing in the Medicare Part D Prescription Drug Insurance Exchange." *American Economic Journal: Economic Policy*. 6(1): 38-64.

Gellad, W.F., J.S. Haas, and D.G. Safran. 2007. "Race/ethnicity and nonadherence to prescription medications among seniors: results of a national study." *Journal of General Internal Medicine*. 22(11): 1572-8. <https://www.ncbi.nlm.nih.gov/pubmed/17882499>.

Gibson-Davis, Christina M. and E. Michael Foster. 2006. "A Cautionary Tale: Using Propensity Scores to Estimate the Effect of Food Stamps on Food Insecurity." *Social Service Review*. 80:1: 93-126.

Gregory, C., Rabbitt, M. and Ribar, D. 2013. "The Supplemental Nutrition Assistance Program and Food Insecurity." *University of Kentucky Center for Poverty Research Discussion Paper Series*, DP2013-10. Retrieved July 22 2019 from <http://www.ukcpr.org/Publications/DP2013-10.pdf.>

Heisler M, Langa KM, Eby EL, Fendrick AM, Kabeto MU, Piette JD. 2004. "The health effects of restricting prescription medication use because of cost." *Med Care*. 42(7):626-634.

Ho, P. Michael, David J. Magid, Susan M. Shetterly, Kari L. Olson, Thomas M. Maddox, Pamela N. Peterson, Frederick A. Masoudi, and John S. Rumsfeld. 2008. "Medication nonadherence is associated with a broad range of adverse outcomes in patients with coronary artery disease." *American Heart Journal.* 155(4): 772-779.

Kersey MA, Beran MS, McGovern PG, Biros MH, Lurie N. 1999. "The prevalence and effects of hunger in an emergency department patient population." *Acad Emerg Med*. 6(11):1109-1114.

Klein, Dawn, Carolyn Turvey, and Robert Wallace. 2004. "Elders Who Delay Medication Because of Cost: Health Insurance, Demographic, Health, and Financial Correlates." *The Gerontologist*. 44(6): 779-787. <http://gerontologist.oxfordjournals.org/content/44/6/779.short>.

Klesges, L M, M Pahor, R I Shorr, J Y Wan, J D Williamson, and J M Guralnik. 2001. "Financial difficulty in acquiring food among elderly disabled women: results from the Women's Health and Aging Study." *American Journal of Public Health*. 91(1): 68–75.

Lacro, J. P., Dunn, L. B., Dolder, C. R., Leckband, S. G., & Jeste, D. V. 2002. "Prevalence of and risk factors for medication nonadherence in patients with schizophrenia: A comprehensive review of recent literature." *The Journal of Clinical Psychiatry*. 63(10): 892-909.

Lee, Jung Sun. 2013. "Food Insecurity and Healthcare Costs: Research Strategies Using Local, State, and National Data Sources for Older Adults." *Advances in Nutrition: An International Review Journal*. 4: 42-50.

Madden, Jeanne M., Amy J. Graves, Dennis Ross-Degnan, Becky A. Briesacher, and Stephen B. Soumerai. 2009. "Cost-related medication nonadherence and Spending on Basic Needs Following Implementation of Medicare Part D." *JAMA*. 302(16): 1755–1756.

Millett C., Everett CJ, Matheson EM, Bindman AB, Mainous AG 3rd. 2010. "Impact of Medicare Part D on seniors' out-of-pocket expenditures on medications." *Arch Intern Med.* 170(15):1325-30. <https://www.ncbi.nlm.nih.gov/pubmed/20696956>.

Munger, Mark A., Benjamin W. Van Tassell, Joanne LaFleur. 2007. "Medication Nonadherence: An Unrecognized Cardiovascular Risk Factor." *Med. Gen. Med*. 9(3): 58.

Nelson, Karin, William Cunningham, Ron Andersen, Gail Harrison, and Lillian Gelberg. 2001. “Is Food Insufficiency Associated with Health Status and Health Care Utilization Among Adults with Diabetes?” *Journal of General Internal Medicine*. 16(6): 404–411.

Newhouse, Joseph P. and the Insurance Experiment Group. 1993. “Free for All? Lessons from the RAND Health Experiment.” Cambridge, Mass.: Harvard University Press.

Nielsen, Robert B., Steven Garasky, and Swarn Chatterjee. 2010. “Food Insecurity and Out-of-Pocket Medical Expenditures: Competing Basic Needs?” *Family and Consumer Sciences Research Journal*. 39(2): 137–151.

Nord, Mark, and Anne Maria Golla. 2009. “Does SNAP Decrease Food Insecurity? Untangling the Self-Selection Effect.” *Economic Research Report No. 85, U.S. Dept. of Agriculture, Economic Research Service*. Accessed July 22 2019. <https://ageconsearch.umn.edu/record/55955/>.

Nord, Mark, and Mark Prell. 2011. “Food Security Improved Following the 2009 ARRA Increase in SNAP Benefits.” *ERR-116, U.S. Department of Agriculture, Economic Research Service*. Accessed July 22 2019. <https://ageconsearch.umn.edu/record/262242/>.

Poppendieck, Janet. 2014. “Food Assistance, Hunger and the End of Welfare in the USA.” In: Riches G., Silvasti T. (eds), *First World Hunger Revisited*. Palgrave Macmillan, London.

Ratcliffe, Caroline, Signe-Mary McKernan, and Sisi Zhang. 2011. “How Much Does the Supplemental Nutrition Assistance Program Reduce Food Insecurity?” *American Journal of Agricultural Economics*. 93(4): 1082–1098.

Rowley, Laura. 2012. “Senior Poverty: Food Insecurity Rising Among Older Americans.” *The Huffington Post*. August 29 2012. Accessed November 20 2017. <https://www.huffingtonpost.com/2012/08/29/senior-poverty-hunger_n_1834583.html>.

Safran, Dana Gelb, Patricia Neuman, Cathy Schoen, Jana E. Montgomery, Wenjun Li, Ira B. Wilson, Michelle S. Kitchman, Andrea E. Bowen, and William H. Rogers. 2002. “Prescription Drug Coverage And Seniors: How Well Are States Closing The Gap?” *Health Affairs*. 21(Suppl1). <https://www.healthaffairs.org/doi/full/10.1377/hlthaff.w2.253>.

Saver, B.G., M.P. Doescher, J.E. Jackson, P. Fishman. 2004. “Seniors with chronic health conditions and prescription drugs: benefits, wealth, and health.” *Value Health*. 7(2):133-43. < https://www.ncbi.nlm.nih.gov/pubmed/15164803>.

Seligman, Hilary K., Barbara A. Laraia, and Margot B. Kushel. 2010. "Food Insecurity Is Associated with Chronic Disease among Low-Income NHANES Participants." *The Journal of Nutrition*. 140(2): 304-310.

Soumerai SB, Pierre-Jacques M, Zhang F, et al. 2006. "Cost-related medication nonadherence among the elderly and the disabled: a national survey one year before the Medicare drug benefit." *Arch Intern Med*. 166(17):1829-1835.

Strickhouser, Sara, James D. Wright, Ph.D., and Amy M. Donley. 2014. "Food Insecurity Among Older Adults." AARP Foundation. September 2014. Accessed January 2 2018. <https://www.aarp.org/content/dam/aarp/aarp_foundation/2015-PDFs/AF-Food-Insecurity-2015Update-Final-Report.pdf>.

"Supplemental Nutrition Assistance Program (SNAP): A Short History of SNAP." 2017. *United States Department of Agriculture: Food and Nutrition Service*. Last Updated November 28 2017. Accessed November 30 2017. <https://www.fns.usda.gov/snap/short-history-snap>.

Wellman, N.S., D.O. Weddle, S. Kranz, and C.T. Brain. 1997. "Elder Insecurities: Poverty, Hunger, and Malnutrition." *Journal of the American Dietetic Association*. (97)10: S120-S122.

Yen, Steven T., Margaret Andrews, Zhuo Chen and David B. Eastwood. 2008. "Food Stamp Program Participation and Food Insecurity: An Instrumental Variables Approach." *American Journal of Agricultural Economics*. 90(1): 117-132.

Zho, Chao and Yuting Zhang. 2012. "The Vast Majority Of Medicare Part D Beneficiaries Still Don't Choose The Cheapest Plans That Meet Their Medication Needs." *Journal of Health Affairs*. 31(10): 2259-2265. <http://content.healthaffairs.org/content/31/10/2259.short>.

Ziliak, James P. and Craig Gundersen. 2018. "The state of senior hunger in America 2016: An annual report." Prepared for Feeding America and the National Foundation to End Senior Hunger. University of Kentucky Center for Poverty Research. <http://ukcpr.org/sites/ukcpr/files/research-pdfs/State-of-Senior-Hunger-in-America-in-2016.pdf>.

VITA

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Education

Duke University
MA Economics, August 2014
Cumulative GPA: 3.29

Grinnell College
BA Economics, May 2011
Cumulative GPA: 3.78, Major GPA: 3.83

Sophia University (Tokyo, Japan): Study abroad (April 2010 - July 2010)

Courses Taught—Primary Instructor
University of Kentucky
Principles of Economics I: Microeconomic Principles
Economic and Business Statistics

Courses Assisted—Grading
University of Kentucky
Advanced Microeconomic Theory

Employment History
Research Assistant for Charles Courtemanche at University of Kentucky (Fall 2018)

Pathways Intern for Monica Saavoss at the Economic Research Service (Summer 2018)

Research Assistant for C. Eugene Steuerle at Urban Institute (June 2011 – June 2013)

Friends Journal Intern, Philadelphia, PA (Summer 2009)

Philadelphia Federal Reserve Community Affairs Intern (Summer 2008)

Research
"Does Medicare Part D Extend Lives?" working paper
"Did Medicare Part D Improve Racial Disparities in Healthcare?" working paper
"Medicare Part D and Financial Insecurity" working paper

Conference Talks
Does Medicare Part D Extend Lives?

- Centre College seminar series (Speaker: October 26, 2018)
- Kentucky Economic Association Conference (Speaker and Discussant: October 12, 2018)

— Ohio Association of Economists and Political Scientists Annual Meeting (Speaker and Award-Winner: September 21-22, 2018)

The Economics of Jane Austen's World Jane Austen Society of North America Annual General Meeting (Speaker: 2015)

University of Kentucky Economics Teaching Workshop (Attendee: 2015, 2016, 2017, 2018)

Academic Awards & Grants

Best Graduate Student Paper Award, Ohio Association of Economists and Political Scientists Annual Meeting (September 2018)

Three Minute Thesis competition finalist (2017, 2018)

Luckett Fellowship (Spring 2017, Fall 2018)

Schnatter Institute Fellowship (Fall 2017, Summer 2016)

Gatton Doctoral Fellowship (Spring 2016, Fall 2017)

Grinnell Trustee Scholarship

National Merit Finalist

Publications

Katherine Toran. "The Economics of Jane Austen's World." *Persuasions On-Line*. Vol. 36, No. 1, 2015.

Katherine Toran. "Tax Policy and Volunteer Labor." Issue Brief Number 5 for the Tax Policy and Charities Project. Washington, DC: The Urban Institute, 2014.

Julia Isaacs, Sara Edelstein, Heather Hahn, Katherine Toran, and C. Eugene Steuerle. *Kids' Share 2013: Federal Expenditures on Children in 2012 and Future Projections*. Washington, DC: The Urban Institute, 2013.

Joseph Rosenberg, C. Eugene Steuerle, and Katherine Toran. "What Does the Fiscal Cliff Deal Mean for Nonprofits?" Washington, DC: The Urban Institute, 2013.

Sara Edelstein, Julia Isaacs, Heather Hahn, and Katherine Toran. *How Do Public Investments in Children Vary with Age? A Kids' Share Analysis of Expenditures in 2008 and 2011 by Age Group.* Washington, DC: The Urban Institute, 2012.

Katherine Toran. "The Unrelated Business Income Tax." Issue Brief Number 4 for the Tax Policy and Charities Project. Washington, DC: The Urban Institute, 2013.

Joseph Rosenberg and Katherine Toran. "IRA Charitable Rollover." Issue Brief Number 1 for the Tax Policy and Charities Project. Washington, DC: The Urban Institute, 2012.

Julia Isaacs, Katherine Toran, Heather Hahn, Karina Fortuny, and C. Eugene Steuerle. *Kids' Share 2012: Report on Federal Expenditures on Children Through 2011*. Washington, DC: The Urban Institute, 2012.

Katherine Toran, Julia Isaacs, Heather Hahn, Karina Fortuny, and C. Eugene Steuerle. *Data Appendix to Kids' Share 2012*. Washington, DC: The Urban Institute, 2012.

Heather Hahn, Genevieve M. Kenney, Christine Coyer, and Katherine Toran. *Federal Health Expenditures on Children on the Eve of Health Reform: A Benchmark for the Future*. Washington, DC: The Urban Institute, 2012.

Tracy Vericker, Julia Isaacs, Heather Hahn, Katherine Toran, and Stephanie Rennane. *How Targeted Are Federal Expenditures on Children?: A Kids' Share Analysis of Expenditures by Income in 2009*. Washington, DC: The Urban Institute, 2012.

Jon M. Bakija, Joseph J. Cordes, Katherine Toran. “The Charitable Deduction: Economics vs. Politics.” Washington, DC: The Urban Institute, 2013.
Evelyn Brody, Mayra Marquez, and Katherine Toran. *The Charitable Property-Tax Exemption and PILOTs*. Washington, DC: The Urban Institute, 2012.
Joseph Rosenberg, Patrick Rooney, C. Eugene Steuerle, and Katherine Toran. *What's Been Happening to Charitable Giving Recently? A Look at the Data.* Washington, DC: The Urban Institute, 2011.
Katherine Toran. “Taxation in DC, The Unofficial 51st State.” *MetroTrends Blog*. February 7. Washington, DC: The Urban Institute, 2013.
Katherine Toran. “How Heavily Taxed is Your City?” *MetroTrends Blog*. November 8. Washington, DC: The Urban Institute, 2012.
Katherine Toran. “Voluntary Taxes in Providence, Rhode Island (Part 2 of 2).” *MetroTrends Blog*. August 15. Washington, DC: The Urban Institute, 2012.
Katherine Toran. “Payments in Lieu of Taxes - Fair Play or Extortion? (Part 1 of 2).” *MetroTrends Blog*. August 13. Washington, DC: The Urban Institute, 2012.
Katherine Toran. “Washington, DC: The Most Optimistic City?” *MetroTrends Blog*. September 10. Washington, DC: The Urban Institute, 2012.
Katherine Toran. “Quench: A One Act Play.” Produced at Grinnell College, Spring 2011.
Katherine Toran. “Dispelling some myths about Hiroshima.” *Friends Journal* 57.2 (2011): 30-31.
Katherine Toran. Four photo essays. *The Spectator*. Grinnell, IA: Grinnell College, 2010.