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Paper No: 2014-003

CESR-SCHAEFFER WORKING PAPER SERIES

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The Effects of Medicare on Medical Expenditure Risk and Financial Strain[*]

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February 10, 2014

Abstract

We estimate the current impact of Medicare on medical expenditure risk and financial strain. At age 65, out-of-pocket expenditures drop by 33% at the mean and 53% among the top 5% of spenders. The fraction of the population with out-of-pocket medical expenditures above income drops by more than half. Medical-related financial strain, such as problems paying bills, is dramatically reduced. Using a stylized expected utility framework, the gain from reducing out-of-pocket expenditures alone accounts for 18% of the social costs of financing Medicare. This calculation ignores the benefits of reduced financial strain and direct health improvements due to Medicare.

Keywords: Medicare, Health Insurance, Medical Expenditure Risk, Regression Discontinuity

JEL codes: I13

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[*] silvia.barcellos@usc.edu, mireille@uci.edu. This work was funded by the National Institute on Aging (NIA R21-AG044737), the Commonwealth Fund's Affordable Health Insurance Program, RAND's Center for the Study of Aging (NIA P30 AG012815), and USC's Resource Center for Minority Aging Research (NIA P30AG043073) and USC's Roybal Center for Financial Decision Making (NIA P30AG024962). We thank Mahshid Abir, M.D., Abby Alpert, Sanjay Arora, M.D., Maria Casanova, Eileen Crimmins, Mark Friedberg, M.D., Dana Goldman, Arie Kapteyn, Adriana Lleras-Muney, Michael Menchine, M.D., Kathleen Mullen, David Powell, James P. Smith, Neeraj Sood, Daniel Waxman, M.D., Julie Zissimopoulos and participants of the monthly USC Resource Center for Minority Aging Research (RCMAR) meetings, the Society of Econometrics annual summer meeting, the NBER Summer Institute Aging workshop, the All-California Labor Economics conference, and the European Conference on Household Finance for many helpful comments. Mikhail Zaydman provided excellent research assistance. All mistakes are our own.

I. Introduction

A key goal of health insurance is to protect individuals against the risk of large unexpected medical expenditures. This function is particularly important for seniors, as nearly half of lifetime medical expenses are incurred after age 65 (Alemayehu and Warner 2004). Simulations suggest that in 2009 an age 65 household had a 5 percent chance of lifetime medical expenditures over $310,000 and an average expenditure of almost $200,000 (Webb and Zhivan 2010). Given the potentially devastating financial consequences of a health shock, it is surprising that we have a relatively poor understanding of the protection health insurance, and in particular Medicare, offers against medical expenditure risk.

Existing studies of the risk protective effects of health insurance tend to focus on relatively young populations (Baicker et al 2013; Finkelstein et al 2012; Gross and Notowidigdo 2011; Mazumder and Miller 2013). These studies find important impacts on financial well-being but cannot address the potentially larger effects at older ages. Only a few studies focus on the medical expenditure risk protection afforded to seniors by Medicare. Those most similar in spirit to ours focus on its introduction in the 1960's or specific components of the program, such as Medicare Part-D. Finkelstein and McKnight (2008) show that within 5 years of its introduction, Medicare decreased out-of-pocket medical spending by 40% among those in the top quartile of spending.[1] Using a very different approach – a dynamic random utility model of the demand for health insurance – Khwaja (2010) concludes that the primary benefit of Medicare is insurance against high expenditures with smaller benefits in terms of improved health and longevity. Englehardt and Gruber (2011) study the introduction of

[1] Although not centrally focused on medical expenditure risk, McWilliams et al. (2007) uses propensity score methods to compare changes in a range of outcomes, including expenditures, for previously (before age 65) insured and uninsured beneficiaries. This paper finds that as the previously uninsured gain Medicare coverage at age 65, they have a significant differential decrease in the odds of incurring high out-of-pocket medical spending.

Part-D and find substantial reductions in out-of-pocket drug spending, concentrated among a small group of beneficiaries. The role of Medicare as a whole in reducing exposure to catastrophic medical spending and related financial stress remains poorly understood and even more so for the elderly today, who likely have much larger exposure to spending risk, given well-documented increases in medical costs and the near tripling of health spending as a share of GDP over the past 50 years (Gruber and Levy 2009).

To fill the gap in our knowledge, we estimate the recent impact of Medicare on expenditure risk and related financial stress among the young elderly (ages 65 to 80) relative to the near elderly (ages 50 to 64). This comparison lends itself to a credible research design – a regression discontinuity (RD) exploiting age-based eligibility for Medicare.[2] Because Medicare provides nearly universal health insurance coverage for those ages 65 and over, it creates a discontinuity in insurance coverage and generates "as good as random" assignment of coverage for individuals near the age-eligibility threshold.

The primary contribution of this paper is to combine (1) this highly credible RD research design with (2) high quality data to analyze the current impact of Medicare on medical expenditure risk and related financial strain. Although the age 65 RD strategy has been used to estimate the effects of Medicare on health care utilization and health outcomes (Card et al. 2008 and 2009), the current application is both novel and important for understanding the benefits and costs of Medicare, the second largest social insurance program in the United States. We use 15 years (1996-2010) of the Medical Expenditure Panel Survey (MEPS), a nationally representative dataset containing information on health insurance coverage, and total and out-of-pocket medical spending. Our

[2] The only other paper we know of that uses a RD strategy to estimate the effect of health insurance on medical expenditure risk is Shigeoka (2012), which analyses the effect of a patient cost-sharing program in Japan.

primary interest is data from the more recent period (2007-2010), which allows us to compare the contemporary costs and benefits of the Medicare program. To operationalize expenditure risk, we analyze changes in the observed *distribution* of out-of-pocket spending (excluding premiums since this is a cost that occurs with certainty, i.e. involves no risk). We also consider the share of the population with medical expenditures that exceed income.

To more fully investigate the impact of Medicare on financial well-being, we use measures of financial strain related to medical expenditures. Specifically, we use 3 waves (2003, 2007 and 2010) of the Health Tracking Household Survey (HTHS), a nationally representative survey that captures information on medical-related financial strain such as difficulty paying medical bills, the amount owed in medical bills, and contact with a collections agency as a result of these bills.

Ultimately, the impact of Medicare on medical expenditure risk and financial strain is an empirical matter. On the one hand, by providing coverage for previously uninsured individuals, Medicare might decrease exposure to medical-related financial risk. On the other hand, the transition to Medicare might increase exposure to medical expenditure risk for individuals who previously had generous employer sponsored health insurance, particularly those who lack retiree or other wrap-around Medicare coverage.[3] Therefore, we interpret our findings as capturing changes due to both the increase in coverage and the transition to a new benefits package, where no specific effect sign is predicted by economic theory.[4] In practice, however, since 90% of Medicare beneficiaries have very generous supplemental insurance (KFF 2010; Baicker and Levy 2012), the increase in coverage at age 65 combined with the effective (if not the default) benefits package likely reduces exposure to medical expenditure risk.

[3] In addition, if doctors overprovide expensive, high-tech care to insured patients (Wagstaff and Lindelow 2008), then medical expenditure risk could increase with coverage.
[4] Because Medicare affects two dimensions of insurance at age 65 – coverage and generosity – we cannot use an IV strategy.

Using the 2007-2010 MEPS data, we find that the distribution of out-of pocket spending shifts significantly to the left at age 65. For example, out-of-pocket expenditures (all in 2010 dollars) drop by 32% ($326) at the mean and by 53% ($1730) among the top 5% of medical spenders. The fraction of the population with out-of-pocket medical expenditures that exceed income drops by 54%, from a base of 7.4%. The declines are smaller, but still significant, if we consider the full 1996-2010 period: out-of-pocket spending at age 65 drops by almost 20% at both the mean ($209) and among the top 5% of medical spenders ($722). The larger impact of Medicare after 2006 is consistent with Englehardt and Gruber (2011), which finds an increase in risk protection due to the introduction of Medicare Part-D.

One potential concern in comparing out-of-pocket spending for those just under versus just over age 65 is that individuals may delay medical care and thus spending in anticipation of gaining Medicare coverage.[5] Although, as we show below, we find little evidence of deferral in our data (i.e., health care utilization is smooth across the age 65 threshold), "doughnut RD" estimates that exclude individuals right at this age threshold show that our results are robust to deferral of medical spending around age 65.[6] To the extent that we cannot account for deferral, this should bias our results against finding reductions in out-of-pocket medical spending due to Medicare.

The implication that Medicare offers substantial protection against large out-of-pocket health expenses is supported by analysis of self-reported financial strain. Using HTHS data, we find that the transition to Medicare at age 65 reduces the likelihood of reporting problems paying medical bills in the past 12 months (by 35%) and the amount owed in medical bills (by 33%). The likelihood of being

[5] Deferral or what looks like deferral could be caused by decreased treatment costs, increased income due to Medicare subsidies, and/or greater access to providers at age 65.
[6] Likewise, sensitivity analyses that focus on individuals with non-deferrable medical conditions show a similar pattern of results (available upon request).

contacted by collections agency about medical bills declines by 28% and borrowing to pay these bills declines by 35%.

To better interpret the economic significance of our expenditure risk estimates, we perform a welfare analysis, similar to Feldstein and Gruber (1995) and Finkelstein and McKnight (2008), that combines a stylized expected utility framework with the RD estimates of changes in the distribution of out-of-pocket medical spending at age 65. We find that the out-of-pocket expenditure risk protection afforded by Medicare translates into an average welfare gain that covers 18% of the program's social costs. This calculation does not include the stress benefits of reduced financial strain or any health benefits associated with transitioning to Medicare at age 65 (see Dobbie and Song 2013; Card et al. 2009).

II. Study Data

We use pooled data from the Medical Expenditure Panel Survey (MEPS), a nationally representative two-year rotating household panel containing information on health insurance coverage, and total and out-of-pocket medical spending. While our primary focus is on the most recent, post Part-D data, 2007-2010, we also use the full 15 years of data (1996-2010).

MEPS's main advantage is its high quality data on health care spending. The MEPS gathers detailed information about health care visits, hospital stays, prescription drug fills, other medical services, out-of-pocket expenses and sources of other payments (Stanton and Rutherford 2006). A provider component obtains follow-up data on payments by private insurance, Medicaid, Medicare and other sources.[7] Because MEPS is a household survey, it misses extreme spending by individuals in institutional settings (Aizcorbe et al. 2010, Zuvekas and Olin 2009). Since institutional spending is relatively low for those near age 65 (Federal

[7] Unfortunately, while the follow-up surveys supplement self-reported payment information, they do not update self-reported utilization (Zuvekas and Olin 2009). That is, the quantity of care from the household survey is taken as given and it is only expenditures that get updated/validated.

Interagency Forum on Aging-Related Statistics 2012), this omission may not be too problematic. Out-of-pocket spending, our primary interest, is quite accurate in the MEPS, with aggregate estimates understating the National Health Expenditure Accounts (NHEA) by only about 5.5% (Bernard et al 2012).[8] Sample sizes are relatively large – with about 7,000 to 9,000 individuals ages 50 to 80 in any given survey year. Finally, in the MEPS we can calculate age in quarters and thereby precisely estimate the age profiles of spending.

Our measure of financial risk from the MEPS – the distribution of out-of-pocket spending – provides only limited insight into medical-related financial stress. To gain additional insight into the financial well-being afforded by Medicare, we use restricted-access data from the Health Tracking Household Survey (HTHS), formerly the Community Tracking Survey, a nationally representative survey conducted by the Center for Studying Health System Changes. We use 3 waves of the HTHS -2003, 2007 and 2010 – that include information on health insurance, use of services and medical-related financial strain, such as difficulty paying medical bills and contact with a collection agency.[9] The restricted data allow us to analyze reports of the exact amount of medical bills owed (top-coded at $70,000).[10] Together these survey waves capture about 19,000 individuals ages 50-64 and 11,000 individuals ages 65-80. Unfortunately, the HTHS provides age only in years but despite this cruder measure, the visual analysis shows striking changes in financial strain at age 65.

Insurance Coverage and Generosity

We investigate the relationship between Medicare eligibility and health

[8] These comparisons adjust the NHEA to account for the MEPS sample frame, i.e., non-institutionalized households. Still some dispute how well the MEPS captures the *distribution* of out-of-pocket medical spending, with Hurd and Rohwedder (2009) treating it as the gold-standard and Marshall, McGarry and Skinner (2010) suggesting that the Health and Retirement Survey, which shows higher out-of-pocket spending in the right tail of the distribution, is more accurate.
[9] Earlier years of this survey do not ask directly about medical-related financial strain.
[10] The publicly available data categorizes the amounts into 4 bins, top-coded at $10,000.

insurance status in two main dimensions: coverage and generosity. Across both surveys, health insurance coverage is measured as an indicator for whether the respondent reported having any type of health insurance at any month during the year preceding the survey. In the MEPS, we measure health insurance generosity using an approach from the literature (Card et al. 2008) – an indicator for whether the respondent reported having two or more health insurance policies in the year preceding the survey. This measure, which says little about generosity prior to age 65, captures reported supplemental insurance coverage, which many consider overly generous since it not only provides additional benefits but often fully covers the high cost-sharing and deductibles in traditional Medicare (Baicker and Levy 2012).[11] The HTHS data ask explicitly about supplemental coverage, therefore we can better assess the extent to which individuals transition to a generous source of coverage at age 65.

Medical Expenditure Risk Measures

We use the empirical distribution of out-of-pocket spending in the MEPS to characterize medical expenditure risk. Although risk is fundamentally an ex-ante concept, the distribution of expenditure realizations is one way for an individual to understand the likelihood of facing extreme out-of-pocket costs. We measure changes in the distribution of out-of-pocket spending at age 65, including the mean, different percentiles and the share of total expenditures paid out-of-pocket. We also consider the share of the population with out-of-pocket expenses that exceed income, an unexplored measure of financial strain. The MEPS defines medical expenditures as the sum of direct payments for care, including out-of-pocket payments and payments by private insurance, Medicaid, Medicare, and

[11] Because it does not capture Medicare Advantage (MA), this measure is likely to underestimate the generosity of insurance benefits at age 65. In 2006, for example, the average net value of an MA plan exceeded traditional Medicare by $55 to $71 per month, depending on the plan type. See Merlis (2008) for details.

other sources. Payments for health insurance premiums and over-the-counter drugs are not included. All medical expenditures are adjusted for inflation using the medical care services (MCS) component of the Consumer Price Index (CPI) and expressed in 2010 dollars.[12] Results using the full CPI are very similar. All age-specific means are calculated taking into account survey design.

Financial Strain Measures

We use the HTHS to get at subjective measures of financial strain. All 3 waves of the HTHS ask respondents whether in the past 12 months they: 1) had any problems paying medical bills, 2) were contacted by a collections agency, 3) had to borrow because of problems paying medical bills or 4) had to take money out of savings because of these problems. In the last 2 survey waves, they ask respondents about the amount owed in medical bills, the event that caused medical bill problems (e.g., an illness, accident, medical test or surgical procedure) and whether the respondent filed or thought about filing for bankruptcy in the past 12 months. In general, the rate of bankruptcy filing or thoughts of filing are too low to provide meaningful information. Therefore we focus on items (1)-(4) and on changes in the amount owed in medical bills.[13]

III. Empirical Strategy: Regression Discontinuity Design

To understand the impact of health insurance on medical expenditure risk and financial strain, we would, in principle, estimate the following reduced-form equation:

$$m_i = \alpha + f(age_i; \lambda) + \beta I_i + X_i \delta + \varepsilon_i \quad (1)$$

where m_i is a measure of medical-related financial exposure (e.g. out-of-pocket spending or difficulty paying medical bills) for individual i; X_i is a set of

[12] For details of the MCS, see http://www.bls.gov/cpi/cpifact4.htm

[13] In ongoing work, we are collecting primary data on individual perceptions of medical expenditure risk as well as reports of ability to make these expenditures.

demographics characteristics of individual i; $f(age_i;\lambda)$ is a smooth function representing the age profile of outcome m_i; I_i is an indicator for whether individual i has health insurance coverage and ε_i is an unobserved error. A fundamental and well-known problem in interpreting β as the causal effect of health insurance on medical expenditure risk is that coverage is endogenous; it both affects and is affected by financial risk, confounding observational comparisons of people with different insurance status.

To circumvent this problem, we exploit the age 65 threshold for Medicare eligibility as a credible source of exogenous variation in insurance status. We adopt a RD design, taking advantage of the fact that individuals just above or below age 65 (e.g., 64 or 66) should be similar on observable and unobservable characteristics that affect medical expenditure risk – that is, these characteristics should have smooth age profiles. This strategy relies on the fact that in the absence of Medicare our outcomes of interest should not change discontinuously at 65; therefore any estimated discontinuities are attributed to Medicare. This age 65 Medicare RD offers a well-established research design, albeit one that has been used largely to understand the impact of Medicare on health care use, diagnoses, mortality, and job lock (e.g., see Card et al. 2008; Card et al. 2009; Fairlie et al. 2012; Kadiyala and Strumpf 2012). As discussed above, because those who had health insurance prior to transitioning on to Medicare experience some change in their benefits package, the analysis will capture a weighted average effect due to the increase in insurance coverage and the change in benefits package at age 65.

Formally, health insurance coverage can be summarized by:

$$I_i = \gamma + g(age_i;\mu) + \pi T_i + X_i\varphi + \upsilon_i \tag{2}$$

where coverage depends on individual characteristics, a smooth function of age and an indicator T_i for age 65 or older, due to Medicare eligibility. Combining equations (2) and (1) the resulting reduced form model for outcome m_i is

$$m_i = \omega + h(age_i;\rho) + \tau T_i + X_i\theta + u_i \tag{3}$$

where $\omega = \alpha + \beta\gamma$; $h(age_i;\rho) = f(\cdot) + \beta g(\cdot)$ and $\tau = \beta\pi$.[14] Assuming the age profiles $f(\cdot)$ and $g(\cdot)$ are both continuous at age 65, any discontinuities in m_i at that age can be attributed to discontinuities in insurance. In other words, if we assume that the age profiles of financial risk are continuous at age 65 in the absence of Medicare's age-based eligibility rule, then, once we empirically control for such profiles, any estimated discontinuity in our risk measures can be attributed to discontinuities in Medicare coverage. Using the MEPS and the HTHS, we show below that the rate of insurance coverage rise discontinuously at age 65. This discontinuity in coverage at age 65 will enable us to estimate the reduced form effect of Medicare on financial risk protection. The magnitude of this effect τ depends on the size of the insurance changes at age 65, π, and the causal effect of insurance on m_i, β.[15]

Equation (3) is our main estimating equation. We allow the age profiles, $h(age_i;\rho)$, to vary on either wise of the age 65 cutoff. For analyses of insurance coverage, mean out-of-pocket spending, the share of total spending paid out-of-pocket, and reports and sources of medical bill problems, we use Ordinary Least Squares (OLS) regressions. To account for potential misspecification of the age-profiles, we adjust our standard errors to allow for an arbitrary correlation at the level of age in quarters in the MEPS or age in years in the HTHS (Lee and Card 2008). Analyses of different points in the distribution of out-of-pocket spending – e.g., spending at the median, 75th and 95th percentile – are estimated using quantile regressions. Standard errors for quantile models are estimated using an

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[14] Assuming covariate smoothness holds, an assumption we partially test, individual characteristics, X_i, are not needed but can be included to increase precision.

[15] The variable age is measured as a deviation from age 65, therefore τ can be interpreted as the discontinuous change on outcome m_i at age 65.

age-based block bootstrap, analogous to age-based clustering, that randomly samples with replacement the data within each age group and estimates the models on these random samples (Efron and Tibshirani 1994). When an age-block is randomly selected all respondents of this age are included in the estimation. The standard errors are then calculated simply as the standard deviation of the coefficient estimates from 500 bootstrap samples.

All regressions (OLS and quantile) employ survey weighting. In order to increase precision, we pool together several years of data. Importantly, the MEPS samples in most years are not completely independent because households are drawn from the same sample geographic areas and many people are in the sample for two consecutive years.[16] Despite this lack of independence, it is valid to pool multiple years of MEPS data and keep all observations in the analysis because each year of the MEPS is designed to be nationally representative.[17]

Other Changes at Age 65

A key assumption of the RD is that observable and unobservable characteristics that affect outcomes have a smooth age profile at the arbitrary threshold used for identification (age 65 for Medicare). An obvious concern in our context is employment, since 65 is a traditional age of retirement. Card et al. (2008) demonstrates that the estimated jumps in employment-related outcomes at age 65 are small in magnitude and statistically insignificant in both the NHIS and the March CPS. In the MEPS and HTHS, we find similar smoothness in employment and retirement rates,[18] educational attainment, family income and geographic location (Figures 1a-1b and Table 1).

[16] See MEPS-HC Methodology Reports for more details at http://www.meps.ahrq.gov.

[17] Bootstrapped standard errors that specify a common variance structure to reflect the complex sample design of the MEPS are generally smaller than those obtained from either clustering by age or the age-block bootstrap. Thus, we opt for a more conservative approach to inference.

[18] The retirement question in the MEPS measures the fraction that reports having ever retired from any job or business. It is asked only of those ages 55 and older. Given it is not conditional on ever working the question yields somewhat low fractions retired, even at older ages.

Across most outcomes, including the shares male, Hispanic and with less than a high school degree (see Table 1), we cannot reject zero discontinuity at age 65. An important exception in both the 2007-2010 MEPS and the HTHS is the share married, where we find a discontinuous increase at age 65. However, using the 2007-2010 March CPS we do not find a similar discontinuity in marriage at age 65 (available upon request). Across all 11 outcomes in the 2007-2010 MEPS, the change in marriage is the only outcome that is significantly different from zero. In the HTHS, we find a discontinuity in the share married, the share male and the share with less than a high school degree. However, as reflected by the F-statistic, the fit for this parametric model is poor: the coarseness of the data, which capture age in years instead of quarters, limits the parametric model fit. If we use the full 1996-2010 MEPS sample in order to maximize the power to detect discontinuities, we cannot reject the hypothesis of no discontinuity for any covariate, including the share married (see Appendix Figure 1 and Appendix Table 1). Given the general smoothness in the data, our analysis satisfies the continuity assumption of the RD design. And, as discussed below, controlling for marital status and, in the HTHS, gender and education, has little effect on our estimates. Thus, we attribute discrete changes in our measures of risk at age 65 to the change in Medicare eligibility at this age.

Sensitivity Checks

We test the sensitivity of our main estimates in several ways. First, we experiment with alternate specifications of the control function, i.e. the age-specific polynomials. While our main specification uses a quadratic in age, which seems to mimic the plots of the outcomes of interest reasonably well, specifications that employ linear or cubic age terms yield quite similar results. Second, we show that narrowing the age window to respondents 55 to 75 years old, and thereby limiting the contribution of observations far from the age-65

Medicare threshold, generates similar findings.

One concern in comparing the distribution of health spending above and below age 65 is that individuals may choose to defer some health spending until they become eligible for Medicare (or alternatively others with very generous insurance may schedule elective procedures prior to their transition to Medicare). Although some previous work demonstrates that hospitalizations increase once individuals transition to Medicare (Card et al. 2008), we find little evidence of deferred care in our sample as a whole, as shown in section IV. Moreover, an increase in health care utilization, particularly costly inpatient stays, at age 65 biases us against finding an effect of Medicare on financial risk protection. Since we might be underpowered to detect changes in utilization, however, we perform "doughnut-RD" estimates that drop observations right around age 65. Although we see no evidence of heaping, the typical rationale for the "doughnut-RD" (Barecca et al. 2011), this approach helps with potential deferral of medical care, since those right around age 65 are the most likely to defer care in anticipation of insurance coverage. These estimates are quite similar to our main results.[19]

IV. Results

Medicare Eligibility and Health Insurance Coverage and Generosity

Figure 2 shows the age profile of health insurance coverage and generosity for the MEPS sample and the HTHS sample. The figures also show smooth functions fitted to the data before and after age 65. As discussed above, Figure 2 demonstrates quite clearly that health insurance coverage rises discontinuously at age 65, from 87% to 99% in the MEPS and from 87 to 98% in the HTHS (see

[19] We have also performed analyses with a sample of those with unanticipated and non-deferrable health events in order to isolate the effect of Medicare on medical expenditure risk from any behavioral effect on the timing of elective care. These results show even larger risk-protective effects of Medicare (available upon request). Because we are interested in the risk-protective value of Medicare for the whole population and not simply those who had a bad health shock, this analysis is not presented here.

Table 2). Likewise, we find large increases in our measures of generosity at age 65. In the MEPS sample, the fraction covered by 2 or more plans increases by about 59 percentage points off a base of only 6 percent. In the HTHS, where we have a direct measure of supplemental coverage, the increase is 64 percentage points off a base of just 6.3 percent. Medicare Advantage and supplemental coverage (not shown) increase at age 65 by 67 percentage points off a base of 6.6 percent.[20] While still below the 90% supplemental coverage found in the Medicare Current Beneficiary Survey (KFF 2010), these figures suggest that most individuals transition to a generous package of insurance benefits at age 65. As shown in Table 2, all these increases at age 65 are statistically different from zero and stable across alternative specifications of the age polynomial. We will use this discontinuous change in coverage and generosity at age 65 to identify the effect of Medicare on medical expenditure risk and financial strain.

Total Spending and Utilization

Here we consider the change in total spending and utilization at age 65. As shown in Figure 3 and Table 3, total medical spending actually declines at age 65 by about $2200 or almost 35%. We find similar estimates if we use different age polynomials (Panels B and C), narrower age bands or doughnut RDs (Appendix Table 2). The 1996-2010 sample results imply a smaller but still significant decline of $850 or 14% (Appendix Table 3).

Importantly, the decline in total medical spending at age 65, which runs contrary to the idea of deferability assuming constant prices, does not appear to come from a change in utilization. Figure 3 and Table 3 show that the likelihood of a physician visit, an outpatient hospital visit or an inpatient stay is essentially unchanged at age 65. This is true across alternate specifications of the age

[20] Specifically, the HTHS allows us to look at Medicare plus a supplemental public or private plan or Medicare Advantage coverage. Restricting to just supplemental coverage, we still see a 64 percentage point increase in generosity off a base of 6.4% in the HTHS data (not shown).

polynomials (Panels B and C) and when we narrow the age window to 55 to 75 or perform donut RD estimates (Appendix Table 2). Likewise, we find no clear evidence to support a change in utilization at age 65 in the full 1996-2010 MEPS (Appendix Table 3). These conclusions are unchanged if we analyze the total number of visits or the log (or inverse hyperbolic sine) of visits (not shown for brevity). A key implication is that deferability may not be a big issue in the sample overall – a fact that is consistent with Card et al.'s (2008) findings for outpatient care, where changes in the likelihood of a doctor's visit at age 65 were on the order of 1 percentage point or 1.5% relative to the pre-65 mean.[21] Since we may be underpowered to detect deferability and, perhaps more importantly, Card et al. (2008) do find a 10% increase in hospitalizations that we do not find here, we conclude that to the extent such behavior exists it will cause us to underestimate the risk protective benefit of Medicare. Moreover, in section V below, we show that the moral hazard costs implied by the Card et al. (2008) estimates are small relative to the risk protection benefits of Medicare.

Medicare Eligibility and Medical Financial Risk Exposure

Next, we analyze changes in the distribution of out-of-pocket medical spending at age 65. Figure 4 presents the regression discontinuity graphs for different parts of the distribution of spending and Table 4 the corresponding RD estimates. We find a discontinuous drop of \$326 in mean of out-of-pocket spending at age 65, a drop of almost 33% relative to the mean prior to age 65. The sharp drop in out-of-pocket spending at age 65 increases as we move to higher percentiles of the distribution. At the median, the decline is small – roughly \$47. At the 75th percentile the decline is about \$210 or almost 18% relative to the pre-65 mean while at the 90th and 95th percentiles, the declines are \$865 (36%) and

[21] Another important implication is that changes in medical spending at age 65 may be driven by lower prices negotiated by Medicare. Since we do not observe the type (e.g., specialist vs. non-specialist) or content (e.g., test use) of care, we hesitate to draw this conclusion but note that this is an important area for further study.

$1730 (52%), respectively. Together with Figure 5, which shows all the RD centile estimates, these estimate imply that the effects of Medicare on out-of-pocket costs are concentrated at the top quartile of the spending distribution. As one might expect, Medicare offers risk protection through declines in high, catastrophic medical spending.

Also in Table 4 and illustrated in Figure 6 are the estimated changes in the share of total expenditures paid out-of-pocket and the share of the population with out-of-pocket spending that exceeds income at age 65. The share of spending paid out-of-pocket drops by approximately 2 percentage points or about 6% off the mean share of 33% below age 65, although this estimate is not statistically distinguishable from zero (Table 4). The share of the population with out-of-pocket expenditures that exceed income, a proxy for "catastrophic" out-of-pocket medical costs, drops precipitously –by more than 50%, from a pre-65 mean of 7.4% to 3.4% (Table 4).

Estimates using linear or cubic age trends (Panels B and C of Table 4) tend to straddle those from our preferred specification with quadratic age trends. With linear age trends, the declines in out-of-pocket spending are $255 (25%) at the mean and $843 (35%) and $1391 (37%) at the 90th and 95th percentiles, respectively. The decline in the share of spending paid out-of-pocket is statistically significant and almost 4 percentage points or 33%. Using cubic age trends, the declines in out-of-pocket spending are $349 (35%) at the mean and $1145 (48%) and $2091 (64%) at the 90th and 95th percentiles, respectively. The estimated decline in the share with out-of-pocket spending that exceeds income is just over 3 percentage points (or about 40%) in both specifications.

Estimates in Appendix Table 4 that control for marital status are virtually identical as are those in Appendix Table 5, based on the narrower age band (Panel A) or the doughnut RDs (Panels B-D). Estimates from the full 1996-2010 MEPS (Appendix Table 6 and Appendix Figure 4) are considerably smaller in magnitude. Using all 15 years of data, the estimated decline in out-of-pocket spending is only about two-thirds of the 2007-2010 decline at the mean and 55% of the 2007-2010 decline at the 90th percentile. The implied smaller effects prior to 2007 are consistent with Englehardt and Gruber (2011), which find that the introduction of Medicare Part-D in 2006 improved medical expenditure risk protection. Separately analyzing categories of spending and time periods, we find that about 41% ($69 of $169) of the larger decline in out-of-pocket spending in 2007-2010 relative to 1996-2006 is attributable to prescription drugs (available upon request).

Medicare Eligibility and Financial Strain

While the observed changes in out-of-pocket spending at age 65, particularly those at the right tail of the distribution, indicate that Medicare offers important risk-protection to seniors, the precise numbers are difficult to put into context. To provide further meaning to these changes, we use the HTHS to measure changes in self-reported measures of financial strain.

Figure 7 and the corresponding estimates in Table 5 show discontinuous changes at age 65 in reported problems paying medical bills, medical-bill related collections agency contact, borrowing to pay these bills and using savings to pay these bills. Prior to age 65, 17% of respondents report problems paying medical bills. At age 65, the fraction reporting problems declines by 6 percentage points or 35%. Estimates using linear or cubic age terms (in Panels B and C) suggest smaller declines in medical bill problems, although in both cases they are still sizeable. Estimates controlling for marital status, gender and education in Appendix Table 7 are also quite similar. Estimates using only respondents ages 55 to 75 or from the doughnut RDs in Appendix Table 8 are roughly the same as the main estimates or ever larger.

Consistent with the decline in perceived problems paying medical bills, the fraction being contacted by collection agencies about these bills declines by

2.8 percentage points or almost 30% off a base of 9.9%. The declines are a bit smaller (17-22%) using alternative polynomials but still meaningful in magnitude, while the narrower age band and doughnut RDs yield even larger declines (32-36%). The fraction borrowing to pay these bills declines by 2.9 percentage points (or 35% off a mean of 8.2%; significant at the 10% level). The fraction using savings to pay medical bills declines by 4 percentage points (or 38% off a mean of 10.5%; significant at the 1% level). Estimated declines in borrowing or using savings from the more restricted age group or from the doughnut RDs are quite similar to the main results and in many cases a bit larger.

Interpreting declines in the likelihood of borrowing or using savings to handle medical bills is somewhat difficult. The implications of borrowing to smooth consumption may be quite different from borrowing that depletes a retirement nest egg. Since we find large declines in the likelihood that individuals delay major purchases as a result of medical bills at age 65 (4 percentage points off a base of just 9% prior to age 65; see col (5), Table 5), these changes in borrowing and savings do not seem to reflect attempts to smooth consumption. However, more detail is needed to fully understand these patterns.

Finally, we analyze changes in the amount owed in medical bills (see Figure 8 and the last 3 columns of Table 5). Even though medical debt is a stock, the rate at which individuals acquire debt or at which existing debt grows can still change at age 65. We find a change at the mean on the order of \$120 off a base of \$936 owed in medical bills prior to age 65, but the estimate is too noisy to statistically distinguish from zero. At the 90th percentile, the change is more than 2.5 times larger or \$306, although this estimate is also quite imprecise. We also analyze the inverse hyperbolic sine, $IHS(Y) = \ln(Y + (Y^2+1)^{1/2})$, of the amount owed. This transformation is used because it is defined for zero owed and like the natural log yields a parameter that can be interpreted as an elasticity (Pence 2006). With this specification, we estimate a 33% percent decline in the amount owed in medical bills at age 65, further evidence that the estimated changes in out-of-pocket spending in the MEPS have meaningful impacts on medical liabilities faced by seniors. Using a cubic in age yields an almost identical decline (33%) while linear age trends yield a far smaller but still sizeable decline of 23% (Panels B and C). In contrast, estimates using the narrower age band or from the doughnut RDs (Appendix Table 8) indicate declines of about 40%. The larger doughnut RDs estimates may reflect the fact that deferred medical care should increase the likelihood of medical bill problems and amounts owed in medical bills and failing to account for such deferral will understate Medicare's protection against medical-related financial strain.

V. Welfare Gain from Reductions in Out of Pocket Expenditure Risk

To interpret the economic significance of the RD estimates of changes in out-of-pocket medical expenditures we use a stylized expected utility framework to simulate the insurance value of the estimated change in medical expenditure risk exposure associated with Medicare. This approach is similar to the one used by Feldstein and Gruber (1995), Finkelstein and McKnight (2008), Engelhardt and Gruber (2011) and Shigeoka (2012). It assumes a utility $u(c)$ where c is non-health consumption and a budget constraint of $c = y - m$, where y is income and m out-of-pocket expenditure. m is a random variable with probability density function $f(m)$ and support $[0, \overline{m}]$. $f(m)$ depends both on random health shocks and the nature of health insurance held (if any). Expected utility is given by

$$\int_0^{\overline{m}} u(y - m) f(m) dm \qquad (5)$$

To calculate the welfare change associated with Medicare, we compare an individual's risk premium (or certainty equivalence) under the pre- and post-65 spending distributions $f(m)$. Following the literature, $f(m)$ is based on the empirical distribution of medical spending in the MEPS. The risk premium (π) is the maximum amount that a risk averse individual would be willing to pay to completely insure against the random variable m:

$$u(y-\pi)=\int_0^{\bar{m}} u(y-m)f(m)\,dm \tag{6}$$

A decrease in risk exposure for the elderly relative to the near elderly due to Medicare would appear as a decline in the risk premium; this decline provides a dollar measure of the insurance value (and hence welfare gain) from Medicare coverage:

$$\Delta\pi=\pi^{post-65}-\pi^{pre-65}. \tag{7}$$

We use quantile estimates from (3) to simulate the expenditure distribution faced by individuals just below and above age 65 and to calculate the risk premium for both groups using (6). We focus on the results from the 2007-2010 sample in order to compare the contemporary costs and benefits of the program.[22]

As shown in Table 4 and Figure 4, Medicare shifts both the variance and mean level of out-of-pocket spending. However, the change in the mean of out-of-pocket spending for those just above relative to just below age 65 represents a transfer from the government to the insured and not a change in risk. To calculate a mean-preserving change in risk due to Medicare, we subtract out from the distribution of out-of-pocket spending at age 65 the mean reduction in out-of-pocket spending due to Medicare.

In practice, the computation of (7) is done as follows. First, we use the estimates of the parameters in (3), shown in Figure 5, to simulate for each

[22] This analysis carries the limitations of a static framework that ignores savings or borrowing to pay for a negative health shock and the idea that Medicare may affect savings and consumption decisions over the life cycle. Given that our estimates are cross-sectional – we don't take into account serially correlated health shocks, for example – the static framework is an appropriate simplification and allows us to compare our results to the existing literature.

individual i in the sample the conditional (on individual's characteristics X) quantiles (superscript j) of the out-of-pocket spending distribution pre-65 (without Medicare),

$$\widehat{m}_{i0}^{j} = \widehat{w}^{j} + X_i \widehat{\theta}^{j} \tag{8}$$

And post-65 (with Medicare):

$$\widehat{m}_{i1}^{j} = \widehat{m}_{i0}^{j} + \hat{\tau}^{j} \tag{9}$$

for i=1,.., N and j=1,...,99. The coefficients are estimated using 50-80 year-olds, but we focus on 64-66 year-olds for the prediction in order to better estimate the change in risk premium around the age 65 threshold. We set the very bottom of the distribution (j=0) equal to zero so that each person has 100 points of equal probability of occurrence in the out-of-pocket spending distribution. Following the literature, we truncate predicted out-of-pocket spending from below at zero and from above at 99% of individual income. We use this truncation because marginal utility goes to infinity as consumption goes to 0 in the CRRA model. Since out-of-pocket health spending can exceed income and, as discussed above, the share of such cases drops precipitously at age 65 (see Figure 5 and Table 4), this truncation underestimates the welfare value of Medicare.[23]

We calculate the risk premium without Medicare for each person using

$$U(y - \pi_{i0}) = \frac{1}{99} \cdot \sum_{j=1}^{99} U\left(y - \widehat{m}_{i0}^{j}\right) \tag{10}$$

where j indexes the quantile from the distribution. Similarly, the risk premium with Medicare for each person is

$$U(y - \pi_{i1}) = \frac{1}{99} \cdot \sum_{j=1}^{99} U\left(y - \widehat{m}_{i1}^{j} - \mu\right) \tag{11}$$

[23] Using larger truncations of 80% or 60% of income, as is done in the literature, further exacerbates this bias.

where μ is the estimate in Table 4 of the change in the mean out-of-pocket expenditures from Medicare ($326) for the 2007-2010 sample. Following the literature, we specify a constant relative risk aversion (CRRA) utility function, i.e. $U(c) = \frac{c^{1-\rho}}{1-\rho}$, where ρ is the Arrow-Pratt relative-risk aversion parameter. There is no consensus on what the coefficient of risk aversion is but the literature uses 3 as the benchmark, which McClellan and Skinner (2006) determine to be the value that best replicates observed spending among the low-income pre-Medicare population using the Panel Survey of Income Dynamics.[24] For this reason, we focus on the results for a CRRA of 3 but discuss the sensitivity of the results.

Using this method and a CRRA of 3, we find an average decline in risk premium (or welfare gain) associated with Medicare of $312 per person. As expected, the higher the coefficient of risk aversion, the higher the welfare gain; the gain varies from a negative $77 with a CRRA of 1 to $458 with a CRRA of 5.

To put these welfare gains from expenditure risk reduction into perspective, we compare them to the social costs of the program. These costs include: (1) the cost of raising revenue for the program and (2) the efficiency costs from the moral hazard effect of health insurance. CBO estimates that increasing the Medicare eligibility age (MEA) by 1 year (to age 66) would save $21 billion dollars or $5,882 per Medicare beneficiary (CBO 2012).[25] Using the consensus value for the deadweight loss per dollar of revenue raised of 30 cents (Poterba, 1996), these figures imply an annual social program cost of $1,765 per recipient. Therefore, using the $312 average gain from reducing expenditure risk, the risk-protection afforded by Medicare at age 65 accounts for about 18% of the social costs of financing the program.

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[24] As McClellan and Skinner (2006) point out, the simulation and determination of 3 as the best measure of relative-risk aversion, also relies on parameter choices related to the relative value of medical spending in bad health and the "necessary" medical spending in bad and good health.
[25] In 2012, there were 3.57 million 65 year olds (Census bureau's American Fact Finder).

The results in this paper suggest no moral hazard costs related to health insurance. That is, we fail to reject zero change in utilization at age 65 (see Table 3) and the "doughnut-RD" exercise points to limited strategic timing in health care utilization. However, since we may be underpowered to detect changes in utilization we use estimates from the literature to calculate the moral hazard costs of Medicare. Card et al. (2008) use hospital discharge data and find an increase of 8% in the discharge rate.[26] Off an average discharge rate of 1,443 per 10,000 people in their sample, this implies an increase of roughly 0.01 stays per person at age 65.Using our 2007-2010 MEPS sample, we find that the average price for a hospital stay (calculated as total spending divided by number of stays) at age 64 is $2,052. Therefore, based on these estimates, the moral hazard costs associated with Medicare are relatively low – about $21 per person – and would not significantly change the cost-benefit analysis above.

Finally, it is important to bear in mind that this calculation ignores the stress-lowering benefits from reduced financial strain at age 65 that we documented in section IV, any impact this stress-reduction has on health and any direct health improvements from Medicare. Dobbie and Song (2013), for example, find that bankruptcy protection decreases five-year mortality by 1.1 percentage points, suggesting that reduced medical financial strain has potentially important effects on health. In addition, Card et al. 2009 document significant Medicare-induced mortality declines among those with emergent, non-deferrable conditions. Using standard value of life estimates, an extension of life by just one extra week would mean that the welfare gains from Medicare at age 65 fully balance the program's social costs.

VI. Conclusion

We use the discontinuity in Medicare coverage at age 65 to estimate the

[26] Card et al. (2008) find an increase in doctor visits as well. Since the increase is small (1.3pp or 1.5%) and doctor visits are cheap compared to hospital stays, this negligibly affects our estimates.

impact of Medicare on medical expenditure risk among those just eligible versus just ineligible for the program based on age. Those just eligible for Medicare based on age are 14% more likely to have health insurance and 10 times more likely to be covered by two or more policies than those just ineligible (i.e. slightly younger than 65).

Our analyses suggest that Medicare plays an important role in protecting against medical expenditure risk for those aged 65 and older. Using the 2007-2010 MEPS data, we find that the distribution of out-of pocket spending shifts significantly to the left at age 65. For example, out-of-pocket expenditures (all in 2010 dollars) drop by 33% ($326) at the mean and by 53% ($1,730) among the top 5% of medical spenders. The declines are smaller, but still significant, if we consider the 1996-2010 period: out-of-pocket spending at age 65 drops by almost 20% at both the mean ($200) and among the top 5% of medical spenders ($722). These results are robust to different strategies that deal with misspecification of functional form. They also appear unlikely to be substantially affected by potential deferability in health care utilization. A welfare calculation indicates that the reductions in out-of-pocket expenditure risk at age 65 translate into a welfare gain of 18% of Medicare's social costs, not including any stress reducing benefits from lower financial strain or direct health improvements.

Results for medical-related financial strain corroborate the importance of changes in out-of-pocket spending for the financial well-being of seniors. Both the fraction reporting medical bill problems and collection agency contacts associated with these bills decline by about a third at age 65. Likewise, the amount owed in medical bills declines by 33% (with a pre-65 mean amount owed of about $900). To the extent that we cannot account for bias due to the deferral of medical care until age 65 by some respondents, our estimated changes in several measures of medical related-financial stress likely provide a lower bound on the true effects of Medicare on medical expenditure risk.

How do our findings of the risk protective benefits of Medicare today compare to the Finkelstein and McKnight (2008) – referred to as FM – estimates of the effect of the introduction of Medicare in 1965 on out-of-pocket spending? Both studies find similar relative reductions in out-of-pocket spending attributable to Medicare (on the order of 30-40%). In addition, both find that the effects are concentrated in the top quartile of the spending distribution. However, key differences in the studies suggest some important nuances. FM uses a different empirical strategy – a difference in differences (DID) in contrast to the Regression Discontinuity (RD) approach use here. The difference in empirical strategy suggests that Medicare provides greater risk protection today than when it was first introduced almost 50 years ago for two reasons. First, the fraction of the population affected (or the "first stage") in the FM exercise is larger than in ours. At its introduction Medicare raised health insurance coverage for the elderly by 75 percentage points (Finkelstein 2007), while the corresponding increase in coverage at the age 65 threshold today is only 12 percentage points. Therefore, the change in out-of-pocket spending we estimate is coming from a smaller share of the population. Said differently, one would need to rescale our expenditure results upwards to make them comparable to FM. Second, our estimates provide average treatment effects for those right around the age 65 cutoff only. In contrast, in their DID, FM calculate the average treatment effect of Medicare for individuals ages 65 to 74. Given that medical expenditure (and risk) is increasing in age one would expect the risk protection from Medicare to be greater at later ages. That Medicare's expenditure risk protection has increased since 1965 is consistent with the rapid rise in total medical spending during the past five decades (Gruber and Levy 2009) and the fact that we estimate larger effects for the 2007-2010 than the overall 1996-2010 period.

Our findings also have important implications for policy. Specifically, several recent proposals to address rising Medicare spending and long-term federal budget shortfalls have involved increasing the Medicare Eligibility age (MEA) (see, for example, Emanuel 2012, Murray and King, 2012 and Herger 2012). Based on our findings, if this policy is implemented, those 65 and 66 year-olds who are no longer eligible for Medicare could face substantial drops in insurance coverage and large increases in out-of-pocket expenditures and medical-related financial stress. This is especially true for those in the right tail of the expenditure distribution who, according to our estimates, would see an increase of several thousand dollars per year in out-of-pocket medical expenditures and a consequent substantial financial loss. If we take into account the persistence in health status, something we do not do here, those faced with a negative health shock might face large expenditures for multiple years, increasing the policy's financial consequences. While the Affordable Care Act (ACA) should attenuate the medical expenditure risk consequences of increasing the MEA, its success in doing so will be limited by the decision of many states, including large states such as Texas, Florida and Louisiana, to opt-out of the Medicaid expansion. If those individuals ages 65 and 66 years old who would have become eligible for insurance via Medicaid expansions are unable to afford private options, increasing the MEA would increase their exposure to medical expenditure risk.

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Figure 1a. Smoothness of Covariates: MEPS, 2007-2010

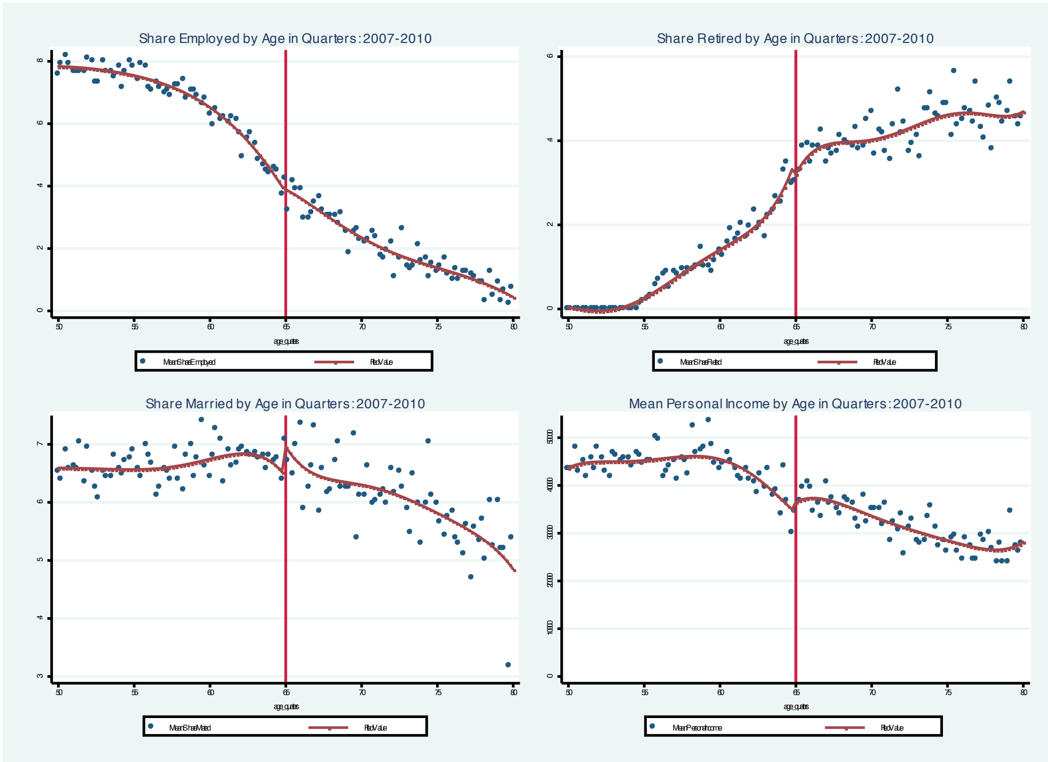


Figure 1b. Smoothness of Covariates: HTHS: 2003, 2007, 2010

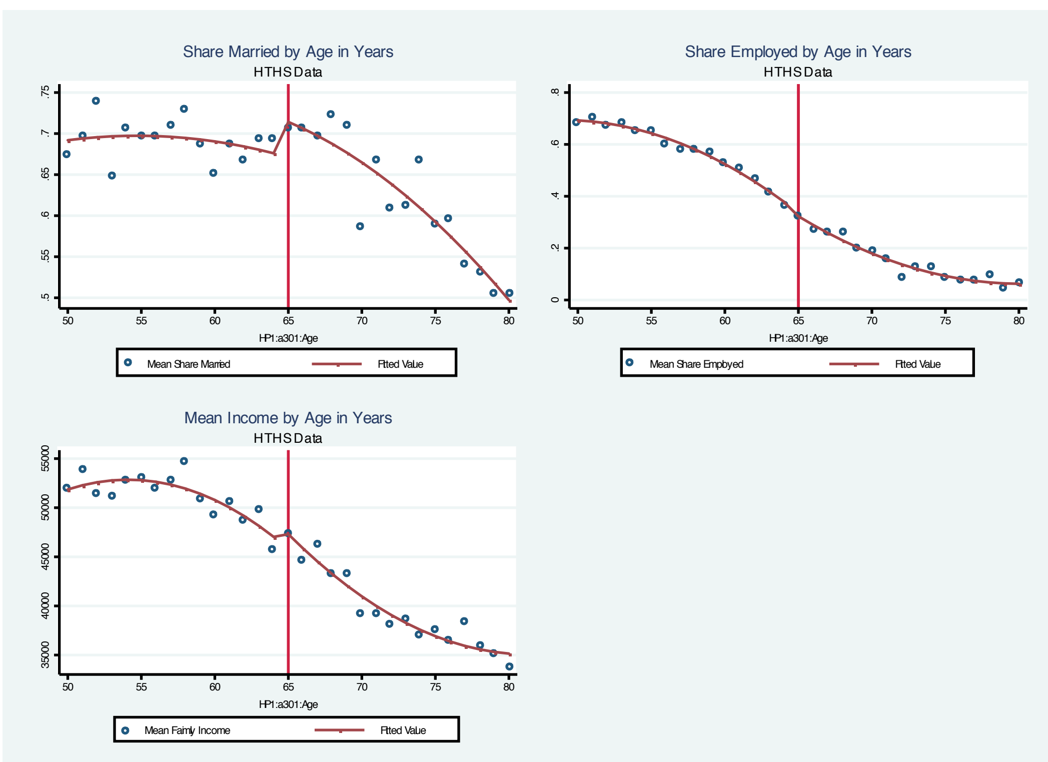


Figure 2a. Change in Health Insurance Coverage at Age 65, MEPS: 2007-2010

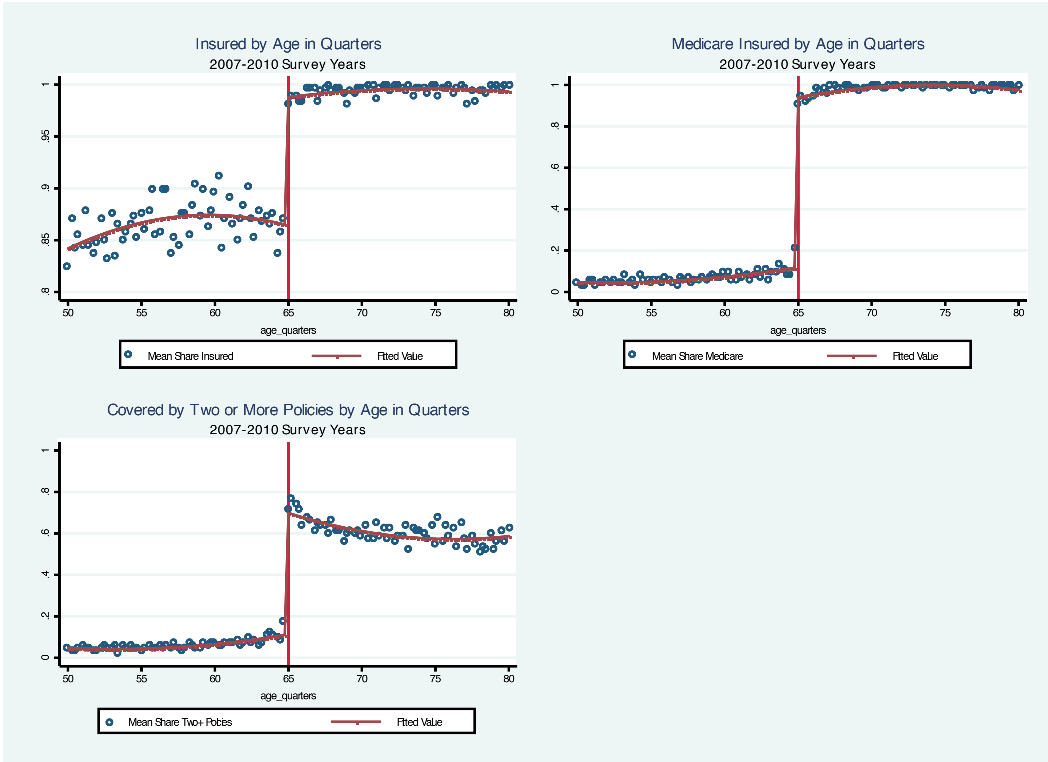


Figure 2b. Change in Health Insurance Coverage at Age 65, HTHS: 2003, 2007, 2010

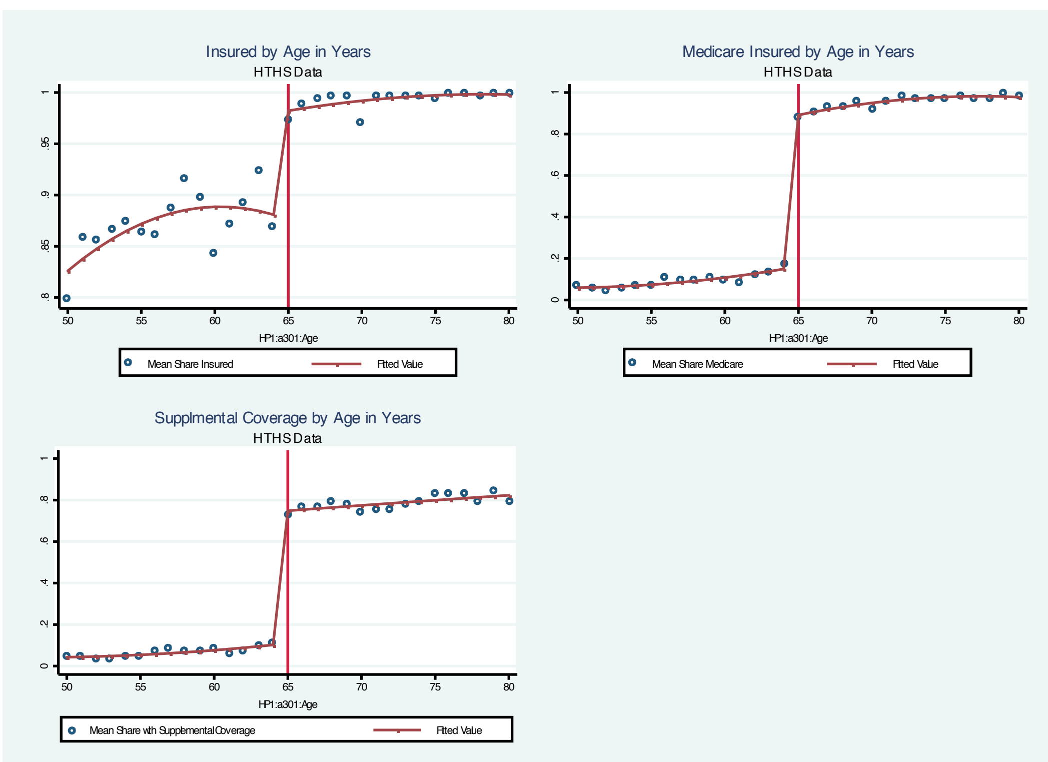


Figure 3. Impact of Medicare on Total Spending and Any Utilization

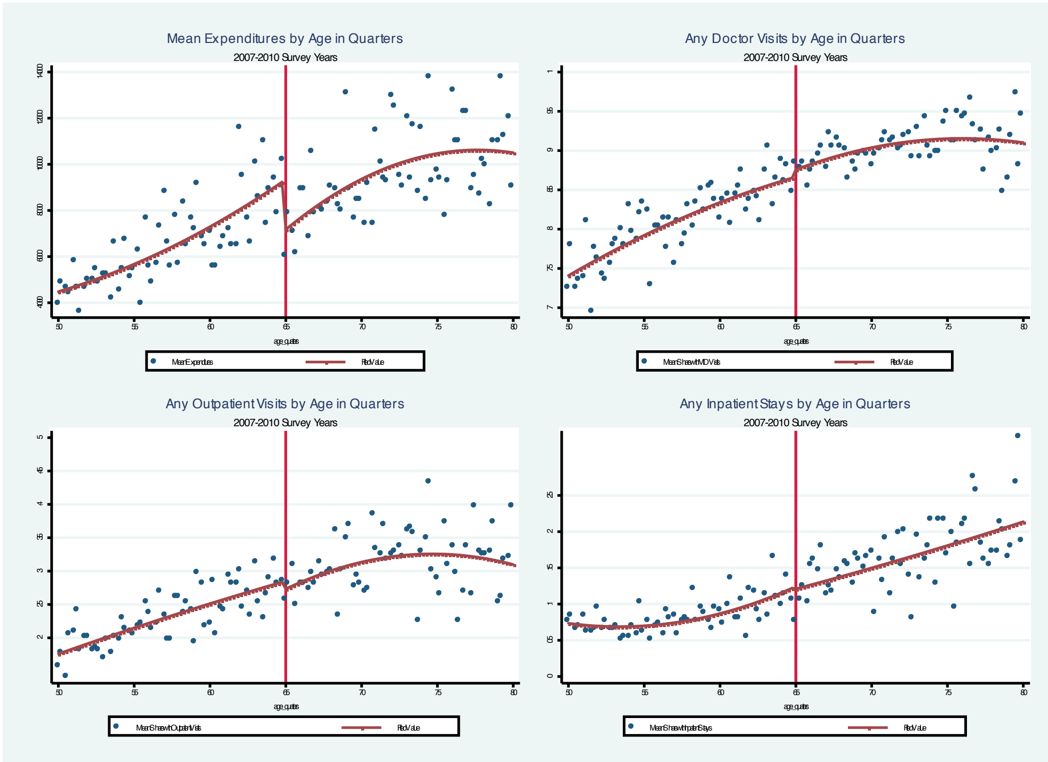


Figure 4. Impact of Medicare on the Distribution of Out-of-Pocket Spending

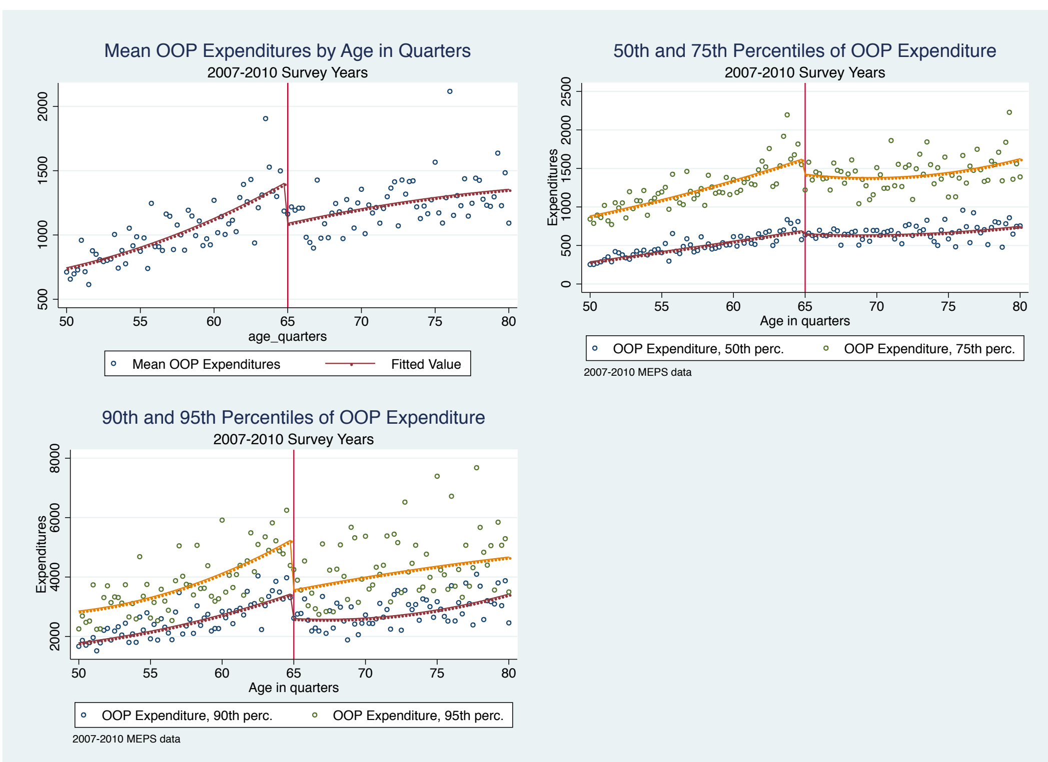


Figure 5. Impact of Medicare on Centiles of Out-of-Pocket Spending, 2007-2010

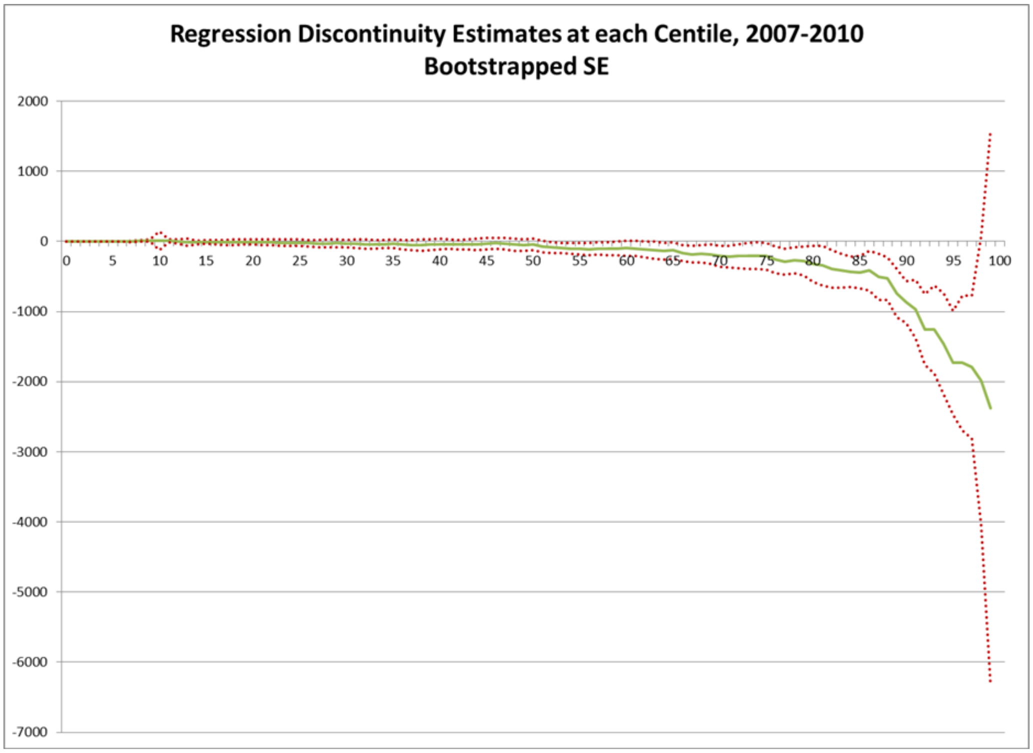


Figure 6. Impact of Medicare on Relative Out-of-Pocket Health Care Costs

Figure 7. Impact of Medicare on Medical Bill Problems and Collections Activity

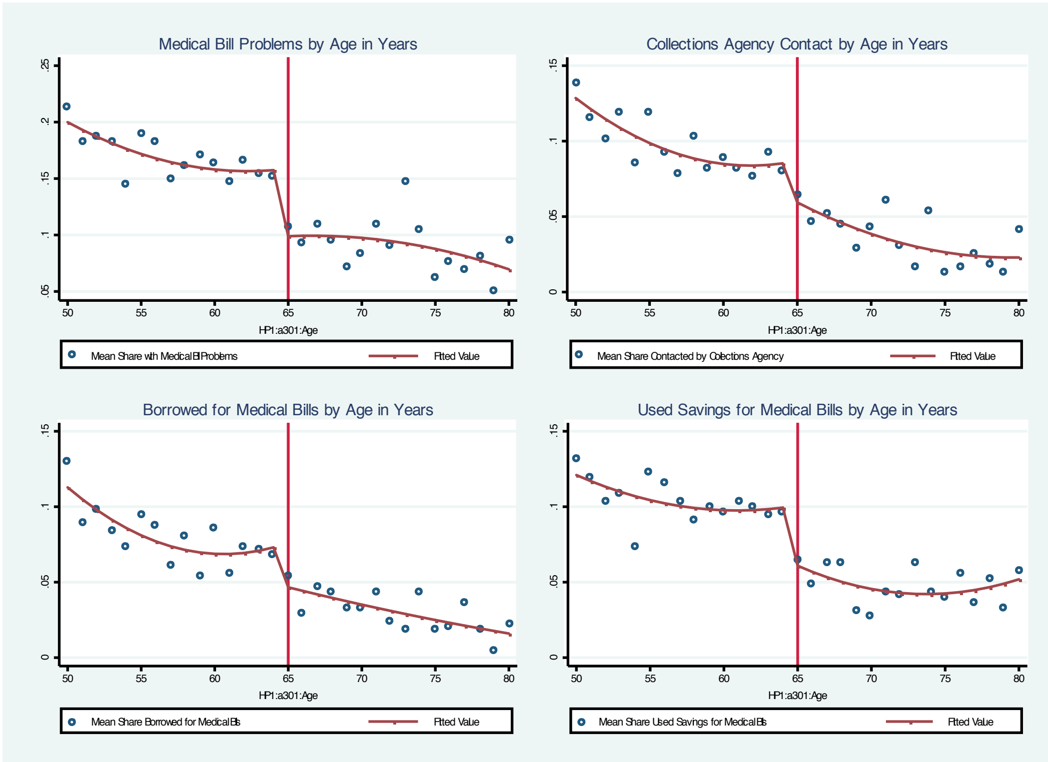


Figure 8. Impact of Medicare on the Amount Owed in Medical Bills

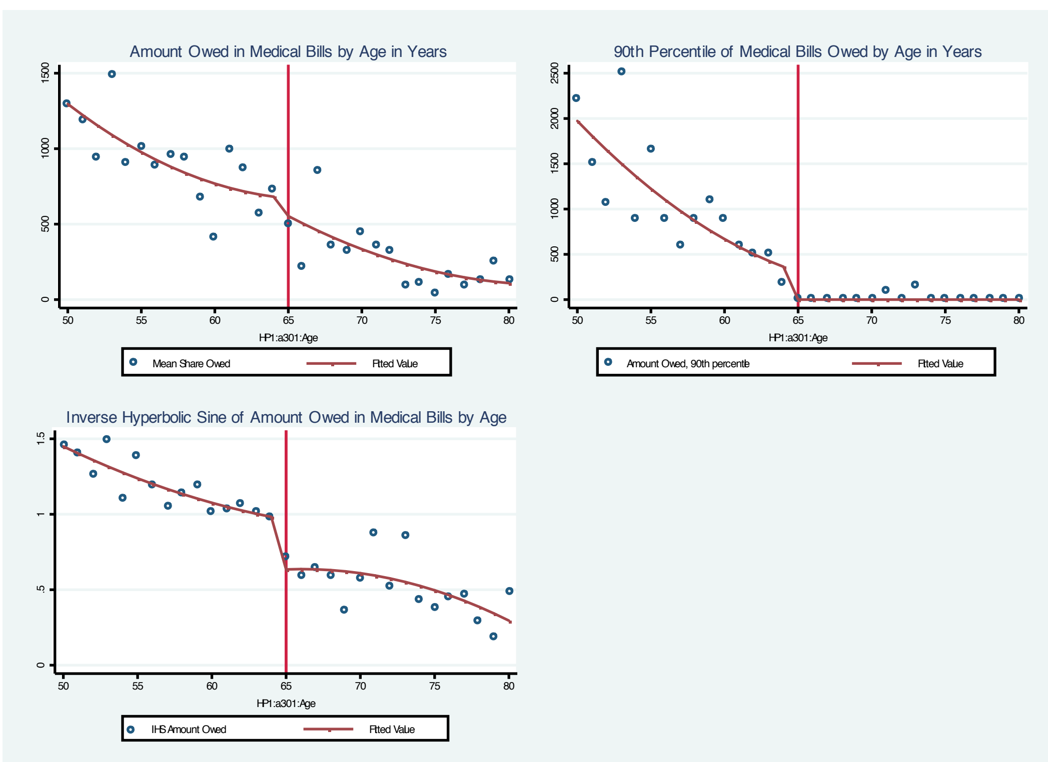


Table 1. Smoothness of Covariates

	Share Employed	Share Retired	Share Married	Income	Share BA or Higher	Family Size	Share living in South	Share Male	Share with less than HS degree	Share Hispanic	Share living in the West
Panel A: MEPS 2007-2010											
Age 65+	0.01	-0.036	0.052**	2,287.05	-0.019	0.023	-0.02	0.005	0.001	0.006	-0.001
	(0.039)	(0.032)	(0.02)	(4017.75)	(0.023)	(0.057)	(0.021)	(0.036)	(0.023)	(0.011)	(0.019)
Mean pre 65	0.69	0.087	0.665	44154	0.308	2.42	0.359	0.490	0.153	0.092	0.226
F-statistic	1.25	1.51	1.45	1.31	1.165	1.53	1.17	1.76	1.10	0.75	1.20
Observations	32569	32241	32569	32569	32569	32569	32569	32569	32569	32569	32569
Panel B: HTHS 2003, 2007, 2010											
Age 65+	-0.014		0.043*	1,163	-0.028	0.045+		-0.090**	-0.036**	-0.021	
	(0.015)		(0.017)	(1381.)	(0.032)	(0.026)		(0.011)	(0.016)	(0.02)	
Mean pre 65	0.588		0.692	51,419	0.308	2.07		0.486	0.128	0.087	
F-statistic	1.48		3.9	1.12	2.74	2.31		1.23	3.46	4.51	
Observations	30172		30172	30172	30172	30172		30172	30172	30172	

Notes: * significant at 5%; ** significant at 1% Data in panel A are from the 2007-2010 Medical Expenditure Panel Surveys. B. Panel B data are from the 2003, 2007 and 2010 HTHS. Both panels include respondents ages 50 to 80 respondents. All regressions include a constant, an indicator for ages 65 and above. Regressions in Panels A include a 5th order polynomial, Panel B uses a fourth order polynomial rather than a fifth order polynomial because of the sparser data, the availability of age in years only and what appeared to be better parametric fits. Standard errors are clustered at the level of age in quarters in the MEPS and by age in years in the HTHS.

Table 2. Impact of Medicare on Health Insurance coverage and generosity

	Insured	Medicare Covered	Covered by 2+ Policies	Insured	Medicare Covered	Covered by 2+ Policies	Insured	Medicare Covered	Covered by 2+ Policies
		Quadratic in Age			Linear in Age			Cubic in Age	
Panel A: MEPS 2007-2010									
Age 65+	0.124**	0.821**	0.586**	0.112**	0.862**	0.576**	0.130**	0.787**	0.599**
	(0.006)	(0.018)	(0.019)	(0.005)	(0.011)	(0.014)	(0.008)	(0.026)	(0.024)
Mean pre 65	0.865	0.064	0.059	0.865	0.064	0.059	0.865	0.064	0.059
Relative Effect (%)	14.34	1282.81	993.22	12.95	1346.88	976.27	15.03	1229.69	1015.25
Observations	32569	32569	32569	32569	32569	32569	32569	32569	32569
Panel B: CTS 2003, 2007, 2010									
Age 65+	0.106**	0.730**	0.639**	0.080**	0.767**	0.650**	0.074*	0.712**	0.642**
	(0.022)	(0.016)	(0.178)	(0.016)	(0.015)	(0.013)	(0.037)	(0.018)	(0.024)
Mean pre 65	0.869	0.089	0.063	0.869	0.089	0.063	0.869	0.089	0.063
Relative Effect (%)	12.20	820.22	1014.29	9.21	861.80	1031.75	8.52	820.22	1019.05
Observations	30172	30172	30172	30172	30172	30172	30172	30172	30172

Notes: + significant at the 10% level; * significant at 5%; ** significant at 1%. Data in panel A are from the 2007-2010 Medical Expenditure Panel Surveys and in Panel B are from the 2003, 2007 and 2010 HTHS. Both panels include respondents ages 50 to 80. All regressions include a constant, an indicator for ages 65 and above and a polynomial in age in quarters in the MEPS and in years in the HTHS that is allowed to vary on either side of age 65.The first three columns show the main specification using a quadratic in age. The next three columns use linear age trends and the last three cubic age terms. Standard errors are clustered by age in quarters for the MEPS samples and age in years in the HTHS..

Table 3. Impact of Medicare on Total Spending and Utilization: MEPS 2007-2010

	Total spending	Any Physician Visits	Any outpatient Hospital Visits	Any Inpatient Visits
Panel A: Quadratic in Age				
Age 65+	-2,168.354*	0.009	-0.012	-0.003
	(672.43)	(0.011)	(0.013)	(0.014)
Mean pre 65	6375.7	0.805	0.228	0.081
Relative Effect (%)	-34.01	1.12	-5.26	-3.70
Observations	32569	32569	32569	32569
Panel B: Linear Trend in Age, MEPS 2007-2010				
Age 65+	-1128.43*	0.011	0.003	0.013
	(498.01)	(0.008)	(0.011)	(0.01)
Mean pre 65	6375.7	0.805	0.228	0.081
Relative Effect (%)	-17.70	1.42	1.47	16.12
Observations	32569	32569	32569	32569
Panel C: 3rd Order Polynomial, MEPS 2007-2010				
Age 65+	-2,629.336*	0.007	-0.022	-0.009
	(785.37)	(0.013)	(0.017)	(0.017)
Mean pre 65	6375.7	0.805	0.228	0.081
Relative Effect (%)	-41.24	0.87	-9.65	-11.11
Observations	32569	32569	32569	32569

Notes: + significant at the 10% level; * significant at 5%; ** significant at 1%. Data are from the 2007-2010 Medical Expenditure Panel Survey and include respondents ages 50 to 80. All regressions include a constant and an indicator for ages 65 and above and a poynomial in age that is allowed to vary on either side of age 65. Panel A uses a quadratic in age while Panel B a linear trend and Panel C a cubic in age in quarters. Standard errors are clustered by age in quarters.. Standard errors are clustered by age in quarters.

Table 4. Impact of Medicare on Out-of-Pocket Spending in the MEPS: 2007-2010

	Mean	Median	75th Percentile	90th Percentile	95th Percentile	Share out-of-pocket	Share out-of-pocket costs that exceed income
Panel A: Quadratic in Age							
Age 65+	-326.420*	-46.705	-209.544*	-865.020**	-1,729.822**	-0.02	-0.04**
	(97.48)	(42.27)	(102.34)	(165.6)	(398.33)	(0.015)	(0.009)
Mean pre 65	1002.98	463.68	1188	2402.87	3723.85	0.327	0.074
Relative Effect (%)	-32.55	-10.07	-17.64	-36.00	-52.84	-6.12	-53.86
Observations	32569	32569	32569	32569	32569	29378	32569
Panel B: Linear Trend in Age, MEPS 2007-2010							
Age 65+	-255.17**	-66.62*	-242.40**	-843.45**	-1390.76**	-0.037**	-0.032**
	(60.77)	(26.75)	(65.24)	(108.05)	(265.89)	(0.011)	(0.006)
Mean pre 65	1002.98	463.68	1188	2402.87	3723.85	0.327	0.074
Relative Effect (%)	25.44	-14.37	-20.40	-35.10	-37.35	-11.31	-43.94
Observations	32569	32569	32569	32569	32569	29378	32569
Panel C: 3rd Order Polynomial, MEPS 2007-2010							
Age 65+	-348.501*	-141.135*	-352.174**	-1,144.957**	-2,091.466**	-0.019	-0.031**
	(125.25)	(55.78)	(124.67)	(239.86)	(470.24)	(0.02)	(0.011)
Mean pre 65	1002.98	463.68	1188	2402.87	3723.85	0.327	0.074
Relative Effect (%)	-34.75	-30.44	-29.64	-47.65	-63.88	-5.81	-41.41
Observations	32569	32569	32569	32569	32569	29378	32569

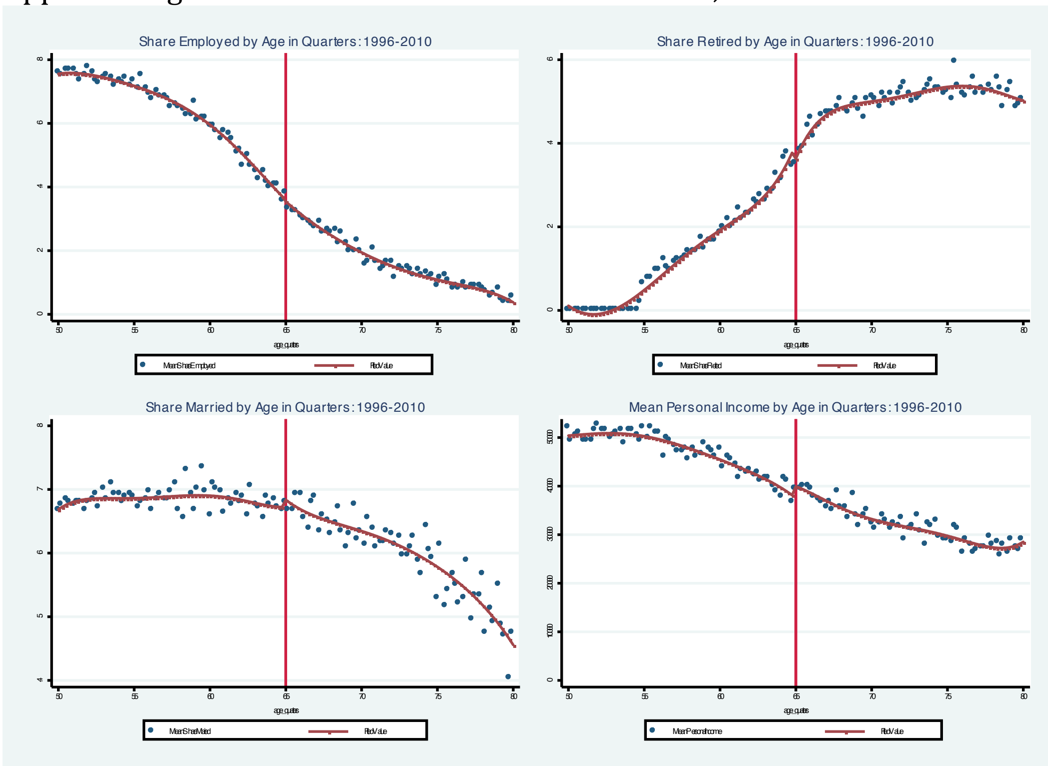
Notes: + significant at the 10% level; * significant at 5%; ** significant at 1% Data are from the 2007-2010 Medical Expenditure Panel Survey and include respondents ages 50 to 80. All regressions include a constant, an indicator for ages 65 and above and a polynomial in age in quarters that is allowed to vary on either side of age 65. Panel A uses a quadratic in age while Panel B a linear trend and Panel C a cubic in age in quarters. Standard errors for OLS regressions (mean out-of-pocket spending and share out of pocket) are clustered by age in quarters. Standard errors for quantile regressions are based on a block bootstrap with 500 draws, where the block is age in quarters.

Table 5. Impact of Medicare on Medical Bill Problems in the Past 12 Months: HTHS 2003, 2007, 2010

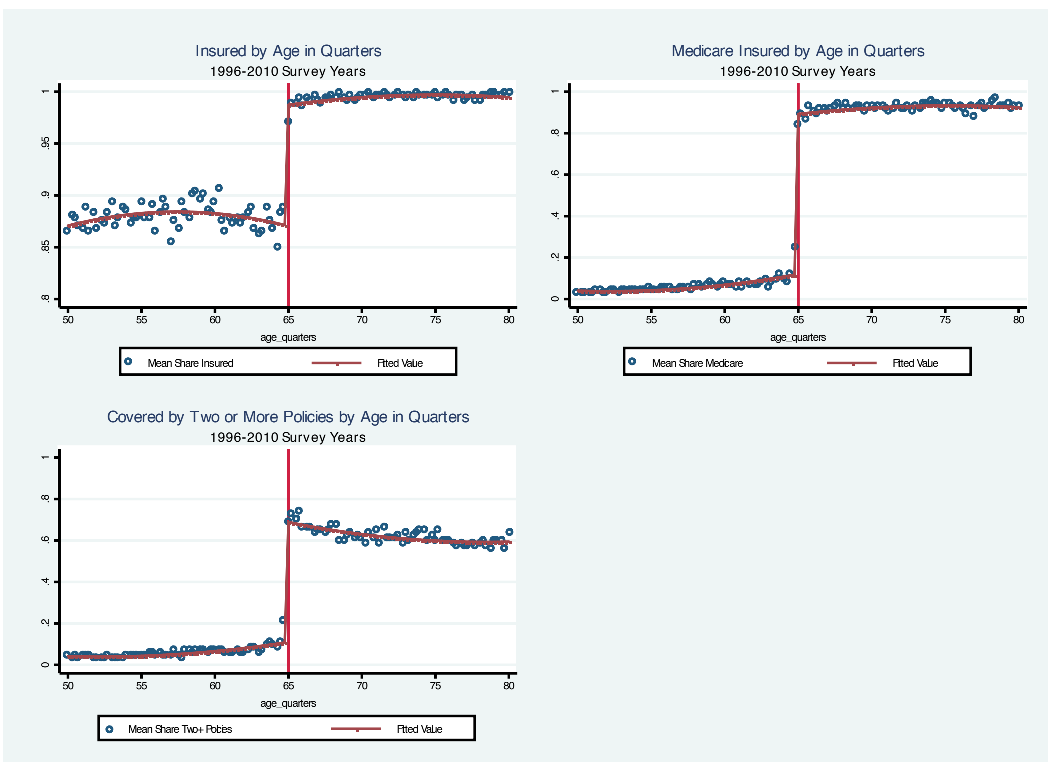
	Medical Bill Problems	Collections Agency Contact	Borrowed to Pay Medical Bills	Used Savings to Pay Medical Bills	Delayed Major Purchase due to Medical Bills	Amount Owed	90th Percentile of Amount Owed	IHS Amount Owed
Panel A: Quadratic in Age								
Age 65+	-0.060**	-0.028**	-0.029**	-0.040**	-0.044**	-117.96	-305.88	-0.330**
	(0.012)	(0.009)	(0.01)	(0.009)	(0.011)	(197.58)	(355.751)	(0.07)
Mean pre 65	0.171	0.099	0.082	0.105	0.092	936.05	1000	936.05
Relative Effect (%)	-35.09	-28.28	-35.37	-38.10	-47.83	-12.60	-30.59	33
Observations	30088	30079	30088	30065	30067	14072	14072	14072
Panel B: Linear Trend in Age								
Age 65+	-0.041**	-0.017*	-0.011	-0.038**	-0.028**	-51.52	-111.35	-0.230**
	(0.008)	(0.007)	(0.008)	(0.007)	(0.009)	(153.42)	(209.92)	(0.054)
Mean pre 65	0.171	0.099	0.082	0.105	0.092	936.05	1000	936.05
Relative Effect (%)	-23.98	-17.17	-13.41	-36.19	-30.43	-5.50	-11.14	23
Observations	30088	30079	30080	30065	30067	14072	14072	14072
Panel C: Cubic in Age								
Age 65+	-0.042**	-0.022+	-0.017	-0.022*	-0.032*	-333.6	65.15	-0.334**
	(0.01)	(0.011)	(0.012)	(0.01)	(0.013)	(213.508)	(459.87)	(0.095)
Mean pre 65	0.171	0.099	0.082	0.105	0.092	936.05	1000	936.05
Relative Effect (%)	-24.56	-22.22	-20.73	-20.95	-34.78	-35.64	6.52	33
Observations	30088	30079	30080	30065	30067	14072	14072	14072

Notes: + significant at 10%; * significant at 5%; ** significant at 1%. Data are from the 2003, 2007 and 2010 waves of the Health Tracking Household Survey and are restricted to respondents ages 50 to 80. Questions about amounts owed were only asked in 2007 and 2010. All regressions include a constant, an indicator for ages 65 and above and a polynomial in age in quarters that is allowed to vary on either side of age 65. Panel A uses a quadratic in age while Panel B a linear trend and Panel C a cubic in age in quarters. Standard errors are clustered by age in years.

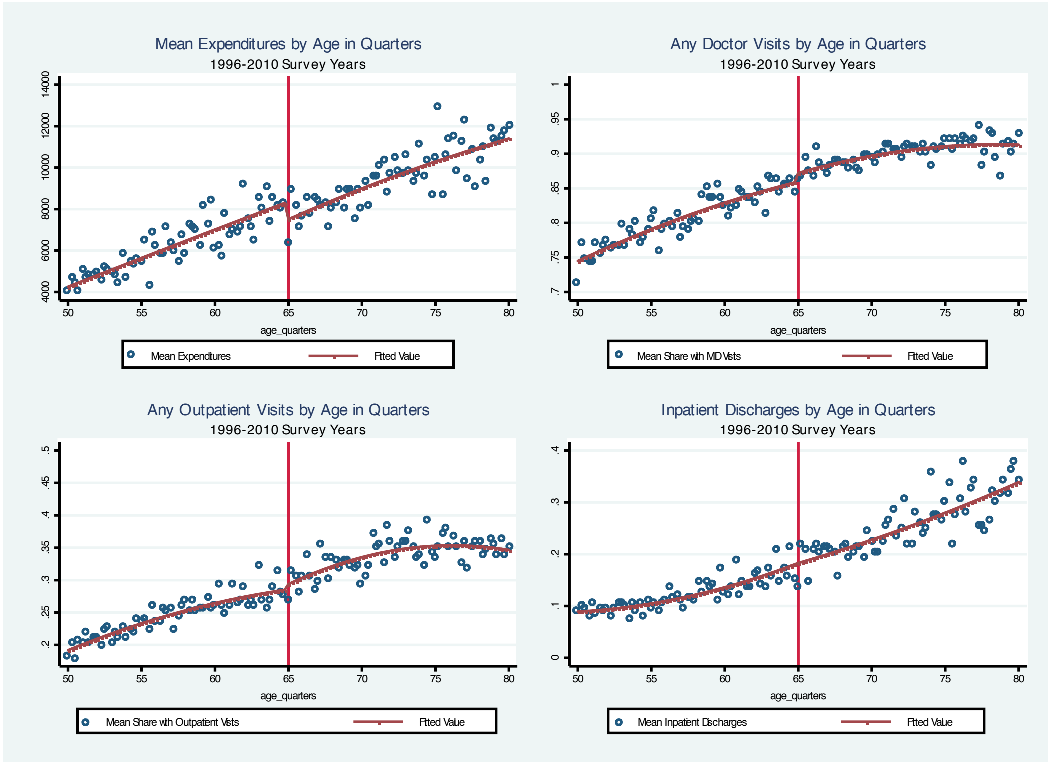
Appendix Figure 1. Smoothness of Covariates: MEPS, 1996-2010



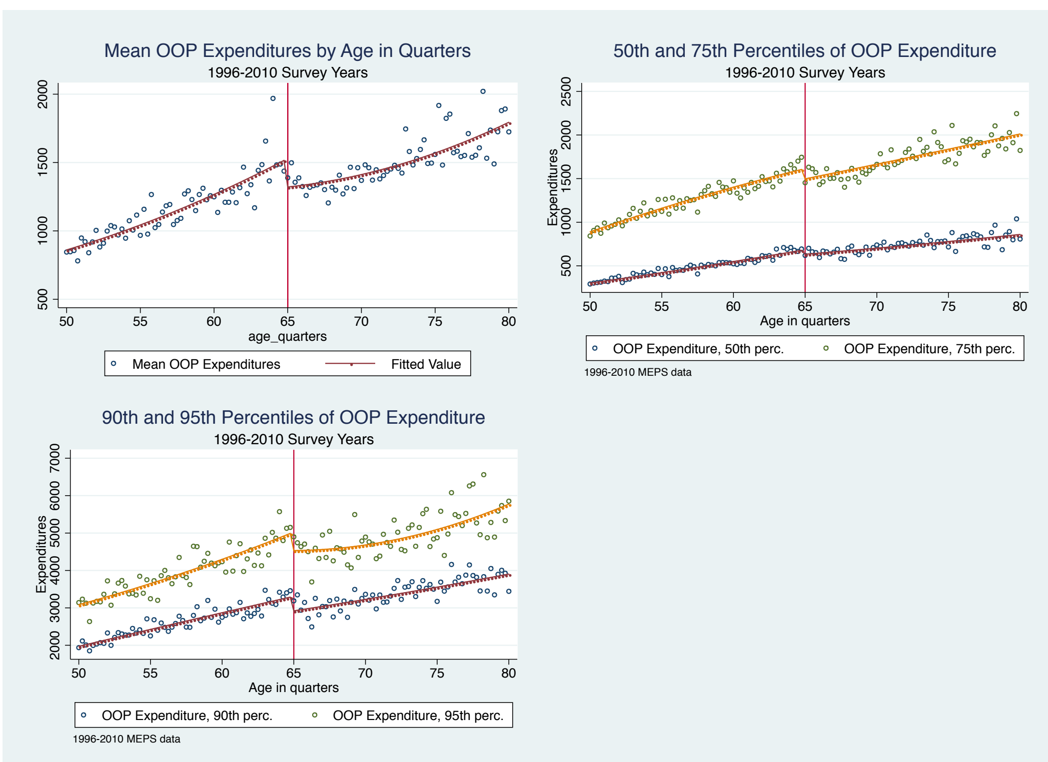
Appendix Fig 2. Change in Health Insurance Coverage at Age 65, MEPS: 1996-2010



Appendix Figure 3. Impact of Medicare on Total Spending and Any Utilization, MEPS:1996-2010



Appendix Figure 4. Change in Out-of-Pocket Spending at Age 65, MEPS: 1996-2010



Appendix Figure 5. Impact of Medicare on Relative Out-of-Pocket Health Care Costs, MEPS: 1996-2010

Appendix Table 1. Covariate Checks for 1996-2010 MEPS

	Share Employed	Share Retired	Share Married	Income	Share BA or Higher	Family Size	Share living in South	Share Male	Share less than HS degree	Share Hispanic	Share living in the West
Panel A: MEPS 1996 -2010											
	-0.005	-0.035	0.011	2,403.53	-0.015	0.043	0.008	-0.002	0.007	-0.003	-0.006
	(0.021)	(0.024)	(0.011)	(1621.13)	(0.011)	(0.043)	(0.013)	(0.017)	(0.012)	(0.007)	(0.017)
Mean pre 65	0.653	0.112	0.684	47663	0.285	2.42	0.356	0.486	0.179	0.084	0.220
F-statistic	1.11	0.967	1.56	1.04	1.02	1.04	1.42	1.58	1.71	0.92	0.97
Observations	109806	108595	109806	109806	109806	109806	109806	109806	109806	109806	109806

Notes: + significant at the 10% level; * significant at 5%; ** significant at 1% Data are from the 2007-2010 Medical Expenditure Panel Survey and include respondents ages 50 to 80 Age is measured in quarters. Regressions include a fifth order polynomial in age that is allowed to vary on either side of age 65.

Appendix Table 2. Robustness Checks on Impact of Medicare on Total Spending and Utilization

	Total spending	Any Physician Visits	Any outpatient Hospital Visits	Any Inpatient Visits
Panel A: Ages 55-75 in MEPS 2007-2010				
Age 65+	-2,404.972*	0.008	-0.017	-0.003
	(764.97)	(0.013)	(0.015)	(0.016)
Mean pre 65	7224.21	0.828	0.249	0.088
Relative Effect (%)	-33.29	0.97	-6.83	-3.41
Observations	21398	21398	21398	21398
Panel B: Ages 50-80 but without Age 65 in MEPS 2007-2010				
Age 65+	-1,942.007*	0.008	-0.009	0.005
	(688.013)	(0.012)	(0.014)	(0.014)
Mean pre 65	6375.70	0.805	0.228	0.081
Relative Effect (%)	-30.46	0.99	-3.95	6.17
Observations	32305	32305	32305	32305
Panel C: Ages 50-80 but without Ages 64.75 to 65.25 in MEPS 2007-2010				
Age 65+	-1,880.551**	0.004	-0.009	0.009
	(790.266)	(0.013)	(0.016)	(0.015)
Mean pre 65	6375.7	0.805	0.228	0.081
Relative Effect (%)	-29.50	0.50	-3.95	11.11
Observations	31757	31757	31757	31757
Panel D: Ages 50-80 but without Ages 64.5 to 65.5 in MEPS 2007-2010				
Age 65+	-1,952.899**	0.005	-0.015	0.015
	(888.523)	(0.015)	(0.018)	(0.017)
Mean pre 65	6375.70	0.805	0.228	0.081
Relative Effect (%)	-30.63	0.62	-6.58	18.52
Observations	31267	31267	31267	31267

Notes: * significant at 5%; ** significant at 1% Data in all Panels are from the 2007-2010 Medical Expenditure Panel Survey. All regressions include a constant, an indicator for ages 65 and above and a quadratic in age in quarters that is allowed to vary on either side of age 65. Standard errors are clustered by age in quarters.

Appendix Table 3. Full MEPS - spending and utilization

	Total spending	Any Physician Visits	Any outpatient Hospital Visits	Any Inpatient Visits
Panel A: MEPS 1996-2010				
Age 65+	-854.632**	0.012	0.008	-0.007
	(394.6)	(0.007)	(0.01)	(0.008)
Mean pre 65	6091.09	0.802	0.241	0.085
Relative Effect (%)	-14.03	1.50	3.32	-8.24
Observations	109806	109806	109806	109806

Notes: Panel A is based on the full 1996-2010 MEPS and Panel B restricts to the sample of respondents from 1996-2010 with non-deferrable conditions in the past year. See Appendix Table 4 for conditions included in this group. Across both panels, we restrict to respondents ages 50 to 80. Regressions include a quadratic in age that is allowed to vary on either side of age 65.

Appendix Table 4. Sensitivity of MEPS Results to Marriage Control

Panel A: Insurance	Insured	Medicare Covered	Covered by 2+ Policies				
Age 65+	0.125**	0.820**	0.586**				
	(0.007)	(0.017)	(0.019)				
Mean pre 65	0.865	0.064	0.059				
Relative Effect (%)	14.45	1281.25	993.22				
Observations	32569	32569	32569				
Panel B: Out-of-pocket Spending	Mean	Median	75th Percentile	90th Percentile	95th Percentile	Share out-of-pocket	Share out-of-pocket costs that exceed income
Age 65+	-325.73**	-54.22+	-223.89**	-854.96**	-1,713.08**	-0.02	-0.039**
	(97.16)	(32.17)	(72.56)	(153.92)	(314.24)	(0.015)	(0.009)
Mean pre 65	1002.98	463.68	1188	2402.87	3723.85	0.327	0.074
Relative Effect (%)	-32.48	-11.69	-18.85	-35.58	-46.00	6.12	52.70
Observations	32305	32305	32305	32305	32305	29127	32569

Notes: * significant at 5%; ** significant at 1%. Data in all Panels are from the 2007-2010 Medical Expenditure Panel Survey. All regressions include a constant, an indicator for married, an indicator for ages 65 and above and a quadratic in age in quarters that is allowed to vary on either side of age 65. Standard errors are clustered by age in quarters.

Appendix Table 5. Robustness Checks of Impact of Medicare on Out-of-Pocket Spending

	Mean	Median	75th Percentile	90th Percentile	95th Percentile	Share out-of-pocket	Share out-of-pocket costs that exceed income
Panel A: Ages 55-75 in MEPS 2007-2010							
Age 65+	-349.302*	-110.38*	-328.70**	-998.37**	-1790.95**	-0.017	-0.030**
	(117.01)	(53.61)	(126.79)	(218.86)	(431.2)	(0.018)	(0.01)
Mean pre 65	1114.79	540.033	1318.348	2626.778	4084	0.319	0.076
Relative Effect (%)	-31.33	-20.44	-24.93	-38.01	-43.85	-5.33	-39.47
Observations	21398	21398	21398	21398	21398	19568	21398
Panel B: Ages 50-80 but without Age 65 in MEPS 2007-2010							
Age 65+	-340.319*	-41.266	-186.647+	-882.78**	-1,789.61**	-0.031**	-0.041**
	(102.82)	(44.31)	(102.55)	(180.21)	(426.41)	(0.014)	(0.009)
Mean pre 65	1002.98	463.68	1188	2402.87	3723.85	0.327	0.074
Relative Effect (%)	-33.93	-8.90	-15.71	-36.74	-48.06	9.48	-55.41
Observations	32305	32305	32305	32305	32305	29127	32305
Panel C: Ages 50-80 but without Ages 64.75 to 65.25 in MEPS 2007-2010							
Age 65+	-404.832*	-60.765	-215.334+	-909.33**	-2,116.46**	-0.042*	-0.044**
	(110.64)	(47.86)	(113.78)	(206.57)	(452.43)	(0.015)	(0.011)
Mean pre 65	1002.98	463	1182.53	2394.97	3707.83	0.327	0.074
Relative Effect (%)	-40.36	-13.12	-18.21	-37.97	-57.08	-12.84	-59.46
Observations	31757	31757	31757	31757	31757	28622	31757
Panel D: Ages 50-80 but without Ages 64.5 to 65.5 in MEPS 2007-2010							
Age 65+	-419.968*	-43.841	-186.20	-893.776**	-1,899.16**	-0.047*	-0.042**
	(125.92)	(50.87)	(124.67)	(236.47)	(546.28)	(0.015)	(0.01)
Mean pre 65	1002.98	460	1175.77	2382.59	3680.05	0.327	0.074
Relative Effect (%)	-41.87	-9.53	-15.84	-37.51	-51.61	14.37	-56.76
Observations	31267	31267	31267	31267	31267	28173	31267

Notes: * significant at 5%; ** significant at 1%. Data in all Panels are from the 2007-2010 Medical Expenditure Panel Survey. All regressions include a constant, an indicator for ages 65 and above and a quadratic in age in quarters that is allowed to vary on either side of age 65. Standard errors are clustered by age in quarters.

Appendix Table 6. Impact of Medicare on Out-of-Pocket Spending in the 1996-2010 MEPS

	Mean	Median	75th Percentile	90th Percentile	95th Percentile	Share out-of-pocket	Share out-of-pocket costs that exceed income
Panel A: MEPS 1996-2010							
Age 65+	-208.584*	-55.781	-114.679+	-473.294**	-722.422**	-0.016+	-0.038**
	(75.61)	(145.51)	(65.78)	(181.84)	(221.15)	(0.009)	(0.01)
Mean pre 65	1127.65	527.86	1318.28	2675.94	4051.9	0.361	0.072
Relative Effect (%)	-18.50	-10.57	-8.70	-17.69	-17.83	-4.43	52.78
Observations	109806	109806	109806	109806	109806	100044	109806

Notes: Panel A is based on the full 1996-2010 MEPS and Panel B restricts to the sample of respondents from 1996-2010 with non-deferrable conditions in the past year. See Appendix Table 4 for conditions included in this group. Across both panels, we restrict to respondents ages 50 to 80. Regressions include a quadratic in age that is allowed to vary on either side of age 65.

Appendix Table 7. Impact of Medicare on Medical Bill Problems in the Past 12 Months with Mariage, Gender and Education Controls

Panel A: Insurance	Insured	Medicare Covered	Covered by 2+ Policies
Age 65+	0.100**	0.735**	0.640**
	(0.021)	(0.017)	(0.183)
Mean pre 65	0.869	0.089	0.063
Relative Effect (%)	11.51	825.84	1015.87
Observations	30172	30172	30172

Panel B: Financial Strain	Medical Bill Problems	Collections Agency Contact	Borrowed to Pay Medical Bills	Used Savings to Pay Medical Bills	Delayed Major Purchase due to Medical Bills	Amount Owed	90th Percentile of Amount Owed	IHS Amount Owed
Age 65+	-0.055**	-0.025*	-0.027**	-0.039**	-0.042**	-77.72	108.37	-0.289**
	(0.011)	(0.009)	(0.01)	(0.009)	(0.011)	(188.59)	(350.98)	(0.071)
Mean pre 65	0.171	0.099	0.082	0.105	0.092	936.05	1000	936.05
Relative Effect (%)	-32.16	-25.25	-32.93	-37.14	-45.65	-8.30	10.80	29
Observations	30088	30079	30088	30065	30067	14072	14072	14072

Notes: + significant at 10%; * significant at 5%; ** significant at 1%. Data are from the 2003, 2007 and 2010 waves of the Health Tracking Household Survey and are restricted to respondents ages 50 to 80. Questions about amounts owed were only asked in 2007 and 2010. All regressions include a constant, separate indicators for married, male and less than high school education, an indicator for ages 65 and above and a polynomial in age in quarters that is allowed to vary on either side of age 65.

Appendix Table 8. Impact of Medicare on Medical Bill Problems in the Past 12 Months, Ages 55-75 and Doughnut

	Medical Bill Problems	Collections Agency Contact	Borrowed to Pay Medical Bills	Used Savings to Pay Medical Bills	Delayed Major Purchase due to Medical Bills	Amount Owed	90th Percentile of Amount Owed	IHS Amount Owed
Panel A: Ages 55-75 in the HTHS								
Age 65+	-0.060**	-0.033**	-0.031**	-0.041**	-0.049**	-294.05	-61.704	-0.393**
	(0.011)	(0.012)	(0.011)	(0.006)	(0.011)	(178.921)	(380.03)	(0.086)
Mean pre 65	0.165	0.09	0.075	0.103	0.088	805.65	700	805.65
Relative Effect (%)	-36.36	-36.67	-41.33	-39.81	-55.68	-36.50	-8.81	-39
Observations	20367	20361	20361	20348	20352	9792	14072	9792
Panel B: Ages 50-80 but without Age 65 in HTHS								
Age 65+	-0.067**	-0.033**	-0.036**	-0.044**	-0.049**	-66.8	-305.88	-0.405**
	(0.015)	(0.01)	(0.011)	(0.011)	(0.012)	(303.852)	(317.37)	(0.083)
Mean pre 65	0.171	0.099	0.082	0.104	0.092	936.05	1000	936.05
Relative Effect (%)	-39.18	-33.33	-43.90	-42.31	-53.26	-7.14	-30.59	-41
Observations	29155	29146	29147	29133	29134	13602	14072	13602
Panel C: Ages 50-80 but without Ages 64-66 in HTHS								
Age 65+	-0.070**	-0.032*	-0.029*	-0.038*	-0.038*	387.26	-476.92	-0.424**
	(0.025)	(0.015)	(0.012)	(0.017)	(0.018)	(265.)	(723.48)	(0.148)
Mean pre 65	0.172	0.1	0.083	0.105	0.092	947.89	1000	947.89
Relative Effect (%)	-40.94	-32.00	-34.94	-36.19	-41.30	40.83	-47.69	-42
Observations	27238	27229	27230	27218	27217	12647	14072	12647

Notes: + significant at 10%; * significant at 5%; ** significant at 1%. Data are from the 2003, 2007 and 2010 waves of the Health Tracking Household Survey. Panel A restricts to respondents ages 55 to 75. Panel B and C includes respondents ages 50 to 80 with the exception of those age 65 (Panel B) or those ages 64 to 66 (Panel C). All regressions include a constant, an indicator for ages 65 and above and a quadratic in age in quarters that is allowed to vary on either side of age 65. Standard errors are clustered by age in years.