Medicare Part D and its Effect on the Use of Prescription Drugs and Use of Other Health Care Services of the Elderly

October 2011

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Abstract

We examine the effect of gaining prescription drug insurance, as a result of Medicare Part D, on use of prescription drugs and other medical services for a nationally representative sample of Medicare beneficiaries. Given the heightened importance of prescription drugs for those with chronic illness, we provide separate estimates for elderly in poorer health. We find that Medicare Part D significantly reduced socioeconomic and geographic disparities in prescription drug insurance among elderly. Gaining prescription drug insurance through Medicare Part D was associated with a 30 percent increase in the number of annual prescriptions and a 40 percent increase in expenditures on prescription drugs for both the general population of elderly and elderly in poorer health. We found little evidence that prescription drug insurance was strongly associated with the use of outpatient and inpatient services, although our investigation of these associations was limited by a lack of statistical power.

Keywords: prescription drugs, insurance, inpatient, outpatient, health

JEL: I12, I18, J14

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Introduction

The Medicare Modernization Act of 2003 (MMA) created a prescription drug benefit—Medicare Part D—for the elderly. The creation of Medicare Part D was motivated, in part, by the relatively large fraction of elderly without prescription drug coverage, the growing financial burden of prescription drug spending among the elderly, and the significant and growing clinical importance of prescription drugs. Around the time of passage of the MMA, approximately one-third of seniors did not have prescription drug insurance (see Table 1 in text; Khan and Kaestner 2009; Levy and Weir 2009). The lack of prescription drug coverage resulted in substantial out-of-pocket spending on prescription drugs. Among the elderly without prescription drug insurance, 50 percent had annual out-of-pocket spending on prescription drugs of $1,200 or more in 2003 (Safran et al. 2005).[1] This amount of out-of-pocket spending represents approximately eight percent of median income of the elderly in 2003.[2] In comparison, food expenditures represent approximately 10 percent of elderly consumption on average (Breischer et al. 2010). Finally, the share of income spent on prescription drugs is likely to be larger for elderly with low-incomes and chronic diseases for which prescription drugs are essential to maintaining good health.

The financial uncertainty associated with the onset of illness for which treatment by prescription drugs is beneficial suggests that Medicare Part D is likely to have had significant welfare benefits for those without prescription drug insurance prior to Medicare Part D. In addition to the financial (insurance) benefits, Medicare Part D may have had significant health consequences, as the program likely increased access and use of prescription drugs that can improve health. However, Medicare Part D is a costly program. Part D provided a subsidy to all Medicare beneficiaries even though approximately two-thirds of Medicare enrollees had prescription drug benefits prior to creation of Part D and would have likely

[1] These figures are for those who reported prescription drug use, which is approximately 90% of all elderly.
[2] Median income in 2004 was $15,593 (EBRI Employee Benefit Research Institute Notes, Volume 28, No. 5, May 2007, http://www.ebri.org/pdf/notespdf/EBRI_Notes_05-2007.pdf, website last accessed April 28, 2011). Note that median income figure includes income from all sources: assets, pensions, social security and other. While median income may understate wealth, most persons with incomes below the median obtain most of their income from social security. Indeed, income from assets accounts only for 14% of average income.

continued to have such benefits in the absence of Part D.[3] The universal nature of the subsidy significantly raised the cost of providing prescription drug insurance to the "newly insured" because for each newly insured person, the government provided a subsidy to two other persons who already had insurance.[4] In 2010, the federal government spent $52.6 billion on Medicare Part D, and Medicare Part D has a projected, net present value deficit (liability) of $7.2 trillion.[5]

The size and potential significance of Medicare Part D has generated interest in its effects. The overarching question is whether the benefits of the program justify the costs. Within this larger question is a narrower one of particular salience: what did Medicare Part D do for those who did not have, or would not have had, prescription drug insurance without it? While Part D benefits were extended to all Medicare enrollees, it was the group of seniors that lacked prescription drug insurance that were often a focus of the Congressional debate surrounding the creation of Part D.[6] In addition, this is the group that experienced the greatest change in prescription drug insurance pre- to post-Part D. Evidence at the time suggested that elderly without prescription drug insurance were particularly likely to forego buying essential medications, and that this adversely affected their health and increased their use of other medical services (Soumerai et al. 2006; Piette et al. 2004; Adams et al. 2001).

In this paper, we provide an assessment of the effect of Medicare Part D on the previously uninsured. We begin by describing the characteristics of those who were without prescription drug insurance prior to the creation of Medicare Part D, and then show changes pre- to post-Medicare Part D in prescription drug coverage by those characteristics. Using the variation in prescription drug coverage due

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[3] Insurance market failures related to adverse selection provide a partial rationale for government intervention in the prescription drug insurance market. To counter adverse selection, the government provided large subsidies and "late enrollment" penalties. Heiss et al. (2009) reported estimates showing that the subsidies were more important than the "late enrollment" penalties in encouraging very high rates of participation.

[4] Engelhardt and Gruber (2010) estimate that 80% of those covered by Medicare Part D would have had prescription drug insurance in the absence of Medicare Part D.

[5] *2011 Annual report of the Boards of Trustees of the Federal Hospital Insurance and Federal Supplementary Medical Insurance Trust Funds* (https://www.cms.gov/ReportsTrustFunds/downloads/tr2011.pdf) and *A Citizen's Guide to the 2009 Financial Report of the U.S. Government* (http://www.fms.treas.gov/fr/09frusg/09frusg.pdf).

[6] A review of the Congressional Record provides numerous statements by Representatives and Senators that the lack of prescription drug insurance among the elderly and financial burden imposed by prescription drugs was a particular problem that needed redress. For typical examples, see statements of Senator Ted Kennedy (http://thomas.loc.gov/cgi-bin/query/F?r108:1:./temp/~r108aLn3B2:e48032:#) and Senator Conrad (http://thomas.loc.gov/cgi-bin/query/F?r108:432:./temp/~r108S8EYe2:e0:#).

to Medicare Part D, which is plausibly exogenous, we examine the effect of gaining prescription drug insurance on the use of prescription drugs. We also provide a more limited, descriptive analysis of the effect of gaining prescription coverage on the use of other medical services. Notably, estimates are obtained using a nationally representative sample of non-Medicaid eligible, Medicare beneficiaries drawn from the Medicare Current Beneficiary Survey in the years 2000 to 2007. Given the heightened importance of prescription drugs for those with chronic illness, we provide separate estimates for those in poorer health.

Results from our analysis are as follows. We find that the expansion of prescription drug coverage, as a result of Medicare Part D, differed substantially by demographic and socioeconomic characteristics. The largest increases in prescription coverage occurred for those who were relatively low-educated, who had relatively low income, and who lived in rural areas. We also find that gaining prescription drug insurance through Medicare Part D was associated with approximately a 30 percent increase in the number of annual prescriptions and a 40 percent increase in total expenditures on prescription drugs. These findings apply to both the general population of non-Medicaid elderly, and non-Medicaid elderly with three or more self-reported chronic illnesses. We also find that gaining prescription drug insurance through Medicare Part D was associated with a large increase in the probability of being in the top quartile of prescription drug use. Among the general population of elderly, the increase was 42 percent, and for the chronically ill elderly, the increase was 80 percent. Finally, preliminary evidence on whether gaining prescription drug insurance through Medicare Part D was associated with changes in spending on other medical services suggests that gaining insurance did not substantially reduce spending, although this is a more tentative conclusion.

Prescription Drug Insurance and Elderly Use of Prescription Drugs and Other Medical Services

Previous study of the effects of prescription drug insurance on elderly use of health care services is limited in a number of ways. In particular, there are relatively few studies that use nationally

representative samples of elderly.[7] There are also only a handful of studies that have examined the effect of prescription insurance, as much prior research has focused on analyzing changes in the generosity of prescription insurance such as changes in co-payments.

We begin reviewing the literature with studies that pre-date Medicare Part D and that used nationally representative samples of elderly. Lillard et al. (1999) used a sample of older persons drawn from the 1990 wave of the Panel Study of Income Dynamics and found that prescription drug coverage (versus no coverage) increased the probability of any use of prescription drugs by 12 percent. Yang et al. (2006) using data from the Medicare Current Beneficiary Survey (MCBS) from 1992 to 2001 reported that prescription drug insurance increased expenditures on prescription drugs by approximately seven percent and decreased mortality slightly (authors do not report precise estimate). Khan and Kaestner (2009) also used the MCBS (1992 to 2000) and reported that prescription drug insurance was associated with a four percent to ten percent increase in the utilization of prescription drugs depending on the type and generosity of the coverage. In a related paper, Khan et al. (2008) found that prescription drug insurance had no effect on self reported health or functional status of Medicare beneficiaries on average, but had some beneficial, but not statistically significant, effect for a chronically ill population. In contrast, Shea et al. (2007) reported that prescription drug insurance is associated with a 50 percent increase in the number of prescriptions used among a sample from the 1999 MCBS. Finally, Breischer et al. (2005) used data from the MCBS (1995 to 2000) to examine changes in prescription drug coverage and changes in inpatient and outpatient spending. These authors reported that prescription drug coverage was associated with a 58 percent increase in spending on prescription drugs and no significant changes in inpatient or outpatient spending.

Other studies have focused on the effect of changes in cost sharing for elderly in specific prescription drug insurance plans. Soumerai et al. (1991) analyzed the impact of a three prescriptions per month limit in the New Hampshire Medicaid program on prescription drug use. Their analysis was

[7] We limit the review to studies that accounted in some way for the non-random choice of prescription drug insurance, and we do not review studies of the effect of prescription drug insurance on elderly persons with specific illnesses (e.g., Stuart et al. 2004; Hsu et al. 2006; Tjia and Briesacher 2008; and Zhang et al. 2009).

limited to non-institutionalized, white, dual-eligible elderly who had an average of three prescriptions per month at baseline, including use of at least one prescription drug for a chronic condition. Their results indicated a 35 percent decline in drug use after the cap was imposed, but no change in rates of hospitalization.

Johnson et al. (1997) examined the effects of changes in cost-sharing between 1988 and 1990 for elderly enrollees in Kaiser-Permanente Northwest Division managed care plans. The investigators reported that a $2 (66 percent) increase in co-payment resulted in a significant decrease in prescription drug use, but no significant change in hospitalization. Hsu et al. (2006) examined the impact of benefit caps on prescription drug use among elderly enrolled in Kaiser-Permanente Northern California Division, and found that caps lowered expenditures on prescription drugs by 31 percent and increased the probability of having glycated hemoglobin ≥8% by 23 percent.

Chandra et al. (2010) examined changes in co-payment for employees in the California Public Employees Retirement System. The authors reported that a doubling of co-payment from approximately $7 to $14 reduced drug utilization by between two percent and five percent for PPO participants and 15 percent for HMO participants, although the latter patients had a lower baseline co-payment. Chandra et al. (2010) reported that this increase in co-payments for prescription drugs increased the probability of hospitalization by three percent for PPO enrollees and six percent for HMO enrollees.

Medicare Part D Studies

Recently, several studies examined the effect of Medicare Part D on prescription drug use and use of other services of elderly. Lichtenberg and Sun (2007) and Yin et al. (2008) used a difference-in-difference approach limited to persons who purchased prescription drugs at Walgreens; Lichtenberg and Sun (2007) compared the elderly to non-elderly and Yin et al. (2008) compared the elderly to the near-elderly (ages 60 to 63). The results of these studies indicated that Medicare Part D was associated with between 5.9 percent (Yin et al. 2008) and 12.8 percent (Lichtenberg and Sun 2007) increase in prescription drug use of elderly. A similar difference-in-differences study was conducted by Ketcham and Simon (2008) with prescription claims data from Wolters Kluwer Health from 2004 to 2007. In this

study, elderly 66 and older were compared to persons 58 to 64. Ketcham and Simon (2008) reported that Medicare Part D was associated with a nine percent increase in prescription drug use (days of medication supplied per capita). Madden et al. (2008) examined pre- to post-Medicare Part D changes in cost-related medication non-adherence (CRN) using a sample of Medicare enrollees from the Medicare Current Beneficiary Surveys of 2004 to 2006. They reported that there was a significant decrease in CRN between 2004 and 2006 with a larger decrease between 2005 and 2006 (22 percent) than between 2004 and 2005 (9 percent). Finally, Liu et al. (2011) used data from the Medical Expenditure Panel Survey to conduct a difference-in-difference study using elderly (65 and older) and non-elderly (53-63). These authors reported that Medicare Part D was associated with a statistically insignificant 10 percent increase in the number of prescriptions filled.[8]

Note that these studies did not examine the effect of prescription drug insurance (versus no insurance) on use of prescription drugs, but were limited to an analysis of the effect of being eligible for, or enrolled in, Medicare Part D. Because approximately two-thirds of the elderly and an even greater number of the non-elderly had prescription drug insurance prior to Part D, these analyses imply much larger effects on drug use of moving from uninsured to insured. If we assume that 20 percent of the elderly moved from uninsured to insured as a result of Medicare Part D (see Table 1 in the text), and that all of the change in prescription use is due to gaining insurance, then the results of these studies suggest that the average effect of gaining Medicare Part D insurance is the following: an increase in prescription drug use of 30 percent for Yin et al. (2008); an increase in prescription drug use of 45 percent for Ketcham and Simon (2008); an increase in prescription drug use of 65 percent for Lichtenberg and Sun (2007); and a decrease in cost-related medication non-adherence of 110 percent for Madden et al. (2008).[9]

[8] Liu et al. (2011) examined changes in pharmacy and non-pharmacy spending of elderly versus non-elderly pre- and post-Medicare Part D. They find no significant difference in non-pharmacy spending (e.g., emergency room spending and inpatient spending).

[9] Interestingly, there is a large difference in the implied effect of gaining prescription drug between Yin et al. (2008) and Lichtenberg and Sun (2007) even though they used the same data. Clearly, estimates are sensitive to the choice of comparison group (non-elderly or near-elderly). Ketcham and Simon (2008) reconciled these two estimates using unpublished results of Lichtenberg and Sun. After adjustment for common time periods and similar comparison groups, Ketcham and Simon (2008) reported that estimates are similar (approximately four percent), although half

There are only three studies that we are aware of that examined the effect of Medicare Part D on those who lacked prescription drug insurance.[10] Zhang et al. (2009) who examined the impact of Part D among elderly enrolled in a Medicare Advantage plan in Pennsylvania. These authors found that moving from uninsured to insured was associated with a 74 percent increase in drug spending and a seven percent decline in non-pharmacy expenditures. Total healthcare spending increased for those who gained coverage. Schneeweiss et al. (2009) used claims data from three pharmacy chains from 2005 to 2006 to measure the change in use of several medications pre- to post-Medicare Part D among a group of previously uninsured seniors. The authors reported that drug use increased pre- to post-Medicare Part D by between 3 percent and 37 percent depending on the drug.

Afendulis et al. (2011) used state-level data from 23 states to estimate the association between prescription drug insurance coverage in a state and hospital admission rates in that state. Near-elderly aged 60 to 64 were used as a comparison group. Results indicated that that the 28 percentage point increase in prescription drug insurance between 2005 and 2007 related to Part D was associated with a 4.4 percent decline in admissions for eight conditions that are thought to be sensitive to greater use of prescription drugs.

Limitations of Previous Research and Our Contributions

There are several limitations of the previous literature that we improve upon. First, few studies used nationally representative samples to study the effect of prescription drug insurance on use of pharmacy and non-pharmacy services (e.g., Soumerai et al 1992; Johnson et al. 1997; Hsu et al. 2006; Zhang et al. 2009; and Chandra et al. 2010). While these samples and settings provide natural experiments that are an advantage from a research design perspective, the narrowness of the samples and

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the size of those reported by Ketcham and Simion (2008). Notably, the range of published estimates of the effect of Medicare Part D on elderly use of prescription drugs remains wide, and estimates are quite sensitive to the choice of comparison group and time period.

[10] Finally, McWilliams et al. (2011) used a sample drawn from the 2004 Health and Retirement Survey (HRS) and examined changes in inpatient and outpatient spending between 2004 and 2007 for persons with generous prescription drug coverage in 2004 relative to persons with no or less generous prescription drug coverage. McWilliams et al. (2011) reported a significant 10 percent decline in inpatient spending for those with no or less generous prescription drug coverage in 2004 relative to those with generous coverage.

contexts limit the applicability (i.e., external validity) of the findings. For example, results of the effect of a change in co-payment for Medicare managed care enrollees in the Pacific Northwest and Northern California, or Medicare Advantage participants in Pennsylvania, may provide little information on the effect of gaining prescription drug insurance through Medicare Part D for a nationally representative sample of persons. In contrast to these studies, we use a nationally representative sample of elderly. We improve upon past studies that used national samples by exploiting the Medicare Part D natural experiment.

Second, a considerable amount of research has focused on the effects of smaller changes in coverage (e.g., changes in co-payments) rather than gaining prescription drug insurance, as we do in this paper (Soumerai et al. 1991; Johnson et al., 1997; Hsu et al., 2006; and Chandra et al., 2010). While these studies exploit these changes in insurance coverage in a productive way vis-à-vis research design consideraitons, the findings from these studies may provide little insight into the effect of gaining prescription drug insurance on use of prescription drugs and other medical services. [11]

Third, a careful review of some of these studies raises questions about internal validity. Studies by Briescher et al. (2005), Khan and Kaestner (2008) and Khan et al. (2009) were based on an assumption that those who changed prescription drug insurance status over time, for example those gaining coverage, were comparable to those who did not change prescription drug insurance status. This is a strong assumption in the absence of a natural experiment such as Medicare Part D and there are plausible reasons to question its validity. Other studies have reported large and immediate changes that seem implausible. Chandra et al. (2010) reported that a 3 percent increase in prescription drug use for the PPO sample was associated with a 3 percent decrease in the probability of hospitalization, a large effect that

[11] McWilliams et al. (2011) classified persons into two groups using self-reported assessment of prescription drug coverage and its generosity: generous coverage and no/less generous coverage. Notably, approximately 40 percent of the people in the no or less generous coverage group had prescription drug insurance coverage including some with very generous Medicaid coverage. Thus, the comparison between those with self-reported generous coverage and those with no or less generous coverage does not provide an estimate of the association between gaining prescription drug coverage through Part D and inpatient use. Medicare Part D pays approximately 75% of the cost of prescription drug up to the doughnut hole. So Medicare Part D is not a very generous plan and may differ little from the coverage among those who reported less generous coverage.

occurred during first quarter after the copayment change. While some treatments may result in immediate improvement in health, Chandra et al. (2010) examined all inpatient services rather than a subset tightly linked to pharmaceutical therapy. McWilliams et al. (2011) also reported an immediate (relative) decrease of 10 percent in inpatient spending in the first quarter of 2006 when Medicare Part D was only partly implemented and only a portion of the no/limited coverage group was affected. The validity of the pre- and post-test with comparison group approach used by Afendulis et al. (2011) was never assessed despite there being differences in rates of hospitalization in the pre-period between elderly and non-elderly and differences in the trend in rates of hospitalization between 2005 and 2007 between the elderly and non-elderly.[12] Finally, McWilliams et al. (2011), Afendulis et al. (2011) and Schneeweiss et al. (2009) included data from 2005 as their pre-Part D comparison year, yet during 2005 Medicare issued drug discount cards, which were provided automatically to some Medicare enrollees such as Medigap policy holders, that were widely used to purchase prescription drugs. The use of 2005 data may have biased estimates from these studies because 2005 was not a true pre-Medicare Part D year and prescription drug use and other outcomes related to it were likely atypical.

Overall, the previous literature concerned with the effect of prescription drug insurance on the use of prescription drugs and use of other medical services of the elderly is relatively limited. With respect to Medicare Part D insurance, there are only three studies that examined the effect of Medicare Part D coverage (versus no insurance) on use of health care services. Two of these studies used non-representative samples of elderly (Zhang et al. 2009; Schneeweiss et al. 2009). The other study used aggregate data at the state level (Afendulis et al. 2011). Here, we add to this literature by examining the effect of prescription drug insurance using the plausibly exogenous change in prescription drug insurance engendered by Medicare Part D. We exploit the natural experiment of Medicare Part D to obtain quasi-experimental estimates of the effect of prescription drug insurance on prescription drug use and use of

[12] These differences suggest that the near-elderly may not be an appropriate comparison group for the elderly. Ketcham and Simon (2008) examined this issue in the context of studies of the effect of Medicare Part D on use of prescription drugs, and these authors showed that published estimates are quite varied and sensitive to the choice of comparison group and time period used.

other medical services for a representative sample of elderly from the Medicare Current Beneficiary Survey (MCBS) from years 2000 to 2007. We examine the effect of prescription insurance on use of prescription drugs and the use of other medical services.

Data

Data for the analysis comes from the Medicare Current Beneficiary Survey (MCBS) from the years 2000 to 2007. We omit the year 2005 because of the availability, and significant use, of drug discount cards that were provided automatically to some Medicare enrollees (e.g., Medigap policy holders) and were available by purchase to others (Thomas et al. 2005). The MCBS data do not allow us to accurately identify whether a respondent had a drug discount card, and so we omit this year for analysis.[13] The MCBS is the only nationally representative survey that exclusively focuses on Medicare enrollees (aged 65 years and above, and disabled). Individuals are drawn using stratified random sampling from an enrollment list of persons entitled to Medicare on January 1st of that year. The stratified sampling ensures that the sample is representative of all geographical areas and age groups. Each year, a supplemental sample is added to account for attrition so as to maintain an average sample size of 12,000 individuals, and to ensure that the sample remains representative of the current Medicare population. We use a sample of non-institutionalized persons 65 to 85 years of age who have complete year information. We omit people who died during the year, and who were ever on Medicaid, not living in the community, or had end stage renal disease. [14] We also use a sub-sample of relatively sicker individuals, which we refer to as the chronically ill or poor health sample. These are persons who reported three or more chronic illnesses (e.g., hypertension, asthma, arthritis).

[13] The discount card program first became available on June 1, 2004 and was in operation for the full year of 2005.
[14] Approximately 18% of the MCBS sample is less than age 65 and 10% is over age 85. Approximately 20% of sample is on Medicaid. Finally, approximately 6% are not living in the community and 6% died or do not have full year information. Thus, our analysis sample represents approximately 40% , or 5000, of the 12,000 annual MCBS sample. Persons on Medicaid were dropped because they are very different in terms of both dependent and independent variables as compared to others in the sample. In addition, those on Medicaid experienced a significant change in insurance coverage due to Medicare Part D, as they were transitioned from state programs to Low-income Subsidy Prescription Drug Plan.

Each sampled individual is interviewed face-to-face three times per year for four years. After four years, the individual is retired from the survey and a new panel is added.[15] Data is released in two file formats, Access to Care and Cost and Use. Cost and Use provides detailed description of the respondent's insurance status including prescription insurance, health status, medication utilization, other health care utilization, and demographic and socioeconomic characteristics. We used the Cost and Use files from 2000-2007, which is the latest available year of data.

A particular strength of the MCBS is the validity checks performed by CMS. Respondents are asked to show receipts, bills, drug vials, and any related paperwork to document prescription drug use and drug insurance. The use of Computer Assisted Personal Interview program and prescription bills, vials, and bottles enhances the accuracy of the collected information during the interview process. After the interview, CMS uses the administrative claims database and other algorithms to clean, supplement, and validate the data. These validity checks have greatly reduced missing information and improved accuracy of the survey (Eppig and Chulis 1997). Nevertheless, there may be measurement error in reported use of prescription drugs that could be systematic. To bias estimates, the measurement error would have to change over time and change differentially for those more or less likely to be without prescription drug insurance prior to Medicare Part D.

MCBS respondents report up to five sources of non-Medicare insurance and prescription drug coverage. The respondent reported the start and stop dates of the insurance and whether this source of insurance provided prescription drug coverage. Based on this information, we assigned a person to insured or uninsured category for each month in the survey. If they had prescription drug insurance for at least six months in a year, we assign them to the insured category, although there is relatively little switching from insured to uninsured.

We examine several dependent variables. Prescription drug use is measured by the self-reported, annual total number of prescription drugs dispensed including refills. We also constructed a dichotomous

[15] Sample sizes are not large enough to exploit successfully the longitudinal data, particularly because of the necessity to omit 2005.

measure indicating heavy prescription drug use, which is prescription drug use in the top quartile of the distribution: >36 prescriptions for the full sample and > 48 prescriptions for the sample of elderly in poorer health. Outpatient visits (events) is the annual total number of hospital-based and non-hospital outpatient visits. Inpatient events (hospitalization) are measured as the total number of events and whether a person had any inpatient visits. For each measure of utilization, prescription drugs, outpatient, and inpatient, we also have measures of total expenditures on these services that we used as dependent variables. All information on utilization and expenditures comes from the MCBS Cost and Use Summary File that is developed by CMS and that is intended to provide the most accurate measures of use and expenditures for all Medicare enrollees including those in managed care plans. The summary measures developed by CMS use data from administrative files and surveys.

Regression analyses also include controls for demographic and socioeconomic characteristics including age, sex, race, education, urban residence, census region of residence, income, marital status, and smoking status. These variables are included in the models as categorical variables. In some models, we include a measure of self-rated general health status (1==excellent,…,5=poor), which is entered as dummy variables. Including self-rated, general health is a potentially important way to control for unmeasured health, which theory suggests is an important determinant of both prescription drug insurance and use of prescription drugs and other medical services. While prescription drug insurance (drug use) may affect health (reverse causality), we believe that this is unlikely to be the case for the self-reported measure of general health we use. However, we report results from models that include and exclude the measure of general measure.

Who Gained Prescription Insurance Coverage from Medicare Part D?

While Medicare Part D was a universal program open to all elderly, approximately two-thirds of elderly had prescription drug insurance prior to Part D. Therefore, less than one-third of the elderly gained prescription drug insurance because of Part D. Who were the elderly who gained coverage? Table 1 presents the proportion of elderly with prescription drug insurance by year and by demographic and socioeconomic characteristics

As shown in Table 1, prescription drug insurance was associated with age, education, income, marital status and whether a person's residence was urban or rural. For example, in 2000 to 2002, 56 percent of elderly with less than a high school degree had prescription drug insurance whereas 74 percent of elderly with a Bachelors degree or more had prescription drug insurance. Similarly, 54 percent of elderly with income below $20,000 had prescription drug insurance, but 75 percent of elderly with income of $40,000 or more had prescription drug insurance.

A second point to note about the figures in Table 1 is that between 2000-2002 and 2003-2004, there was very little change in prescription drug insurance. More importantly, because of the implication it has for the validity of our research design, which we describe later in the article, changes in prescription drug insurance between 2000-2002 and 2003-2004 did not differ by demographic or socioeconomic characteristics.

The last point to highlight about Table 1 is the large and significant changes in prescription drug insurance that occurred between 2003-2004 and 2006-2007, or pre- to post-Medicare Part D. In contrast to changes in prescription drug insurance between 2000 and 2004, which were largely the same (zero) for all persons, changes in prescription drug insurance between 2004 and 2007 were large and differed significantly by demographic and socioeconomic characteristics. Consider changes in prescription drug insurance by education. Between 2004 and 2007, prescription drug insurance increased by 32 percentage points for those with less than a high school education; for those with a Bachelors degree or more, the similar increase was only 19 percentage points. In general, the figures in Table 1 indicate that Medicare Part D greatly reduced demographic and socioeconomic disparities in prescription drug insurance. From a research design perspective this is variation that can be used to identify the effect of prescription drug insurance on prescription drug use and the use of other medical services. For example, assuming that gaining prescription drug insurance increases use of prescription drugs, changes in prescription drug use between 2004 and 2007 should be greater for those with low-education and low-income than for those with high-education and high-income. In addition, if changes in prescription drug insurance are what is principally causing changes in prescription drug use, then it is also to be expected that changes in

prescription drug use between 2000 and 2004 should be the same for those with low-education and low-income and those with high-education and high-income, as the change in prescription drug insurance between these periods was the same (zero) for both groups.

While it is possible to carry out a series of comparisons of changes in prescription drug insurance and changes in prescription drug use between 2004 and 2007 by demographic and socioeconomic characteristics, it is easier to accomplish the same task by combining the demographic and socioeconomic characteristics listed in Table 1 into an index measuring the probability of being without prescription drug insurance prior to Part D. After all, education, income and other characteristics in Table 1 are simply proxy measures for the probability of being without prescription drug insurance prior to Part D and, therefore, proxy measures of the extent to which Medicare Part D affected such groups by providing access to prescription drug insurance. Constructing an index of the probability of being without prescription drug insurance prior to Part D is a more parsimonious way to measure the effect of Medicare Part D on prescription drug insurance.

Accordingly, we used the characteristics listed in Table 1 with the addition of two more, gender and Census region of residence, to construct an index of the probability of being without prescription drug insurance prior to Medicare Part D. We used regression methods to construct the index. Specifically, we used data from 2000 to 2003 to estimate the following regression model:

$$\begin{aligned} & UNIN_{it} = \mu + X_{it}\pi + e_{it} \\ (1)\quad & i = 1,...,N \\ & t = 2000,2001,2002,2003 \end{aligned}$$

In equation (1), the probability that person i in year t does not have prescription drug insurance prior to Medicare Part D—we used the years 2000 to 2003—depends on demographic and socioeconomic factors (X_{it}). We constructed the predicted probability of being uninsured using the parameter estimates from equation (1):

$$(2)\quad \hat{UNIN}_{it} = \hat{\mu} + X_{it}\hat{\pi} .$$

Thus, our measure of the predicted likelihood of being uninsured prior to Medicare Part D is just a linear combination of (exogenous) demographic and socioeconomic characteristics.

Table 2 presents the regression estimates from equation (1). Estimates were obtained for all elderly and for a sub-sample of those who reported at least three chronic illnesses. Estimates listed in Table 2 are consistent with the associations found in Table 1. Education and income were negatively and significantly related to the probability of being without prescription drug insurance prior to Medicare Part D, and elderly who lived in rural areas were significantly more likely to be without prescription drug insurance prior to Part D. There is also some variation across Census regions in prescription drug insurance. Estimates are largely the same for the sub-sample of chronically ill elderly as for the full sample (and the sample of non-chronically ill).

As noted, we used the estimates in Table 2 to construct an index of the probability of being without prescription drug insurance. For each person in each year, we calculated the predicted probability of being uninsured using equation (2). We then divided the sample into quartiles of the predicted probability of being without prescription drug insurance in each year. Table 3 presents the proportion of elderly with prescription drug insurance by year and by quartile of the predicted probability of being uninsured prior to Medicare Part D.

Not surprisingly, figures in Table 3 indicate that prescription drug insurance is strongly related to the probability of being without prescription drug insurance prior to Medicare Part D. The key observation related to Table 3 is that the gap in prescription drug insurance between those in the 1st and 4th quartiles is markedly (significantly) smaller in 2006-2007, post Medicare Part D, than in 2000-2002 (or 2003-2004). In other words, it is clear that Medicare Part D increased prescription drug insurance more for those whose demographic and socioeconomic characteristics make them more likely to be uninsured prior to Part D. It is also the case that changes in prescription drug insurance between 2000-2002 and 2003-2004 were insignificant and the same (zero) for all four quartiles. Between 2003-2004 and 2006-2007, changes in prescription drug insurance were significantly larger for those more likely to be uninsured prior to Part D.

Associations between the predicted probability of being uninsured prior to Part D and prescription drug insurance can be obtained using regression methods, and doing so highlights some of the important aspects of the research design that we use to obtain estimates of the association between prescription drug insurance and use of prescription drugs and other medical services. Specifically, we estimated the following regression model for prescription drug insurance (*INSURED*):

$$(3)\quad INSURED_{it} = \alpha + \sum_{k=2}^{4} \rho_k \hat{UNIN}_{kit} + \sum_{t=2001}^{2007} \theta_t YEAR_t + \sum_{t=2001}^{2007} \sum_{k=2}^{4} \delta_{kt} (\hat{UNIN}_{kit} * YEAR_t) + X_{it}\lambda + e_{it}$$

In equation (3), prescription drug insurance depends on dummy variables indicating the quartile of the predicted probability of being without prescription drug insurance prior to Part D ($\hat{UNIN}_{kit}$), year effects (*YEAR*), demographic and socioeconomic characteristics (*X*), and interactions between year and quartile of the predicted probability of being without prescription insurance. Except for the inclusion of separate year effects (e.g., 2003 and 2004 instead of 2003 or 2004) and demographic and socioeconomic characteristics, equation (3) would produce identical information as shown in Table 3.

Estimates of equation (3) are presented in Table 4. Estimates were obtained by Ordinary Least Squares (OLS) regression methods, and we present separate estimates for the entire sample and those in poorer health, which we define as those with three or more chronic illnesses. We refer to the latter group as the "chronically ill" sample. Standard errors are constructed allowing for non-independence within person (i.e., clustered on the individual).

For the complete sample, estimates in the left panel of Table 4 have a clearly identifiable pattern consistent with the figures in Table 3. The more likely a person was of being without prescription drug insurance prior to Part D, as measured by the quartiles of the distribution of being uninsured, the more likely they were to gain prescription drug insurance subsequent to Medicare Part D (2006 and 2007). For example, estimates associated with being in the top quartile of the distribution of the probability of being uninsured are 0.218 in 2006 and 0.265 in 2007. Relative to those in the bottom quartile of the probability of being uninsured, those in the top quartile were approximately 27 percentage points more likely to gain prescription drug insurance by 2007. Note also, that these estimates are nearly equal to the differences

between quartiles reported in Table 3. Adjusting for covariates and including dummy variables for each year have little effect on estimates. Finally, the F-statistic on the year 2006 and year 2007 interactions is large and highly significant. These results provide evidence that the instrumental variables (IV) approach we employ to obtain estimates of associations between prescription drug insurance and prescription drug use and use of other medical services is reasonable in terms of the correlation between the instrument (essentially the 2006 and 2007 interactions) and prescription drug insurance coverage. Estimates obtained using the sample of chronically ill are very similar to those for the entire sample.

Estimates (not shown) associated with the interactions between the quartiles of the probability of being uninsured and the year dummy variables prior to 2006 are not statistically significant and small in magnitude (estimates not shown). In Table 4, we report the F-statistic and p-value associated with the test that the pre-2006 interactions between the quartiles of the predicted probability of being without prescription insurance and year dummy variables are jointly zero. The p-value for this test for the complete sample is 0.41, and for the chronically ill sample 0.79. This result also provides support for the IV approach we use to obtain estimates of associations between prescription drug insurance and prescription drug use and use of other medical services. The IV approach is based on the Medicare Part D natural experiment and the assumption that pre- to post-Medicare Part D, those in different quartiles of the distribution of the probability of being uninsured would have similar trends in outcomes. The F-statistics reported in Table 4 show this to be true for prescription drug insurance.

Estimates of Associations between Prescription Drug Insurance and Prescription Drug Use

We exploited the natural experiment afforded by Medicare Part D, which was fully implemented in 2006, to estimate the effect of prescription drug insurance on use of prescription drugs and use of other medical services of the elderly. Our research design is an instrumental variables (IV) approach that uses variation in prescription drug insurance caused by Medicare Part D.

The objective is to obtain estimates of the association between prescription drug insurance and prescription drug use (and other outcomes). The regression model to accomplish this task is given by:

$$PRES_{it} = \alpha + \phi_1 INSURED_{it} + \sum_{t=2001}^{2007} \beta_t YEAR_t + X_{it}\lambda + v_{it}$$

(4) $i = 1,..., N$

$t = 2000,...,2004,2006,2007$

In equation (4), the number of prescription drugs used by person i in year t ($PRES_{it}$) depends on prescription drug insurance (*INSURED*), year effects ($YEAR_t$), and other measured demographic and socioeconomic factors (X_{it}) such as age, race, marital status and income. Note that we do not use data from 2005 because in 2005, prescription drug discount cards were available to Medicare beneficiaries, but we are unable to accurately identify who did or did not have a (subsidized) discount card.

The empirical challenge associated with equation (4) is that prescription drug insurance is not randomly chosen and those with prescription drug insurance may differ by measured and unmeasured characteristics from those without prescription drug insurance. For example, those with prescription drug insurance may be sicker and/or more risk averse than those without insurance, and both of these factors would likely affect prescription drug use and use of other services. In general, estimates of equation (4) will be biased because prescription drug insurance is likely to be correlated with the error term (v_{it}).

To address this problem, we use an instrumental variable procedure. We use variation in prescription drug insurance caused by the implementation of Medicare Part D to obtain estimates of the association between prescription drug insurance and the outcomes listed earlier. Specifically, we used the residual inclusion approach because of the non-linear regression methods we employ (Newey 1987; Terza et al. 2008). The logic of the residual inclusion approach is based on the following (linear) relationships:

(5) $$PRES_{it} = \alpha + \phi_1 INSURED_{it} + \sum_{t=2001}^{2007} \beta_t YEAR_t + X_{it}\lambda + (\phi_2 RES_{it} + v_{it})$$

(6) $$INSURED_{it} = \alpha + \sum_{k=2}^{4} \rho_k \hat{UNIN}_{kit} + \sum_{t=2001}^{2007} \theta_t YEAR_t + \sum_{t=2001}^{2007} \sum_{k=2}^{4} \delta_{kt} (\hat{UNIN}_{kit} * YEAR_t) + X_{it}\lambda + RES_{it}$$

Equation (5) is the same as equation (4) except that the error term now includes an unobserved variable (RES_{it}) that is correlated with both prescription drug use ($PRES_{it}$) and prescription drug insurance

($INSURED_{it}$). It is this unmeasured variable that causes the bias in the estimate of the association between prescription drug insurance and prescription drug use. Equation (6) specifies the relationship between prescription drug insurance and the unmeasured variable (RES_{it}). Note that it is the same as equation (3) with the error relabeled (*RES*).

The residual inclusion method proceeds in two steps. First, equation (6) is estimated to obtain a predicted measure of RES_{it} :

(7) $\hat{RES}_{it} = INSURED_{it} - \hat{INSURED}_{it}$

Next, the predicted measure of RES_{it} is used to estimate equation (5).

(8) $PRES_{it} = \alpha + \phi_1 INSURED_{it} + \sum_{t=2001}^{2007} \beta_t YEAR_t + X_{it}\lambda + \phi_2 \hat{RES}_{it} + v_{it}$

In practice, we estimate a slightly modified version of equation (8). We include the square of RES_{it} and also the variable $\hat{UNIN}_{kit}$.

(9) $PRES_{it} = \alpha + \phi_1 INSURED_{it} + \sum_{k=2}^{4} \gamma_k \hat{UNIN}_{kit} + \sum_{t=2001}^{2007} \beta_t YEAR_t + X_{it}\lambda + \phi_2 \hat{RES}_{it} + \phi_2 \hat{RES}_{it}^2 + v_{it}$

Estimates of equation (9) are obtained using a variety of methods appropriate to the dependent variable. Measures of utilization are counts of the number of events (visits) per year, and for these variables we use Negative Binomial regression methods (and Logit first stage to estimate probability of having prescription drug insurance). When we use dichotomous versions of utilization, we used Logit regression methods. We also examine expenditures on services, which are continuous variables. For expenditures, we used a Gamma regression model (Logit first stage). Standard errors of the instrumental variables estimates are obtained using the procedure of Murphy and Topel (1985), and allow for clustering of errors at the individual level.

The identifying assumption of the instrumental variables approach is that, in the absence of Medicare Part D, changes in prescription drug use and other outcomes are the same for those more or less likely to be without prescription drug insurance prior to Medicare Part D. While we cannot test this

assumption definitively, we can provide some evidence of the validity of this assumption. Specifically, we can re-estimate equation (9) including interactions between the probability of being without prescription drug prior to Medicare Part D and pre-2006 year dummy variables:

$$PRES_{it} = \alpha + \phi_1 INSURED_{it} + \sum_{k=2}^{4} \gamma_k \hat{UNIN}_{kit} + \sum_{t=2001}^{2004} \sum_{k=2}^{4} \delta_{kt} (\hat{UNIN}_{kit} * YEAR_t) + \sum_{t=2001}^{2007} \beta_t YEAR_t + X_{it}\lambda + \phi_2 \hat{RES}_{it} + \phi_2 \hat{RES}_{it}^2 + v_{it} \quad (10)$$

Equation (10) is the "just identified" model that excludes only the interactions between the probability of being without prescription drug prior to Medicare Part D and the year 2006 and 2007 dummy variables. A test of the validity of the IV approach (over identification restrictions) is $\delta_{kt} = 0$. The pre-2006 interaction effects measure whether changes in prescription drug use and use of other medical services are the same for those more or less likely to be without prescription drug insurance prior to Medicare Part D. We report the results of these statistical tests below, but note here that in only a small proportion of instances can we reject the hypothesis that $\delta_{kt} = 0$.

It is important to note that the instrumental variables approach yields estimates of effects of prescription drug use on outcomes that are applicable to those who were affected by Medicare Part D (local average treatment effect-LATE). Our analysis of the probability of being without prescription drug insurance prior to Medicare Part D indicates that education, income, race and region are all significant predictors of being uninsured (see Table 2). In sum, those without prescription drug insurance prior to Medicare Part D tend to low-educated, low-income, black, and more likely to come from some regions (e.g., east and west south central) than others. Thus, our estimates of the effect of prescription drug coverage due to Medicare Part D are most applicable to persons (in our sample) with these characteristics. Because a substantial portion of this group may be eligible for the low-income subsidy of Medicare Part D, results of the analysis are likely to reflect this more generous insurance coverage in the Low Income Subsidy program of Medicare Part D than the typical elderly person received in Part D.

It is also important to note that the IV approach is not strictly valid if there were general equilibrium effects associated with Medicare Part D, for example, if prices of prescription drugs changed. In addition,

there is the possibility that some elderly with prior prescription drug insurance switched insurance plans (i.e., generosity) as a result of Medicare Part D. Given these possible general equilibrium changes, IV estimates will be measuring the effect of gaining coverage among those previously uninsured and the effect of any, arguably minor, change in prices or the generosity of prescription drug insurance among those with prescription drug insurance.[16] At a minimum, the IV estimate of associations between prescription drug insurance and outcomes that we obtain can be interpreted as the effect of a relative, large change in the generosity of insurance. This interpretation is not altered by changes in prices or plan generosity for those with and without prescription drug insurance prior to Part D.

Results-Instrumental Variables

Table 5 reports the average number of annual prescriptions by year, by demographic and socioeconomic characteristics and by quartile of the probability of being without prescription drug insurance prior to Medicare Part D. During the pre-Medicare Part D period, we observe a slightly rising number of annual prescriptions, but between 2004 and 2007 there is a significant increase in the use of prescription drugs. Notably the change in prescription drug use between 2004 and 2007 is largest for those most likely to be uninsured prior to 2006. For example, the change in the annual number of prescriptions between 2004 and 2007 for those with less than a high school degree was 10. This group experienced a 32 percentage point increase in prescription drug insurance during the same period. On the other hand, the change in the annual number of prescriptions between 2004 and 2007 for those with a Bachelors degree or more was 6.7. This group experienced a 19 percentage point increase in prescription drug insurance during the same period.

Differences in prescription drug use by quartile of the predicted probability of being uninsured are presented at the bottom of Table 5. Remember that, between 2004 and 2007, those in the 1st quartile experienced the smallest gains in prescription drug insurance and those in the 4th quartile experienced the

[16] Duggan and Scott (2010) concluded that Medicare Part D reduced prices paid to manufacturers of prescription drugs by between 13% and 20%.To the extent that retail prices of prescription drugs changed post-Medicare Part D, IV estimates will include both the effect of prescription drug insurance and effect of price changes. However, since the price effect also affected those who always had insurance, the general price decline will affect both groups and part of this effect will be differenced out of estimates.

largest gains in prescription drug insurance. As can be observed in Table 5, those in the 1st quartile experienced the smallest increase in prescription drug use and those in the 4th quartile experienced the largest increase in prescription drug use, and the difference is statistically significant. These descriptive results suggest that prescription drug insurance significantly increased prescription drug use. Note, however, that changes in prescription drug use between 2000 and 2004 were the same for persons in all four quartiles. Thus, prior to Medicare Part D, trends in prescription drug use did not differ significantly by quartile of the predicted probability of being uninsured. This is evidence in support of the IV research design.

In Table 6, we present estimates of the effect of prescription drug insurance on annual use of prescription drugs for the entire sample (left panel) and the sample of chronically ill (right panel). Several models were estimated. Starting with the full sample (left panel), estimates in column (1) from a negative binomial regression indicate that prescription drug insurance is associated with a statistically significant 18.6 percent increase in prescription drug use. Adding self-reported general health status to the model (column 2) has little effect, as the estimate remains almost the same (17.4 percent). Instrumental variables estimates in column 3 indicate that prescription drug insurance is associated with a statistically significant 29.3 percent increase in prescription drug use.[17] Again, adding self-reported general health to the model has little impact. Note too, that we cannot reject the over identification restrictions implied by the instrumental variables model, and recall that evidence from Table 4 revealed that the first stage correlation between the instruments and prescription drug insurance was very strong. The IV estimate in column 6 indicates that prescription drug insurance is associated with an 11.0 percentage point (42 percent) increase in the probability of being a heavy prescription drug user (greater than 36 prescriptions annually). Here too, we cannot reject the over identification restrictions. Finally, in column (7), the IV estimate indicates that prescription drug use is associated with a statistically significant 42.9 percent

[17] Note that non-IV and IV methods estimate different parameters. The IV estimate represents a LATE parameter, and this may differ from the non-IV estimate, which is a likely biased estimate of the Average Treatment Effect (ATE). There is no reason to expect these estimates to be the same, or for one estimate to be smaller or larger than the other. In addition, the bias of the non-IV estimate may be positive or negative. For example, adverse selection may suggest a positive bias whereas advantageous selection would suggest a negative bias.

increase in prescription drug expenditures, and we cannot reject the over identification restrictions for this outcome. In sum, evidence in Table 6, indicates that obtaining prescription drug insurance through Medicare Part D was associated with a large, 30 to 40 percent, increase in the use of, and expenditures on, prescription drugs.[18]

The right panel of Table 6 presents results for the sample of persons with three or more self-reported chronic illnesses. Estimates are very similar to those for the full sample. IV estimates indicate that prescription drug insurance is associated with a 30 to 40 percent increase in the use of, and expenditure on, prescription drugs. For this sample, we reject the over identification restrictions in one case.

The magnitudes of estimates in Table 6 are smaller than those reported in the only other study related to Medicare Part D. Zhang et al. (2009) found that moving from uninsured to insured was associated with a 74 percent increase in drug spending for Medicare Advantage enrollees in Pennsylvania. Our sample is a nationally representative sample, but the IV estimate pertains to only part of that sample—those who gained insurance through Part D. As noted, these are elderly with relatively low education and low income that live in rural areas.

Results-Fixed Effects

We conducted an alternative analysis to the instrumental variables approach that exploited the longitudinal aspect of the MCBS survey.[19] For this analysis, we limited the sample to persons who were in the MCBS survey in both 2004 and 2006. This selection criterion resulted in 1583 persons. We then estimated fixed-effects regression models (identical to equation 5 except for the years included) by Ordinary Least Squares allowing each person to have their own intercept. The identifying assumption of this approach is that changes in prescription drug insurance between 2004 and 2006 were exogenous and caused by Medicare Part D. In fact, between 2004 to 2006 only 24 of 1065 people switched from having

[18] The MCBS reported the therapeutic class of the prescription, but there were many unclassified drugs. Given this caveat, analyses using the same methods as described above indicated that prescription drug insurance was associated with approximately a 10 percent increase in the number of therapeutic classes used by elderly.
[19] Results available from authors upon request.

prescription insurance in 2004 to not having it in 2006; during the same period 368 out of 518 people who did not have prescription drug insurance in 2004 gained coverage by 2006. The estimate of the association between prescription drug insurance and the number of prescriptions from the fixed effects regression was 4.8 (standard error of 1.1). In relative terms, the fixed effect estimate represents an 18 percent increase relative to the mean prescription drug use of uninsured persons in 2004, which is in line with the estimates reported in Table 6. The fixed effect estimate of the association between prescription drug insurance and total spending on prescription drugs was $431, which is 31 percent of mean spending on prescription drugs of uninsured persons in 2004. This estimate is similar to that reported in Table 6.

Associations between Prescription Drug Insurance and Use of Other Services

A prominent hypothesis is that the financial access to prescription drugs afforded by prescription insurance results in greater and more appropriate (e.g., better adherence) use of prescription drugs, and that this increase in prescription use has positive spillovers on the use of other services, for example, less use of inpatient services. Here, we examine whether prescription drug insurance is associated with use of and expenditures on outpatient and inpatient services. We provide only a descriptive analysis because, for these outcomes, we lack the statistical power to obtain sufficiently precise estimates.

Table 7 presents the average use of outpatient and inpatient services by year and by quartile of the predicted probability of being uninsured prior to Medicare Part D. The top panel presents estimates for the full sample, and the bottom panel present estimates for the sample of chronically ill. In regard to outpatient services, there is a modest (5 to 10 percent) increase in use of outpatient services between 2000 and 2004 for both the general population and the sub-sample of chronically ill. Note, however, that the increases in outpatient services between 2000 and 2004 are the same (statistically speaking) for those in all quartiles of the predicted probability of being without prescription drug insurance. Between 2004 and 2007, there were smaller increases in the use of outpatient services than between 2000 and 2004, and during this period too, increases in outpatient services were the same for those in all quartiles of the predicted probability of being without prescription drug insurance. If prescription drug insurance had large effects on the use of outpatient services, then changes in the use of outpatient services should

correspond to changes in prescription drug insurance; for example, the change in outpatient use should have been the greatest for those in the 4th quartile of the of the predicted probability of being without prescription drug insurance. This does not appear to be the case, but we lack the statistical power to know this definitively. The figures in Table 7 pertaining to any use of inpatient services are similar in that there does not seem to be a strong association between quartile of the predicted probability of being without prescription drug insurance prior to Part D, and thus changes in prescription drug insurance, and changes in the use of inpatient services.

Table 8 presents data on expenditures for outpatient and inpatient services by quartile of the predicted probability of being without prescription insurance prior to Part D. These figures are consistent with those in Table 7. Between 2000 and 2004, and 2004 and 2007, there was an increase in spending on outpatient services, but increases in spending did not differ significantly by the predicted probability of being without prescription drug insurance in either period. There was also no systematic association between increases in spending on inpatient services and quartile of the predicted probability of being without prescription drug insurance prior to Part D.

Conclusions

The growing clinical and financial importance of prescription drugs, particularly among the elderly, highlighted the absence of a prescription drug component in Medicare, and in part, led to the creation of Medicare Part D. While Medicare Part D is for all seniors, it was the experiences of those who lacked prescription drug insurance prior to Part D that policymakers often referred to as a reason for creating Part D. In this paper, we assessed the effects of Medicare Part D on this group who tend to be low-educated, low-income, black and living in rural areas. Specifically, we obtained estimates of the association between prescription drug insurance, as provided by Medicare Part D (versus no coverage), on the use of prescription drugs, and use of outpatient and inpatient services.

To obtain the estimates of interest, we exploited the natural experiment afforded by Medicare Part D and the fact that most elderly had prescription drug insurance prior to Medicare Part D. This enabled us to compare changes in outcomes between those more or less likely to gain prescription drug insurance as

a result of Medicare Part D. We then used these differential responses to Medicare Part D to identify the effect of prescription drug insurance on outcomes. We provided substantial evidence that this empirical approach was reasonable.

We found that prescription drug insurance is associated with a significant increase in the use of prescription drugs. Estimates suggest that gaining prescription drug coverage through Medicare Part D was associated with approximately a 30 percent increase in the use of prescription drugs for both the general population of elderly for those elderly in poorer health (chronically ill sample). Much of the increase in prescription drug use was due to moving persons into the upper quartile of use; prescription drug insurance was associated with a 42 increase in the probability of being in the upper quartile of prescription drug use among the general population. Prescription drug insurance was also associated with approximately a 40 percent increase in total expenditures on prescription drugs. Our estimates are smaller than the only other study that examined this same question. Zhang et al. (2009) reported that gaining prescription drug insurance through Medicare Part D was associated with a 74 percent increase in spending on prescription drugs for enrollees in a Medicare Advantage plan in Pennsylvania. We note that our results should be interpreted through the lens of Medicare Part D, which has a very specific benefit design, and our results are applicable to the group that gained prescription drug through Medicare Part D. Those who gained coverage in our sample (e.g., non-Medicaid) through Medicare Part D were more likely to be low-educated, low-income, black, and come from the east and west south central regions. Finally, there may have been general equilibrium effects (e.g., price changes) associated with Medicare Part D, and if so, then IV estimates will include these effects.

We also conducted a descriptive analysis of the association between prescription drug insurance and the use of outpatient and inpatient services. Overall, results from this analysis indicated that prescription drug insurance was not strongly associated with outpatient services or inpatient services. However, these results are tentative, and the analysis lacked sufficient statistical power to provide a more in depth investigation.

To summarize, we find that prescription drug insurance obtained because of Medicare Part D was associated with a large increase in prescription drug use. However, we did not find much evidence that prescription drug insurance greatly affected the use of other services, although we provided only limited evidence on this question. An important question that we, and most others, have not addressed is whether the increase in prescription drug use had benefits in terms of better health. This is an issue of central importance to assessing the efficacy of Medicare Part D and an issue that needs greater research attention.

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Table 1. Proportion of MCBS Sample with Prescription Drug Insurance by Year and Demographic and Socioeconomic Characteristics

Age	2000 to 2002	2003 to 2004	Difference (2003/4) – (2000/2)	2006 to 2007	Difference (2006/7) – (2003/4)
65-69 (reference)	0.69	0.69	0.00	0.92	0.23*
70-74	0.67	0.69	0.02	0.92	0.23*
75-79	0.64	0.63	-0.02	0.91	0.28*[a]
80-85	0.60	0.62	0.02*	0.90	0.28*[a]
Race					
Non-Hispanic White (reference)	0.65	0.65	0.00	0.91	0.25*
Non-Hispanic Black	0.60	0.60	-0.01	0.91	0.32*[a]
Non-Hispanic Other Race	0.70	0.76	0.05	0.89	0.13*[a]
Hispanic	0.68	0.73	0.04	0.94	0.22*
Education					
Less than High School (reference)	0.56	0.54	-0.01	0.87	0.32*
High School	0.65	0.65	0.00	0.92	0.26*[a]
Some College	0.71	0.71	0.01	0.92	0.21*[a]
BA or more	0.74	0.74	0.01	0.93	0.19*[a]
Income					
<20,000 (reference)	0.54	0.53	-0.02*	0.88	0.35*
21,001 to 40,000	0.71	0.70	0.00	0.91	0.21*[a]
40,001 or more	0.75	0.78	0.03*[a]	0.95	0.17*[a]
Marital Status					
Married (reference)	0.67	0.69	0.01	0.92	0.23*
Widowed	0.61	0.62	0.01	0.91	0.29*[a]
Separated/Divorced	0.60	0.57	-0.03	0.86	0.29*[a]
Never Married	0.60	0.55	-0.05	0.84	0.29*
Urban-Rural					
Urban (reference)	0.70	0.70	-0.01	0.92	0.23*
Rural	0.51	0.54	0.03*[a]	0.88	0.34*[a]

Source: MCBS Survey Cost and Use File 2000-2007

Notes:

1. The total sample size is 42639 with approximately 6,000 observations per year. Those on Medicaid , not living in the community, or who had end stage renal disease are not included in the sample.
2. * indicates that difference is statistically different from zero at the 0.05 level of significance.
3. [a] indicates that difference is statistically different from the reference category (difference) at the 0.05 level of significance.

Table 2
OLS Estimates of Associations between Demographic and Socioeconomic Characteristics
and the Probability of Being Without Prescription Drug Insurance Prior to Medicare Part D
MCBS Sample 2000 to 2003

Variable	Full Sample Coefficient	Chronically Ill Coefficient	Variable	Full Sample Coefficient	Chronically Ill Coefficient
Age 66	-0.012	-0.032	Current Smoker	0.035**	0.039**
Age 67	-0.056	-0.091**	Former Smoker	-0.005	-0.002
Age 68	-0.034	-0.048	Income 10,001-15,000	-0.059**	-0.063**
Age 69	-0.025	-0.030	Income 15,001-20,000	-0.116**	-0.128**
Age 70	-0.019	-0.044	Income 20,001-25,000	-0.190**	-0.214**
Age 71	-0.009	-0.050	Income 25,001-30,000	-0.197**	-0.196**
Age 72	-0.021	-0.038	Income 30,001-40,000	-0.212**	-0.227**
Age 73	-0.004	-0.014	Income 40,001-50,000	-0.230**	-0.248**
Age 74	-0.004	-0.003	Income 50,001 or more	-0.222**	-0.240**
Age 75	-0.009	-0.016	Census Region Mid Atlantic	0.010	0.017
Age 76	0.021	0.008	Census Region East North Central	0.002	-0.005
Age 77	0.024	0.015	Census Region West North Central	0.140**	0.134**
Age 78	0.018	0.004	Census Region South Atlantic	0.037**	0.036
Age 79	0.036	0.005	Census Region East South Central	0.096**	0.085**
Age 80	0.049	0.034	Census Region West South Central	0.008	-0.014
Age 81	0.057	0.033	Census Region Mountain	-0.098**	-0.090**
Age 82	0.036	0.003	Census Region Pacific	-0.068**	-0.073**
Age 83	0.035	0.006	Rural	0.148**	0.140**
Age 84	0.016	-0.003			
Age 85	0.042	0.019			
Female	-0.036**	-0.031**			
Widowed	0.001	-0.001			
Separated/Divorced	0.062**	0.044**			
Never Married	0.058**	0.031			
Non-Hispanic Black	-0.008	-0.029*			
Non-Hispanic Other Race	-0.017	0.012			
Hispanic	-0.039**	-0.057**			
High School	-0.049**	-0.058**			
Some College	-0.060**	-0.056**			
BA or more	-0.065**	-0.075**			
Number of Observations	25,512	14182			

Source: MCBS Survey Cost and Use File 2000-2003
Notes:
1. ** p-value <=0.05, * 0.05 < p-value < 0.10
2. p-values based on robust standard errors (clustered on person) are in parentheses.

Table 3. Proportion of MCBS Sample with Prescription Drug Insurance by Year and Predicted of Being Without Prescription Drug Insurance Prior to Part D

Full Sample	2000 to 2002	2003 to 2004	Difference (2003/4) – (2000/2)	2006 to 2007	Difference (2006/7) – (2003/4)
1st Quartile Uninsured (reference)	0.81	0.82	0.01	0.96	0.14*
2nd Quartile Uninsured	0.73	0.71	-0.01	0.92	0.21*[a]
3rd Quartile Uninsured	0.64	0.64	0.00	0.90	0.26*[a]
4th Quartile Uninsured	0.46	0.45	0.00	0.85	0.40*[a]
Chronically Ill					
1st Quartile Uninsured (reference)	0.81	0.82	0.00	0.97	0.15*
2nd Quartile Uninsured	0.74	0.73	0.00	0.93	0.20*[a]
3rd Quartile Uninsured	0.65	0.64	-0.01	0.91	0.27*[a]
4th Quartile Uninsured	0.47	0.47	0.00	0.87	0.40*[a]

Source: MCBS Survey Cost and Use File 2000-2007

Notes:

1. Predicted uninsured is constructed from estimates of a regression of the probability of being uninsured on demographic and socioeconomic characteristics using data from the 2000 to 2003 period (see Table 2 for estimates). Using these estimates (i.e., constants or weights), the probability of being uninsured is predicted for all persons in the sample from 2000 to 2007 using the current values of socioeconomic and demographic characteristics (see text for details).
2. * indicates that difference is statistically different from zero at the 0.05 level of significance.
3. [a] indicates that difference is statistically different from the reference category (difference) at the 0.05 level of significance.

Table 4
OLS Estimates of the Effect of Medicare Part D on the Probability of Having Prescription Drug Insurance

	Full Sample		Chronically Ill Sample	
2nd Quartile Uninsured*Year 2006	0.034*	0.033*	0.010	0.010
	(0.017)	(0.017)	(0.022)	(0.022)
2nd Quartile Uninsured*Year 2007	0.058**	0.056**	0.036	0.035
	(0.017)	(0.017)	(0.022)	(0.022)
3rd Quartile Uninsured*Year 2006	0.108**	0.107**	0.106**	0.106**
	(0.018)	(0.018)	(0.023)	(0.023)
3rd Quartile Uninsured*Year 2007	0.125**	0.124**	0.132**	0.133**
	(0.019)	(0.019)	(0.024)	(0.024)
4th Quartile Uninsured*Year 2006	0.218**	0.217**	0.203**	0.204**
	(0.020)	(0.020)	(0.026)	(0.026)
4th Quartile Uninsured*Year 2007	0.265**	0.264**	0.258**	0.258**
	(0.020)	(0.020)	(0.025)	(0.025)
F Statistic (p-value), Joint Test of Significance, Year 2006 and 2007 Interactions	32.2**	32.0**	20.4**	20.3**
	(0.000)	(0.000)	(0.000)	(0.000)
F Statistic (p-value), Joint Test of Significance, Pre-Year 2006 Interactions	1.0	1.0	0.7	0.7
	(0.41)	(0.41)	(0.79)	(0.77)
Health Status	No	Yes	No	Yes
Number of Observations	42639		24307	

Source: MCBS Survey Cost and Use File 2000-2007
Notes:

1. Quartiles of (predicted) uninsured were constructed from predicted uninsured, which is the probability of being uninsured prior to Medicare Part D. Predicted uninsured is constructed from estimates of a regression of the probability of being uninsured on demographic and socioeconomic characteristics using data from the 2000 to 2003 period (see Table 2 for estimates). Using these estimates (i.e., constants or weights), the probability of being uninsured is predicted for all persons in the sample from 2000 to 2007 using the current values of socioeconomic and demographic characteristics (see text for details).
2. Besides those listed in the table, covariates include: female, year of age dummy variables, race dummy variables, marital status dummy variables, income dummy variables, education dummy variables, rural dummy variable, smoking status dummy variables, region dummy variables, year fixed effects, and quartile of predicted uninsured fixed effects, and interactions between year and quartile of predicted uninsured dummy variables.
3. Robust standard errors (clustered on person) are in parentheses. ** p-value <=0.05

Table 5. Number of Prescriptions by Year and Demographic and Socioeconomic Characteristics

Age	2000 to 2002	2003 to 2004	Difference (2003/4) – (2000/2)	2006 to 2007	Difference (2006/7) – (2003/4)
65-69 (reference)	23.5	25.3	1.8*	33.8	8.5*
70-74	24.1	26.6	2.6*	32.9	6.2*[a]
75-79	26.8	27.7	0.9	36.9	9.2*
80-85	27.7	29.6	1.8*	38.9	9.4*
Race					
White (reference)	25.7	27.6	1.9*	35.5	7.9*
Black	27.4	27.4	0.1	39.2	11.8*[a]
Other Race	20.5	21.3	0.8	32.9	11.6*
Hispanic	22.0	25.4	3.5*	37.4	12.0*[a]
Education					
Less than High School (reference)	28.4	31.0	2.6*	41.0	10.0*
High School	25.4	27.2	1.8*	35.6	8.4*
Some College	24.4	26.6	2.1*	35.8	9.2*
BA or more	22.9	24.1	1.3	30.8	6.7*[a]
Income					
<20,000 (reference)	27.4	29.5	2.1*	40.6	11.0*
21,001 to 40,000	25.2	27.3	2.1*	35.7	8.4*[a]
40,001 or more	22.8	24.2	1.4*	31.4	7.3*[a]
Marital Status					
Married (reference)	24.4	25.9	1.4*	34.1	8.2*
Widowed	28.6	30.9	2.3*	40.4	9.5*
Separated/Divorced	23.6	26.9	3.7*	33.6	6.7*
Never Married	22.2	23.2	1.0	32.4	9.2*
Urban-Rural					
Urban (reference)	25.5	27.0	1.5*	34.9	7.9*
Rural	26.0	28.6	2.6*	38.2	9.6*[a]
Predicted Uninsured					
1st Quartile (reference)	23.0	24.4	1.4*	30.6	6.2*
2nd Quartile	24.7	26.8	2.1*	35.9	9.1*[a]
3rd Quartile	26.4	28.0	1.6*	36.6	8.5*[a]
4th Quartile	27.9	30.5	2.6*	41.4	10.9*[a]

1. Predicted uninsured is constructed from estimates of a regression of the probability of being uninsured on demographic and socioeconomic characteristics using data from the 2000 to 2003 period (see Table 2 for estimates). Using these estimates (i.e., constants or weights), the probability of being uninsured is predicted for all persons in the sample from 2000 to 2007 using the current values of socioeconomic and demographic characteristics (see text for details).
2. * indicates that difference is statistically different from zero at the 0.05 level of significance.; [a] indicates that difference is statistically different from the reference category (difference) at the 0.05 level of significance.

Table 6
Estimates of Effect of Prescription Drug Insurance on Annual Number of Prescription Drugs

Dependent Var.	Full Sample							Chronically Ill Sample						
	Total Number Prescriptions				Prescriptions>36		Total Exp.	Total Number Prescriptions				Prescriptions>48		Total Exp.
Method	Negative Binomial		Negative Binomial. IV		Logit	Logit IV	Gamma IV	Negative Binomial		Negative Binomial IV		Logit	Logit IV	Gamma IV
Prescription Drug Insurance	0.186** (0.014)	0.174** (0.013)	0.296** (0.123)	0.293** (0.116)	0.297** (0.035) [0.055]	0.615** (0.301) [0.110]	0.429** (0.146)	0.122** (0.014)	0.118** (0.014)	0.319** (0.125)	0.296** (0.118)	0.312** (0.046) [0.056]	1.262** (0.385) [0.200]	0.397** (0.150)
Chi-square Statistic (P-Value), Test of Endogeneity			25.0** (0.00)	15.6** (0.00)		11.7** (0.00)	2.22 (0.33)			19.2** (0.00)	15.9** (0.00)		17.9** (0.00)	2.00 (0.37)
Chi-square Statistic (P-Value), Test of Over Id. Restrict.			15.0 (0.24)	14.5 (0.27)		11.6 (0.48)	9.2 (0.69)			16.1 (0.19)	16.5 (0.17)		23.5** (0.02)	9.5 (0.66)
Health Status	No	Yes	No	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes
Number of Obs.	42639	42639	42639	42639	42639	42639	42639	24307	24307	24307	24307	24307	24307	24307
Mean (Std. Dev.) of Dep. Var. for Unins. in 2003-04	26.3 (24.6)				0.26		1372 (1699)	35.4 (25.7)				0.25		1835 (1550)

Source: MCBS Survey Cost and Use File 2000-2007

Notes:

1. Column headings indicate the dependent variable and method of estimation: Negative Binomial indicates negative binomial regression; Logit indicates Logistic regression; Gamma indicates a Gamma regression; IV indicates an instrumental variables estimate. Marginal effects from Logit model are in brackets[].
2. Instrumental variables estimates were obtained using the residual inclusion method. The first stage of this method predicted prescription drug insurance using a Logistic regression model with the same specification as that used in to obtain estimates in Table 2. The second stage included the residual and squared residual from the first stage.
3. The over identification test of excluded instruments is based on the "just-identified" model. IV models are re-estimated using only year 2006 interactions with the predicted uninsured quartile dummy variables as instruments. Interactions between the predicted uninsured quartiles and other years (<2006) are included in second stage, and the test statistic reports the test of joint significance of these variables.
4. Besides those listed in the table, covariates include: female, year of age dummy variables, race dummy variables, marital status dummy variables, income dummy variables, education dummy variables, rural dummy variable, smoking status dummy variables, region dummy variables, year fixed effects, and quartile of predicted uninsured fixed effects.
5. IV estimates standard errors have been corrected using the Murphy-Topel (1985) approach.
6. ** p-value <=0.05, * 0.05 < p-value<=0.10

Table 7. Use of Outpatient and Inpatient Services by Year and Predicted Uninsured

Full Sample Outpatient Visits	2000 to 2002	2003 to 2004	Difference (2003/4) – (2000/2)	2006 to 2007	Difference (2006/7) – (2003/4)
1st Quartile (reference)	24.6	27.3	2.7*	28.4	1.1
2nd Quartile	27.7	30.1	2.4*	32.4	2.4*
3rd Quartile	26.4	28.6	2.2*	30.1	1.4
4th Quartile	25.9	27.3	1.4*	28.7	1.4
Any Inpatient Visit					
1st Quartile (reference)	0.16	0.14	-0.02	0.13	-0.01
2nd Quartile	0.19	0.18	-0.01	0.18	0.01
3rd Quartile	0.19	0.18	-0.01	0.17	-0.01
4th Quartile	0.20	0.20	-0.01	0.19	-0.01
Chronically Ill Sample Outpatient Visits	2000 to 2002	2003 to 2004	Difference (2003/4) – (2000/2)	2006 to 2007	Difference (2006/7) – (2003/4)
1st Quartile (reference)	32.0	34.4	2.5*	36.6	2.1
2nd Quartile	34.6	37.5	2.9*	37.7	0.2
3rd Quartile	33.7	35.5	1.8	35.7	0.2
4th Quartile	32.0	33.6	1.6	35.8	2.2
Any Inpatient Visit					
1st Quartile (reference)	0.22	0.19	-0.03*	0.19	0.00
2nd Quartile	0.25	0.22	-0.03*	0.21	0.00
3rd Quartile	0.24	0.25	0.01[a]	0.23	-0.02
4th Quartile	0.26	0.24	-0.02	0.26	0.02

Source: MCBS Survey Cost and Use File 2000-2007

Notes:

1. Predicted uninsured is constructed from estimates of a regression of the probability of being uninsured on demographic and socioeconomic characteristics using data from the 2000 to 2003 period (see Table 2 for estimates). Using these estimates (i.e., constants or weights), the probability of being uninsured is predicted for all persons in the sample from 2000 to 2007 using the current values of socioeconomic and demographic characteristics.
2. * indicates that difference is statistically different from zero at the 0.05 level of significance; [a] indicates that difference is statistically different from the reference category (difference) at the 0.05 level of significance.

Table 8. Expenditures on Outpatient and Inpatient Services by Year and Predicted Uninsured

Full Sample Outpatient Expenditures	2000 to 2002	2003 to 2004	Difference (2003/4) – (2000/2)	2006 to 2007	Difference (2006/7) – (2003/4)
1st Quartile (reference)	3121	3902	781*	4385	483*
2nd Quartile	3549	4180	631*	5130	950*[a]
3rd Quartile	3236	3892	656*	4846	954*[a]
4th Quartile	3080	3802	722*	4277	474*
Inpatient Expenditures					
1st Quartile (reference)	2041	1958	-84	1968	10
2nd Quartile	2603	2435	-168	2761	326
3rd Quartile	2364	2442	78	2462	20
4th Quartile	2261	2494	233	2638	144
Chronically Ill Outpatient Expenditures	2000 to 2002	2003 to 2004	Difference (2003/4) – (2000/2)	2006 to 2007	Difference (2006/7) – (2003/4)
1st Quartile (reference)	4089	4910	822*	5659	748*
2nd Quartile	4449	5281	832*	5797	516*
3rd Quartile	4193	4825	631*	5770	945*
4th Quartile	3819	4767	948*	5424	657*
Inpatient Expenditures					
1st Quartile (reference)	2969	2744	-225	3036	293
2nd Quartile	3484	3128	-357	3279	152
3rd Quartile	3257	3383	126	3276	-107
4th Quartile	2996	3224	228	3729	505

Source: MCBS Survey Cost and Use File 2000-2007

Notes:

1. Predicted uninsured is constructed from estimates of a regression of the probability of being uninsured on demographic and socioeconomic characteristics using data from the 2000 to 2003 period (see Table 2 for estimates). Using these estimates (i.e., constants or weights), the probability of being uninsured is predicted for all persons in the sample from 2000 to 2007 using the current values of socioeconomic and demographic characteristics.
2. * indicates that difference is statistically different from zero at the 0.05 level of significance; [a] indicates that difference is statistically different from the reference category (difference) at the 0.05 level of significance.