Effects of Prescription Drug Insurance on Hospitalization and Mortality: Evidence from Medicare Part D

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Abstract

We examine whether obtaining prescription drug insurance through the Medicare Part D program affected hospital admissions, expenditures associated with those admissions, and mortality. We use a large, geographically diverse sample of Medicare beneficiaries and exploit the natural experiment of Medicare Part D to obtain estimates of the effect of prescription drug insurance on hospitalizations and mortality. Results indicate that obtaining prescription drug insurance through Medicare Part D was associated with an 8% decrease in the number of hospital admissions, a 7% decrease in Medicare expenditures, a 12% decrease in total resource use, and no significant change in mortality.

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1. Introduction

Congress created the Medicare Part D program to provide subsidized prescription drug insurance for Medicare recipients. The creation of Part D was motivated, in part, by the growing importance of prescription drugs in preventing and treating diseases, and the growing costs of buying prescription drugs.[1] As a result of Part D, the proportion of elderly with prescription drug insurance increased from approximately 66% to 90% (Zimmer 2012; Kaestner and Khan 2012; Levy and Weir 2010; Engelhardt and Gruber 2011; Kaiser Family Foundation 2010).

The cost of Medicare Part D is substantial. Federal and State expenditures on Part D were $67.7 billion in 2011.[2] Moreover, the Congressional Budget Office (CBO) forecasted that expenditures on Part D will increase by $51 billion from 2013 to 2022 because of the expansion of the generosity of Medicare Part D contained in the Affordable Care Act that will gradually eliminate the gap in coverage popularly referred to as the doughnut hole (Congressional Budget Office 2012). Notably, the CBO forecast was net of $35 billion in savings ("offsets") from Part D due to reductions in the use of other medical services because of greater use of prescription drugs. Indeed, during the debate over Part D, many legislators made statements reflecting the notion that obtaining prescription drug insurance will reduce other types of health care spending. Typical of such statements are the following taken from the Congressional Record June 17, 2003, (http://thomas.loc.gov/cgi-in/query/D?r108:12:./temp/~r108FHAhy2::)

> "Now we find through research funded by Government, through research funded by the drug companies, and products that have emerged from that research, that many of the sicknesses you used to go to the hospital for and stayed for 3 or 4 days can be taken care of by taking a pill. Yet Medicare says if you go to the hospital and run up a bill of however many tens of thousands of

[1] For the 20 years prior to passage of Medicare Part D, prescription drug use was growing faster than the population and prescription drug spending was growing faster than overall spending on health care. See *Prescription Drug Trends*, Kaiser Family Foundation 2010, http://www.kff.org/rxdrugs/upload/3057-08.pdf, website accessed April 2, 2013.

[2] 2012 Annual Report of the Board of Trustees, Federal Hospital Insurance and Federal Supplementary Medical Insurance Trust Funds, http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/ReportsTrustFunds/downloads/tr2012.pdf, website accessed April 2, 2013.

dollars to stay that many days, we will pay for it. But if you take the pill that makes the hospital visit unnecessary, we will not. That clearly doesn't make sense. There is the need for the benefit of prescription drugs, and the Medicare system needs to catch up to circumstance." (Senator Robert Bennett, Republican Utah)

"There is a dramatic change in the pattern and practice of medicine. Perhaps no better example is what happens with stomach illness. Twenty years ago, there was not much one could do for somebody who suffered from ulcers other than to have surgery. But now with prescription drugs that address the underlying causes, stomach surgery has been reduced by two-thirds. Yet, in Medicare there is no coverage for those prescription drugs. You can't have a modern Medicare without a prescription drug component." (Senator Kent Conrad, Democrat North Dakota)

While Senators Bennett and Conrad, among others, believed that a prescription drug benefit would reduce spending on non-pharmacy services and improve health, the evidence at the time to support their statements was, at best, sparse. Moreover, there are plausible reasons to expect that prescription drug coverage would have little effect on non-pharmacy spending, for example, because of the possibility that much of the additional prescription drug use that comes with insurance may be marginal in terms of health benefits. The relative dearth of evidence on whether prescription drugs are substitutes for other medical spending persists today and is reflected in the recent CBO (2012) report, which relied on a limited number of studies to draw its conclusions about offsetting effects of Part D on spending on other medical services.[3]

In this paper, we examine whether obtaining prescription drug coverage through the Medicare Part D program affected hospital admissions and inpatient expenditures associated with those admissions for a variety of illnesses such as congestive heart failure (CHF), stroke, dehydration and chronic

[3] The applicability of some of the studies reviewed in the CBO report to Medicare Part D is questionable. For example, Gaynor et al. (2007) examined non-elderly, and Stuart et al. (2009) treated prescription drug coverage as exogenous. We review most of the other studies contained in CBO report below.

obstructive pulmonary disease (COPD). We also assess whether gaining Medicare Part D coverage was associated with mortality. Data for the analysis is primarily from Medicare claims for inpatient services (Medicare Provider Analysis and Review, MEDPAR) from 2002 to 2009, thus spanning the implementation of Medicare Part D in 2006. We also use data from the Medicare Current Beneficiary Survey (MCBS) over the same period to obtain information about prescription drug insurance of Medicare beneficiaries because such information is not available in the data on inpatient claims. With these data, we compare hospital admissions, inpatient spending and mortality before and after implementation of Medicare Part D for elderly who were more or less likely to gain prescription drug insurance through Medicare Part D.

We find that obtaining prescription drug insurance through Medicare Part D significantly reduced hospital admissions and Medicare expenditures for those admissions. Overall, gaining prescription drug insurance through Medicare Part D was associated with an 8% decrease in the number of hospital admissions, a 7%, or $138, decrease in annual Medicare expenditures for hospitalization, and a 12%, or $728, annual decrease in total resource use (i.e., charges) associated with hospital admissions. Among specific types of admissions, prescription drug insurance was associated with significant decreases in admissions for CHF (18%), coronary atherosclerosis (13%), and COPD (32%). Associations between prescription drug insurance and resource use were larger than associations between prescription drug coverage and the number of admissions, which implies that gaining prescription drug insurance affected resource-intensive admissions more than low-cost admissions. Gaining prescription drug coverage through Medicare Part D was not associated with mortality. Given that approximately 11 million persons gained prescription drug insurance through Medicare Part D, mostly through stand-alone Part D plans, we estimate that reduced hospital expenditures associated with increased prescription drug coverage produced aggregate savings of approximately $1.5 billion per year, or approximately 2.2% of the total cost of Medicare Part D in 2011.

2. Prescription Drug Insurance and Hospitalization: Previous Literature[4]

Relatively few studies have examined the association between prescription drug insurance and the use of non-pharmacy services, including hospitalization, among the elderly. No study that we are aware of examined whether prescription drug insurance affected mortality. The lack of research on these important questions stands in contrast to the large literature that has examined the effect of prescription drug insurance (or changes in cost sharing) on prescription drug use. In a systematic review of the literature, Goldman et al. (2007) concluded that there are a relatively small number of studies of the association between prescription drug insurance (or cost sharing), and health and use of other (e.g., inpatient) services. Moreover, these authors noted that studies in this area usually focused on small samples of chronically ill patients. For the chronically ill, Goldman et al. (2007) reported that most studies found consistent evidence that prescription drug insurance was associated with improved health. However, results from studies of broader populations are inconsistent. A similar conclusion was reached by Gibson et al. (2005) in their review.

There are several studies closely related to the current research, but instead of reviewing them individually, we summarize the gaps in knowledge that remain so as to highlight the contribution of our research. First, few studies used nationally representative samples of elderly persons. Soumerai et al (1991), Johnson et al. (1997), Hsu et al. (2006), and Zhang et al. (2009) all used samples from one specific insurance plan to study how changes in prescription drug benefit design (Soumerai et al 1991; Johnson et al. 1997; Hsu et al. 2006), or prescription drug insurance (Zhang et al. 2009), affected non-pharmacy medical spending. While these samples and settings provided natural experiments that were an advantage from a research design perspective, the narrowness of the samples and contexts limit the applicability (i.e., external validity) of the findings. For example, estimates of the effect of a change in prescription plan benefit generosity on hospitalizations of Medicare managed care enrollees in Northern

[4] We limit the review to studies of elderly, so we exclude studies such as Gaynor et al (2007), and we include studies that used methods that accounted in some way for the non-random choice of prescription drug insurance. We do not review studies of the effect of prescription drug insurance on elderly persons with specific illnesses (e.g., Soumerai et al. 1994; Pilote et al. 2002; Stuart et al. 2004; Hsu et al. 2006; and Tjia and Briesacher 2008). We also do not include studies of the effect of entering the coverage gap in Part D (see Stubbings and Lau 2013 for a review).

California (Hsu et al 2006), or managed care enrollees in Pennsylvania (Zhang et al. 2009) may not generalize to broader population and the effect of gaining prescription drug insurance through Medicare Part D.

Second, a considerable amount of previous research has focused on the effects of changes in benefit generosity rather than gaining prescription drug insurance (Soumerai et al. 1991; Johnson et al., 1997; Hsu et al., 2006; Chandra et al., 2010; McWilliams et al. 2011). It is unclear whether these studies can inform the debate over the possible offsetting effects of gaining prescription drug coverage through Medicare Part D because gaining coverage represents a larger treatment, and extrapolating from these studies to infer the effect of Part D may be misleading.

Third, because of the non-experimental nature of previous studies, there are standard concerns with respect to internal validity. For example, Chandra et al. (2010) used a difference-in-differences approach to examine the effect of prescription drug benefit design changes in two insurance plans for retired California public employees on the use of other medical services. The authors report large and often significant differences in pre-policy trends in prescription drug use and hospitalizations between the treatment and comparison groups, which suggest that the research design may not be completely valid.[5] Afendulis et al. (2011) and Liu et al. (2011) also used a difference-in-differences approach to study whether Medicare Part D was associated with changes in hospitalization and non-pharmacy spending. In both cases, the authors compared the non-elderly to the elderly. One concern with these studies is whether the non-elderly are indeed comparable to the elderly. As Afendulis et al. (2011) reported, there were differences in rates of hospitalization in the pre-period between the elderly and non-elderly and differences in the trend in rates of hospitalization between the elderly and non-elderly. These differences suggest that the near-elderly may not be an appropriate comparison group for the elderly.

[5] Chandra et al. (2010) also reported that the decreases in prescription drug use associated with the policy changes were associated with immediate and relatively large increases in hospitalization (e.g., first quarter after the copayment change). While some pharmaceutical 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.

Finally, there are no studies that we are aware of that have examined whether prescription drug insurance is associated with mortality. It is plausible that gaining prescription drug insurance would decrease mortality among the elderly given the demonstrated clinical effectiveness of some drugs such as statins, anti-hypertensive drugs and blood thinners.

To summarize, there are relatively few studies of the effect of prescription drug insurance on the use of non-pharmacy medical services such as hospitalization among the elderly, and the evidence from these studies is mixed—some studies find offsets (e.g., Chandra et al. 2010 and McWilliams et al. 2011) and some do not (e.g., Soumerai et al. 1991; Breischer et al. 2005; Khan et al. 2008; Liu et al. 2011; Kaestner and Khan 2012). Indeed, there are only two studies of the effect of gaining prescription drug insurance through Medicare Part D on the use of inpatient services for a representative sample of the Medicare population and these studies report mixed evidence (Kaestner and Khan 2012; Afendulis et al. 2011). There are no studies of the effect of prescription drug use on mortality. Moreover, most studies in the literature examine changes in co-payments and plan design features and not whether a person did or did not gain prescription drug insurance (e.g., Soumerai et al. 1991; Hsu et al. 2006; Chandra et al. 2010; McWilliams et al. 2011). Many studies use narrow samples from one insurance plan (e.g., Zhang et al. 2009) that lack external validity in terms of producing knowledge of the effects of prescription drug insurance on the broad population of elderly in the United States. Finally, as is often the case with non-experimental studies, there are standard concerns about the internal validity of the research designs.

Our paper fills some of the gaps in the previous literature and provides evidence relevant to theory—whether prescription drugs are substitutes with other medical services for a large, national sample of Medicare beneficiaries—and policy—whether the costs of Medicare Part D are likely to be reduced by offsets in the use of inpatient services. We also provide the first analysis of the effect of prescription drug coverage on mortality.

3. Empirical Approach

3.a. Conceptual Model

The empirical analysis is motivated by basic, economic theory and substantial empirical evidence that obtaining insurance for prescription drugs, for example through Medicare Part D, increases use of prescription drugs because insurance lowers the price of prescription drugs (moral hazard effect) and increases the ability to pay for prescription drugs (income effect).[6] Because virtually all elderly in the United States have medical insurance through Medicare prior to Part D, elderly without prescription drug insurance may have underutilized drug therapy vis-à-vis non-drug treatments because medical treatments were heavily subsidized. However, after gaining prescription coverage through Part D, which substantial evidence has showed increased prescription drug use, the use of non-pharmacy services such as inpatient care may have decreased because of substitution of now cheaper drug therapy for medical treatment.

Whether substituting drug therapy for medical treatment will improve or worsen health depends on whether drug therapy is more or less efficacious than the medical treatments it replaced. It may be rational to replace medical care (e.g., inpatient) with prescription drugs even if doing so adversely affects health because there may be costs savings (i.e., reduced copayments associated with medical care), or other benefits (e.g., less invasive treatment) associated with using prescription drugs. Health, and therefore hospitalization, may also be unaffected by prescription drug insurance because of moral hazard effects of insurance (health benefits of prescription use that are below the marginal cost of use). Consider that prior to Medicare Part D, data from the Medicare Current Beneficiary Survey (MCBS) indicate that elderly without prescription drug insurance filled nearly as many prescriptions per year as elderly with prescription drug insurance (Kaestner and Khan 2012). Thus, many seniors without prescription drug insurance use at least some of the drugs that may have been essential to maintain health. The additional drug use associated with prescription drug insurance may have modest health benefits and little effect on hospitalizations. In fact, greater use of prescription drugs and use of a greater number of therapeutic classes of drugs may increase adverse drug events, worsen health and increase hospitalizations (Laazrou et al. 1998; Tamblyn et al. 2001; Gurwitz et al. 2003; Fu et al. 2010).

[6] See for example: Lichtenberg and Sun (2007), Ketcham and Simon (2008), Yin et al. (2008), Schneeweiss et al. (2009), Zhang et al. (2009) and Kaestner and Khan (2012).

In sum, while it is possible that prescription drug insurance may lead to more prescription drug use, improvements in health, and reductions in downstream medical costs such as hospitalizations, it is also possible that the primary effect of prescription drug insurance is to increase the use of drugs with marginal health benefits and little change in hospitalizations or mortality. Indeed, prescription drug insurance may even lead to worse health outcomes and increased hospital and other health care utilization due to adverse drug reactions.

3.b. Estimation: Difference-in-differences Approach

Our empirical objective is to estimate the association between gaining prescription drug insurance through Medicare Part D, and hospitalization and mortality. The main obstacle to obtain estimates that can be plausibly interpreted as causal is that elderly with and without prescription drug insurance are likely to differ in ways that affect health and use of services. For example, elderly with prescription drug insurance may be sicker and/or more risk averse than elderly without insurance, and both of these factors would likely affect health and use of other healthcare services. To address this selection problem, we exploit the natural experiment afforded by Medicare Part D, which significantly increased prescription drug insurance coverage.

The first approach we use in conjunction with the implementation of Medicare Part D is a difference-in-differences (DID) approach. The DID approach compares changes in the use of, and spending on, inpatient services (mortality) pre- to post-Medicare Part D for those who were more likely to gain prescription insurance as a result of Medicare Part D to changes in the use of, and spending on, inpatient services (mortality) pre- to post-Medicare Part D for those who were less likely to gain prescription drug insurance from Part D. Note that we refer to elderly more or less likely to gain prescription drug coverage as a result of Medicare Part D because, as we explain in more detail later, we do not know whether a person was or was not covered by prescription drug insurance before or after Medicare Part D. We can only measure the proportion of people with or without prescription drug insurance for groups defined by demographic characteristics.

We implement the DID approach using Medicare claims for inpatient services (MEDPAR) and enrollment (Medicare Denominator file) data aggregated by year (2002 to 2009), age (66-68, 69-70,71-72, 73-74, 75-77, 78-79, 80-81, 82-84), gender and region (nine Census regions). We aggregated the data by these three attributes because information about these characteristics are available in the MCBS, which we use to derive prescription drug coverage before and after Medicare part D.[7] Aggregation yields 672 cells: 96 age-gender-region cells for each of eight years.[8] For each aggregated cell, we construct rates of mortality (from Denominator file), and rates of hospitalization (from MEDPAR) for several types of illnesses (e.g., congestive heart failure) and for all hospitalizations combined. We also construct measures of expenditures per person for each type of hospitalization. We describe the data more completely below.

To classify persons into treatment and comparison groups, we use information from the MCBS on prescription drug insurance during the 2002 to 2005 period, which is prior to implementation of Medicare Part D, to calculate the proportion of persons in each of the 96 demographic cells that lacked prescription drug insurance prior to Part D. We drop cells with less than 75 observations from the combined 2002 to 2005 MCBS to ensure that the estimate of the proportion without prescription insurance is reasonable.[9] The proportion of each cell that is uninsured prior to Medicare Part D measures the extent of treatment because after Medicare Part D, the variation in the proportion of each cell without prescription drug insurance was greatly reduced and cells with a high proportion uninsured in 2002 to 2005 period experienced the largest decrease in uninsured pre- to post Medicare Part D. Note that we do not calculate the proportion uninsured for each cell in each year, but for groups of years. The MCBS, while relatively large, is not large enough to calculate reliable year-specific estimates of the proportion without prescription drug insurance in each cell (i.e., age, gender and region group). The constructed

[7] Ideally, we would like to use more characteristics than these three, but, as we describe below, the sample size of the MCBS limits the amount of characteristics we can use. For example, the MCBS is too small to use state instead of region, and too small to use race. However, the variables we have used are effective, as we demonstrate below.
[8] There are 768 possible combinations of year (8), age (8), gender (2) and region (9). Of these, we used 672 because we selected only cells that 75 or more observations in the MCBS, which was used to construct information about prescription drug insurance. For example, no cells of sufficient size were available in New England region, so there were only eight regions. Using a different threshold for the minimum number of observations in a cell in the MCBS made little difference to results reported below.
[9] We have used different thresholds (e.g., 50 or 100) and results are very similar to those we report below.

measure of the proportion without prescription insurance in each cell is constant in all years between 2002 and 2005. We constructed a similar variable for the period between 2006 and 2009. Finally, we constructed the proportion of each cell that had prescription drug insurance (i.e., one minus the proportion uninsured) in each of these two periods.

Figure 1 shows the relationship between the change in the proportion without prescription insurance between 2006-09 and 2002-05 (i.e., 2006-09 minus 2002-05), and the proportion without prescription insurance in 2002-2005 for the 96 age-gender-region cells. As the figure indicates, the change in the proportion uninsured is negatively related to the proportion uninsured in 2002 to 2005—the groups more likely to be without prescription insurance in 2002 to 2005 experienced the greatest gains in prescription drug insurance pre- to post-Part D. A linear regression line (shown in Figure 1) has a slope of –0.92 indicating that for each percentage point increase in the proportion without prescription drug insurance in 2002 to 2005, the change in the proportion uninsured pre- to post-Part D decreased by nearly one (0.92) percentage point. The figure reveals clearly that the proportion of a cell that is uninsured in 2002 to 2005 accurately measures the extent of treatment—the increase in prescription drug coverage associated with Medicare Part D.

Note that the variation in prescription drug insurance is due to differences in insurance by age, gender and region. It is well known that there are substantial, longstanding regional differences in health insurance by region (Morrisey and Jensen 1989; Cohen and Makuc 2008). The variation in health insurance for those under age 65 extends to prescription drug insurance among the elderly, which is not surprising given that a large share of prescription drug insurance is through retiree benefits linked to health insurance coverage. There are also substantial differences in health insurance coverage by gender and age. Again, differences in prescription drug insurance by age and gender among the elderly is expected as access to employee health insurance differ by gender, for example, because of previous work experience and marriage, and age because of declining retiree health insurance coverage and cohort-specific changes in employment (McCormack et al. 2002; McArdle et al. 2014). Importantly, the variation in prescription drug insurance by age, gender and region is sufficient to obtain precise estimates of the

effect of prescription drug insurance (conditional on a full set of age, gender and region fixed effects—see details below).

The regression model to implement the DID approach is:

$$HOSP_{it} = \alpha_i + \sum_{t=2002}^{2009} \beta_t YEAR_t + \sum_{t=2002}^{2009} \gamma_t (YEAR_t * UNINSURED_i) + v_{it}$$

(1) $i = 1,...,96$

$t = 2002,...,2009$

In equation (1), the hospitalization rate (*HOSP*) of cell "*i*" in year "*t*" depends on a cell-specific fixed-effect (α_i) and year fixed effects ($YEAR_t$), which are allowed to differ by the proportion of the cell that is without prescription insurance in 2002 to 2005 ($YEAR_t * UNINSURED_i$).[10] Also included in the regression model, but not shown in equation (1), are age-by-gender-by-year fixed effects, region-by-year fixed effects, and the proportion of each cell that is enrolled in Medicare Advantage (HMO). We highlight the inclusion of the share of enrollees in Medicare Advantage, as it is well known that the proportion of enrollees was increasing during our period of analysis. Including this time-varying control accounts for any potential changes in sample composition that could be correlated with the implementation of Medicare Part D. Including or excluding this variable makes little difference to results reported below. An analogous model is used for mortality.

The key coefficients in equation (1) are for the interactions between year and the proportion of a cell that is uninsured in 2002 to 2005. Prior to 2006, the coefficients on the interaction terms should ideally be zero because the time trend in hospitalization (mortality) should, by assumption of the research design, be equal for cells more or less likely to be uninsured prior to Medicare Part D. Subsequent to 2006, the majority who were uninsured gained prescription drug coverage. Therefore, if there is an effect of prescription drug coverage on hospitalizations (mortality), it would appear in the coefficients on the post-2005 interaction terms.

3.c. Evidence of the Validity of the DID Approach

[10] We also used a quadratic specification for the proportion uninsured and results (not reported) are very similar to those obtained using the linear specification shown in equation (1).

The validity of the DID approach depends on whether in the absence of Medicare Part D, trends in hospitalizations and mortality were the same for demographic groups (cells) more or less likely to be without prescription drug insurance prior to Medicare Part D. The specification of equation (1), which includes interactions between the demographic components (i.e., age, region and gender) that define the cells and year, bolsters the likely validity of the key assumption, as the specification controls for differential trends by age-by-gender and by region.

While the identifying assumption of common trends cannot be tested in a definitive manner, it is possible to observe whether the coefficients on the pre-2006 interaction terms ($YEAR_t * UNINSURED_i$) are significant, which tests whether prior to Medicare Part D the trends in hospitalizations and mortality are the same for demographic groups (cells) more or less likely to be without prescription drug insurance prior to Medicare Part D. Finding that the coefficients on the pre-2006 interaction terms are insignificant supports the validity of the DID approach. We discuss results of the specification tests in more detail below, but we note here that in all but one (out of 26) cases, we are unable to reject the null hypothesis of common trends prior to 2006, which is evidence that supports the DID research design.

Evidence from a previous study also suggests that the DID approach used here is valid. Khan et al. (2008) also use a DID research design that compares changes in the use of inpatient services of people who gained (or lost, but most gained) prescription drug insurance status to changes in inpatient use of people who experienced no change in prescription drug insurance. To test the validity of their approach, Khan et al. (2008) estimate DID models using all observations for people who never switched insurance status and observations on those that switched, but only in years prior to the time they switched prescription drug insurance status. The authors randomly assigned true, future switchers a pseudo-switch year—a year in which they supposedly gained prescription drug coverage. If those who switched prescription drug insurance and those who did not switch insurance status have common trends in outcomes, which is the underlying assumption of the DID approach, then the coefficient on the pseudo insurance coverage variable is expected to be zero. Khan et al. (2008) find exactly this for all outcomes in

their study (self-reported poor health status, functional disability, and hospitalization). Results from Khan et al. (2008) provide substantial support for the validity of the DID approach we use in this paper, particularly because the changes in prescription drug insurance that are used here are solely due to the implementation of Medicare Part D.[11]

3.d. Estimation: Instrumental Variables Approach

DID estimates of the interaction terms between year and the proportion of a cell uninsured prior to Medicare Part D are intention-to-treat estimates because not everyone without prescription drug insurance prior to Part D obtained prescription insurance after Part D. Previous studies suggest that approximately 70% to 80% of those without prescription drug insurance prior to Part D obtained coverage (Levy and Weir 2010; Engelhardt and Gruber 2011; Kaestner and Khan 2012).[12] One approach to estimating the effect of prescription drug insurance on hospitalization, or the treatment-on-treated effect, is instrumental variables (IV). The following algebraic representation illustrates the IV approach:

$$HOSP_{it} = \delta_i + \pi\, POST\_PARTD_t + \lambda\, \hat{INSURED}_{it} + \nu_{it}$$
$$(2)\quad i = 1,...,96$$
$$t = pre = 2002-05,\ post = 2006-09$$

$$INSURED_{it} = \tilde{\alpha}_i + \tilde{\beta}\, POST\_PARTD_t + \tilde{\gamma}(POST\_PARTD_t * UNINSURED_i) + \tilde{\nu}_{it}$$
$$(3)\quad i = 1,...,96$$
$$t = pre = 2002-05,\ post = 2006-09$$

In equation (2), the hospitalization rate (*HOSP*) of cell "*i*" in year "*t*" depends on a cell-specific fixed-effect (δ_i), a dummy variable indicating the year is post 2005 (*POST*=1 if year is 2006 to 2009), and the *predicted* proportion of cell "*i*" that had prescription drug insurance in in period "*t*" (*INSURED*). As described earlier, we calculate prescription drug insurance information from the MCBS. Also included in the regression model, but not shown in equation (2), are age by gender by post-period (*POST)* fixed

[11] Khan et al. (2008) used longitudinal data from the MCBS and changes in prescription drug insurance resulting from individual decisions, which are less likely to be exogenous, although tests results indicated that the changes in insurance appear to be plausibly exogenous.

[12] This range of estimates is consistent with data from the Medicare Current Beneficiary Survey reported in Kaestner and Khan (2012) that showed that 368 out of 518 (71%) people who did not have prescription drug insurance in 2004 gained coverage by 2006. Kaestner and Khan (2012) also reported that only 24 of 1065 people with prescription drug insurance in 2004 reported dropping prescription drug insurance between 2004 and 2006.

effects, region by post-period (*POST)* fixed effects, and the proportion of each cell that is enrolled in a HMO.

Equation (3) is analogous to equation (1), except for the dependent variable *INSURED*, and it is the first stage model used to predict the proportion of a cell that is insured. We have used the symbol "~" to differentiate parameters in equations (1) and (3). The excluded instrument used to predict the proportion insured is the interaction between the post-Part D indicator and proportion without prescription drug insurance in 2002 to 2005.

We estimate the IV approach using data collapsed to the pre-Medicare Part D period (2002-2005) and the post-Medicare Part D period (2006-2009). Doing so reflects the fact that we derive the information on the proportion of each demographic cell that has prescription drug insurance from the MCBS and because of small samples in the MCBS we use several years of data to create cell means. The information on prescription drug insurance does not vary by individual year, but only by the pre- and post-Medicare Part D periods. Collapsing the data is unproblematic given that tests of whether there were differences in pre-Part D trends in hospitalization by the proportion uninsured could not reject the null hypothesis of common trends.

3.e. Evidence of the Validity of the IV Approach

The identifying assumption of the IV approach is the same as that of the DID. Namely, that in the absence of Medicare Part D, trends in hospitalizations and mortality would not differ by the proportion of a cell that is without prescription drug insurance prior to Part D. In other words, the exclusion restriction—omitting the interaction between the post-Part D indicator and proportion uninsured from equation (2)—is valid. The same arguments made above as to the validity of the DID approach apply to the IV approach so we will not repeat them here. However, we conducted another assessment of the identifying assumption by estimating the reduced form model associated with the IV, but using data only from the pre- Medicare Part D period. Specifically, we estimate:

$$HOSP_{it} = \ddot{\alpha}_i + \ddot{\beta}\, POST\_2003_t + \ddot{\gamma}(POST\_2003_t * UNINSURED_i) + \ddot{v}_{it}$$

(4) $i = 1,...,96$

$t = pre = 2002-03,\ post = 2004-05$

In equation (4), we have used the symbol "¨" to denote reduced form parameters. The key aspect to note about equation (4) is that only pre-Part D data are used. So the test of the identification assumption is whether the coefficient on the interaction term between proportion of a cell that is uninsured (in 2002 to 2005) and the indicator post-2003 is zero. We discuss the results of this placebo analysis in greater detail below, but note here that in all cases (26) the coefficient on the interaction term between proportion of a cell that is uninsured and the indicator post-2003 is not statistically significant and small in magnitude. The insignificant placebo estimates obtained from equation (4) are evidence that the IV approach is valid.

3.f. Interpretation of IV Estimate

The IV approach estimates the effect of prescription drug insurance on hospitalization and mortality for elderly affected by Medicare Part D (local average treatment effect-LATE). Kaestner and Khan (2012) examined characteristics of the group likely to be uninsured prior to Part D, and reported that age, education, income, race and region are all significant predictors of being uninsured. Overall, those without prescription drug insurance prior to Medicare Part D tend to low-educated, low-income, black, older and more likely to come from the east and west south central divisions. Thus, our estimates of the effect of prescription drug coverage due to Medicare Part D will be applicable to persons with these characteristics (except for race), which is a group particularly interesting to public health policy. Our estimates also pertain to the benefit design and generosity of prescription drug insurance as obtained through Medicare Part D. One alternative way to view the IV estimates is as the effect of a relative change in prescription insurance coverage that generates approximately a 30% to 40% increase in use of prescription drugs, which is in the middle of the range of estimates in the literature of the change in

prescription drug use associated with gaining coverage through Medicare Part D (Lichtenberg and Sun 2007; Yin et al. 2008; Zhang et al. 2009; Kaestner and Khan 2012).[13]

4. Data

The data we use are from three sources: the Medicare Provider Analysis and Review file (MEDPAR), the Medicare Beneficiary file (Denominator file), and the Medicare Current Beneficiary Survey (MCBS). The MEDPAR files provide information on all hospital admissions for Medicare beneficiaries not enrolled in Medicare Advantage (i.e., capitated HMO). The Denominator file provides information on all Medicare beneficiaries and the reason for their eligibility, whether they are in Medicare Advantage plan, whether they are disabled or have ESRD, and the year of death. The MCBS provides information on prescription drug insurance. The years covered by each of these data sources are 2002 to 2009.

The sample used in the analysis is selected using the following criteria:

- Non-Hispanic, white persons 66-84 years old on December 31 of the year;
- enrolled in fee-for-service Medicare (i.e., no Medicare Advantage) and not covered by Medicaid;
- exclude people with ESRD or Disability;
- and exclude people who died during the year (for analysis of hospitalizations).

We exclude people in Medicare Advantage because they do not have information in MEDPAR claims. We exclude people covered by Medicaid and people with ESRD or Disability because they are quite sick relative to the large majority of Medicare enrollees, and their greater level of illness may cause them to have significantly different trends in hospitalization and mortality. For the analysis of hospitalizations, we exclude people who died because they do not have full-year information. Finally, we exclude Hispanic and non-Hispanic black persons because of the limited number of such persons in the MCBS and the relative geographic concentration of these groups.

[13] For studies that estimated intention-to-treat effects of Medicare Part D on prescription drug use, we have scaled the estimate by the change in prescription drug insurance.

The MCBS is a nationally representative survey of Medicare beneficiaries that we use to construct measures of prescription drug insurance coverage pre- and post-Medicare Part D. Individuals in the MCBS are drawn using stratified random sampling from an enrollment list of persons entitled to Medicare on January 1st of that year, and the survey is intended be 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 approximately 12,000 individuals. Persons remain in the sample for four years. We use the Cost and Use file of the MCBS which provides detailed information of the respondent's insurance status including prescription insurance.

We define someone as uninsured if they did not have prescription drug insurance for the full year.[14] We aggregate the MCBS data into demographic cells based on eight age groups (66-68, 69-70, 71-72, 73-74, 75-77, 78-79, 80-81, and 82-84), two gender groups, and nine Census regions. However, sample sizes in each year for the 144 possible cells were relatively small, so we combine years into two periods: 2002-2005 and 2006-2009. We then drop all cells that had fewer than 75 observations in the pre-period of 2002-2005 leaving 96 demographic cells. For each cell, we calculate the weighted mean of the proportion with and without prescription drug insurance. We impose the minimum observation threshold of 75 to increase the precision of our estimate of the proportion of the cell that is uninsured. We also verified the quality of the MCBS information by using information on prescription drug insurance that is available post-2006 from Medicare registry data (i.e., indicator of credible coverage in 2006 and after). Indeed, replacing the post-2006 estimate of prescription drug insurance obtained from the MCBS with the estimate of prescription drug insurance from the Medicare registry data produced estimates that are almost the same as those we report below.

The Denominator file provides the number of persons covered by Medicare in each demographic cell defined by year, age, gender and region, which we use as the denominator in the calculation of cell hospitalization rates. The Denominator file also provides information on the year of death, which we use

[14] Approximately 90% of persons who were uninsured at least 7 or more months during the year were uninsured for the entire year. Using a less stringent definition (e.g., 7 or more months uninsured) had little effect on estimates.

to construct rates of mortality (per 1000 persons). We apply the same sample selection criteria to these data. There are a total of 768 cells reflecting the 96 demographic groups and eight years of data. We also use the Denominator file to construct the proportion of people in each demographic cell that is enrolled in Medicare Advantage. Because we do not include persons enrolled in Medicare Advantage in the analysis and because the proportion of enrollees was increasing during our period of analysis, we constructed the proportion of persons enrolled in Medicare Advantage to include in the regression models to account for any potential changes in sample composition that could be correlated with the implementation of Medicare Part D. Including or excluding this variable makes little difference to results reported below.

The MEDPAR file provides information on all hospitalizations for the sample of Medicare beneficiaries. We sum the number of hospitalizations in each of the 96 demographic cells in each year and this count became the numerator in the cell-specific hospitalization rates. Note that hospitalization rates are measured per 1,000 persons. We sum hospitalizations within a cell in two ways: first, by the number of people, so persons with more than one hospitalization are only counted once, and second, by the number of hospitalizations, which counts all hospitalizations. Results do not differ significantly for the two measures so we only report results using the latter measure. We define several measures of hospitalization focusing on the most common hospitalizations, as well as those designated as patient quality indicators (PQI) by the Agency for Healthcare Research and Quality. Specifically, we use the following categories of hospitalization: acute myocardial infarction (AMI), congestive heart failure (CHF), stroke, pneumonia, chronic obstructive pulmonary disease (COPD), osteoarthritis (osteoarthrosis), coronary atherosclerosis and other heart disease, cardiac dysrhythmias, urinary tract infection, trauma (injuries and poisonings not including from prescription drugs), and all hospitalizations combined. We include admissions for trauma, which consist of a relatively large group of conditions (e.g., burns, fractures), because it is less likely that prescription drug insurance would affect trauma admissions. So

trauma admissions are used as a falsification test. Definitions of trauma hospitalizations are based on information from the Agency for Healthcare Quality and Research.[15]

In addition to the number of hospitalizations per 1,000 persons, we also construct measures of expenditures for each type of hospitalization. We measure expenditures as the total Medicare payments made to the hospital for each type of admission per person. To construct expenditures, we sum all payments for a specific type of hospitalization for all persons in a cell and then divide by the number of persons in that cell. Therefore, this is a measure of expenditures per person for each type of hospitalization. We construct a similar variable using total hospital "charges" for the admission, which we view as a measure of resource use.

Table 1 reports the weighted, sample means and standard deviations for the different rates of hospitalizations by year. The 11 types of admissions account for approximately 40% of all hospital admissions, which is consistent with the selection of the most common admissions. If trauma is omitted, the other 10 admission types account for approximately 35% of all admissions. Approximately 25% of the sample is admitted to the hospital each year. Total admissions remained relatively constant from 2002 to 2006, but declined by approximately 10% between 2006 and 2009. Many admissions, particularly for heart disease and respiratory illness declined substantially over the period. However, admissions for osteoarthritic conditions increased by approximately 25%. Mortality rates were 32 per 1000 in 2002 and declined steadily to 27 per 1000 by 2009.

5. Results

5.a. Difference-in-differences Estimates: Number of Hospital Admissions

In Table 2 we present difference-in-differences (DID) estimates for the 12 types of hospital admissions. We obtain estimates using weighted, ordinary least squares methods where the weight is the

[15] The definitions of hospitalizations are taken form the following two sources: http://www.qualityindicators.ahrq.gov/Modules/PQI_TechSpec.aspx. and "Statistical Brief #14" by HealthCare Cost and Utilization Project, October 2006. The link for the codebook is "Appendix A - Clinical Classification Software-DIAGNOSES (January 1980 through September 2013)" http://www.hcup-us.ahrq.gov/toolssoftware/ccs/AppendixASingleDX.txt.

number of persons in each cell.[16] DID estimates in Table 2 use a sample that omits 2006, which is the transitional year when Medicare Part D was implemented.[17] For each outcome, we show estimates of the coefficients on the interactions between the proportion uninsured and year dummy variables. Also shown in the column to the right of these estimates are F-tests of the hypothesis that the pre-period (2002 to 2005) and post-period (2007 to 2009) interactions are jointly zero. Finally, the constrained DID estimate, which we obtain using data collapsed to two periods (pre- and post-Medicare Part D), is in the last row for each type of hospitalization. The constrained DID estimate is the reduced form estimate for the IV approach.

We first note that only one of the 12 F-tests of the hypothesis that interactions between the proportion of a cell that is uninsured and the pre-Medicare Part D year dummy variables are jointly zero is statistically significant. The significant case is for AMI and it is due to one unusually large coefficient. In fact, only two of the 36 individual estimates associated with the pre-period interactions are statistically significant (reference year is 2002), and p-values of the F-statistics range from 0.16 to 0.997 with 8 of the 12 p-values above 0.50, and only two p-values below 0.2. The results of these F-tests provide evidence to support the validity of the DID research design, as they suggest that trends in hospitalizations prior to the implementation of Medicare Part D did not differ by the proportion of a cell that is without prescription drug insurance, which is the measure of treatment intensity. In contrast, F-tests of whether trends in hospitalization differed by the proportion without prescription insurance in the post-Part D period indicate some significant differences. Three of the F-tests are statistically significant and half have p-values of 0.22 or less.

The DID estimates from a sample that has been collapsed to two periods, pre- and post-Medicare Part D, provide a useful way to assess the implications of the larger set of DID estimates. As noted, these constrained, two-period estimates are the reduced form of the instrumental variables procedures. The DID

[16] Un-weighted estimates were also obtained. We do not show these. However, below we report the weighted and un-weighted IV estimates to indicate the difference due to weighting.
[17] In Appendix Table 1 we provide estimates based on data from 2002 to 2009 inclusive of 2006.

estimates are shown in the last row for each type of hospital admission. Eleven of the 12 reduced form estimates are negative and five are statistically significant at 0.10 level.[18]

Magnitudes of the reduced form estimates are non-trivial. For CHF admissions, the reduced form estimate suggests that increasing the proportion of a cell that is without prescription drug insurance in 2002 to 2005 by 100 percentage points (from 0 to 1) is associated with a 1.82 decrease in CHF admissions per 1000, or approximately a 18% decrease in CHF admissions. Analogous estimates for the other types of admission are: -2.34 (13%) for Coronary Atherosclerosis; -2.19 (31%) for COPD; -0.79 (20%) for dehydration; and -19.81 (8%) for any type of admission. Given that every percentage point increase in the proportion without prescription insurance in the pre-period (2002 to 2005) is associated with nearly a percentage point (0.92) increase in the proportion who gained insurance pre- to post-Medicare Part D, the DID reduced form estimates will have magnitudes that are similar to the IV estimates.

To assess the validity of the DID and IV approaches, we estimated the reduced form model (see equation 4) using pre-Part D data (2002 to 2005). We refer to this as a placebo test and it assesses whether trends in hospitalizations between 2002-03 and 2004-05 are the same for demographic groups with different proportions of elderly without prescription drug insurance, which is the measure of treatment intensity. Table 3 reports these placebo reduced form estimates and, for comparison purposes, the actual reduced form estimates that were already reported in Table 2.

Estimates in row one of Table 3 are from the placebo, reduced form analyses. No estimates are statistically significant. In addition, all estimates are relatively small in magnitude; 8 of the 12 estimates have effect sizes of 5% (of mean) or less and the largest effect size is 11% (stroke). In cases where the actual reduced form effect was statistically significant, the effect sizes of the placebo estimates are

[18] We also calculated standard errors using a permutations test. To conduct the test, we randomly assigned the proportion of a cell without prescription drug insurance to each of the 96 demographic cells (using the 96 actual values). We then estimated the reduced form model We conducted 500 such analyses and calculated the p-value as the proportion of estimates with an absolute value greater than the actual estimate. Interestingly, using this method produced six reduced form estimates that were significant at the 0.05 level. In general, the p-values obtained from the permutations test were smaller than those obtained from the regression models.

substantially smaller. Finally, the placebo reduced form estimates are about evenly divided between negative and positive estimates. Overall, estimates in Table 3 provide evidence that the DID and IV approaches are reasonable and plausibly valid.[19]

5.b. Instrumental Variables Estimates: Number of Hospitalizations

Table 4 presents instrumental variables estimates (equation 2). For each type of hospitalization, we report four estimates. We obtained estimates using two time periods, 2002 to 2009 inclusive and exclusive of 2006, and two methods of estimation, weighted and un-weighted regression. Arguably, estimates from weighted regressions are preferred because they are representative of the underlying population. Similarly, because Medicare Part D was not fully implemented until June of 2006, it is reasonable to prefer estimates that exclude 2006. Accordingly, we focus the discussion of the IV estimates on weighted estimates that exclude the transition year of 2006.

Our preferred estimates indicate that gaining Medicare Part D prescription drug coverage is associated with a significant (0.10 level or greater):

- 0.6 per 1000 (8%) decrease in AMI admissions;
- 1.9 per 1000 (18%) decrease in CHF admissions;
- 2.5 per 1000 (13%) decrease in Coronary Atherosclerosis admissions;
- 2.3 per 1000 (32%) decrease in COPD admissions;
- 0.8 per 1000 (20%) decrease in dehydration admissions;
- and a 20.8 per 1000 (8%) decrease in all types of admissions.

In most cases, the time period (include/exclude 2006) and the method (weighted/unweighted) we use to obtain estimates does not alter substantially the basic results reported above. Other estimates in Table 3 are quite small including trauma admissions, which we did not expect to be influenced by prescription drug insurance.

5.c. Instrumental Variables Estimates of Hospital Charges and Expenditures

[19] Appendix Table 3 presents the placebo, reduced form estimates for Medicare hospital expenditures. Results are qualitatively similar to those for the quantity of admissions.

Table 5 presents instrumental variables estimates for total "charges" per person for each type of hospital admission. The organization of Table 5 is the same as that used for Table 4. The corresponding DID estimates are in Appendix Table 2.

The IV estimates in Table 5 are generally consistent with those in Table 4—decreases in the rate of admission per 1000 persons are associated with decreases in charges per person. Specifically, gaining prescription drug insurance through Medicare Part D is associated with a:

- $49 per person (27%) decrease in charges on CHF admissions;
- $73 per person (11%) decrease in charges on Coronary Atherosclerosis admissions;
- $42 per person (39%) decrease in charges on COPD admissions;
- $18 per person (35%) decrease in charges on dehydration admissions;
- $62 per person (22%) decrease in charges on admissions for trauma;
- and a $728 per person (12%) decrease in charges on all admissions.

Notably, in most cases, the effect of prescription drug insurance on hospital charges is greater in percentage terms than the effect of prescription drug insurance on rates of hospitalization, which suggests that prescription drug insurance reduced resource-intensive admissions more than other admissions. For example, prescription drug coverage is associated with a 32% decrease in the number of COPD admissions and a 39% decrease in charges per person on COPD admissions.

Table 6 presents instrumental variables estimates for Medicare expenditures per person for each type of hospital admission. Gaining prescription drug insurance through Medicare Part D is associated with a:

- $12 per person (23%) decrease in Medicare expenditures on CHF admissions;
- $11 per person (34%) decrease in Medicare expenditures on COPD admissions;
- $4 per person (27%) decrease in Medicare expenditures on dehydration admissions;
- and a $138 per person (7%) decrease in Medicare expenditures on all admissions.

As was the case with charges, the effect of prescription drug insurance on Medicare hospital expenditures tends to be greater in percentage terms than the effect of prescription drug insurance on rates of hospitalization, which suggests that prescription drug insurance reduced resource-intensive admissions more than other admissions., although this is not the case for all admissions combined.

5.d. Instrumental Variables Estimates: Mortality

Table 7 presents instrumental variables estimates for mortality and its presentation follows that of previous tables (Appendix Table 4 shows DID estimates for mortality). The preferred estimates indicate that prescription drug insurance is associated with a small and statistically insignificant 0.12 per 1000 (0.3%) increase in mortality. Other estimates in Table 7 are similarly small and none are significant.

6. Conclusions

Evidence from clinical trials establishes that prescription drugs improve health. Indeed, for some drugs such as statins, anti-hypertensive drugs and blood thinners, the (cost) effectiveness of pharmaceutical therapy is substantial (Musini et al. 2009; Taylor et al. 2013). There is also ample evidence that prescription drug insurance, including Medicare Part D, significantly increases prescription drug use (see for example, Goldman et al. 2007; Yin et al. 2008; Zhang et al. 2009; Kaestner and Khan 2012). Combined, these two facts imply that gaining prescription drug insurance through Medicare Part D will improve health and reduce the use of, and spending on, non-pharmacy medical services. However, there are reasons to expect that this logic may not be correct and that gaining prescription drug insurance through Medicare Part D will not affect the use of other medical services. Most importantly, there may be a relatively small health benefits from greater use of prescription drugs that comes with insurance such as Medicare Part D because of moral hazard. Prior to gaining prescription drug insurance, many elderly bought a substantial number of prescription drugs, and if so, it is logical they bought the most effective drugs in terms of health benefits.

To date, the evidence on whether prescription drug insurance will improve health (mortality) and result in offsets—savings form reduced spending on other services—is inconclusive. To our knowledge

there are no previous studies of the effect of prescription drug insurance on mortality, and there are only three studies examined whether there are offsets associated with gaining prescription insurance through Medicare Part D. Zhang et al. (2009), using a sample of elderly in one health plan from Pennsylvania, found that a 74% increase in prescription drug spending associated with Medicare Part D resulted in a 7% decrease in spending on non-pharmacy medical care. Afendulis et al. (2011), using aggregate state-level data, reported that the 28 percentage point increase in prescription drug insurance through Medicare Part D is associated with a 4% decrease in hospitalizations. Finally, Kaestner and Khan (2012), using a sample from the MCBS, reported that gaining prescription drug insurance through Medicare Part D was not significantly associated with changes in inpatient or outpatient spending, although the study lacked statistical power to detect small to moderate effects. Other evidence related to the question, but not specifically in the context of Medicare Part D, is mixed, as described in the literature review earlier in Section 2.

Given the importance of the issue and the lack of a consensus answer, we examined whether gaining prescription drug insurance through Medicare Part D is associated with changes in mortality and rates of, and expenditures on, several types of hospitalizations and all hospitalizations combined for a large, geographically diverse group of Medicare beneficiaries. Our estimates indicate that gaining prescription drug insurance through Medicare Part D is associated with an 8% decrease in the number of hospital admissions per 1000 people, a 7% decrease in Medicare payments per person for inpatient services, and a 12% decrease in inpatient charges per person. Our estimates also indicate that Medicare Part D prescription insurance is associated with changes in the severity of admissions as the change in expenditures and charges associated with prescription drug coverage was usually greater than the change in the quantity of admissions associated with prescription drug coverage. We found no evidence that gaining prescription drug insurance through Medicare Part D affected mortality.

Overall, Medicare Part D prescription insurance is associated with a $138, or 7%, decrease in Medicare inpatient expenditures per person. This figure represents a considerable “offset” of the cost of prescription drugs. The CBO estimates that in 2008, average spending on prescription drugs among non-

poor (not low-income subsidy eligible), Medicare Part D participants was $1,800.[20] So the offset we estimate here represents 8% of the total cost of prescription drugs among the elderly affected. If we assume that 11 million (28%) elderly gained prescription drug coverage through Medicare Part D, which is consistent with actual estimates, and that the offset we find here applies, then the total "offset" is $1.5 billion per year, or approximately 2.2% (1.5 divided by 67.7 total state and federal expenditure) of the total annual cost of Medicare Part D.

In summary, our estimates suggest that gaining prescription drug insurance through Medicare Part D significantly reduced hospital admissions and hospital expenditures. The "offset" in downstream spending resulting from gaining prescription drug insurance is considerable and represents approximately 2.2% of total Medicare Part D spending. The existence of such offsets substantially lowers the net cost of Medicare Part D—more so than estimated by the CBO. The existence of "offsets" also implies that stand alone prescription drug plans such as those that characterize Medicare Part D cannot exploit these offsets through pricing because the "offsets" accrue to the medical insurer, which in this case is the federal government for fee-for-service Medicare enrollees. Medicare Advantage (HMO) plans can exploit this source of savings and this may partly explain why Medicare Advantage plans often included prescription drug benefits prior to Medicare Part D.

[20] See: Congressional Budget Office, Economics and Budget Issue Brief, December 2011, *Spending Patterns for Prescription Drugs under Medicare Part D*, http://www.cbo.gov/sites/default/files/cbofiles/attachments/12-01-MedicarePartD.pdf).

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Figure 1
Association Between the Change in Proportion Uninsured
and Proportion Uninsured in 2002-2005

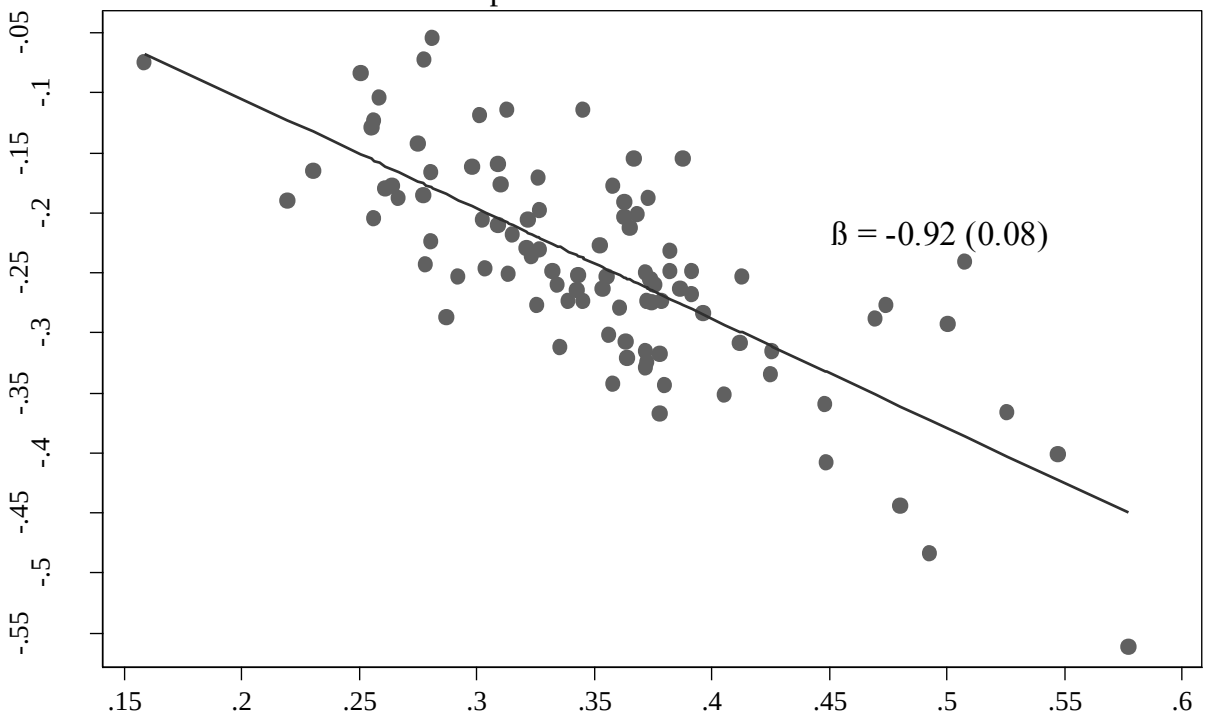

Table 1
Sample Means and Standard Deviations of Hospital Admissions per 1000 by Year

Type of Admissions	2002	2003	2004	2005	2006	2007	2008	2009
Acute Myocardial Infarction	8.63	8.07	7.54	6.93	6.54	6.12	5.96	5.55
	(3.15)	(3.00)	(2.85)	(2.65)	(2.45)	(2.35)	(2.30)	(2.17)
Congestive Heart Failure	10.66	10.71	10.41	9.64	9.29	8.50	7.94	7.60
	(5.87)	(6.07)	(6.14)	(5.83)	(5.73)	(5.36)	(5.19)	(5.00)
Coronary Atherosclerosis and Other Heart Disease	19.33	18.48	18.48	17.06	16.59	14.05	12.16	10.34
	(6.49)	(6.58)	(6.50)	(6.37)	(6.22)	(5.34)	(4.72)	(4.12)
Stroke	6.58	6.14	5.88	5.65	5.49	5.15	5.01	4.88
	(2.95)	(2.80)	(2.71)	(2.62)	(2.54)	(2.42)	(2.37)	(2.30)
Cardiac Dysrhythmias	11.97	11.46	11.31	10.96	11.14	11.14	11.17	10.94
	(4.57)	(4.54)	(4.58)	(4.43)	(4.53)	(4.52)	(4.56)	(4.57)
Pneumonia	9.88	9.99	9.19	10.04	8.84	8.47	7.71	7.16
	(4.90)	(4.82)	(4.52)	(5.05)	(4.45)	(4.33)	(4.26)	(3.82)
COPD	7.93	7.57	6.70	6.23	5.57	5.46	6.41	6.04
	(2.35)	(2.16)	(2.00)	(1.95)	(1.71)	(1.73)	(2.25)	(2.04)
Dehydration	4.13	3.99	3.92	3.91	4.08	4.12	3.54	2.98
	(2.28)	(2.14)	(2.06)	(2.08)	(2.18)	(2.16)	(1.95)	(1.62)
Osteoarthritis	12.25	13.14	14.47	15.31	15.30	15.35	15.39	15.80
	(2.78)	(3.26)	(3.50)	(3.65)	(3.51)	(3.59)	(3.62)	(3.62)
Urinary Tract Infection (UTI)	3.27	3.40	3.56	3.66	3.74	3.89	4.00	4.07
	(2.10)	(2.24)	(2.42)	(2.56)	(2.68)	(2.86)	(3.05)	(3.18)
Trauma	11.83	11.95	12.11	12.17	12.17	12.06	11.63	11.24
	(7.89)	(7.97)	(8.14)	(8.26)	(8.29)	(8.16)	(7.87)	(7.73)
All Admission	259.64	256.41	255.73	252.79	250.02	242.17	235.65	226.23
	(76.64)	(77.33)	(78.29)	(78.41)	(78.22)	(76.48)	(76.78)	(73.52)
Mortality	32.29	31.48	30.27	30.02	29.26	28.62	28.34	27.05
	(19.10)	(18.76)	(18.23)	(18.24)	(17.79)	(17.66)	(17.66)	(16.97)
Observations	96	96	96	96	96	96	96	96

Notes: The unit of observation is the age-gender-region cell. Figures are weighted by cell size. Standard deviations are in parenthesis.

Table 2
Difference-in-differences Estimates of the Effect of Prescription Drug Insurance on Hospital Admissions

	AMI	Joint F-Test	CHF	Joint F-Test	Athero-sclerosis	Joint F-Test	Stroke	Joint F-test	Cardiac Dys-rhythmias	Joint F-Test	Pneum.	Joint F-Test
Interactions Proportion Uninsured in 02-05 and Year												
2003	0.61 (0.90)		-1.07 (1.25)		-0.62 (1.56)		0.03 (0.83)		-1.69 (1.16)		0.11 (1.03)	
2004	1.82 (0.90)**	2.86	-0.28 (1.25)	0.56	-0.48 (1.56)	0.53	-1.30 (0.83)	1.26	0.28 (1.16)	1.22	-0.38 (1.03)	1.74
2005	-0.73 (0.90)	0.04**	-1.42 (1.25)	0.64	1.17 (1.57)	0.66	0.01 (0.83)	0.29	0.03 (1.17)	0.30	1.80 (1.04)*	0.16
2007	-0.28 (0.92)		-1.90 (1.28)		-1.16 (1.60)		-0.12 (0.85)		-0.63 (1.19)		-0.38 (1.06)	
2008	-0.33 (0.93)	0.12	-2.16 (1.28)*	2.39	-2.99 (1.60)*	1.58	0.27 (0.85)	1.03	-0.60 (1.20)	1.09	1.36 (1.06)	1.48
2009	0.15 (0.93)	0.95	-3.39 (1.29)**	0.07*	-2.82 (1.61)*	0.19	-1.14 (0.85)	0.38	-2.09 (1.20)*	0.35	-0.77 (1.06)	0.22
Reduced Form Estimate												
2007-09	-0.58 (0.55)		-1.82 (0.94)*		-2.34 (1.17)**		-0.05 (0.51)		-0.74 (0.76)		-0.17 (0.62)	
Mean 02-05	7.79		10.36		18.34		6.06		11.42		9.78	
	COPD	Joint F-Test	Dehy-dration	Joint F-Test	Osteo-arthritis	Joint F-Test	UTI	Joint F-Test	Trauma	Joint F-Test	Any Admit.	Joint F-Test
Interactions Proportion Uninsured in 02-05 and Year												
2003	-0.99 (1.05)		0.16 (0.66)		-1.29 (1.40)		-0.22 (0.72)		0.34 (1.37)		-2.1 (8.6)	
2004	-0.50 (1.05)	0.53	0.23 (0.66)	0.04	-2.07 (1.40)	0.74	0.20 (0.72)	0.12	-0.88 (1.37)	0.40	3.9 (8.6)	0.17
2005	-1.22 (1.06)	0.66	0.14 (0.66)	0.99	-1.09 (1.41)	0.53	0.07 (0.72)	0.95	-0.83 (1.37)	0.76	0.8 (8.6)	0.92
2007	-2.14 (1.08)**		0.05 (0.68)		-0.82 (1.43)		0.11 (0.74)		-0.88 (1.40)		-12.1 (8.8)	
2008	-3.58 (1.08)**	4.19	-1.28 (0.68)*	1.78	-0.47 (1.44)	0.88	0.60 (0.74)	0.94	-0.47 (1.41)	0.34	-22.0 (8.8)**	2.88
2009	-2.93 (1.08)**	0.01**	-0.79 (0.68)	0.15	-2.24 (1.45)	0.45	-0.66 (0.74)	0.42	-1.36 (1.41)	0.80	-22.4 (8.8)**	0.04**
Reduced Form Estimate												
2007-09	-2.19 (0.76)**		-0.79 (0.40)*		-0.14 (1.04)		0.02 (0.60)		-0.60 (1.30)		-19.8 (7.6)**	
Mean 02-05	7.11		3.99		13.80		3.47		12.02		256.1	

Notes: Unit of observation is the year-age-gender-region cell and there are 672 observations. All regressions include HMO share, cell fixed effects, year fixed effects, region by year fixed effects, and age by gender by year fixed effects. All regressions are weighted by cell size. Standard errors are shown in parentheses.
* p<0.10, ** p<0.05.

Table 3
Placebo Tests: Reduced Form Estimates of the Effect of Prescription Drug Insurance on Hospital Admissions

	AMI	CHF	Athero-Sclerosis	Stroke	Cardiac Dys-rhythmias	Pneum.	COPD	Dehy-dration	Osteo-arthritis	UTI	Trauma	Any Admit
Placebo Reduced Form	0.24	-0.24	0.64	-0.67	0.91	0.47	-0.24	0.12	-0.68	0.21	-0.86	4.6
	(0.62)	(1.00)	(1.18)	(0.61)	(0.80)	(0.72)	(0.86)	(0.45)	(0.98)	(0.44)	(0.84)	(6.0)
Actual Reduced Form	-0.58	-1.82	-2.34	-0.05	-0.74	-0.17	-2.19	-0.79	-0.14	0.02	-0.60	-19.8
	(0.55)	(0.94)*	(1.17)**	(0.51)	(0.76)	(0.62)	(0.76)**	(0.40)*	(1.04)	(0.60)	(1.30)	(7.5)**
Weighted Mean 02-05	7.79	10.36	18.34	6.06	11.42	9.78	7.11	3.99	13.80	3.47	12.02	256.13
Observations	192	192	192	192	192	192	192	192	192	192	192	192

Notes: Unit of observation is the period-age-gender-region cell. For the placebo test, the pre-period is 2002-2003 and the post period is 2004-2005. All regressions include HMO share, cell fixed effects, post, region by post fixed effects, and age by gender by post fixed effects. All regressions are weighted by cell size. Standard errors are shown in parentheses. * $p<0.10$, ** $p<0.05$

Table 4
Instrumental Variables Estimates of the Effect of Prescription Drug Insurance on Hospital Admissions

Type of Hospital Admission	Weighted		Unweighted	
	Post 2006	Post 2007	Post 2006	Post 2007
Acute Myocardial Infarction (AMI)	-0.46	-0.60*	-0.72**	-0.89**
	(0.34)	(0.36)	(0.36)	(0.38)
Weighted Mean 2002-05 = 7.79				
Congestive Heart Failure (CHF)	-1.70**	-1.91**	-1.67**	-1.82**
	(0.57)	(0.63)	(0.62)	(0.66)
Weighted Mean 2002-05 = 10.36				
Coronary Atherosclerosis	-2.05**	-2.45**	-1.61**	-2.15**
	(0.75)	(0.74)	(0.77)	(0.72)
Weighted Mean 2002-05 = 18.34				
Stroke	0.13	-0.05	0.46	0.31
	(0.32)	(0.33)	(0.36)	(0.36)
Weighted Mean 2002-05 = 6.06				
Cardiac Dysrhythmias	-0.54	-0.78	-0.27	-0.42
	(0.45)	(0.48)	(0.50)	(0.53)
Weighted Mean 2002-05 = 11.42				
Pneumonia	0.17	-0.18	0.12	-0.30
	(0.41)	(0.39)	(0.47)	(0.43)
Weighted Mean 2002-05 = 9.78				
COPD	-2.10**	-2.29**	-2.45**	-2.66**
	(0.46)	(0.50)	(0.51)	(0.54)
Weighted Mean 2002-05 = 7.11				
Dehydration	-0.89**	-0.82**	-0.92**	-0.93**
	(0.26)	(0.26)	(0.30)	(0.29)
Weighted Mean 2002-05 = 3.99				
Osteoarthritis	-0.16	-0.15	0.01	-0.06
	(0.61)	(0.67)	(0.69)	(0.72)
Weighted Mean 2002-05 = 13.80				
Urinary Tract Infection (UTI)	0.13	0.02	-0.11	-0.25
	(0.33)	(0.38)	(0.37)	(0.43)
Weighted Mean 2002-05 = 3.47				
Trauma	-0.54	-0.63	-0.28	-0.34
	(0.72)	(0.83)	(0.81)	(0.91)
Weighted Mean 2002-05 = 12.02				
All Admission	-17.36**	-20.76**	-19.03**	-22.44**
	(4.58)	(5.07)	(4.86)	(5.28)
Weighted Mean 2002-05 = 256.13				
Observations	192	192	192	192

Notes: Unit of observation is the period-age-gender-region cell. The instrument for proportion insured is the interaction term between proportion uninsured in 2002-2005 and post-period dummy variable. All regressions include HMO share, cell fixed effects, post, region by post fixed effects, and age by gender by post fixed effects. Weighted regressions are weighted by cell size. Standard errors are shown in parentheses. * $p<0.10$, ** $p<0.05$

Table 5 Total Charge Amount
Instrumental Variables Estimates of the Effect of Prescription Drug Insurance on Hospital Expenditures

Type of Hospital Admission	Weighted		Unweighted	
	Post 2006	Post 2007	Post 2006	Post 2007
Acute Myocardial Infarction (AMI)	1.8	-19.1	-5.7	-30.0
	(21.4)	(21.1)	(23.6)	(23.0)
Weighted Mean 2002-05 = 328.7				
Congestive Heart Failure (CHF)	-37.7**	-48.5**	-39.8**	-50.3**
	(14.1)	(15.7)	(16.1)	(17.1)
Weighted Mean 2002-05 = 177.0				
Coronary Atherosclerosis	-72.2*	-73.3*	-51.1	-58.6
	(40.7)	(38.8)	(42.7)	(39.8)
Weighted Mean 2002-05 = 671.6				
Stroke	-5.7	-15.8	7.7	-0.9
	(13.1)	(14.3)	(15.0)	(15.9)
Weighted Mean 2002-05 = 135.2				
Cardiac Dysrhythmias	8.2	-4.2	25.7	19.2
	(19.0)	(19.6)	(21.1)	(21.4)
Weighted Mean 2002-05 = 259.4				
Pneumonia	-10.1	-18.7	-11.5	-20.7
	(12.1)	(13.6)	(13.5)	(14.7)
Weighted Mean 2002-05 = 163.4				
COPD	-43.9**	-41.6**	-48.0**	-45.0**
	(9.2)	(10.9)	(9.9)	(11.4)
Weighted Mean 2002-05 = 107.0				
Dehydration	-19.0**	-18.2**	-17.1**	-17.0**
	(5.2)	(5.7)	(5.9)	(6.4)
Weighted Mean 2002-05 =50.6				
Osteoarthritis	28.1	28.4	32.2	28.2
	(27.5)	(31.8)	(31.7)	(35.5)
Weighted Mean 2002-05 = 413.1				
Urinary Tract Infection (UTI)	9.6	9.5	13.3	13.0
	(8.0)	(8.8)	(9.5)	(10.2)
Weighted Mean 2002-05 = 45.3				
Trauma	-47.6*	-61.7**	-40.5	-54.7
	(28.1)	(30.6)	(33.7)	(34.8)
Weighted Mean 2002-05 = 280.8				
All Admission	-528.7**	-727.5**	-500.6**	-726.2**
	(204.0)	(232.3)	(221.6)	(240.5)
Weighted Mean 2002-05 = 6078.0				
Observations	192	192	192	192

Notes: Unit of observation is the period-age-gender-region cell. The instrument for proportion insured is the interaction term between proportion uninsured in 2002-2005 and post-period dummy variable. All regressions include HMO share, cell fixed effects, post, region by post fixed effects, and age by gender by post fixed effects. Weighted regressions are weighted by cell size. Standard errors are shown in parentheses. * $p<0.10$, ** $p<0.05$

Table 6 Medicare Payment Amount
Instrumental Variables Estimates of the Effect of Prescription Drug Insurance on Hospital Expenditures

Type of Hospital Admission	Weighted		Unweighted	
	Post 2006	Post 2007	Post 2006	Post 2007
Acute Myocardial Infarction (AMI)	-2.4	-7.5	-7.2	-13.8**
	(5.6)	(5.6)	(6.2)	(6.1)
Weighted Mean 2002-05 = 100.4				
Congestive Heart Failure (CHF)	-9.6**	-12.0**	-9.3**	-11.7**
	(3.3)	(3.7)	(3.6)	(3.9)
Weighted Mean 2002-05 = 52.8				
Coronary Atherosclerosis	-6.0	-8.6	-1.2	-6.1
	(9.5)	(8.7)	(10.0)	(8.9)
Weighted Mean 2002-05 = 217.9				
Stroke	-0.03	-4.2	5.9	2.1
	(4.3)	(4.7)	(4.8)	(5.3)
Weighted Mean 2002-05 = 44.8				
Cardiac Dysrhythmias	8.1	5.6	12.5**	11.1*
	(5.6)	(5.8)	(6.3)	(6.4)
Weighted Mean 2002-05 = 79.4				
Pneumonia	0.5	-1.8	-0.03	-2.2
	(3.0)	(3.1)	(3.4)	(3.4)
Weighted Mean 2002-05 = 49.6				
COPD	-10.8**	-11.1**	-13.5**	-13.0**
	(2.5)	(2.8)	(2.8)	(3.0)
Weighted Mean 2002-05 = 32.4				
Dehydration	-4.8**	-4.4**	-4.9**	-4.9**
	(1.3)	(1.4)	(1.5)	(1.5)
Weighted Mean 2002-05 = 16.3				
Osteoarthritis	7.0	7.7	8.6	8.3
	(6.8)	(7.7)	(7.8)	(8.5)
Weighted Mean 2002-05 = 130.9				
Urinary Tract Infection (UTI)	2.7*	2.8	3.2*	2.9
	(1.5)	(1.7)	(1.8)	(1.9)
Weighted Mean 2002-05 = 13.4				
Trauma	-8.2	-12.8	-5.7	-10.1
	(6.7)	(7.8)	(7.9)	(9.0)
Weighted Mean 2002-05 = 86.6				
All Admission	-79.3*	-137.5**	-81.2*	-148.8**
	(42.2)	(47.9)	(46.8)	(52.2)
Weighted Mean 2002-05 = 1980.6				
Observations	192	192	192	192

Notes: Unit of observation is the period-age-gender-region cell. The instrument for proportion insured is the interaction term between proportion uninsured in 2002-2005 and post-period dummy variable. All regressions include HMO share, cell fixed effects, post, region by post fixed effects, and age by gender by post fixed effects. Weighted regressions are weighted by cell size. Standard errors are shown in parentheses. * $p<0.10$, ** $p<0.05$

Table 7
Instrumental Variables Estimates of the Effect of Prescription Drug Insurance on Mortality

	Weighted		Unweighted	
	Post 2006	Post 2007	Post 2006	Post 2007
Mortality	-0.49	0.12	0.18	1.03
	(0.68)	(0.66)	(0.76)	(0.71)
Weighted Mean 2002-05 = 31.01				
Observations	192	192	192	192

Notes: Unit of observation is the period-age-gender-region cell. The instrument for proportion insured is the interaction term between proportion uninsured in 2002-2005 and post-period dummy variable. All regressions include HMO share, cell fixed effects, post, region by post fixed effects, and age by gender by post fixed effects. Weighted regressions are weighted by cell size. Standard errors are shown in parentheses. * $p<0.10$, ** $p<0.05$

Appendix Table 1
Difference-in-differences Estimates of the Effect of Prescription Drug Insurance on Hospital Admissions, 2002 to 2009 Including 2006

	AMI	Joint F-Test	CHF	Joint F-Test	Athero-sclerosis	Joint F-Test	Stroke	Joint F-test	Cardiac Dys-rhythmias	Joint F-Test	Pneum.	Joint F-Test
Interactions Proportion Uninsured in 02-05 and Year												
2003	0.61 (0.89)		-1.08 (1.22)		-0.62 (1.57)		0.03 (0.82)		-1.68 (1.15)		0.10 (1.04)	
2004	1.81 (0.89)**	2.96	-0.29 (1.22)	0.59	-0.48 (1.57)	0.53	-1.30 (0.82)	1.29	0.30 (1.15)	1.26	-0.38 (1.04)	1.71
2005	-0.74 (0.89)	0.03**	-1.43 (1.23)	0.62	1.16 (1.58)	0.66	0.01 (0.82)	0.28	0.05 (1.15)	0.29	1.79 (1.04)*	0.16
2006	0.56 (0.90)		-1.44 (1.24)		-0.47 (1.59)		0.24 (0.83)		-0.58 (1.16)		1.48 (1.05)	
2007	-0.30 (0.91)		-1.92 (1.25)		-1.18 (1.60)		-0.12 (0.84)		-0.59 (1.17)		-0.38 (1.06)	
2008	-0.36 (0.91)	0.32	-2.18 (1.25)*	1.95	-3.01 (1.61)*	1.44	0.27 (0.84)	0.92	-0.55 (1.18)	0.81	1.36 (1.07)	1.82
2009	0.12 (0.91)	0.86	-3.42 (1.26)**	0.10*	-2.85 (1.62)*	0.22	-1.14 (0.84)	0.45	-2.03 (1.18)*	0.52	-0.77 (1.07)	0.12
Reduced Form Estimate												
2006-09	-0.43 (0.50)		-1.59 (0.85)*		-1.92 (1.16)		0.12 (0.49)		-0.50 (0.70)		0.16 (0.63)	
Mean 02-05	7.79		10.36		18.34		6.06		11.42		9.78	
	COPD	Joint F-Test	Dehy-dration	Joint F-Test	Osteo-arthritis	Joint F-Test	UTI	Joint F-Test	Trauma	Joint F-Test	Any Admit	Joint F-Test
Interactions Proportion Uninsured in 02-05 and Year												
2003	-0.99 (1.03)		0.16 (0.66)		-1.28 (1.39)		-0.23 (0.71)		0.34 (1.34)		-2.0 (8.3)	
2004	-0.49 (1.03)	0.55	0.23 (0.66)	0.04	-2.05 (1.39)	0.74	0.20 (0.72)	0.12	-0.88 (1.35)	0.41	4.0 (8.3)	0.18
2005	-1.21 (1.04)	0.65	0.14 (0.66)	0.99	-1.06 (1.39)	0.53	0.06 (0.72)	0.95	-0.83 (1.35)	0.75	0.9 (8.4)	0.91
2006	-2.16 (1.04)**		-0.89 (0.67)		-1.37 (1.41)		0.46 (0.72)		-0.80 (1.36)		-6.8 (8.4)	
2007	-2.13 (1.05)**		0.05 (0.67)		-0.78 (1.42)		0.10 (0.73)		-0.89 (1.38)		-11.9 (8.5)	
2008	-3.57 (1.06)**	3.25	-1.29 (0.67)*	1.50	-0.41 (1.42)	0.71	0.58 (0.73)	0.87	-0.48 (1.38)	0.27	-21.7 (8.5)**	2.50
2009	-2.92 (1.06)**	0.01**	-0.79 (0.68)	0.20	-2.18 (1.43)	0.59	-0.67 (0.74)	0.48	-1.37 (1.39)	0.90	-22.1 (8.6)**	0.04**
Reduced Form Estimate												
2006-09	-1.96 (0.68)**		-0.83 (0.38)**		-0.15 (0.94)		0.12 (0.50)		-0.50 (1.10)		-16.2 (6.8)**	
Mean 02-05	7.11		3.99		13.80		3.47		12.02		256.1	

Notes: Unit of observation is the year-age-gender-region cell and there are 768 observations. All regressions include HMO share, cell fixed effects, year fixed effects, region by year fixed effects, and age by gender by year fixed effects. All regressions are weighted by cell size. Standard errors are shown in parentheses.
* p<0.10, ** p<0.05.

Appendix Table 2 Total Charge Amount
Difference-in-differences Estimates of the Effect of Prescription Drug Insurance on Hospital Expenditures

	AMI	Joint F-Test	CHF	Joint F-Test	Athero-sclerosis	Joint F-Test	Stroke	Joint F-test	Cardiac Dys-rhythmias	Joint F-Test	Pneum.	Joint F-Test
Interactions Proportion Uninsured in 02-05 and Year												
2003	-0.2 (56.4)		-27.2 (36.2)		-75.9 (86.6)		-5.8 (36.5)		-69.0 (47.5)		22.9 (32.2)	
2004	61.1 (56.5)	0.74	13.0 (36.3)	0.55	-57.7 (86.7)	0.54	-16.6 (36.5)	0.08	-10.9 (47.6)	1.74	46.9 (32.2)	1.99
2005	-17.4 (56.7)	0.53	-22.9 (36.4)	0.65	18.0 (87.0)	0.66	-12.7 (36.7)	0.97	38.3 (47.7)	0.16	75.2 (32.4)**	0.11
2007	-20.2 (57.7)		-16.9 (37.1)		-64.7 (88.6)		-4.2 (37.3)		19.1 (48.6)		8.6 (32.9)	
2008	-13.1 (58.0)	0.12	-57.5 (37.2)	2.61	-145.2 (89.0)	0.93	-2.1 (37.5)	1.06	-5.0 (48.8)	0.74	48.2 (33.1)	1.52
2009	12.9 (58.1)	0.95	-95.5 (37.3)**	0.05**	-93.4 (89.2)	0.43	-57.4 (37.6)	0.37	-52.0 (49.0)	0.53	-21.9 (33.2)	0.21
Reduced Form Estimate												
2007-09	-18.2 (33.0)		-46.3 (23.6)*		-69.9 (60.3)		-15.0 (22.4)		-4.0 (30.7)		-17.8 (21.1)	
Mean 02-05	328.7		177.0		671.6		135.2		259.4		163.4	

	COPD	Joint F-Test	Dehy-dration	Joint F-Test	Osteo-arthritis	Joint F-Test	UTI	Joint F-Test	Trauma	Joint F-Test	Any Admit	Joint F-Test
Interactions Proportion Uninsured in 02-05 and Year												
2003	-42.4 (26.0)		4.7 (14.9)		-19.9 (61.5)		2.9 (17.3)		-3.3 (57.4)		-145 (369)	
2004	-7.2 (26.0)	1.38	11.0 (14.9)	0.19	-36.4 (61.6)	0.18	20.3 (17.3)	0.54	-8.1 (57.5)	0.01	464 (369)	0.99
2005	-38.7 (26.1)	0.25	7.0 (15.0)	0.90	2.6 (61.8)	0.91	7.1 (17.4)	0.66	-9.2 (57.7)	0.99	80 (370)	0.40
2007	-59.5 (26.6)**		7.3 (15.2)		17.9 (62.9)		9.4 (17.7)		-46.8 (58.7)		-304 (377)	
2008	-68.0 (26.7)**	2.69	-32.5 (15.3)**	2.55	61.6 (63.2)	0.73	35.3 (17.8)**	1.46	-59.1 (59.0)	0.59	-659 (379)*	1.67
2009	-53.1 (26.7)**	0.05**	-13.2 (15.4)	0.06*	-30.9 (63.4)	0.54	7.9 (17.8)	0.22	-73.7 (59.2)	0.62	-756 (380)**	0.17
Reduced Form Estimate												
2007-09	-39.7 (16.9)**		-17.4 (8.7)*		27.1 (50.5)		9.1 (14.0)		-58.9 (46.9)		-694 (336)**	
Mean 02-05	107.0		50.6		413.1		45.3		280.8		6078	

Notes: Unit of observation is the year-age-gender-region cell and there are 672 observations. All regressions include HMO share, cell fixed effects, year fixed effects, region by year fixed effects, and age by gender by year fixed effects. All regressions are weighted by cell size. Standard errors are shown in parentheses.
* p<0.10, ** p<0.05.

Appendix Table 3 Total Charge Amount
Placebo Tests: Reduced Form Estimates of the Effect of Prescription Drug Insurance on Hospital Expenditures

	AMI	CHF	Athero-sclerosis	Stroke	Cardiac Dys-rhythmias	Pneum.	COPD	Dehy-dration	Osteo-arthritis	UTI	Trauma	Any Admit
Placebo Reduced Form	21.0	4.0	13.4	-9.0	47.2	44.4	2.8	4.8	-5.2	12.0	1.2	336.8
	(34.4)	(29.6)	(55.7)	(21.3)	(28.3)*	(18.3)**	(18.4)	(10.2)	(36.9)	(10.2)	(41.4)	(225.0)
Actual Reduced Form	-18.2	-46.3	-69.9	-15.0	-4.0	-17.8	-39.7	-17.4	27.1	9.1	-58.9	-694
	(33.0)	(23.6)*	(60.3)	(22.4)	(30.7)	(21.1)	(16.9)**	(8.7)*	(50.5)	(14.0)	(46.9)	(336)**
Weighted Mean 02-05	328.7	177.0	671.6	135.2	259.4	163.4	107.0	50.6	413.1	45.3	280.8	6078
Observations	192	192	192	192	192	192	192	192	192	192	192	192

Notes: Unit of observation is the period-age-gender-region cell. For the placebo test, the pre-period is 2002-2003 and the post period is 2004-2005. All regressions include HMO share, cell fixed effects, post, region by post fixed effects, and age by gender by post fixed effects. All regressions are weighted by cell size. Standard errors are shown in parentheses. * $p<0.10$, ** $p<0.05$

Appendix Table 4
Difference-in-differences Estimates of the Effect of Prescription Drug Insurance on Mortality

	Mortality	Joint F-Test
Interactions Proportion Uninsured in 02-05 and Year		
2003	-2.34 (1.69)	
2004	-1.92 (1.69)	1.58
2005	0.80 (1.70)	0.19
2007	-0.23 (1.73)	
2008	-1.58 (1.74)	0.33
2009	-0.28 (1.74)	0.80
Reduced Form Estimate		
2007-09	0.11 (1.02)	
Mean 02-05	31.01	

Notes: Unit of observation is the year-age-gender-region cell and there are 672 observations. All regressions include HMO share, cell fixed effects, year fixed effects, region by year fixed effects, and age by gender by year fixed effects. All regressions are weighted by cell size. Standard errors are shown in parentheses.* $p<0.10$, ** $p<0.05$