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Examining the Number of Competitors and the Cost of Medicare Part D

Andrew Stocking
Congressional Budget Office
(andrew.stocking@cbo.gov)

James Baumgardner
Congressional Budget Office
(jim.baumgardner@cbo.gov)

Melinda Buntin
Vanderbilt University
(melinda.buntin@vanderbilt.edu)

Anna Cook
Congressional Budget Office
(anna.cook@cbo.gov)

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Abstract

Most beneficiaries of Medicare's Part D prescription drug insurance choose among private drug plans to receive their coverage. This paper is the first to examine the relationship between the number of competing plan sponsors and the cost of Part D during the program's first five years. Over the period from 2006 to 2010, regional Part D markets contained between 16 and 22 plan sponsors offering stand-alone plans. Consistent with economic theory, we find that increases in the number of plan sponsors within a market were associated with lower bids and lower overhead and profits of plans in that market. For example, among stand-alone plans that were not eligible to be assigned low-income beneficiaries, we find that each additional plan sponsor entering an 18-firm market was associated with a reduction in bids for a month of basic coverage to a beneficiary of average health of 0.4 percent—or $0.33 for a plan that bid $85—which corresponds to an elasticity of -0.071. (That result is an arithmetic average across six specifications in which estimates range from $0.20 to $0.50.) Because bids are used to directly determine government spending, we estimate that an additional plan sponsor nationwide was associated with a reduction in government spending of $7 million to $17 million each year.

I. Introduction

Medicare Part D was created by the Medicare Prescription Drug, Improvement, and Modernization Act of 2003 as a voluntary program through which Medicare beneficiaries could receive prescription drug coverage. The Part D program was launched in 2006 and between that year and 2012, Medicare Part D enrollment grew from 23 million to 32 million enrollees. In 2013, Part D cost the federal government an estimated $50 billion, representing 10 percent of net federal Medicare spending. A defining characteristic of the Medicare Part D program is that most beneficiaries must select an insurance plan from among competing private insurance firms, or plan sponsors, to receive coverage.[1] (For a thorough summary of Medicare Part D, see Duggan et al., 2008.)

The ability of competition between insurers, hospitals, or other entities to hold down the cost of health care is an area of research that has been debated and evaluated for many years. (Summaries of the literature are available from Gaynor and Town, 2011; Dafny, 2008; and Dranove and Satterthwaithe, 2000). Besides Part D, the federal government currently encourages some form of competition in the market for durable medical equipment in fee-for-service Medicare, for the provision of hospital and physicians' services through the Medicare Advantage program, and through health insurance exchanges under the Affordable Care Act (ACA).[2] In addition, under recent premium support proposals for restructuring Medicare financing, beneficiaries would buy insurance coverage from private insurers who would submit competitive bids to the federal government. Those bids would directly determine the government's contribution on behalf of a beneficiary (Congressional Budget Office, 2013).

Part D was designed to contain the federal cost of providing a prescription drug benefit by encouraging insurance firms to compete with each other to attract enrollees through lower premiums. Under Part D, those private insurance firms lower their costs and thus the premium they charge for prescription drug coverage by, for example, negotiating for rebates from manufacturers and encouraging their enrollees to use less expensive brand-name drugs or more generic drugs. Two large government programs—one operated by the Veterans Health Administration (VHA) and another that is part of Medicaid—also offer prescription drug coverage as part of their health benefits, but their primary method of containing drug spending relies on statutory formulas whereby drug manufacturers are required to provide a substantial rebate, or discount, off of average market prices. However, VHA retains an incentive to limit its drug costs further because it must pay for the program out of its annual appropriation, so higher spending on drugs would mean that fewer resources could be spent elsewhere within VHA. Similarly, states cover about 40 percent, on average, of the cost of the Medicaid program, and thus have an incentive to further limit program spending. Consequently, VHA and state Medicaid administrators have responded to that incentive by negotiating additional rebates (beyond the statutory minimums) for some brand-name drugs with manufacturers and requiring or encouraging the use of generic drugs, when they are available.

Within Part D and other competitive markets, competition between firms occurs along two main dimensions. On the extensive margin, the entry or exit of a competitor to a market can influence the premiums offered by firms in that market; economic intuition suggests that a larger number of competitors is correlated with lower premiums. On the intensive margin, the rules of the market encourage firms to find ways to reduce costs and lower their premiums or discourage them from doing so;

[1] Some Part D beneficiaries receive drug coverage from their current or former employer and just receive a subsidy for that coverage.

[2] Analyses of imperfect competition have been done for the durable medical equipment markets (Cramton and Katzman, 2010), medigap as a component of Medicare Advantage (Starc, forthcoming), the health insurance exchanges in Massachusetts (Ericson and Starc, 2012), and health insurance exchanges under the ACA (Dafny et al., 2014).

markets with rules rewarding the firms with the lowest premiums tend to have lower average premiums. This paper focuses on the extensive competitive margin within Part D by examining the relationship between the marginal plan sponsor and Part D insurance premiums. A companion paper focuses on the rules of the market—in particular, on how rules that differ within Part D for beneficiaries receiving low-income subsidies influence premiums (Stocking et al., 2014).

We are aware of only one other study that evaluates the extensive competitive margin within the Part D market; however, that paper focuses on the first year of the program (Simon and Lucarelli, 2006). The authors conclude that variation in the number of plan sponsors did not influence premiums during the first year of the program. Other studies have evaluated the effect of the increasing number of competitors on insurance premiums in other health care markets (Wholey et al., 1995; Pauly et al., 2013). Those analyses were conducted on the health maintenance organization (HMO) market in the 1990s and found that an additional competitor in a regional market led to lower premiums or lower insurance company profits. Some of that research, however, has been criticized because it does not measure interactions between HMO premiums and the premiums of other health insurance options available in the market. (Health insurers often offer both a less expensive, tightly managed HMO product and a more expensive preferred provider organization, or PPO, product.) If the HMO product attracts healthy individuals or the plan sponsor is able to subsidize the HMO product with the PPO, then that could influence the analysis of the extensive competitive margin on HMO premiums. Several other studies consider the effect of concentration on premiums and find that as the concentration increases premiums rise (Dafny et al., 2014; Dafny et al., 2012; and Pizer and Frakt, 2002). For example, Dafny et al. (2012) examine the effect of a large merger on premiums and find evidence that the merger does contribute to premium increases, and more so when the merged entity is associated with a more concentrated market. Dafny et al. (2014) examine the exchange markets created from the ACA and find if a large sponsor that decided not to participate had instead decided to participate, the second lowest premium would be lower by 5.4 percent, on average.

Our paper is unique to the literature on competition in health care markets because we measure the extensive competitive margin over a 5-year period and we do so in an environment that eliminates many of the analytic hurdles present when just analyzing HMOs. Within Part D, two broad categories of plans participate: stand-alone prescription drug plans, which enroll beneficiaries in the traditional fee-for-service Medicare program, and Medicare Advantage prescription drug (MAPD) plans. (A small number of beneficiaries are enrolled in a Part D plan offered through their former employer or union.) We restrict our analysis to stand-alone Part D plans—which contained about 60 percent of Part D enrollment in 2012—for two primary reasons. First, the premium of stand-alone plans probably plays a more important role in determining plan selection for beneficiaries than the premium of MAPD plans. Under Medicare Advantage (MA), enrollees choose among available private health plans for their nondrug Medicare benefits; if those enrollees want a prescription drug benefit, they must obtain both prescription drug coverage and nondrug coverage from the same plan, which causes the plans' sponsors to compete for beneficiaries based on the cost and design of their entire insurance offering and not just drug coverage. Second, because the selection of an MAPD plan must be done concurrently with an MA plan, plan sponsors may have incentives to cross-subsidize Part D premiums with other lines of MA business, similar to the concern regarding HMOs; conversely, plan sponsors have less opportunity to cross-subsidize stand-alone plans relative to MAPDs.

II. Background on Medicare Part D

The Part D marketplace for stand-alone prescription drug plans (PDPs) divides the United States into 34 independent regions, each of which is defined by state lines and contains a different number of plan

sponsors and plans. Part D plans are required to issue insurance to all Medicare beneficiaries who apply and to charge the same premium for all enrollees in a particular plan within a region. By 2010, 27.5 million beneficiaries had enrolled in a Part D plan, with about 60 percent enrolled in a stand-alone PDP, 31 percent in an MAPD plan, and the remainder in an employer plan (see **Table 1**). Although the share of enrollees in stand-alone PDPs declined between 2006 and 2010, that change reflects an increase in MAPD plan enrollment and not a drop in overall PDP enrollment, which has remained relatively stable over the period evaluated.

Part D plan sponsors must offer a benefit package that meets certain minimum standards, as specified by the Centers for Medicare & Medicaid Services (CMS). "Defined standard coverage" has a fixed deductible ($310 in 2014), requires the beneficiary to pay 25 percent coinsurance for spending between the deductible and the initial coverage limit ($2,850 in 2014), has limited coverage when spending is between the initial coverage limit and the catastrophic threshold (called the coverage gap or "doughnut hole"), and has 5 percent coinsurance when spending exceeds the catastrophic threshold ($4,550 in 2014).[3] Part D plan sponsors can also offer a benefit that is "actuarially equivalent" to that coverage, meaning that the average beneficiary would expect to pay an amount equal to the cost of a plan offering defined standard coverage. That can include reduced cost sharing for some drugs on the formulary or some coverage in the coverage gap in exchange for higher cost sharing elsewhere within the benefit. A third type of plan is the "basic alternative" plan, which also must be actuarially equivalent to the defined standard coverage but can offer a deductible lower than that in the defined standard plan in addition to lower cost sharing. Collectively, this paper refers to defined standard coverage and any coverage that is actuarially equivalent to it as the "basic benefit." Part D plans can also offer an "enhanced" version of the basic alternative benefit package, which would contribute more toward drug spending than a plan offering the basic benefit (in exchange for a higher premium). That design could include a reduced deductible, lower copayments, an expanded formulary (list of covered drugs), or more comprehensive coverage in the gap. Over the first few years of the program, enhanced and basic plans were quite similar, causing CMS in 2011 to require all enhanced plans to have cost-sharing differences that resulted in at least $22 per month lower out-of-pocket costs than basic plans. Only about one-quarter of the approximately 16.5 million stand-alone Part D enrollees were enrolled in an enhanced plan over the first five years of the program (see **Table 1**).

Each year, plans submit a bid that reflects the amount they would accept to supply the basic benefit to a beneficiary of average health in a particular region (see **Table 2**). (The bid excludes reinsurance, which is also part of the basic benefit and covers 80 percent of spending above the catastrophic threshold.) A plan sponsor wanting to offer a nationwide stand-alone plan must submit 34 separate bids for each of the 34 PDP regions. The bids from each PDP and MAPD plan are averaged, and roughly 75 percent of that average and 75 percent of estimated reinsurance costs are included in the government's contribution toward each beneficiary's Part D costs (see **Figure 1**).[4] The difference between the plan's bid and the government's contribution is the plan's premium, which is paid by the enrollee unless the enrollee qualifies for the low-income subsidy part of the program (see **Table 2**). Once a plan submits its bid for the upcoming year, it cannot alter the bid and must accept all enrollees at the premium that results. Because the premium is the difference between the bid for the basic benefit and the standard government contribution, it reflects the full marginal difference in bids between any two plans.

[3] Before the Affordable Care Act, there was no coverage between the initial coverage limit and the catastrophic threshold. Coverage has been phased in as part of the ACA and by 2020 plans and manufacturers will collectively cover 75 percent of spending for brand-name and generic drugs for beneficiaries not qualifying for low-income subsidies.

[4] The formula for calculating the average bid changed over time. In 2006, for example, the bids from all PDPs were weighted equally and MAPD bids were weighted by the previous year's enrollment. Over the subsequent four years, that formulation changed to put increasing weight on the enrollment weighting of bids. By 2009, all bids were enrollment weighted.

Between 2006 and 2007, the number of plan sponsors offering stand-alone plans in the Part D program increased from an average of 16 to 22 per region. But in 2008, the number of plan sponsors fell to 18, on average, in each region and remained at that level through 2010 (see **Table 3**). Although the number of participating plan sponsors is not reported in advance of plans submitting their bids, the process of developing a plan and submitting a bid makes it likely that other plan sponsors would learn about entering or exiting plans prior to their submission of a bid. For example, pharmacy benefit managers often administer the drug benefit and negotiate prices with drug manufacturers on behalf of many different drug plans.

Plan Incentives

The design of the Part D program creates incentives for plans to cost-effectively manage drug benefits in order to hold down premiums and attract enrollees. Part D plans primarily use three techniques to achieve those objectives. First, plans can develop formularies to steer beneficiaries to drugs with lower costs. They do that by placing some drugs on a preferred tier with a lower copayment and other drugs on tiers with higher copayments. Second, plans often receive lower net drug prices from manufacturers on the basis of their ability to steer beneficiaries toward particular brand-name drugs. In exchange for offering preferred placement on their formularies, Part D plan sponsors have been able to negotiate significant rebates that lower the net cost of brand-name drugs. Third, plans can encourage a shift toward the increased use of generic drugs primarily through a lower copayment for those drugs. Increased generic use reflects substitution of generic drugs for brand-name counterparts that are chemically equivalent and substitution of generic drugs or less expensive brand-name drugs for other drugs that are chemically different but belong to the same pharmacologic or therapeutic class.

The more competitive the bidding environment is, the greater the incentives are for plans to reduce their profits and costs. When plans submit their bid for providing the basic benefit, they are required to indicate the share of their bid that represents estimated direct drug costs, net of rebates, the share that represents estimated administrative expenditures, and the share that is profit. Recognizing that firms may misestimate the direct costs, Part D includes rules that are intended to mitigate the risk to plans if they underestimate costs and penalize plans that overestimate costs, known as the risk corridor program. Plans that spend much more on drugs than anticipated could expect to receive additional payments from the federal government to cover some of their higher-than-expected costs. Conversely, plans that overestimate the amount of drug spending they actually incur by a certain threshold are required to return some of that net revenue to the federal government in the form of risk corridor payments.

Choice Environment

Beneficiaries in the Part D program can be divided into two different groups: 1) standard beneficiaries, and 2) low-income beneficiaries. Standard beneficiaries face a choice environment where basic plans are actuarially equivalent but may differ in terms of premium, deductible, formulary, and coinsurance, among other factors. Researchers find that standard beneficiaries place significant weight on the premium as a proxy for total plan costs, which encourages plans to compete on premiums (Abaluck and Gruber, 2011; Ketcham et al., 2012). However, those same researchers find that beneficiaries do not tend to select the plan with the lowest combination of costs (including premium, deductible, and out-of-pocket costs) given their actual drug usage in the coming year (see also Heiss et al., 2012). That suggests that other plan attributes may also influence plan selection and that beneficiaries could benefit from additional support in selecting the plans (Kling et al., 2012; Ericson, forthcoming).

Low-income beneficiaries represent about half of PDP enrollees and receive a government subsidy for their premium up to the weighted average premium calculated for the region in which the low-income beneficiary resides (see **Table 2**). (They also receive a subsidy to cover the deductible and most copayments in their selected plan.) Low-income beneficiaries who select a plan with a premium below the

low-income subsidy (LIS) benchmark have their full premium covered by the government. (About 2.5 percent of LIS beneficiaries who receive a subsidy have less than the full premium covered by the government.) Low-income beneficiaries who select a plan above the LIS benchmark pay the difference between the LIS benchmark and their plan's premium. To help ensure that low-income beneficiaries do not inadvertently stay in expensive plans, CMS automatically reassigns low-income beneficiaries from plans above the benchmark to plans below the benchmark, unless those beneficiaries have actively chosen their plan. In the event that a low-income beneficiary actively signed up for a plan with a premium above the LIS benchmark, he or she would be liable for any difference between that plan's premium and the LIS benchmark.

III. Conceptual Framework for Evaluating Competition

In an analysis of bidding strategies, we focus on plan sponsors as distinct entities because the bidding strategies tend to be formulated at the level of the plan sponsor and not independently for each plan offered by the same plan sponsor. To conceptualize the relationship between the number of plan sponsors and plan bids, we explored models of the Part D market as a first-priced, sealed-bid auction. We also explored an alternative approach to analyzing competition using a Cournot model.[5]

Auction Models

Auction theory offers insight into the effect on bids, and thus premiums, when there are a fixed number of competitors and about how bids change with the addition or subtraction of a competitor. Initially, we assume that each firm offers one plan and that the plan with the lowest premium enrolls all of the beneficiaries in a region, although below we relax that simplification on the actual dynamics of enrollment. Under such a setting, firm i submits a bid (b_i) to maximize expected profits:

$$\max_{b_i|c_i} (b_i - c_i) \Pr(b_i \leq b_{j\neq i}) \tag{1}$$

where the cost of Part D coverage, including claims (net of rebates), administration, and normal economic returns, for an average enrollee is c_i, the expected profit earned by the firm for the average beneficiary is $b_i - c_i$, and the probability that firm i submits a bid lower than any of the other competitors and thus enrolls the average beneficiary is represented by the probability function.

Solving (1) requires that each firm has private information about its costs and knowledge of the distribution of other firm's costs. Under that assumption, it becomes a dominant strategy for each firm of the N firms in the region to bid:

$$b_i(c_i) = c_i + \frac{\int_{c_i}^{\bar{c}} (1 - F(v))^{N-1} dv}{(1 - F(c_i))^{N-1}} \tag{2}$$

[5] In both approaches we abstract away from specific features of insurance markets that would suggest that the costs to plan sponsors of providing insurance coverage decreases as the number of beneficiaries covered by the plan sponsor increases because the average cost of coverage becomes more certain.

where $F(\bullet)$ is the cumulative distribution function of costs for all firms in the region and $\overline{c}$ is some maximum cost or upper limit on costs given $F(\bullet)$.[6] Using equation (2), we can identify three characteristics of bids that hold true regardless of the functional form used for the distribution of costs.

Prediction 1: Bids are decreasing with the number of competitors ($\partial b/\partial N < 0$) to the limit where bids converge to each firm's cost.

Prediction 2: Bids are decreasing at a decreasing rate as the number of competitors increases ($\partial^2 b/\partial N^2 > 0$).

Prediction 3: As the underlying cost of supplying insurance increases, bids fall but by a smaller amount when the number of competitors increases ($\partial^2 b/\partial N \partial c > 0$). That is, firms with a higher cost of providing insurance are less responsive to changing levels of competition.

To offer further insight into the magnitude of each of those characteristics, we apply a distribution of costs to the bid function in equation (2). We start by assuming that costs are distributed according to a uniform distribution $\sim U(\underline{c},\overline{c})$, such that $F(c) = (c-\underline{c})/(\overline{c}-\underline{c})$ and $f(c) = 1/(\overline{c}-\underline{c})$. Solving for firm i's bid when there are N firms in the market yields:

$$b_i(c_i) = c_i + \frac{\overline{c} - c_i}{N} \tag{3}$$

If the distribution of bids was uniform along a range that was normalized to run between zero and one, equation (3) suggests that a firm with costs in the middle of the distribution ($c = 0.5$) would submit a bid of 0.625 in a market with four firms and 0.6 if a fifth firm joined the market, which is 4 percent lower (Prediction 1). If the number of firms was 15, that same firm would submit a bid of 0.533, which would fall to 0.531 with the addition of a new firm, or 0.4 percent lower (Prediction 2). A firm with higher costs ($c = 0.8$) would submit a bid that falls from 0.813 with 15 firms to 0.812 with 16 firms, or 0.1 percent lower (Prediction 3). Given the rapidly decreasing response in bids from changes in the number of competitors, it may be more intuitive to calculate an elasticity with respect to the number of competitors. The elasticity on bids from adding one new firm to the auction can be derived from (3):

$$\varepsilon = \frac{N(\overline{c} - c)}{(N+1)\left(c(N-1) + \overline{c}\right)} \tag{4}$$

Taking the derivative of (4) with respect to N indicates that the elasticity falls as the number of firms increases (assuming $N^2 + 1 > \overline{c}/c$) but is less sensitive than the bid to changes in the number of firms.

Thus far, we have modeled firm strategic behavior as if firms assumed that other firms have costs distributed according to a uniform distribution. That may be a good approximation of firm behavior if we believed firms had only limited information about the costs of their competitors or only had a general sense of the maximum and minimum costs without an understanding of how costs were distributed within that range. Conversely, firms might believe that they had more information about the distribution of costs for other firms. For example, after observing the distribution of bids in the first year of the program, firms may infer that those bids were distributed roughly similarly to costs and thus costs exhibited a normal distribution around a mean near that specified in **Table 3**. In that case, they would incorporate a normal

[6] For a more detailed derivation and discussion, see Krishna (2002).

distribution and not a uniform distribution when solving equation (2) for their equilibrium bid. The left panel of **Figure 2** illustrates the change in bid resulting from a new firm joining the market (or an increase in bid when a firm exits the market) under both the assumption of a uniform and normal distribution using the bid distribution for 2010; the uniform result was defined for the average bidder under the assumption that costs are distributed uniformly between the largest and smallest bids in 2010. Between 15 and 22 firms (the range within the Part D market in 2010), the average elasticity is -0.007 for the normal distribution and -0.026 for the uniform distribution.

The third prediction of bids described above is that firms with lower costs would have a larger response to an additional entrant than firms with higher costs. Intuitively, that occurs because firms with higher costs have less capacity to increase their bid above their costs and still stand a chance of winning compared to firms with very low costs. And when the number of competitors increases, bids fall toward costs; the bids of firms with high costs have less room to fall before they equal the costs. For example, adding a firm to a 10-firm market under the uniform distribution of costs used in **Figure 2** would cause a firm with very low costs to lower its bid by $0.73 and a firm with very high costs to lower its bid by $0.09 (see the right panel of **Figure 2**).

The model used above assumes that the firm with the lowest bid will enroll all of the beneficiaries in a region (i.e., $\varphi_1 = 1$). Loosening that assumption, we next consider the case when the lowest two bidders each win some share of enrollees:

Proposition 1: Two Winners

Assume an auction with N firms competing for enrollees and the two lowest bidding firms receive positive shares of enrollment ($\varphi_i \mid \varphi_1 + \varphi_2 = 1$), such that the plan sponsor with the lowest bid receives a larger share of enrollment than the firm with the second lowest bid ($\varphi_1 > \varphi_2$). We find that bids rise as the second lowest bidder picks up market share ($\partial bid / \partial \varphi_1 < 0$), and the marginal effect of adding a plan sponsor to the market is larger when there are two winners than when there is one.

Proof: See Appendix A

Intuitively, Proposition 1 follows from the logic that offering some reward to the second lowest bidder reduces the incentive to bid low. Consequently, equilibrium bids are slightly higher when there are two winners, holding the number of competing firms constant. We can calculate the effect of changing the number of competing firms by comparing equation (3) with the equilibrium bid function derived in Proposition 1. Using Mathematica, we observe that under a uniform distribution of costs, the entry of a new firm to the market causes bids to fall by a larger amount when there are multiple winners compared to the case when there is a single winner (Wolfram 2012). Specifically, the elasticity on bids from adding one plan sponsor to a 15- to 22-firm market—under the uniform distribution used above to describe Part D bids in 2010—would be -0.031 if $\varphi_1 = 0.75$ (compared to -0.026 if $\varphi_1 = 1$). If the share of enrollees captured by the lowest bidding plan sponsor were to fall yet further, bids would be larger and the marginal new entrant would suppress bids even further, or the marginal exiting plan sponsor would allow bids to rise more.

A Cournot Model

This paper predominantly analyzes the Part D market through an auction lens. Another model commonly used in the analysis of markets, particularly when participating firms have sufficient market power to influence prices, is a Cournot oligopoly model. In that model, each firm in a market is assumed to know the cost function of the other firms, which it uses to calculate the profit-maximizing production quantity

and resulting market price. Some of the main predictions of this model are similar to those of the auction models.

To illustrate, consider a demand curve for insurance that has an attachment point denoted as $\overline{c}$ (i.e., no one would consider purchasing insurance for a price above $\overline{c}$) and for ease of exposition, assume each firm has a constant marginal cost of providing insurance equal to c. The simultaneous version of the Cournot game requires each firm to maximize profits by setting a price that maximizes its enrollment. For a market with N firms – each of which has an identical cost function – the price in a Cournot game is:

$$P(c) = \frac{\overline{c} + Nc}{N+1} \tag{5}$$

One can see that the price emerging from a Cournot game exhibits the same characteristics as the optimal bid shown in equation (3). First, the optimal price is decreasing with the number of firms. Second, the marginal new firm in the market reduces the optimal price by less than the previous new firm. One can also show that when firms are not identical, those with lower costs would have a larger response to an additional entrant than firms with higher costs.

IV. Data

The data used for this analysis came from a variety of publicly available and confidential CMS data sets. All data are reported in aggregate. The data came primarily from three sources: public use data, confidential bid data, and the confidential denominator file.

CMS makes available on their website information on Part D contracts and the associated enrollment each year between 2006 and 2010 in a set of files called "Monthly Enrollment by Plan." Available data include the name of each plan sponsor and its associated plans as offered in each region. The data used in this analysis harmonized plan sponsor names across time and plan names across regions and time. In a set of files called "Plan Crosswalks," CMS makes available information about any planned transfer of beneficiaries from one plan to another, which could occur when a plan sponsor automatically enrolls beneficiaries from a terminated plan into a new plan offered by the same plan sponsor. From files titled "2006-2012 PDP, MA, and SNP Landscape Files," we added information about whether the plan was basic or enhanced, the plan's premium and deductible, and whether the plan followed the standard design or was actuarially equivalent. CMS also makes available information about the annual regional LIS subsidy and the nationwide weighted average bid.

The confidential data include the same identifying information from the enrollment and landscape files above as well as information about the bid for the basic component of each plan, the expected claims, overhead, and profit associated with each bid, and the relative risk of the plan's beneficiaries when compared to a beneficiary of average health. The data also include information on risk corridor payments for each plan, similar to what is publicly available for each plan sponsor in CMS's public files titled "Plan Payment Data."

This analysis also used confidential information about the numbers of individual enrollees in each plan. This denominator file allowed us to extract information about actual December and July enrollment between 2006 and 2010 for each plan, low-income enrollment in each year, and information related to enrollee switching.

V. Analysis

The two most commonly used measures of the extensive competitive margin in the literature on competition in health care insurance markets are a count of the number of firms in a given market and the Herfindahl-Hirschman Index (HHI)—a measure of market concentration using each firm's share of total enrollment in a given market (Baker, 2001; Scanlon et al., 2006).[7] Both are summarized in **Table 3**. The count of the number of distinct entities bidding in an auction is the more standard measure of competitiveness within the research literature about auctions and is the primary measure used in this paper. (For additional discussion of HHI and the difficulties in using it for this type of analysis, see **Appendix B**.)

Using historical data between 2006 and 2010, our empirical objective is to estimate the relationship between the number of plan sponsors in a region and plan bids. We focus on differences in the number of plan sponsors across regions and time. Over the period from 2006 to 2010, we observe a large number of plan sponsors entering and exiting the regions. Although much of the entrance occurred in 2007, each year of the study period witnessed at least several new plan sponsors in some regions. Similarly, plan sponsors exited regions in each year of the program. **Figure 3** summarizes entry and exit activity divided between activity by plan sponsors that are national in scope (i.e., serving more than 31 of the 34 regions) and those that are regional and serve 31 or fewer regions. (Most plan sponsors served either one region or more than 31 regions; fewer than 15 percent of plan sponsors served between 1 and 31 regions.) Of the 18 distinct new plan sponsors included in the "Regional Plan Sponsors" category of the figure, 12 offered plans in only a single region.

For this analysis, we focus on the bids of basic plans and not enhanced plans mainly because basic plans are designed to be more responsive to the amount of competition. Basic plans tend to offer benefit packages that have very similar features (e.g., deductible, copayments, maximum out-of-pocket limits)—with about 20 percent having identical benefit structures (other than the premium) and 56 percent having the same deductible but different cost sharing and premiums. As a result, for basic plans the premium is a relatively more important difference between the plans. In contrast, enhanced plans offer a benefit package that differs between plans in more ways.

Several other factors also contribute to our choice to focus on the bids of basic plans and exclude bids for enhanced plans. First, all plan sponsors in a region must offer at least one basic plan but are not required to offer an enhanced plan, which makes the count of the number of plan sponsors an exact measure of the number of competitors offering the basic plan but not the enhanced plan. Second, the decision to offer an enhanced plan once a plan sponsor has the infrastructure to offer a basic plan is much different than the decision to enter a new region and set up that infrastructure. Thus, the number of enhanced plans may have a different relationship with bids than the number of plan sponsors for basic plans. Third, the bid of enhanced plans includes both a basic and supplemental component, but despite regulation to the contrary, enhanced plans may cross-subsidize some of the supplemental portion of their bid with the basic component (to maximize the government subsidy), further reducing the comparability of the two types of plans.

Number of Plan Sponsors and Plan Bids

As is evident from **Figure 4**, we observe that a larger number of plan sponsors offering basic plans is associated with lower weighted average bids, which reduce the cost of the Part D program to the

[7] The HHI is calculated as a sum of the square of the market share for each firm in a market. Thus, a market with two equally sized firms would have an HHI equal to 5,000; the HHI for a market with 10 equally sized firms would be 1,000.

government. In the subsequent discussion, we show that that result holds under a variety of specifications, after controlling for other factors related to the number of plan sponsors in a market.

Methods. To quantify the relationship observed in **Figure 4**, we use several econometric strategies. As a first strategy, we identify the association between the number of plan sponsors and plan bids through variation in the number of plan sponsors across both the region and the year, with fixed effects for region, year, and plan sponsor:

$$\ln\left(bid_{jiRt}\right) = \beta_0 + \beta_1 \ln\left(Comp_{Rt}\right) + \beta_2 Type_{jiR,t-1} + \beta_3 New_{jiRt} + \beta_4 Type_{jiR,t-1} \ln\left(Comp_{Rt}\right) + \beta_5 New_{jiRt} \ln\left(Comp_{Rt}\right) + \beta_6 MAPD_{R,t} + \rho_R + \tau_t + \varphi_i + \varepsilon_{jiRt} \quad \text{Regression (1)}$$

where plan sponsor i offers several plans j, each of which submits a bid that represents the average monthly amount it would be willing to accept to provide Part D coverage in region R and year t to a beneficiary of average health. Our identification strategy relies on a plan sponsor's decisions to change its bids across time and regions, controlling for systemic differences in bids between plan sponsors, regions, and time.

Summary statistics of the variables in this regression are provided in **Table 4**. The main variable of interest is the number of plan sponsors ($Comp_{Rt}$). Interactions are estimated between the number of plan sponsors and the plan type, the first year the plan bids, and the first year of the program. Given those interactions, the coefficient on the number of plan sponsors represents the relationship between the number of plan sponsors and the bid of plans with a premium above the low-income benchmark after the first year the plan bids and after the initial year of the program.

We focus on plans having relatively few low-income subsidy recipients by including an indicator equal to one if the plan's premium was below the low-income benchmark in the previous year ($Type_{jiR,t=t_1}$)[8] and its interaction with the number of plan sponsors. As briefly described earlier, plans with a premium below the low-income subsidy (referred to as "LIS plans") are exposed to a choice environment that differs in three ways. First, beneficiaries who receive the low-income subsidy pay no premium for their plan unless they select a plan with a premium above the benchmark. Second, if a low-income beneficiary is enrolled in a plan that increases its bid such that its premium rises above the low-income benchmark, CMS will automatically reassign that beneficiary to a plan with a premium below the benchmark, giving preference first to other plans offered by the same plan sponsor and then, if those are not available, randomly and with equal probability to other plans in the region with a premium below the benchmark. (Between 1 million and 2 million beneficiaries were randomly reassigned between 2007 and 2010.) Third, in each year between 2006 and 2010, beneficiaries not receiving a low-income subsidy migrated away from plans with a premium below the low-income benchmark. Because we expect that difference in the choice environment to result in different behavior by LIS and non-LIS plans, we use controls for plan type and its interaction with the number of plan sponsors to estimate separate coefficients for LIS plans and non-LIS plans.[9]

[8] In 2006, no plan was aware of the level of the benchmark, and thus all plans were PlanType=0. In subsequent years, however, new plans knew the level of the benchmark from the previous year and could choose a bid such that the resulting premium would be above or below. Thus, new plans that joined the market after 2006 were assumed to have actively selected their plan type.

[9] Of the 3,054 sponsor – region – year interactions in our data set, only 260 of those observations are sponsors who offered only plans below the low-income benchmark in a particular region and year. Of those, 116 sponsors offered only plans below the low-income benchmark for all years in a particular region. Only 1 of the 72 plan sponsors present in the data set offered only plans below the benchmark for all years and regions (that one plan sponsor offered 2 plans below the benchmark in one region for one year and then exited the market).

We include an indicator equal to one if the plan sponsor was bidding in the region for the first time (New_{jiRt}), which includes all plan sponsors in 2006. That control allows for the possibility that plan sponsors may become better at predicting the level of competition and crafting their bid with experience.

We control for the fraction of a region's covered beneficiaries enrolled in an MAPD plan ($MAPD_{R,t}$). That control allows for any difference in bid levels that might reflect systematic differences between regions with high and low fee-for-service (FFS) costs relative to Medicare Advantage costs.

We also include fixed effects for each of the 34 PDP regions (ρ_R), each year (τ_t), and a plan-sponsor fixed effect (φ_i). The purpose of the plan-sponsor fixed effect is to control for systematic differences between bids that are related to the use of a similar bidding strategy over time for all of that sponsor's plans across all regions. However, we also consider two alternative fixed-effect specifications, which control for systematic differences in other ways.

One alternative, a plan-fixed effect, captures differences between plans offered by the same sponsor. (The average plan sponsor offers 1.4 unique basic plans.) We include that fixed effect by replacing φ_i in the above regression with φ_{ji}. That fixed effect was constructed by grouping together plans with identical names offered by the same parent across regions. That fixed effect controls for features of the plan that do not vary over time, such as a consistent bidding strategy for a lower-premium basic plan that may differ from that for a higher-premium basic plan.

As another alternative, we consider plan-by-region fixed effects. That fixed effect, a plan and region interaction term ($\rho_R \cdot \varphi_{ji}$), controls for bidding strategies and other features of the plan that do not vary over time within a given region.

Before proceeding with the results, we also consider a second identification strategy that restricts identification to using just information from plan sponsors' decisions to change their plans' bids across time but within regions. To do that, we take the first difference of regression (1):

$$\Delta \ln\left(bid_{jiRt}\right) = \beta_0 + \beta_1 \Delta \ln\left(Comp_{Rt}\right) + \beta_4 Type_{jiR,t-1} \Delta \ln\left(Comp_{Rt}\right) + \beta_7 \Delta MAPD_{R,t} + \rho_R + \tau_t + \varphi_i + \Delta\varepsilon_{jiRt} \qquad \text{Regression (2)}$$

(The delta indicates a first difference between the previous period's value and the current period's value.) This second identification strategy only uses information from plan sponsors' decision to change their plans' bids across time.

Results. The results of regression (1) and (2) are shown in **Table 5** with the first three columns corresponding to the results from regression (1) and the second three from regression (2). Because the dependent variable and measure of competition are both expressed in natural logarithms, the coefficient of interest on the number of plan sponsors represents an elasticity that describes the percentage change in the bid resulting from a 1 percent change in the number of plan sponsors in the region. Across all six specifications, the results are consistent with our theoretical predictions.

Following Prediction 1, we find that more competition is correlated with lower bids, and thus lower premiums of basic plans. The arithmetic average elasticity is -0.071 (with a range from -0.038 to -0.095), which suggests that one plan sponsor entering an 18-firm market was associated with a fall in bids to provide a month of basic coverage to a beneficiary of average health of 0.4 percent, or $0.33 for a plan that bid $85. In the range of sponsors observed in most regions, an additional plan sponsor is

associated with a reduction in bids of $0.20 to $0.50 for plans with a premium above the low-income benchmark after the first year in which the plan bids and after the initial year of the program.

Other observations can also be made from the results shown in **Table 5**. We observe that plans offered by plan sponsors that had not previously bid in the region tend to bid $20 to $30 lower than incumbent plans and have a weaker relationship with the number of plan sponsors than other plans. Plans had very little information about the program when submitting their bid for the 2006 coverage year, and the largely insignificant coefficient on competition for new plan sponsors (the sum of the coefficient on competition and competition interacted with being a new plan sponsor) suggests that plans did not respond to varying numbers of plan sponsors in their first year nearly as much as in other years of the program.

The results also suggest that, similar to new plans, plans bidding below the LIS benchmark in the previous year ($Type_{jiR,t=t_1}$ =1) appear to bid lower and not conform to predictions about the effect of changing levels of competition. Those results for LIS plans are explored in more detail in a companion paper (Stocking et al. 2014). In short, plans with a premium below the low-income benchmark have very little incentive to maintain low bids. That is because the cost of the premium is fully subsidized for low-income beneficiaries who receive no additional financial or other benefit from enrolling in the lowest bidding plan in a region relative to a higher bidding plan, as long as the premiums of both plans are below the benchmark.

We examined the functional form of regression (2) to assess how the association between changes in bids and the change in the number of plan sponsors varies when the number of plan sponsors is larger. Specifically, we included a control for the effect of changes in competition when the number of plan sponsors in the previous year was more than 18 (the average number of plan sponsors) and found evidence that the relationship is nonlinear, consistent with Prediction 2 (as illustrated in **Figure 2**). Using the three specifications for regression (2) as shown in **Table 5**, when there were more than 18 plan sponsors, the absolute value of the elasticity of bids with respect to the marginal competitor becomes statistically significantly smaller in two specifications and not significantly different from zero in all three. In other words, when there were more than 18 sponsors, changes in the number of plan sponsors had a smaller association with bids than when there were fewer than 18 plan sponsors. Using the results from **Table 5**, the average elasticity suggests that adding a plan sponsor to a 10-firm market was associated with a fall of 0.71 percent ($0.60 for a plan that bid $85); adding that same plan sponsor to a 22-firm market was associated with a fall of 0.30 percent ($0.27 for a plan that bid $85).

One issue of concern is the potential for variables omitted from the analysis above to be causing plan sponsor entry and exit. If entry or exit decisions were caused by an omitted variable that is also correlated with the bids, then our elasticity estimates of competition would not represent causal effects. For example, plans in a region may have experienced lower than expected claims costs or otherwise have higher profits in a particular year. If plan sponsors in that region estimated claims for the subsequent year taking that past experience into account, they might submit lower bids in the subsequent year; alternatively, if they treated claims costs as a random variable that fluctuates around a known average, they might not submit a lower bid. Plan sponsors not in that region might simultaneously observe those higher profits and decide to enter that region. (Because the omitted variable is a regional transitory effect, the only way to control for it is to use fixed effects that interact time and region but that leave no other variation in the number of competitors.) Thus, depending on the reaction of plan sponsors to that one year of low drug costs, lower bids could be correlated with entry even though the increase in the number of plan sponsors did not cause the lower bids. As it turns out, the average amount of overhead and profit in a region does not predict entry or exit. A number of other factors that could be potential omitted variables—such as HHI, the LIS benchmark, the regional average bid, the percent enrollment in MAPD plans, the total number of beneficiaries per PDP sponsor, and the share of PDP enrollment in basic plans—turn out to have little

relationship with entry or exit. We provide further discussion of all these issues regarding potential omitted variables in **Appendix C**.[10]

One approach to addressing the specific concern about endogeneity of plan type over time is to modify our definition of plan type so that it does not change over time. Above, we defined plan type based on behavior of the plan in the previous year. In **Table 6**, we redefine plan type as an indicator equal to one if the plan was below the LIS benchmark in the first year that plan was offered. (In 2006, we code all plans as type zero and for plans that entered after 2006, we code them as type one if their first year premium was above the previous year's low-income benchmark.) To consolidate any confounding factors associated with the first year of operation, we include only one control for the first year the plan operates. As is evident, the results and level of significance for each of the variables are similar to those appearing in **Table 5**.

Interactions With Plan Size

In addition to the type of plan, another factor that may interact with the number of plan sponsors in determining plan bids is the size of the plan. The economic literature often differentiates between small (or fringe) firms and large (or incumbent) firms. Incumbent plan sponsors are assumed to have been successful in attracting beneficiaries in the region in the past, and the literature reports that, in general, incumbent firms tend to bid less aggressively than fringe firms under a variety of competitive settings (Jofre-Bonet and Pesendorfer, 2000; Estache and Limi, 2008).

Methods. To test the hypothesis that the association between the number of plan sponsors and bids interacts with the market share of the plan, we construct a continuous variable (*PlanSize*) that represents the share of regional enrollment in the previous year measured from 1 to 100. As a point of comparison, about 25 percent of plans are bidding from a market position where they enroll more than 5 percent of the regional beneficiary pool, and about 25 percent of plans are bidding with about 0.25 percent of regional beneficiaries. We then interacted the regional enrollment share with the number of plan sponsors in a variant of regression (2).

Results. The bids of a larger "incumbent" plan that enrolls 5 percent of the regional beneficiary pool are less responsive (elasticity = -0.01) to changes in the number of plan sponsors than the bids of a smaller "fringe" plan that enrolls less than 0.25 percent (elasticity = -0.12). Those results are shown in **Table 7**. We observe that as a plan becomes larger, it becomes less sensitive to competition (among plans that do not primarily serve low-income beneficiaries). One additional plan sponsor in an 18-firm market is associated with a bid 0.06 percent lower ($0.05 for a plan that bid $85) for a plan sponsor enrolling 5 percent of the regional beneficiary pool, all else being equal. Conversely, the bid of a plan enrolling only 0.25 percent of the regional beneficiary pool is 0.6 percent lower ($0.56 for a plan that bid $85), all else being equal.

Incumbent plans do not appear to be any more sensitive to competition if they primarily serve low-income beneficiaries (as shown by the coefficient on the interaction of competition with plan size and plan type). That phenomenon is explained more fully in Stocking et al. (2014).

[10] We have also attempted to use some instrumental variables that would be exogenous predictors of entry and exit by plan sponsors. However, most of the available instruments, such as population or share of MAPD enrollment, have low or no explanatory power. Although those instruments are predictive of the number of national plan sponsors, our models included fixed effects for each year that are collinear with changes in the number of national plan sponsors; those instruments have very little power in predicting the entrance or exit of regional plan sponsors.

Number of Plan Sponsors and Plan Profits

Our final analysis separately examines the association between the number of plan sponsors and drug claims net of rebates, overhead costs, and profit. We find that a larger number of plan sponsors is associated with lower combined overhead and profit.

Methods. Our analysis of profit is based on information from CMS's risk corridor program. Under Part D, the bid that each plan submits must include estimates of the per capita drug costs net of any rebates, overhead, and profit the plan anticipates in the coming year for a beneficiary of average health. The sum of those three estimates represents the bid and is adjusted by CMS based on the plan's estimated risk-adjustment factor (which is a measure of the percentage by which the plan's enrollees are more or less expensive than the average for Part D overall). However, at the end of the year, each plan is required to report its actual total drug costs, net of rebates or other discounts, which CMS compares to its estimated total drug costs. If actual claims exceed the sum of expected claims by a specified threshold, then CMS issues a payment to the plan for some fraction of the amount lost. Conversely, if plans overestimate their actual claims relative to the expected claims by a specified threshold, then plans must submit a payment to CMS for some fraction of the excess amount.

Because we observe the amount of a plan's risk corridor payments, we can estimate the actual drug costs for plans, as well as the total overhead and profit. (To estimate actual drug costs, we must make an assumption about the plans' actual risk-adjustment factor; we assume for this analysis that actual and estimated risk-adjustment factors are the same.) Over the first five years of the program, only about 25 percent of plans did not make or receive payments as part of the risk corridor program in any given year, and in most years the majority of plans made payments (see **Table 8**). As a result, for those 75 percent of plans that made or received payments, we can use the risk corridor formulas to calculate their actual drug costs. Specifically, the risk corridor payments (Θ) were calculated as follows in 2006:

$$\Theta = S(\pi)\begin{cases} 0 & if \ |\pi| < 2.5\% \\ \lambda_1 \cdot C_E\left(|\pi| - 2.5\%\right) & if \ 2.5\% < |\pi| < 5\% \\ \lambda_1 \cdot C_E\left(2.5\%\right) + \lambda_2 \cdot C_E\left(|\pi| - 5\%\right) & if \ 5\% < |\pi| \end{cases} \quad (6)$$

where $\pi = 1 - C_A/C_E$ is the amount by which expected claims (C_E) for beneficiaries with the expected risk-adjustment factor exceeded actual claims (C_A) as a share of expected claims; $\lambda_1 = 75\%$ is the risk-sharing amount in the first threshold (2.5 percent to 5 percent); $\lambda_2 = 80\%$ is the risk-sharing amount in the second threshold (above 5 percent); and $S(\bullet)$ is an operator that extracts the sign of ($\bullet$) such that if $(\bullet) < 0$, the amount calculated is a receipt to the plan and if $(\bullet) > 0$, the amount calculated is a payment from the plan. In 2008, the first and second thresholds were changed such that $\lambda_1 = 50\%$ is the risk-sharing amount in the first threshold (5 percent to 10 percent); and $\lambda_2 = 80\%$ is the risk-sharing amount in the second threshold (above 10 percent). Substituting the amount paid or received by the plan into equation (6) depending on the year allows us to calculate π, from which we can solve for actual claims, using the expected claims submitted as part of the plans' bids.

Although we do not observe actual claims for 25 percent of the sample, the censored claims are for those plans whose actual claims experience was sufficiently close to the expected claims listed in their bid that no risk corridor payment was triggered. If no payments were made or received, we assumed the estimated claims, as submitted in their bid, were an unbiased estimate of actual claims. That implicitly assumes that plans not making or receiving risk corridor payments had actual claims that differed from estimated

claims by a percentage that was equally distributed in absolute value between zero and the first threshold of the risk corridor program.

Based on calculations using equation (6), we construct three new dependent variables that are used in regression (2):

- ΔClaims: This variable is the difference between current and prior year actual claims ($C_{A,t} - C_{A,t-1}$), as estimated from risk corridor payments.

- ΔNet Overhead & Total Profit: This variable incorporates the contribution to profits that are included in the plan's bid and that occur when the plan overestimates or underestimates its claims and is the difference from the prior year. This variable is net of risk corridor payments.

- ΔOverhead & Total Profit: For comparison, we reproduce the above variable but do not net out risk corridor payments.

Results. An increase (decrease) in the number of plan sponsors is correlated with a decrease (increase) in combined plan overhead and profits for those plans that primarily enroll beneficiaries who do not qualify for low-income subsidies. Details related to this result are found in **Table 9** from analysis based on regression (2). The results presented in the table suggest an additional plan sponsor is associated with an increase in actual claims, although in most cases, not of a statistically significant magnitude. The results also show that one additional plan sponsor is associated with plan profit and overhead net of risk corridor payments that is lower by roughly $0.30 per beneficiary per month. If risk corridor payments are not netted out of overhead and profits, one additional plan sponsor is associated with overhead and profits that are lower by $1.08 per beneficiary per month.

The finding that claims appear to be larger when the number of plan sponsors is higher, albeit by a statistically insignificant amount in some specifications, is consistent with other research finding that plan sponsors can less successfully negotiate for lower net drug prices when there are more competitors (Lakdawalla and Yin, 2009). Based on that negotiation factor alone, larger claims with a higher number of plan sponsors would be expected to result in higher bids. However, we observe lower bids, which suggests that other factors, such as overhead and profits, are falling by a large enough amount to offset any increase in claims costs.

The finding with respect to overhead and profit net of risk corridor payments is consistent with the results presented earlier in **Table 5**. Specifically, a $0.30 reduction in net overhead and profits for each new plan sponsor suggests an elasticity of bids from changes in competition of roughly -0.06 (for an $85 bid and 18 competitors), which is close to the results from **Table 5** although by a statistically insignificant amount in some specifications. Those results, however, include the risk corridor payment, which is not netted out of bids in **Table 5**. In analysis of overhead and profits without netting out risk corridor payments based on regression (2), we observe a larger coefficient, implying an elasticity with respect to a change in the number of plan sponsors of roughly -0.23. Under either approach, and as predicted by theory, reduced competition allows plan sponsors to earn greater profits.

The risk corridor program could have varying effects on bids. The risk corridors reduce the probability that a shock in the consumption of prescription drugs would cause any plan to declare bankruptcy. That might allow plans to bid more aggressively, knowing that if they bid too low, their losses would be partly absorbed by the government. Similarly, the reduced probability of bankruptcy for any plan would be expected to reduce their cost of capital, which would lower the overhead for the plan and allow plans to decrease their bid. However, the observation that plans tend to make risk corridor payments suggests that, on average, plans are not bidding overly aggressively. As an alternative theory, if the owners of for-profit

plan sponsors wanted their plans to generate a return greater than the sum of the profit included in their bid and the first threshold described above, then plans that wanted to meet those expectations would need to bid high enough that risk corridor payments would regularly be made and that profits after risk corridor payments were consistent with such expectations.

VI. Discussion

To assess the relationship between the number of plan sponsors and the budgetary cost of Part D within the range of plan sponsor numbers observed in Part D between 2006 and 2010, we formulated a simple model of how changes in bids affect government spending per beneficiary for the program. In 2010, there were 28 million beneficiaries in the program, of which about 10.8 million were enrolled in MAPD plans or employer plans. Drawing from **Figure 1**, the monthly amount paid by the government for beneficiaries not receiving low-income subsidies is:

$$Monthly\ Govt\ Pay_{Non-LIS,t} = Adj(Bid_t) - Bid_t + 74.5\%(NWAB_t) - 25.5\%(NWAR_t) + 80\%(Cat_t) \quad (7)$$

$NWAB_t$ is the national enrollment weighted average bid, $NWAR_t$ is an average reinsurance estimate, and Cat_t are the actual claims above the catastrophic threshold for year t (see **Figure 1**). The risk adjustment ($Adj(\bullet)$) is a ratio of the costs for the average beneficiary enrolled by the plan to a beneficiary of average health. That allows the risk-adjusted bid to be decomposed into the sum of the bid and the percentage by which the plan's enrollees differ from the average enrollee. Making that substitution, the first two terms on the right-hand side of equation (7) simplify to the additive percentage adjustment. We also assume that a plan's bid does not change the mix of beneficiaries it receives, which would mean that between time t and $t+1$, the additive adjustment, catastrophic spending, and reinsurance would remain constant. Under those assumptions, the per capita change in government spending for beneficiaries not receiving low-income subsidies is equal to the change in bids between the two time periods.

For beneficiaries of basic plans bidding above the low-income benchmark, **Table 5** quantifies the amount by which those plans respond to competition. We have not quantified the extent to which MAPD plans, employer plans, and enhanced plans also respond to changing numbers of competitors, and thus we conservatively assume that they do not change their bid in response to competition. To calculate the effect on the national enrollment weighted average bid, the bids of basic PDPs that bid above the benchmark in the previous year are weighted by the amount of enrollment in those plans, which was about 20 percent in 2010.[11] Thus, the annual change in government spending for each beneficiary as a function of the monthly bid of plans bidding above the low-income benchmark is:

$$\Delta Annual\ Govt\ Pay_{Non-LIS} = 12 \cdot 0.745 \cdot 0.20(Bid_t - Bid_{t+1}) \quad (8)$$

For beneficiaries receiving low-income subsidies, the government also pays the cost of the premium up to a maximum amount represented by the low-income benchmark. After 2008, the benchmark was equal to the weighted average premium of all PDPs and MAPD plans in a region weighted by each plan's total low-income enrollment. Under that design, the sum of the low-income benchmark and 74.5 percent of the national weighted average bid represents the average bid of all plans, weighted by the share of low-income beneficiaries enrolled in each plan. Under the assumption made above, plans with a premium

[11] The remaining 80 percent of enrollment consisted of beneficiaries in MAPD and employer plans in the previous year (39 percent), beneficiaries in basic plans that bid below the low-income benchmark in the previous year (27 percent), and beneficiaries in enhanced plans (13 percent).

below the benchmark would not change their bid in response to changing number of competitors and thus not affect government payments. However, in 2010 about 14 percent of beneficiaries receiving low-income subsidies were in plans with a premium above the low-income benchmark and those plans would respond to changing amounts of competition—resulting in a higher low-income benchmark. Thus, we model the change in federal spending for beneficiaries receiving low-income subsidies as a function of the increase in the low-income benchmark:

$$\Delta Annual\ Govt\ Pay_{LIS} = 12 \cdot 0.14\left(Bid_t - Bid_{t+1}\right) \tag{9}$$

That increase would apply to all low-income beneficiaries enrolled in plans with a premium above the benchmark (Pop_{LIS+}). Combining (8) and (9) and recognizing that a higher national average will increase the government payments for all beneficiaries in Part D not receiving low-income subsidies (Pop_S) regardless of whether they were enrolled in MAPD plans or PDPs, we find the following:

$$\Delta Annual\ Govt\ Pay = 12\left(0.745 \cdot 0.20 \cdot \left(Pop_S\right) + 0.14 \cdot \left(Pop_{LIS+}\right)\right)\left(Bid_t - Bid_{t+1}\right) \tag{10}$$

An additional plan sponsor entering a regional market was associated with a reduction in the average bid of a plan bidding above the low-income benchmark by $0.20 to $0.50 (**Table 5**). Using equation (10), a $0.20 to $0.50 reduction in bids of plans that bid above the benchmark would reduce the average annual per capita government payments by $0.24 to $0.60, or roughly $7 million to $17 million per year. (Net federal spending for Part D in 2010 was about $53 billion.) It is also true, however, that the exit of a plan sponsor from the market would increase government expenditures by $7 million to $17 million each year. And thus, the loss of four plan sponsors that occurred in each region, on average, between 2007 and 2010 is estimated to have resulted in increased payments by the government of between $27 million and $68 million, or 0.05 percent to 0.1 percent of annual spending on Part D.

There are no obvious policies available to the federal government to increase the number of plan sponsors in the market.[12] The government could consider altering market regulations to make it easier for plans with low bids to attract beneficiaries, and it would need to weigh the benefits and costs of such changes. Such changes might induce entry by reducing the cost of growing a plan's beneficiary pool and developing economies of scale in its operations. Policies that made it easier for beneficiaries to select the least expensive plan available to them would benefit plan sponsors that offered less expensive plans. For example, the government could send information to beneficiaries about the cost of their plan and other plans offered in their region at the time of plan selection. Alternatively, a requirement that all beneficiaries actively reaffirm their choice of plan or select a new plan every few years—combined with reassignment to a low-cost plan in their region that covered their drugs if they failed to meet that requirement—could increase the likelihood that beneficiaries would select low-cost plans, although it might also cause some beneficiaries to exit the program.

VII. Conclusion

The research presented above finds that competition between plan sponsors creates an incentive to lower bids, which ultimately reduces the cost of the Medicare program for beneficiaries not receiving a low-income subsidy. Consistent with economic theory, we find that an increasing number of plan sponsors

[12] In addition, there may be cases when the federal government would not want to increase the number of plan sponsors in a region. For example, if the number of plan sponsors grew to a level outside of the range analyzed for this study, the average uncertainty of plan sponsors about their costs may increase to a level that raised their bids and thus also raised the cost to the federal government.

active in the Part D market is associated with lower bids submitted by plan sponsors. For example, among plans that were not eligible to be assigned low-income beneficiaries, we find that each additional plan sponsor entering an 18-firm market was associated with a fall in bids to provide a month of basic coverage to a beneficiary of average health of 0.4 percent—or $0.33 for a plan that bid $85 per month—which corresponds to an elasticity of -0.071. Those results are an average across six specifications in which estimates of that fall range from $0.20 to $0.50.

The entrance of a new plan sponsor is correlated with a greater decrease in bids when there are fewer sponsors in a region. Bids also decrease more for small plan sponsors than large plan sponsors following the entrance of a new plan sponsor. We also find that overhead and profits fall when the number of plan sponsors increases and by an amount similar to the change in bids. That allows us to conclude that, consistent with theory, increasing amounts of competition are correlated with falling levels of profit. Finally, because plans' bids are used to directly calculate the government's contributions to Medicare Part D, a larger number of plan sponsors would probably reduce the government's spending on Part D. Using the estimates observed in the paper, the loss of four plan sponsors, as occurred between 2007 and 2010, is estimated to have cost the government between $27 million and $68 million each year.

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Appendix A: Mathematical Proof

Assume a reverse auction (firms competing to sell a good to a single buyer) with $N+1$ firms, each with a cost of providing Part D coverage to a beneficiary of average health (c_i) that is distributed according to a uniform distribution ($\sim U(\underline{c},\overline{c})$), such that the supernormal profit earned by the firm for each beneficiary is its bid (b_i) minus the cost of providing the coverage. The firm with the lowest bid is assumed to attract φ_1 share of total enrollment, and the remaining enrollees select the firm with the second lowest bid ($\varphi_1+\varphi_2=1$). Each plan sponsor submits its bid to maximize expected profits:

$$\pi=\max_{b_i|c_i}\varphi_1(b_i-c_i)\Pr\left(b_i\le\min\left(b_{j\neq i}\right)\right)+\varphi_2(b_i-c_i)\Pr\left(\min\left(b_{j\neq i}\right)<b_i\le\min\left(b_{k\neq i\neq j}\right)\right) \tag{1}$$

Following Krishna (2002), each firm optimally adopts the same bid function $b=\beta(c)$, which is monotonic and increasing in c. Thus, $\min\left(b_{j\neq i}\right)=\min\left(\beta\left(c_{j\neq i}\right)\right)=\beta\left(\min\left(c_{j\neq i}\right)\right)=\beta\left(Y_1^N\right)$, where Y_1^N is the first order statistic (i.e., the order statistic for the plan with the lowest costs for coverage in an N-plan market). Similarly, $\min\left(b_{k\neq i\neq j}\right)=\beta\left(Y_2^N\right)$, where Y_2^N is the second order statistic. Using that notation and then taking the inverse bid function within each probability, equation (1) is transformed to:

$$\pi=\max_{b_i|c_i}\varphi_1(b_i-c_i)\Pr\left(\beta^{-1}(b_i)\le Y_1^N\right)+\varphi_2(b_i-c_i)\Pr\left(Y_1^N<\beta^{-1}(b_i)\right)\Pr\left(\beta^{-1}(b_i)\le Y_2^N\right) \tag{2}$$

The probabilities in equation (2) now represent cumulative distribution functions of the respective order statistics (the plan-specific subscripts have been removed for notational simplicity), such that the cumulative density function (CDF) of Y_k^N is $G_k(\bullet)$ and the probability density function (PDF) is $g_k(\bullet)$.

$$\pi=\max_{b_i|c_i}\varphi_1(b-c)\left[1-G_1^N\left(\beta^{-1}(b)\right)\right]+\varphi_2(b-c)\beta^{-1}(b)\left[1-G_2^N\left(\beta^{-1}(b)\right)\right] \tag{3}$$

Taking the first order condition of equation (3) and then substituting $c=\beta^{-1}(b)$ and $b=\beta(c)$ yields a dominant strategy bid function:

$$\beta(c)=-\frac{\int_{\underline{c}}^{c}\varphi_1 x g_1(x)-\varphi_2 x\left[g_1(x)\left(1-G_2(x)\right)-g_2(x)G_1(x)\right]dx}{\varphi_1\left(1-G_1(c)\right)+\varphi_2 G_1(c)\left(1-G_2(c)\right)} \tag{4}$$

Integrating equation (4) by parts and substituting out φ_2 yields:

$$\beta(c)=c+\frac{\int_{c}^{\overline{c}}\varphi_1\left(1-G_1(x)\right)+\left(1-\varphi_1\right)G_1(x)\left(1-G_2(x)\right)dx}{\varphi_1\left(1-G_1(c)\right)+\left(1-\varphi_1\right)G_1(c)\left(1-G_2(c)\right)} \tag{5}$$

We transform (5) using the two substitutions:

$$A=\int_{c}^{\overline{c}}\left(1-G_1(x)\right)dx \tag{6}$$

$$B=\int_{c}^{\overline{c}}G_1(x)\left(1-G_2(x)\right)dx \tag{7}$$

where A is the probability that the firm's costs are less than those of the lowest-bidding other firm and B is the probability that the firm's costs are greater than those of the lowest-bidding other firm but lower than those of the second-lowest-bidding other firm. Applying the Leibniz integral rule, we then have that $A_c' = -\left(1-G_1(c)\right)$ and $B_c' = G_1(c)\left(1-G_2(c)\right)$. That allows us to rearrange (5) to become:

$$\beta(c) = c - \frac{\varphi_1 A + (1-\varphi_1) B}{\varphi_1 A_c' + (1-\varphi_1) B_c'} \equiv c - \frac{1}{\frac{\partial}{\partial c}\left[\ln\left(\varphi_1 A + (1-\varphi_1) B\right)\right]} \tag{8}$$

Taking the derivative of the optimal bid function with respect to φ_1 now yields:

$$\frac{\partial \beta(c)}{\partial \varphi_1} = -\frac{\partial}{\partial \varphi_1}\left(\frac{1}{\frac{\partial}{\partial c}\left[\ln\left(\varphi_1 A + (1-\varphi_1) B\right)\right]}\right) \equiv -\frac{-\frac{\partial}{\partial \varphi_1}\frac{\partial}{\partial c}\left[\ln\left(\varphi_1 A + (1-\varphi_1) B\right)\right]}{\left(\frac{\partial}{\partial c}\left[\ln\left(\varphi_1 A + (1-\varphi_1) B\right)\right]\right)^2} \tag{9}$$

The denominator is positive and thus we focus on the numerator. We reverse the order of differentiation to yield:

$$\frac{\partial}{\partial c}\frac{\partial}{\partial \varphi_1}\left[\ln\left(\varphi_1 A + (1-\varphi_1) B\right)\right] = \frac{\partial}{\partial c}\left(\frac{A-B}{\varphi_1 (A-B) + B}\right) \equiv \frac{\partial}{\partial c}\left(\frac{1}{\varphi_1 + \frac{1}{\frac{A}{B}-1}}\right) = \frac{\frac{\partial}{\partial c}\left(\frac{A}{B}\right)}{\left(\frac{A}{B}-1\right)^2\left(\varphi_1 + \frac{1}{\frac{A}{B}-1}\right)^2} \tag{10}$$

Again, the denominator is positive and thus we focus on the numerator. As the firm's cost of providing coverage increases, the probability that it is the lowest-bidding firm (A) falls and the probability that it is the second-lowest-bidding firm (B) rises and then falls (but it falls at a lower rate than A falls), suggesting that (10) is negative. To verify that, we substitute the two order statistics into (6) and (7) and solve (10):

$$G_1(c) = 1 - \left[1 - F(c)\right]^N \tag{11}$$

$$G_2(c) = 1 - \left[1 - F(c)\right]^{N-1}\left[1 + (N-1)F(c)\right] \tag{12}$$

That confirms that for all costs, $\frac{\partial}{\partial c}\left(\frac{A}{B}\right) < 0$ and thus $\partial \beta(c)/\partial \varphi_1 < 0$. Therefore, as the share of enrollment attracted to the lowest-bidding firm decreases, the equilibrium bid increases.

To show the second result, we turn to Mathematica to demonstrate that:

$$\left.\frac{\partial \beta(c)}{\partial N}\right|_{\varphi_1 = 1} < \left.\frac{\partial \beta(c)}{\partial N}\right|_{\varphi_1 < 1} \tag{13}$$

Appendix B: The Herfindahl-Hirschman Index

The Herfindahl-Hirschman Index (HHI) is commonly used by the Federal Trade Commission and the Department of Justice as an indicator of competitiveness when considering the effect of mergers on prices in a particular market. A market with one firm would have an HHI of 10,000; a market with four identically sized firms would have an HHI of 2,500. An HHI below 1,500 is described as competitive, between 1,500 and 2,500 as moderately concentrated, and above 2,500 as concentrated. Using that method, the HHI for the Part D market for basic plans has been between 1,100 and 1,400 during the period from 2006 to 2010 and could thus be characterized as competitive.

Basing a measure of competition on the number of competing plan sponsors in the market may be more sensible than measuring the number of competing plans because the same sponsor often operates multiple plans, presumably as part of a strategy to benefit the sponsor. Combining basic and enhanced plans across plan sponsors, the HHI across regions ranged between 1,500 and 1,800 from 2006 to 2010, suggesting that the Part D market is moderately concentrated. Most of the regions have become less concentrated over time (see **Figure B1**).

Using HHI to predict bidding behavior would be problematic. There is no theory to directly connect the HHI with a bidding strategy because a well-designed auction reduces the ability of firms to exercise market power (Myerson, 1981). For example, in the auctions to provide prescription drug insurance to Medicare beneficiaries, all plan sponsors simultaneously submit their bids and know exactly how their bid will be mapped into the premium that beneficiaries will see when selecting a plan. All premiums are then presented to the beneficiaries in an equivalent manner, irrespective of the size of the firm or number of beneficiaries it enrolled in the previous year. To the extent that beneficiaries make purchases based on the premium, the most important factor for each plan is whether they are the lowest-premium plan in the region and, if not, how far they are from the plan with the lowest premium.[13] That concern is captured more accurately by a measure of the number of competitors than by the degree of competitiveness as measured by the HHI. In addition, an increasing HHI could be associated with either an increase or a decrease in the number of competitors. Consider, for example, a market with two firms that each control 50 percent of the market. The addition of a third competitor would increase the HHI if one of the firms obtained a market share sufficiently greater than 50 percent (e.g., the market shifted from 50/50/0 to 70/15/15). The new entrant's arrival would decrease the HHI if no firm obtained a market share greater than 50 percent (e.g., the market shifted to 50/45/5).

[13] For evidence on how the switching of consumers between plans is related to the number of plans with premiums near the lowest premium in a region, see Ketcham et al. (2013).

Appendix C: Factors Potentially Correlated With Entry and Exit

The estimates presented in **Table 5** and **Table 6** could suffer from omitted variable bias if there are factors that are correlated with both bids and the number of plan sponsors that are not included in regressions (1) and (2). If that were the case, then the coefficient on the number of plan sponsors in those regressions might represent—at least in part—the effect of the omitted factors rather than that of the number of plan sponsors. The following is a list of potential omitted variables and hypotheses about why those variables might be associated with the entry and exit of plan sponsors.

- *Overhead and profit.* Plans in a region may have experienced lower-than-expected claims costs or otherwise have earned higher profits for a particular year. If other firms observe those higher profits, they might decide to enter that region.
- *HHI:* A region with a high Herfindahl-Hirschman Index (HHI) in the previous year is generally a region with a few dominant plan sponsors. Recent literature suggests that plan sponsors in such regions are able to extract lower prices from providers, all else being equal (Moriya, Vogt, and Gaynor, 2010). Thus, a highly concentrated insurance market could induce entry from plan sponsors who believe they can also capture lower rates from providers (in this case, drug manufacturers) and could induce exit from plan sponsors that are not large because they cannot compete with the low rates obtained by the large plan sponsors. To the extent that the lower prices are reflected in lower bids and not higher profits, this would be distinct from the *overhead and profit* omitted variable.
- *LIS benchmark:* If low-income populations are sufficiently similar across regions, a high low-income-subsidy (LIS) benchmark in the previous year indicates that plans with higher claims costs or less efficient claims management would qualify as a zero-premium plan for low-income beneficiaries. Thus, a high LIS benchmark could induce entry and reduce exit by firms that would like to qualify to receive auto-assigned enrollees.
- *Regional average bid:* If populations are sufficiently similar across regions, a high regional average bid in the previous year indicates that plans can operate less efficiently and still be relatively competitive in that region relative to other regions. Thus, a high regional average bid could induce entry and reduce exit by firms wishing to obtain that relatively high rate of reimbursement.
- *Percent enrollment in MAPD plans:* Having a high share of Medicare Advantage prescription drug (MAPD) enrollment in a region suggests that private plan sponsors can offer Medicare coverage at a lower cost than the standard fee-for-service (FFS) plan. To the extent that MAPD plans enroll beneficiaries who have lower health care expenditures than the Centers for Medicare & Medicaid Services' (CMS's) risk-adjustment system would predict (as some research suggests they do), a high MAPD enrollment share might suggest that the remaining pool of beneficiaries in FFS are more expensive than CMS's risk-adjustment system would predict. Bidding for higher cost beneficiaries would probably induce exits and deter entrance.
- *Total beneficiaries per prescription drug plan (PDP) sponsor:* A region with a large number of beneficiaries for each plan sponsor suggests that relative to other regions, plans may be able to exhibit greater economies of scale or negotiate lower drug prices with pharmacies, which would be expected to induce entry and deter exit.
- *Share of PDP enrollment in basic plans:* A large share of enrollment in basic plans relative to enhanced plans suggests that beneficiaries in the region prefer basic plans. Because basic plans are largely homogeneous, they would be expected to attract beneficiaries who are more sensitive

to price. As such, a region with high basic enrollment relative to enhanced enrollment could deter the entrance of new plan sponsors.

- *Number of plan sponsors in the previous year:* A region with few plan sponsors means that existing plan sponsors can more easily attract beneficiaries who switch between plans. Similarly, a region with many sponsors may make it more difficult for any single plan sponsor to gain market share, making such plans less able to generate profits from economies of scale and power in negotiating pharmacy rates. Thus, a region with few sponsors would probably induce the entrance of new plan sponsors.
- *Number of plan sponsors in 2006:* Because there was much less information available about market conditions in 2006 than thereafter, the number of plan sponsors in 2006 may have been unexpectedly high and the average of bids may have been unexpectedly low in some regions (or vice versa). If such a correlation occurred by chance, then regions with larger numbers of plan sponsors may have experienced greater exit and rising bids (or vice versa) because of those initial conditions rather than because of competition between firms.

To assess those potential omitted variables, we first examined the extent to which they predict various measures of entry into and exit from Part D regions. Firms had much less information about market conditions in 2006 than in 2007 and thereafter, and it may have taken firms more than one year to act on information revealed in 2006. For those reasons, we hypothesized that the levels of the potential omitted variables in the previous year (rather than the changes in them over time) might affect the change in the number of plan sponsors between that previous year and the next year. We exclude from our analysis the entrance or exit of a national plan sponsor, because they are not making different decisions across regions. Some national plan sponsors entered a limited number of the regions in one year and the remaining regions in the next year; those plan sponsors are also excluded from the regressions because they ultimately entered all regions.

We find that only one of the potential variables discussed above offers a statistically significant explanation for any change in the number of plan sponsors. A larger number of plan sponsors in the previous year appears to be correlated with an increased likelihood of exit; a smaller number of plan sponsors deters exits (see **Table C1**). Excluding the number of other plan sponsors in the region, we cannot reject the joint hypothesis that all other parameters are zero based on F-tests for several different specifications.

To examine the influence of the lagged number of plan sponsors on our main results for changes in bids, we estimated variants of regression (2) that include controls for the number of plan sponsors present in each region in the previous year. As can be seen in **Table C2**, the coefficient on the log of the number of plan sponsors in the previous year is statistically insignificant and small and its inclusion in the regression dilutes the precision of the coefficient on our variable of interest (change in the log of the number of plan sponsors in the current year) by increasing the standard error by about 50 percent. Although we do not have sufficient statistical power to estimate the coefficient of interest very precisely after the inclusion of this additional variable, the point estimates of the coefficient on the change in the log of the number of plan sponsors in the current year are not greatly different from those in specifications that exclude this additional variable, indicating that the results are not highly sensitive to this potential omitted variable. We do not include it in our main specification because it appears to be largely collinear with our variable of interest, and we do not have a strong conceptual reason to include it separately in the analysis of changes in bids.[14]

[14] The other potential variable that exhibits some explanatory power is the number of regional plan sponsors in 2006. Running a variant of **Table C2** with that variable leaves our coefficient of interest largely unchanged with no statistically significant effect observed for the number of plan sponsors in 2006 (the mean is -0.54 and the standard error is 0.044).

Tables

Table 1. Market Size and Plan Distribution

Year	Total Nationwide Enrollment (millions)[1]	Share of Total Enrollment in MAPD Plans	Share of Enrollment in PDPs	Nationwide Enrollment in PDPs	
				Basic Plans (millions)	Enhanced Plans (millions)
2006	22.8	23.5%	69.5%	12.9	2.7
2007	24.3	25.0%	67.3%	13.0	3.3
2008	25.6	27.2%	64.4%	12.8	3.7
2009	26.6	29.1%	62.1%	12.2	4.3
2010	27.5	30.7%	60.4%	12.9	3.7

Notes: (1) Total enrollment includes enrollment in Medicare Advantage prescription drug (MAPD) plans, Part D prescription drug plans (PDPs), and employer prescription drug plans.

Table 2. Bids, Premiums, and the Low-Income Benchmark for Basic Stand-alone Plans

Year	Avg Low-Income Subsidy Level (regional range)[1]	Plan Bids mean (st dev)[2]	Plan Premiums mean (st dev)[2]
2006	$31.42 (23 - 36)	$84.23 ($8.30)	$24.13 ($8.30)
2007	$27.87 (21 - 34)	$77.00 ($6.54)	$23.95 ($6.54)
2008	$27.33 (16 - 36)	$79.25 ($6.03)	$26.66 ($6.03)
2009	$29.19 (16 - 38)	$84.66 ($6.67)	$30.69 ($6.67)
2010	$32.29 (21 - 41)	$89.92 ($7.61)	$33.53 ($7.61)

Note (1) Averages are weighted by total regional enrollment; the range of LIS benchmarks across regions is shown in parentheses; (2) Plan bids and premiums are weighted by plan enrollment in July of each year (i.e., weighted by enrollment earned as a result of their bid), with the standard deviation shown in parentheses.

Table 3. Measures of Competition Across the 34 PDP Regions

Year	Herfindahl–Hirschman Index (HHI)[1]		# of Competitors[2]	
	Plan Level mean (st dev)	Plan Sponsor Level mean (st dev)	# Plan Sponsors mean (range)	# Plans mean (range)
	Basic	Basic + Enhanced	Basic	Basic
2006	1347 (344)	1811 (352)	16 (10 - 19)	25 (15 - 29)
2007	1392 (289)	1764 (350)	22 (18 - 26)	29 (24 - 36)
2008	1166 (324)	1566 (356)	18 (16 - 22)	27 (22 - 32)
2009	1274 (370)	1539 (390)	18 (15 - 21)	24 (20 - 28)
2010	1266 (311)	1558 (403)	18 (15 - 22)	23 (19 - 28)

Notes: All values are weighted by regional enrollment; some insurers may offer multiple plans; (1) The standard deviation of the HHI is shown in parentheses; (2) The range of insurers and plans across regions are shown in parentheses.

Table 4. Summary Statistics of Variables Used in Regressions

Summary Statistics	Mean St Dev.	25th percentile	75th percentile
Plan Bid (bid)	87.4 [10.8]	80.2	92.74
Change in Plan Bid (Δbid)	1.8 [11.0]	-3.47	7.7
Number of Plan Sponsors (Comp)	18.2 [2.6]	17	20
Change in Plan Sponsors current and previous yr (ΔComp)	0.260 [3.50]	-2	1
Plan Type (1 = receive LIS based on stats in year 1) (D) (Type)	0.57 [0.50]	0	1
Plan Type (1 = receive LIS based on stats prev year) (D) (Type)	0.36 [0.48]	0	1
Plan Size (% of benes in region year t-1)	3.10% [4.8%]	0.18%	3.75%
Share of New Plans in year t	7.40% [26.1%]	na	na
Percent of MAPD Subscribers in Region (of total Medicare) (MAPD)	13.4% [7.3%]	7.57%	18.86%
Change in Percent of MAPD Subscribers in Region (ΔMAPD)	1.3% [0.94%]	0.65%	1.72%

All statistics are unweighted and averaged over 5 years and based on Basic plans only.

Table 5. Elasticity Bids With Respect to Changes in the Number of Plan Sponsors Controlling for Plan Strategy in Previous Year

Dependent Variable	(1)	(2)	(3)	(4)	(5)	(6)
	$\ln(bid_{jiRt})$			$\ln(bid_{jiRt}) - \ln(bid_{jiR(t-1)})$		
ln(No. Plan Sponsors)	-0.084**	-0.038	-0.043	-0.095***	-0.075**	-0.090*
-or- Δln(No. Plan Sponsors)	[0.036]	[0.031]	[0.048]	[0.035]	[0.033]	[0.050]
Plan Type (1 = receive LIS	-0.48***	-0.33***	-0.27***			
reassignment prev year)	[0.066]	[0.062]	[0.090]			
New Plan Sponsor (first year	-0.31***	-0.24***	-0.16			
sponsor in a region)	[0.097]	[0.086]	[0.14]			
Interaction with Competition Variable: Plan Type	0.14***	0.10***	0.088***	0.20***	0.17***	0.20***
	[0.022]	[0.021]	[0.031]	[0.021]	[0.019]	[0.030]
Interaction with Competition Variable: New Plan Sponsor	0.11***	0.088***	0.068			
	[0.032]	[0.028]	[0.046]			
% MAPD Subscribers in Region	0.23*	0.22**	0.15	0.20***	0.17***	0.20***
-or- Δ %MAPD Subscribers	[0.12]	[0.11]	[0.19]	[0.021]	[0.019]	[0.030]
Constant	4.76***	4.61***	4.57***	0.063***	0.069***	0.074***
	[0.10]	[0.088]	[0.14]	[0.0093]	[0.0092]	[0.0051]
Bid Reduction: 15 -> 16 Sponsors	-$0.48	-$0.22	-$0.25	-$0.54	-$0.42	-$0.51
Bid Reduction: 21 -> 20 Sponsors	$0.36	$0.16	$0.18	$0.41	$0.32	$0.38
Region Controls	X	X		X	X	
Year Controls	X	X	X	X	X	X
Plan Sponsor Controls	X			X		
Plan Controls		X			X	
Plan*Region Controls			X			X
Identification Strategy	Across Time & Region		Across Time; Within Region			
Observations	4276	4276	4276	2613	2613	2613
R2	0.53	0.65	0.72	0.52	0.58	0.63
Adjusted R2	0.52	0.64	0.55	0.50	0.56	0.36
F-statistic	70.0	66.6	172.0	59.9	54.0	224.5

Note: Robust standard errors in brackets * p<0.10; ** p<0.05; *** p<0.01. "New Plan Sponsor" variable equal to 1 if the plan sponsor is new to the region, which includes all plan sponsors in 2006. "Plan Type" equals 1 if the plan's previous year premium was below the low-income benchmark in that year and the plan was a basic plan. All plans in 2006 are Plan Type=0. Plans that entered after 2006 are assumed to be able to actively select their plan type in the first year based on observing the previous year's low-income benchmark. Regressions (3) and (6) include a full set of plan and region interacted dummy variables. For regressions (3) - (6), the competition terms and %MAPD subscribers are differenced, similar to the dependent variable.

Table 6. Elasticity of Bids With Respect to Changes in the Number of Plan Sponsors Controlling for Plan Strategy in First Year of Operation

Dependent Variable	(1)	(2)	(3)	(4)	(5)	(6)
	$\ln(bid_{jiRt})$			$\ln(bid_{jiRt}) - \ln(bid_{jiR(t-1)})$		
ln(No. Plan Sponsors) -or-	-0.082**	-0.031	-0.016	-0.14***	-0.14***	-0.15***
ΔIn(No. Plan Sponsors)	[0.037]	[0.032]	[0.045]	[0.036]	[0.033]	[0.050]
Plan Type (1 = receive LIS	-0.097	-0.0010	0.42***			
reassignment in first year)	[0.071]	[0.065]	[0.092]			
New Plan Sponsor (first year after	-0.31***	-0.24***	-0.16			
2006 sponsor in a region)	[0.096]	[0.088]	[0.12]			
Interaction with Competition Variable: Plan Type	0.025	0.0020	-0.096***	0.24***	0.24***	0.27***
	[0.024]	[0.022]	[0.031]	[0.020]	[0.018]	[0.027]
Interaction with Competition Variable: New Plan Sponsor	0.11***	0.086***	0.059			
	[0.032]	[0.029]	[0.038]			
% MAPD Subscribers in Region	0.17	0.17	0.014	-0.22	-0.24	-0.21
-or- Δ %MAPD Subscribers	[0.13]	[0.11]	[0.17]	[0.28]	[0.26]	[0.38]
Constant	4.76***	4.59***	4.54***	0.062***	0.069***	0.075***
	[0.10]	[0.092]	[0.13]	[0.0093]	[0.0091]	[0.0050]
Bid Reduction: 15 -> 16 Sponsors	-$0.46	-$0.17	-$0.09	-$0.78	-$0.77	-$0.86
Bid Reduction: 21 -> 20 Sponsors	$0.35	$0.13	$0.07	$0.58	$0.58	$0.64
Region Controls	X	X		X	X	
Year Controls	X	X	X	X	X	X
Plan Sponsor Controls	X			X		
Plan Controls		X			X	
Plan*Region Controls			X			X
Identification Strategy	Across Time & Region			Across Time; Within Region		
Observations	4276	4276	4276	2613	2613	2613
R2	0.50	0.64	0.75	0.53	0.59	0.64
Adjusted R2	0.49	0.63	0.59	0.51	0.57	0.38
F-statistic	58.4	62.2	201.0	59.6	59.6	246.4

Note: Robust standard errors in brackets * p<0.10; ** p<0.05; *** p<0.01. "New Plan Sponsor" variable equal to 1 if the plan sponsor is new to the region after 2006. Plan Type determined by bid and corresponding premium in the first year of the plan's operation where a plan with a premium below the LIS benchmark is Plan Type=1. All Plans are Type=0 in 2006. Plans that entered after 2006 were coded based on whether their first year premium was above (Type=0) or below (Type=1) the previous year's low-income benchmark. Regressions (3) and (6) include a full set of plan and region interacted dummy variables. For regressions (3) - (6), the competition terms and %MAPD subscribers are differenced, similar to the dependent variable.

Table 7. Changing Elasticity as a Function of Plan Size and Type (based on firm type in previous year)

Dependent Variable	(1)	(2)	(3)
	$\ln(bid_{jiRt}) - \ln(bid_{jiR(t-1)})$		
Δln(No. Plan Sponsors)	-0.13***	-0.11***	-0.13**
	[0.037]	[0.034]	[0.052]
Interaction with # Sponsors in Region (or Δ) Plan Type	0.24***	0.19***	0.23***
	[0.024]	[0.022]	[0.035]
Interaction with # Sponsors in Region (or Δ) Plan Size[1]	0.022***	0.021***	0.025***
	[0.0038]	[0.0036]	[0.0053]
Interaction with # Sponsors in Region (or Δ) Plan Size * Plan Type	-0.024***	-0.021***	-0.026***
	[0.0040]	[0.0038]	[0.0058]
% of MAPD Subscribers in Region (or Δ)	-0.22	-0.19	-0.17
	[0.28]	[0.27]	[0.39]
Constant	0.065***	0.069***	0.074***
	[0.0094]	[0.0092]	[0.0051]
Region Controls	X	X	
Year Controls	X	X	X
Plan Sponsor Controls	X		
Plan Controls		X	
Plan*Region Controls			X
Identification Strategy	Across Time; Within Region		
Observations	2613	2613	2613
R2	0.52	0.58	0.63
Adjusted R2	0.50	0.56	0.36
F-statistic	59.0	54.3	177.1

Note: Robust standard errors in brackets * p<0.10; ** p<0.05; *** p<0.01. "Plan Type" equals one if the plan's previous year premium was below the low-income benchmark in that year and the plan was a basic plan. All plans in 2006 were Plan Type=0. Plans that entered after 2006 are assumed to be able to actively select their plan type in the first year based on observing the previous year's low-income benchmark. Regression (3) includes a full set of plan and region interacted dummy variables. "Plan Size" is the share of regional beneficiaries in basic plans enrolled by the plan in the previous year (i.e., the relevant year when the plan submitted its bid).

Table 8. Distribution of Risk Corridor Payments Across Basic Stand-alone Plans

Risk Corridor Payments	Received Payment	Received Payment	Neither Received nor Made Payment	Made Payment	Made Payment	Share Receiving Payments	Share Making Payments
Profit Threshold	Second	First		First	Second		
2006	11%	3%	8%	7%	71%	14%	78%
2007	27%	4%	14%	4%	52%	31%	55%
2008	23%	12%	30%	16%	18%	35%	34%
2009	16%	8%	30%	15%	32%	23%	47%
2010	16%	9%	30%	19%	25%	25%	45%

Table 9. The Relationship of Claims Costs, Overhead, and Profits With the Number of Plan Sponsors

Dependent Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	ΔClaims (Actual Claims Net of Rebates)			ΔNet Overhead & Profit Δ[Bid - Claims - RC Payments]			ΔOverhead & Profit Δ[Bid - Claims]		
Δ(No. Plan Sponsors)	0.37	0.46	0.99*	-0.30*	-0.24	-0.37	-0.90*	-0.88*	-1.46**
	[0.46]	[0.47]	[0.59]	[0.16]	[0.16]	[0.23]	[0.53]	[0.53]	[0.70]
ΔSponsor * PlanType	-0.096	-0.34	-0.84**	0.39***	0.33***	0.50***	1.18***	1.26***	1.96***
	[0.21]	[0.23]	[0.33]	[0.080]	[0.082]	[0.13]	[0.25]	[0.27]	[0.39]
Change in % of MAPD	33.9	44.1	31.4	-20.6	-23.1	-24.3	-60.5	-69.3	-52.7
Subscribers in Region	[60.5]	[60.7]	[62.0]	[21.7]	[21.0]	[28.4]	[69.0]	[68.6]	[76.3]
Constant	-2.30	-2.49	3.79***	3.07*	3.62**	2.74***	8.03	8.79	3.06***
	[6.94]	[7.00]	[0.82]	[1.58]	[1.58]	[0.40]	[6.99]	[7.06]	[0.97]
Region Controls	X	X	X	X	X	X	X	X	X
Year Controls	X	X	X	X	X	X	X	X	X
Plan Sponsor Controls	X			X			X		
Plan Controls		X	X		X	X		X	X
Plan*Region Controls			X			X			X
Observations	2613	2613	2613	2610	2610	2610	2613	2613	2613
R2	0.15	0.17	0.57	0.26	0.32	0.48	0.15	0.19	0.50
Adjusted R2	0.11	0.12	0.26	0.23	0.28	0.100	0.12	0.15	0.14
F-statistic	4.21	3.77	21.0	8.50	8.96	35.1	8.55	8.89	33.5

Note: Robust standard errors in brackets * p<0.10; ** p<0.05; *** p<0.01. "Plan Type" equals 1 if the plan's previous year premium was below the low-income benchmark in that year and the plan was a basic plan. All plans in 2006 were Plan Type=0. Plans that entered after 2006 are assumed to be able to actively select their plan type in the first year based on observing the previous year's low-income benchmark. Actual claims for each plan are calculated using the risk corridor payments. Some plans did not make risk corridor payments, suggesting that the claims estimated in the plan's bid were sufficiently close to their actual claims that no payments were required. In that case, estimated claims were used as a proxy for actual claims.

Table C1. Regression Results Testing for Endogenous PDP Entry or Exit

Dep. Var.	(1) Number of New Regional Entrants [0,1,2,3,4]	(2) New Regional Entrant [0,1]	(3) Number of Regional Exits [0,1,2]	(4) New Regional Exit [0,1]	(5) Net Number of Regional Change [-2,-1,0,1,2,3]	(6) Net Regional Entry [1=net entry]	(7) ∆ln(No. Plan Sponsors)
Regression (Type Profit)	Ordered	Binary	Ordered	Binary	Ordered	Binary	OLS
Overhead and Profit	0.013	-0.0088	-0.017	0.032*	0.0011	-0.022	-0.0030
(Regional Average) (Year-1)	[0.021]	[0.020]	[0.015]	[0.019]	[0.0013]	[0.019]	[0.0024]
HHI (Year-1)	0.60	-1.67	-1.42	1.55	0.075	-1.22	-0.16
	[1.28]	[1.34]	[1.11]	[1.36]	[0.092]	[1.28]	[0.11]
LIS Benchmark (Year-1)	0.0040	0.00065	-0.012	0.026	0.00050	-0.019	-0.00083
	[0.024]	[0.026]	[0.029]	[0.026]	[0.0019]	[0.024]	[0.0027]
Regional Weighted	-0.024	0.016	-0.0049	-0.016	-0.00096	0.049	0.0038
Average Bid (WAB) (Year-1)	[0.033]	[0.033]	[0.033]	[0.034]	[0.0022]	[0.031]	[0.0035]
Percent Enrollment in	-0.57	0.77	-0.77	0.88	-0.0018	0.87	0.057
MAPD Plans (Year-1)	[0.93]	[1.03]	[0.85]	[1.00]	[0.059]	[0.94]	[0.097]
Million Part D Beneficiaries	-3.41*	2.73	0.55	-0.074	-0.24	2.74	0.11
per Plan Sponsor (Year-1)	[1.82]	[2.18]	[1.85]	[2.06]	[0.19]	[1.95]	[0.16]
Percent of PDP enrollment	0.20	-0.012	-0.71	0.86	0.038	-0.87	0.015
in Basic Plans (Year-1)	[0.58]	[0.67]	[0.55]	[0.62]	[0.048]	[0.61]	[0.059]
Number of Regional Plan	0.013	-0.032	-0.13***	0.14***	0.0064	-0.055	-0.021***
Sponsors (Year-1)	[0.038]	[0.042]	[0.041]	[0.041]	[0.0052]	[0.039]	[0.0051]
Number of Regional Plan	0.050*	-0.060*	0.052	-0.054	0.000013	-0.031	-0.0024
Sponsors in 2006	[0.028]	[0.034]	[0.041]	[0.035]	[0.0024]	[0.032]	[0.0038]
Year Dummy	X	X	X	X	X	X	X
F-Test on all Hypotheses	5.65	4.98	19.03**	16.51**	16.17**	11.57	2.90***
F-Test on all but #Sponsors	5.50	4.86	7.14	6.55	9.74	10.44	1.07
N	136	136	136	136	136	136	
Chi2	23.1	20.2	63.6	58.1	49.9	27.9	F=122.9
Prob > chi2	0.000	0.000	0.000	0.000	0.000	0.006	Prob>F = 0

Marginal effects. Robust standard errors in brackets; * p<0.10, ** p<0.05, *** p<0.01. Regression (7) is OLS and includes a constant. The year of exit is the first year the sponsor does not offer any plans. The first F-test on all hypotheses tests jointly for the significance of all regressors except Year and reports the chi-squared result. The second F-test tests jointly the significance of all regressors except the number of regional plan sponsors and Year.

Table C2. Regression Results Testing for Effect of Competition in Previous Year

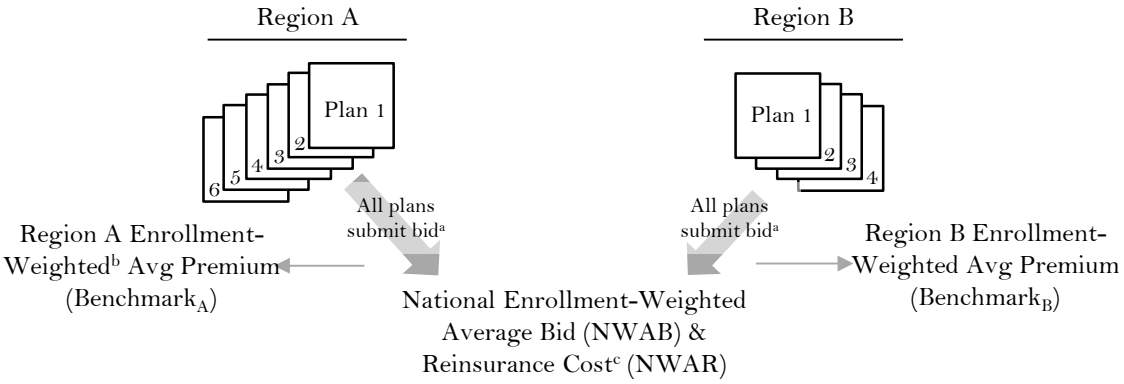
	Reproduced from Table 5			With No. Plan Sponsors(t-1)		
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	$\ln(bid_{jiRt}) - \ln(bid_{jiR(t-1)})$			$\ln(bid_{jiRt}) - \ln(bid_{jiR(t-1)})$		
ΔIn(No. Plan Sponsors)	-0.095***	-0.075**	-0.090*	-0.061	-0.034	-0.047
	[0.035]	[0.033]	[0.050]	[0.057]	[0.053]	[0.077]
ΔIn(No. Sponsors) * Plan Type	0.20***	0.17***	0.20***	0.19***	0.16***	0.19***
	[0.021]	[0.019]	[0.030]	[0.021]	[0.018]	[0.029]
In(No. Plan Sponsors(t-1))				0.036	0.038	0.025
				[0.054]	[0.050]	[0.077]
In(No. Plan Sponsors(t-1)) * Plan Type				0.013***	0.017***	0.028***
				[0.0013]	[0.0014]	[0.0020]
ΔMAPD Subscribers in Region	0.20***	0.17***	0.20***	-0.14	-0.13	-0.13
	[0.021]	[0.019]	[0.030]	[0.28]	[0.26]	[0.36]
Constant	0.063***	0.069***	0.074***	-0.055	-0.059	-0.030
	[0.0093]	[0.0092]	[0.0051]	[0.15]	[0.14]	[0.22]
Region Controls	X	X		X	X	
Year Controls	X	X	X	X	X	X
Plan Sponsor Controls	X			X		
Plan Controls		X			X	
Plan*Region Controls			X			X
Observations	2613	2613	2613	2613	2613	2613
R2	0.52	0.58	0.63	0.53	0.60	0.67
Adjusted R2	0.50	0.56	0.36	0.51	0.58	0.43
F-statistic	59.9	54.0	224.5	60.3	60.1	204.5

Note: Robust standard errors in brackets * p<0.10; ** p<0.05; *** p<0.01."Plan Type" equals 1 if the plan's previous year premium was below the low-income benchmark in that year and the plan was a basic plan. All plans in 2006 are Plan Type=0. Plans that entered after 2006 are assumed to be able to actively select their plan type in the first year based on observing the previous year's low-income benchmark. Regression (3) includes a full set of plan and region interacted dummy variables.

Figures

Figure 1. Overview of How the Government's Contribution is Set for Prescription Drug Plans

Calculating the Medicare Part D Premium and Government Contribution



	Individual Premium (for Plan 1, Region A)	**Government Contribution to Basic Benefit**[d] (for Plan 1, Region A)
Standard Beneficiary	$Prem_1 = Bid_1 - 74.5\%(NWAB) + 25.5\%(NWAR)$	$Govt\ Cont. = \overbrace{Adj(Bid_1) - Prem_1}^{\text{Direct Subsidy}} + \underbrace{80\%(Actual\ Cat\ Spending)}_{\text{Reinsurance}}$
Low-Income Beneficiary[e]	If $Prem_1 < Benchmark_A$, then $Prem_{1,LI} = \$0$ Otherwise: $Prem_{1,LI} = Prem_1 - Benchmark_A$	

Source: Congressional Budget Office based on MedPac, *Part D Payment System* (October 2013).

Notes:

a. Each plan sponsor submits one or more bids that reflect the amount it is willing to accept to provide the basic benefit to a beneficiary of average health (but not including costs associated with reinsurance which are part of the basic benefit). In addition, plan sponsors submit an estimate of the expected costs associated with reinsurance (which covers 80 percent of drug costs above a catastrophic threshold).

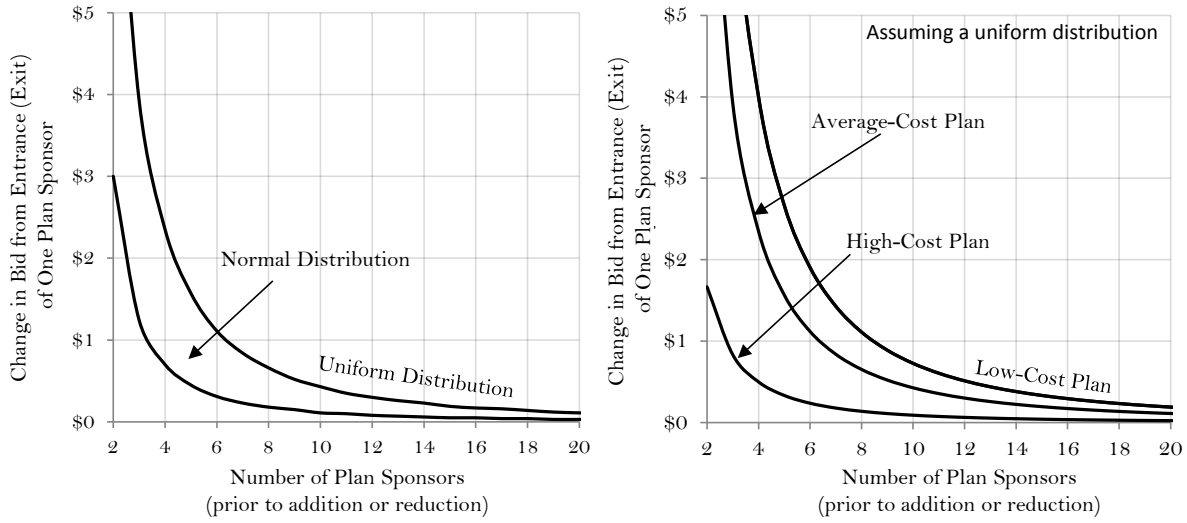
b. Starting in 2009, the Benchmark was constructed by weighting premiums by the enrollment of low-income beneficiaries in the previous year, not by total enrollment in the previous year.

c. The NWAR is the product of the national enrollment-weighted bid and a ratio of total expected estimated nationwide reinsurance expenses to total nationwide bid payments.

d. The government adjusts the direct subsidy based on whether the plan attracts more expensive (larger direct subsidy) or less expensive (smaller direct subsidy) beneficiaries than they anticipated when they submitted their bid. In addition, once all direct subsidy payments are made, additional adjustments are made to guarantee each plan a minimum level of profit (large profits result in reduced payments).

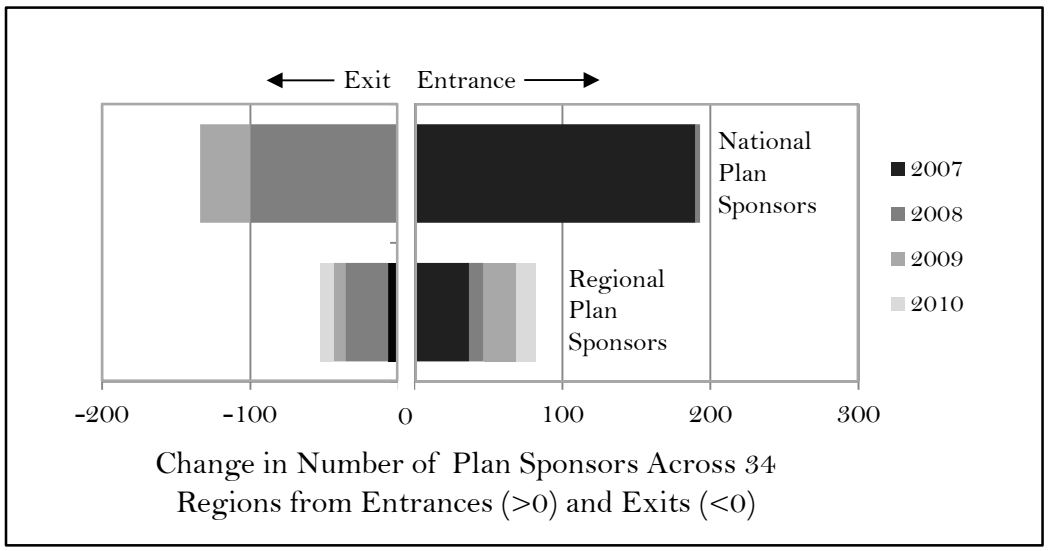
e. Low-income beneficiaries pay no premium if they select a plan with a premium that is below the low-income benchmark in their region; otherwise, they pay the difference between the premium and their regional low-income benchmark.

Figure 2. Theoretical Effect on Bids from Changing the Number of Plan Sponsors



Note: In the second figure, the low-cost plan represents a plan that bids $60, the average-cost plan bids $95, and the high-cost plan bids $130.

Figure 3. Firm's Entry and Exit, by Firm's Geographic Reach



Note: Each shading represents the marginal exit and entry of plan sponsors for that particular year. A nationwide sponsor joining the Part D market represents an entrance of 34 sponsor*region units; a regional sponsor entering a single region represents an entrance of 1 sponsor*region units. Exits reported for a particular year occurred prior to bidding and thus the previous year was their last year of operation.

Figure 4. Relationship Between Government Costs and the Number of Plan Sponsors

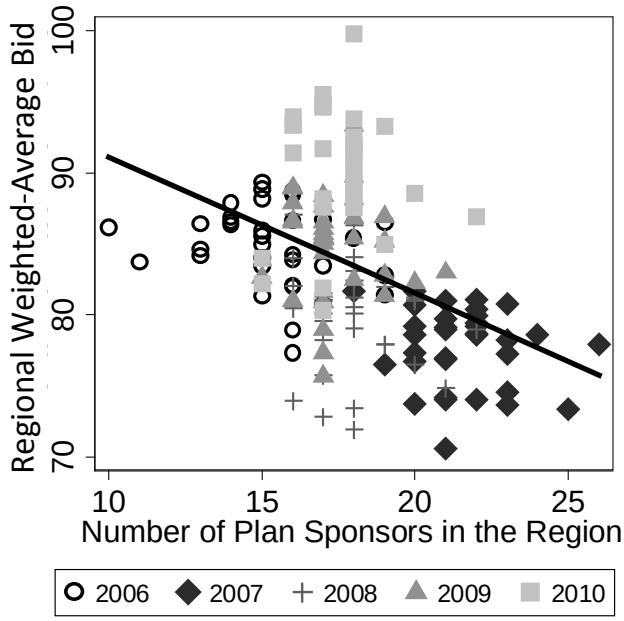


Figure B1. Comparison of Herfindahl–Hirschman Index (HHI) Between 2006 and 2010