The Welfare Impact of Reducing Choice in Medicare Part D:

A Comparison of Two Regulation Strategies

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Abstract

Medicare's prescription drug benefit (Part D) has been its largest expansion of benefits since 1965. Since the implementation of Part D, many regulatory proposals have been advanced in order to improve this government-created market. Among the most debated are proposals to limit the number of options, in response to concerns that there are "too many" plans. In this paper we study the welfare impact of two feasible approaches (of similar magnitude) toward limiting the number of Part D plans: reducing the maximum number of plans each firm can offer per region and removing plans that provide doughnut hole coverage. To this end, we propose and estimate a model of market equilibrium, which we later use to evaluate the impact of regulating down the number of Part D plans. Our counterfactuals provide an important assessment of the losses to consumers (and producers) resulting from government limitations on choice. These losses must be weighed against the widely discussed expected gains due to reduced search costs from limiting options. We find that the annual search costs should be at least two thirds of the average monthly premium in order to justify a regulation that allows only two plans per firm. However, this number would be substantially lower if the limitation in the number of plans is coupled with a decrease in product differentiation (e.g., by removing plans that cover the doughnut hole). For validation purposes, we also assess the impact of a recent major merger, and find that our model performs very well out of sample.

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1. Introduction

The Medicare prescription drug program started in January 2006, and constitutes the largest expansion of Medicare benefits since 1965. There is an immediate need to understand the functioning of this program to better inform policy as changes are already under consideration. A much debated potential reform is the reduction in the number of plans. This is in response to the massive entry of Part D plans, which has been argued to create large search costs when the elderly make their drug insurance decisions. A series of studies (Rice et al. (2008); Cubanski (2008); Kaiser Family Foundation 2006a), advocate for a reduction of Part D plans. These findings indicate that there may be political pressure to limit the number of choices.

In light of the challenges the U.S. government faces in regulating this market effectively, this paper studies the welfare impact of two easily implementable, and fundamentally different, approaches toward limiting the number of Part D plans: reducing the maximum number of plans each firm can offer per region and removing plans that offer doughnut hole coverage. Both approaches would result in a reduction in plans of a similar magnitude (approximately 20%). However, the latter involves eliminating a dimension of plans' characteristics, the net consequences of which depend on consumers' valuation of that dimension versus firms' ability to soften competition by differentiating along it.

To accomplish this task, we first provide evidence on the relative utility (or disutility) that the elderly derive from plan design features such as premium, deductible, gap coverage, etc. By measuring how seniors value these plan characteristics, we can assess whether they view Part D plans as differentiated products. Then, using our demand- and supply-side estimates, we assess the effects on equilibrium premia and welfare from limiting each firm to its two most popular plans per region (as opposed to the current three) and from removing plans that offer doughnut hole coverage. Although we do not model search costs explicitly (in that a likely benefit of reducing the number of plans is a reduction in search costs from considering fewer options), our analysis can inform us about the magnitude of the flipside – how large these search costs should be in order to justify the welfare costs of limiting the number of plans offered in a market. These costs may result from the elimination of plans that consumers value and/or from higher premia due to reduced competition. Importantly, our analysis allows us to determine whether one approach is clearly superior to the other. Finally, for validation purposes, we also use our estimates to assess the impact of a recent major merger between two Part D insurers.

Our empirical strategy utilizes discrete choice methods pioneered by Berry (1994) to recover structural estimates of parameters of the demand and cost functions for the differentiated prescription drug plans (PDP). This method is especially appealing since it requires only aggregate data at the plan level, which is publicly available (e.g., plan market shares and characteristics)[1]. The estimates from this procedure allow us to measure the value of plan characteristics to consumers, price elasticities of demand for each plan, and the consumer surplus created by the market. We combine our demand system with a Nash-Bertrand assumption to generate equilibrium premia and quantities[2], where firms take into account the expected subsidy they receive from the government. We then back out firms' marginal costs and ultimately producer surplus. The structural nature of the estimates allows us to conduct counterfactual policy experiments to see how prices and welfare would change if we made changes in program design.

Using this approach, we have several key findings. When plans covering in the doughnut hole are removed, the average premia for other "enhanced" plans[3] rise by 2 percent while average premia for non-enhanced plans rise by only 0.1 percent. We find that consumer surplus and producer surplus fall by about 4 percent and 3 percent, respectively. In addition, the number of seniors enrolled in any PDP drops by 2.7 percent. In this case, we find that most of the welfare loss comes from seniors substituting for a less valuable option or dropping coverage. The premium effect concentrates mostly within the set of closest substitutes, i.e. the remaining enhanced plans.

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[1] Due to Part D's recent implementation, no individual-level data is available in the public domain linking individuals to their plan choices.

[2] The actual mechanism is a bidding process that we cannot implement due to lack of data on key components such as reinsurance payments and the size of enhancements for enhanced plans. We postulate that firms submit their bids having in mind the premium the beneficiary will pay as a result of the bidding process, because consumers will make their enrollment decisions based on this premium and the characteristics of the plan. Therefore, a Bertrand game with differentiated products would capture the relevant features of the game.

[3] Enhanced plans are plans that are actuarially more generous than the standard plan design for Part D, and for which the government does not subsidize the extra premium associated with the enhancement. One kind of enhancement is to provide doughnut hole coverage.

On the other hand, when firms are limited to two plans in each region (as opposed to three)[4], we find more extreme results. In this case, the average premium rises by about 7 percent and enrollment in PDP plans drops by about 14 percent. Consumer surplus falls by 25 percent and producer surplus falls by 14 percent. In this case, most of the welfare loss happens via premium increases. It is important to note that we find these results to be qualitatively robust for several alternative model specifications.

The above two counterfactuals illustrate the potential costs from limiting plan offerings. These expected costs must be weighed against expected gains from reduced search costs when deciding to place stricter limitations on the number of plans that can be offered. For example, our results from limiting firms to offering two plans per region suggest that the reduction in annual search costs from this regulation must outweigh a loss of $24.40 per capita in consumer surplus – approximately two-thirds of the average monthly premium. In contrast, our results from eliminating plans that cover the gap imply that the necessary reduction in search costs is only $3.70 per capita.

The strong contrast in our measurements for these two counterfactuals highlights how differing methods for reducing the number of plans can have substantially different effects on equilibrium prices and welfare. Eliminating plans covering the gap and restricting firms to two plans per region reduces the number of plans by similar amounts – 18 percent and 21 percent, respectively. However, the former approach eliminates a key mode of product differentiation, leaving the remaining plans, which are relatively similar in features, to compete primarily on price. In contrast, restricting firms to two plans per region still allows for all forms of product differentiation, which better enables firms to soften price competition. Our results suggest then that a mandated reduction in the number of plans will likely have the least welfare losses if it is coupled with a restriction on plan features (ultimately restricting product differentiation).

Finally, we validate our model by assessing the impact of a recent merger between two large insurers in this market, United Health Care and Pacificare. In 2006, these insurers submitted plans on a separate entity basis. In 2007, they submitted plans as a joint entity. Our model predicts that the increase in market power due to this merger would result in a 4.1 percent increase in average premia for the merged firms and a 0.7

[4] We assume the firms drop the plan with the lowest enrollment in 2006.

percent increase in premia for other firms. In addition, consumer surplus would decline by 2.8 percent while producer surplus would increase by 1.7 percent. Furthermore, we compared our prediction about the increase in premium using post-merger data for year 2007, and found that our model performed extremely well. These results not only illustrate the effects of a merger of this magnitude on this market, but also demonstrate our model's ability to produce sensible counterfactual results, consistent with economic theory, and that perform well out-of-sample.

The remainder of the paper is organized as follows. Section 2 provides a description of the Medicare Part D market and Section 3 provides a literature review. Section 4 details our empirical methods, and Section 5 describes the data. Section 6 presents our results, and Section 7 concludes.

2. Description of the market

Medicare Part D was signed into law as part of the Medicare Prescription Drug, Improvement and Modernization Act (MMA) of 2003 and went into effect in January 2006. Unlike the Hospital Insurance (Part A) and the Supplemental Medical Insurance (Part B), the delivery of the new benefit has been completely entrusted to the private sector. Private companies can provide the new benefit as either stand-alone plans, called Prescription Drug Plans (PDPs), or they can offer it together with Parts A and B as Medicare Advantage plans (MA-PDs).[5] Our study focuses just on the PDP market since prescription drug coverage cannot be priced separately in the MA-PD market. Medicare beneficiaries can enroll in these plans by paying a 74.5 percent-subsidized premium. Further price reductions happen according to income and dual Medicaid status. The first open enrollment took place from November 15th 2005 to May 15th 2006, during which time the elderly could make decisions about participating in this market. PDP plans enrolled 16.5 million of the 22.5 million Part D enrollees in 2006. In subsequent years, open enrollment takes place from November 15th-December 31st of the previous year. In 2006, a total of 1,429 different insurance plans owned by approximately 70 different

[5] Before the enactment of MMA, private plans could also provide the benefits of Parts A and B of Medicare as Part C, later named Medicare+Choice. However, the benefits of Parts A and B have been delivered mainly through the traditional fee-for-service Medicare, with private plans accounting for 15 percent of the total Medicare enrollees in 2000 and 12 percent in 2005. (Kaiser Family Foundation, 2005)

companies were available in 34 regions into which the country is divided.[6] In 2007 even more plans entered, with a new total of 1,875 plans across all regions, increasing the relevance of the debate about limiting the number of plans. For 2009, 1,689 will be available. Dual eligible beneficiaries (those eligible for Medicaid as well as Medicare) were automatically enrolled in certain low cost plans, but allowed to switch to other plans. Although MMA specifies a standard drug benefit, the law allows deviations from that design as long as the modified plans are actuarially equivalent to the standard benefit.[7] Most beneficiaries are locked in to their current plan for a full year, but are allowed to switch plans each open enrollment period at a premium that is community rated. The exception is for Medicaid-Medicare dual eligible enrollees who are allowed to switch plans at any point in the year, and who may have to pay a small premium to the extent that they switch into certain higher priced plans.

The standard drug benefit design specified in MMA for year 2006 comprises a deductible of $250 and three coverage zones where the fraction of the additional drug dollar covered by the insurer varies substantially. Figure 1 shows how out-of-pocket drug expenses vary with total drug spending in the different coverage zones of the plan. After the deductible is exhausted, the elderly are covered 75 percent for the next $2,000 spent in total prescription drug expenditure (initial coverage zone, ICZ), 0 percent between $2,250 and $5,100 (so the next $2,850) of total drug expenditure, the doughnut hole zone, and 95 percent after the $5,100 threshold (catastrophic coverage zone). Thus, at the point that catastrophic coverage begins, the beneficiary has spent $3,600 out of pocket ($250 in zone 1, $500 in zone 2, and $2,850 in region 3).

The plans offered are differentiated along several dimensions, such as premium, deductibles, gap coverage, number of drugs in the formulary, copay sizes, etc. Insurance companies can deviate in plan design from the standard benefit described above and offer

[6] The regions are composed of one or mores states, and were set by the government at the beginning of year 2005. The regions were established to meet the MMA requirement of having no fewer than 10 and no more than 50 regions in all, and to maximize the availability of plans to eligible individuals regardless of health status, with particular attention to rural areas. Most (25) PDP regions consist of one state, six consist of two states pooled together, one consists of three states, and one consists of seven states.

[7] To the extent that the plan is more generous in actuarial terms than the standard benefit, the additional premium associated with the extra coverage is not subsidized by CMS.

a variety of plans as long as they satisfy certain requirements.[8] For example, an insurer can offer plans with lower or no deductibles and higher coinsurance rates for the initial coverage zone, or offer plans with tiered cost sharing in the initial coverage level as long as the tiered structure is equivalent to the standard 25 percent coinsurance rate.[9] Private insurers have taken advantage of the ability to offer modified plans and only nine percent of the 2006 plans (containing 22 percent of PDP enrollees in 2006) followed the standard benefit design. The actuarially equivalent design (same deductible, different cost sharing) was adopted by 21 percent of plans containing 17.1 percent of enrollees, while the basic alternative design (smaller deductible with different cost sharing) was selected by 27 percent of plans containing 44.2 percent of PDP enrollees. In addition to benefit designs that are identical or actuarially equivalent to the standard benefit, insurance companies can also offer enhanced plans, i.e., coverage that is more generous than the standard benefit (this can be gap coverage, or lower deductible and lower cost sharing, or addition of non-Medicare covered drugs[10]). Gap coverage (coverage of generic and/or branded drugs in the doughnut hole) was the enhancement that received the most attention because of the unpopularity of the donuthole (gap) in the first place. Enhanced benefits have additional premia associated with more generous coverage that are not subsidized by CMS. These enhancements were included in 43 percent of plans, containing 16.7 percent of PDP enrollees. Firms could design up to three benefit packages per region, as

[8] These are a) they should provide the same catastrophic coverage as the standard benefit (same cost sharing rule of 5 percent and same threshold of $3,600 in true out of pocket expenses) b) the deductible should not be higher than the standard benefit's deductible of $250 c) assure actuarial equivalency of i) the value of total coverage (e.g., if they remove the deductible, the cost sharing in the initial coverage zone should be set higher than 25 percent), ii) cannot increase the threshold at which the 3rd coverage zone ends (the end of the donut hole) and iii) cannot change the threshold at which the 3rd coverage zone starts (start of the donut hole). These details are contained in the 2003 MMA. Also see Duggan et al (2008) for a description of the Medicare Part D program

[9] For example, a company cannot offer a plan with initial coverage limit higher than $2,250 (in 2006) that has a higher co-insurance rate above the deductible since this would violate condition iii) in the footnote above.

[10] All plan formularies must include at least two drugs in each therapeutic category (see CMS 2007 for details of categories), and must include substantially all drugs in six key therapeutic classes. CMS 2008 provides further details of what drugs must be covered. Plans are also forbidden to design formularies that discriminate against those with costly medical conditions (Hoadley 2005b); there is no evidence of heavy auditing of these requirements, but the threat remains.

long as one of them was standard or actuarially equivalent to a standard plan (Hoadley et al, 2006).[11]

To participate in the Part D PDP market, the insurance companies submit bids (separate bids for each region, even if they design just one plan to be offered nationally) stating their expected cost per beneficiary of providing the basic drug coverage. The expected cost is calculated with the understanding that CMS (and not the individual insurer) is responsible for 80 percent of drug costs that are incurred in the catastrophic zone.[12] This is required by MMA 2003, and is referred to as the reinsurance feature of Part D which lessens fears of adverse selection among private insurers.[13] CMS also asks plans to separately inform them of the cost of covering an individual if CMS were to not provide this reinsurance, in order to asses the total amount by which CMS subsidizes the coverage. This reporting is also required by MMA to make sure that CMS's total subsidy to Part D (which includes the subsidy through reinsurance and the 'direct subsidy' paid prospectively to the insurer) on average comes to 74.5 percent of the total cost of providing coverage.

3. Previous literature

Many recent papers have studied several aspects of Medicare Part D in order to guide future policy. Lakdawalla and Sood (2007) propose and calibrate a dynamic model to study the welfare effects of Medicare Part D, focusing on pharmaceutical innovation. They find that public drug insurance can be welfare enhancing by lowering the static welfare loss coming from the monopoly power granted by patent protection, and by encouraging innovation from pharmaceutical firms. Their study provides insights on a separate important policy issue, which is whether the government should be allowed to participate in price negotiations. They find that price negotiation by the government

[11] However, the costs of the extra benefit will not be subsidized by the government, and therefore, the beneficiaries will have to pay an additional premium at the market rate. Enhanced plans must submit separate bids, in which it is made clear what portion of the plan is standard and what part is additional. On average, the monthly premium for enhanced benefits is $10 higher than the premium for basic coverage (standard or modified). An example of enhanced benefits would be provision of coverage within the doughnut hole. It is also important to note that such coverage is considered additional to the standard Part D benefit and will not count towards reaching the catastrophic coverage threshold.

[12] This means that only 15 percent of the catastrophic cost will be paid by the insurance company as the remaining 5 percent is the beneficiary's liability by the plan design.

[13] MMA also calls for 'risk corridors'to further reduce adverse selection fears and incentives to cream skim.

could slightly distort the monopoly price and decrease the deadweight loss from optimal monopoly pricing, and this would not have a negative effect on innovation as long as patent lengths are increased. Their result is consistent with the traditional “long and narrow” dynamic optimal patent. Heiss, McFadden and Winter (2006) surveyed seniors through WebTV devices to study consumers’ perceptions and choices of Medicare Part D plans during the open enrollment period. They found that most seniors chose the optimal action of enrolling. This result was expected since, according to their calculations, enrolling in Medicare Part D was immediately beneficial for 81.7 percent of the population, and inter-temporally beneficial for 97.5 percent. With respect to their choice of plan, they found that consumers often chose cheaper plans when more expensive and comprehensive coverage was actuarially favorable.

Kling et al (2008) conduct an experiment in which they recruit a sample of seniors from Wisconsin, find out their current list of medications taken, provide half with customized information and compare their plan choices to the other half which serve as a control group. They find that customized information (data on the prices of drugs under different plans and a recommendation of the cheapest plans for them, based on their current medications) leads the treatment group to select a plan that is cheaper for them in predicted terms than the control group (by $104 a year). Whether we should expect this to be zero optimally depends on whether consumers value non-price features like insurer reputation, as well as whether customers should choose an insurance plan only based on current information. Domino et al (2008) point out that about ½ of all seniors are likely to have medication experiences over the next 12 months that would have, in retrospect, made another plan appear cheaper than the one that is the cheapest based on current medications.

Other papers that report results of surveys that include seniors post Part D are Neuman et al (2007) and Levy and Weir (2008), both confirming the overall percent of seniors who are uninsured for prescription drugs fell to around 10 percent in 2006.

Using discrete choice methods similar to those used here, Keating (2007) studies the switching behavior of the elderly and the pricing behavior of insurers during the first couple years of Part D. He finds that there are substantial *switching* costs for consumers, which on average exceed the premia paid by beneficiaries. In contrast, our paper aims at bounding the search costs.

Closest in spirit to our work is Town and Liu (2003), who estimate the welfare impact of Medicare HMOs during the 1993 to 2000 period. They found big increases in consumer surplus due to the introduction of Medicare HMOs, and a sizable portion of that surplus in the last year of their study (45 percent) comes from making available prescription drugs to the elderly through these plans. They study the effect of counterfactuals such as what would happen to welfare if more plans were added to the markets, and find increases in consumer surplus, stemming mostly from increased price competition. In Medicare HMO markets, whose geographic unit is a county, the number of options available to consumers was quite limited, with the most frequent market structure being monopoly. This paper provided early evidence that broad prescription drug coverage for the elderly could be achieved through private managed care plans, and that competition in Medicare HMO markets increased consumer welfare. Our work complements theirs by showing that competition enhances consumer surplus under a very different market structure, one with many more competitors. In addition, we show that product differentiation could play an important role when considering mechanisms for limiting choices. We also find that the distribution of welfare is more evenly distributed between consumers and producers under Medicare Part D than under Medicare HMO.

A primary motivation for our work comes from studies that document the prevailing desire among seniors and other interested parties to see reduced choice in the Part D market. A Kaiser Family Foundation-Harvard School of Public Health poll conducted during the open enrollment period 2006[14] finds that seniors favor simplification,[15] removing the donuthole,[16] and reducing the number of plans available.[17] Only 11 percent strongly favored keeping the program as is. Rice et al (2008) proposes that CMS "acts as a broker to winnow down the number of choices so that beneficiaries face a small subset of those judged to be best on several dimensions," specifically limiting the number of choices that consumers would face to 10 per region, with 8 being

[14] Kaiser Family Foundation, 2006b.
[15] 51 percent of seniors 'strongly agree' that the design of part D is 'too complicated'.
[16] 46 percent 'strongly favor' spending more government money to remove the coverage gap.
[17] 44 percent of seniors 'strongly favor' reducing the number of plans.

national plans and 2 being regional or state-only plans. CMS would select these plans from bids submitted by insurers (up to 3 bids each), so that the 10 choices selected would provide lower-cost, lower-coverage options as well as higher-cost, higher-coverage options. The study then goes on to describe the logistics of three cases where the government has acted as an agent for consumers in selecting the options they face: pension plans for state employees (New York and Ohio), Arizona's Medicaid program, and California's Medicaid hospital contracting.

Lab surveys also find seniors expressing preference for reduced choice. Reed, Mikels and Simon (2008) find that seniors report desiring fewer choices across several domains than younger adults, and that the gap is larger for health care domains (including drug plans). Mikels, Reed and Simon (2008) find that seniors report lower willingness to pay for increasing the number of choices available for drug coverage plans than younger adults. Both findings are consistent with older adults experiencing decreased decision-making capacity and high search costs. Cubanski (2008) reports that 49 percent of seniors enrolled in Part D say in the Medicare Current Beneficiary Survey 2006 that there are 'too many' drug plans to choose from. There are benefits from reduced cognitive loads /reduced search costs when seniors have fewer choices from which to choose their drug coverage. Our paper's counterfactual exercises quantify how high these benefits must be to overcome the costs of reduced choices in the form of consumer welfare lost from reduced competition and reduced options.

4. Empirical method

For our empirical analysis, we estimate the structural parameters of the demand and supply sides of the market. The approach follows that of, e.g., Berry (1994), Berry et al. (1995), Bresnahan et al. (1997), Nevo (2001), Petrin (2002), and Town and Liu (2003).

Demand Estimation

For our demand-side analysis, we estimate demand(s) for differentiated PDPs using aggregate data following the seminal work of Berry (1994). The approach is as follows. First, we write down an expression for the utility experienced by an individual from purchasing a given Medicare Part D plan as a function of plan characteristics, premium, a set of parameters, and unobservables. Next, given this utility function, we derive an analytical formula for the market share that should result for a given plan. Market shares represent the outcome of consumer decision-making in the aggregate. Then, using a clever transformation first described by Berry (1994), we solve for the parameters of the utility function.

Each individual is assumed to maximize her utility by choosing among the $J_t + 1$ alternatives regarding prescription drug coverage available to her in the following way:

(1) $$\max_{j \in \{0,\ldots,J_t\}} u_{ijt} = \alpha(y_i - p_{jt}) + X'_{jt}\beta + \xi_{jt} + \varepsilon_{ijt}$$

$i = 1,\ldots,I \qquad j = 0,\ldots, J_t \qquad t = 1,\ldots,T$

where y_i is the income of individual *i*, p_{jt} is the premium of plan *j* in market *t*, X'_{jt} is a vector of observable plan characteristics (e.g., deductible), ξ_{jt} is an unobserved (by the econometrician) product characteristic, and ε_{ijt} is a random, idiosyncratic utility shock for individual *i* for plan *j* in market *t*. We assume that utility for the "outside option" (*j* = *0*) has the following form:

(2) $$u_{i0t} = \alpha(y_i) + \varepsilon_{ijt}$$

where ξ_{0t} has been normalized to 0. The outside option represents choosing not to enroll in any plan.

We decompose utility into two parts – mean utility and an idiosyncratic shock. The mean utility for product *j* is as follows:

(3) $$\delta_{jt} = X'_{jt}\beta + \alpha p_{jt} + \xi_{jt}$$

and the idiosyncratic shock is simply ε_{ijt}. We ignore the income term since it is common to all plans and will eventually drop out of the analysis[18].

Within the above framework, once a distribution for the idiosyncratic error terms is chosen, we can then calculate the probability that an individual will choose a given plan. At the aggregate level, these probabilities represent market shares for each plan. For example, if we assume the ε_{ijt}'s are distributed i.i.d., Type I Extreme Value, the above model simplifies to the aggregate logit model, where the probability of choosing a given plan, and hence the market share of that plan is:

$$(4) \qquad s_{jt}(\delta) = \frac{\exp(\delta_{jt})}{1+\sum_{k=1}^{J}\exp(\delta_{kt})}$$

Next, we find the vector of mean utilities, $\delta(s)$, that solves the system of equations:

$$(5) \qquad s = s(\delta)$$

where s is the vector of observed market shares.

For the logit model, this system has a simple solution. By taking logs of both sides, subtracting the log of the market share of the outside good, and solving, we get:

$$(6) \qquad \ln(s_{jt}) - \ln(s_{0t}) = \delta_{jt}(s)$$

Since δ_{jt} is the mean utility as defined above, we have the following relationship:

$$(7) \qquad \ln(s_{jt}) - \ln(s_{0t}) = X_{jt}^{'}\beta - \alpha p_{jt} + \xi_{jt}$$

[18] Implicitly, we are assuming no income effects since income enters utility linearly.

Written this way, we can use a 2SLS estimator using proper instruments to get estimates for α and β. If we assumed X_{jt} and p_{jt} are uncorrelated with ξ_{jt}, we will get proper estimates by simply performing OLS, however, it is likely that p_{jt} is correlated with the unobserved characteristic, and therefore, we follow and instrumental variable approach.

A common criticism of the logit assumption is that it imposes strong restrictions on substitution patterns across products. For example, it forces cross-price elasticities to be functions only of price and market share, not observable characteristics. With regard to Medicare plans, we might think that, say, plans with similar drug coverage are closer competitors than those with significantly different drug coverage. For this reason, we follow a nested logit approach. This approach is identical to the one described above except it allows for correlations in the idiosyncratic error terms. It separates the plans into subgroups (or nests), and allows the error terms for plans sharing a nest to be correlated. For example, we may separate plans into those that are enhanced (i.e., are more than actuarially equivalent to the basic plan design) and not enhanced. This nest structure allows for the likely possibility that plans with similar drug coverage are more substitutable than plans with notably different drug coverage.

We incorporate the nest structure in Figure 2, which places enhanced and non-enhanced plans in separate nests, and allow for correlated error terms within these nests. To do this, we augment our formulation for utility (from equation (1)) to get:

$$(8) \qquad u_{ijt} = \alpha(y_i - p_{jt}) + X'_{jt}\beta + \xi_{jt} + \zeta_{ig} + (1-\sigma)\varepsilon_{ijt}$$

Here, ζ_{ig} is common to all plans in group *g* and has a distribution that depends on σ ($0 \le \sigma \le 1$). As σ approaches one, the within group correlation of utility goes to one, and as it approaches zero, the utility of plans in the same group becomes uncorrelated. The distribution of ζ_{ig} is such that $\zeta_{ig} + (1-\sigma)\varepsilon_{ijt}$ is Type I Extreme Value.

Given this utility formulation, we follow the same procedure as described above for the logit and arrive at the following analog to equation (7)[19]:

[19] Full details of the intermediate steps are in Berry (1994), page 253.

(9) $$\ln(s_{jt}) - \ln(s_{0t}) = X'_{jt}\beta - \alpha p_{jt} + \sigma \ln(\bar{s}_{j/g}) + \xi_{jt}$$

Note that equation (9) is identical to equation (7) except for the additional term $\ln(\bar{s}_{j/g})$, which is the log of the market share of plan *j* within group *g*.

Using the nested logit approach, we can again use 2SLS to get estimates for α and β. OLS is no longer an option because, even if we assumed X_{jt} and p_{jt} are uncorrelated with ξ_{jt}, $\ln(\bar{s}_{j/g})$ is correlated with ξ_{jt} by construction. We build our set of instruments following Bresnahan et al. (1997). These variables are assumed to be uncorrelated with unobserved plan characteristics but correlated with within group share. In particular, we use the following as instruments:

observed product characteristics (X_j) for each product *j*,

counts and means of X for products sharing a cluster with product *j*,

counts and means of X for products sold by the firm offering product *j*, and

counts and means of X for products sharing both cluster and seller.

Supply and Marginal Costs

On the supply side, we assume firms partake in Bertrand-Nash competition. Specifically, each firm maximizes its profit:

(10) $$\Pi_{ft} = M \sum_{j \in J_t} (p_{jt} - mc_{jt}) s_{jt}(\delta)$$

where M is market size and mc_{jt} is marginal cost for product j in market t. This leads to the following first-order condition

(11) $$s_{jt}(\delta) + \sum_{j \in J_t} (p_{jt} - mc_{jt}) \frac{\partial s_{jt}(\delta)}{\partial p_{jt}} = 0$$

We can invert the system of first-order conditions to solve for marginal costs as follows:

(12) $mc = p - \Delta(p, X; \theta)^{-1} s(\delta)$

where mc, p, and s are vectors of marginal costs, premia, and market shares, and $\Delta(p, X; \theta)$ is the appropriately defined matrix of own- and cross- price share derivatives (Petrin, 2002). Once we have estimates for the demand-side parameters, we can directly solve for marginal costs using equation (12).

Using the estimated parameters of the utility function, we can calculate own- and cross-price elasticities for each product. Further, combining these demand-side estimates with our marginal cost estimates, we can calculate welfare measures and conduct counterfactuals for the choice sets. We describe these procedures, their outcomes, and the robustness of the results in Section 6.

5. Data

This paper uses data on enrollment and plan characteristics of stand-alone Part D plans offered during 2006. Using the first year of data for this analysis has two particular advantages. First, firms had less knowledge of regional demands for this product, reducing the likelihood that product characteristics are correlated with unobserved components of demand (i.e., this makes it less likely the product characteristics in our model are endogenous). Second, as this is the first time consumers bought this product, there are no switching costs. For subsequent years, these could be relevant (Keating 2007) and would be difficult to fully capture using aggregate data.

The CMS Landscape file contains basic characteristics of each plan (premium, deductible, coverage during the gap, number of top 100 drugs that are on the plan's formulary or not, etc.).[20] Enrollment data come from the CMS enrollment file for 2006, released July 2006. This file shows the number of people enrolled in each of 1415 plans on which we have data on all items needed (with enrollment numbers under 10 suppressed by CMS). Certain plans are designated Low Income Subsidy (LIS) eligible, and were automatically assigned enrollees in the region who were previously qualifying

[20] This is available for download from [http://www.medicare.gov/medicarereform/map.asp] (access date May 2006).

for full Medicaid coverage, as Medicare beneficiaries for drug coverage. However, these plans are also the lowest cost options in the region by definition, and thus enjoyed high enrollment from voluntary enrollees, too. Automatically enrolled individuals were free to change plans (paying the difference in premia when moving to plans that are not LIS eligible), and they are able to do so at any time, unlike others who are locked in by the annual enrollment period. CMS has not released any information that allows researchers to tell what portion of a plan's enrollment is due to Medicaid duals as opposed to others; however, even if it were known, our outcome of interest would anyway be the total enrollment given that everyone has flexibility of choosing their own plan, with LIS eligible individuals receiving a fixed amount of money to apply toward premium payments.

Our data set consists of one observation for each of 1,429 plans (of which enrollment data are available for 1415 plans as the others enrolled fewer than 10) that were offered in the PDP market in 2006. Of these, we observe all the relevant variables for 1,251 plans. We provide variable definitions and summary statistics in Tables 1 and 2, respectively.

6. Results

6.1. Economic Measures

In Table 3, we present the results for two models: the nested logit with no IVs and the nested logit with IVs (both with region and firm fixed effects). The IV results suggest instrumenting is important in this case, as the OLS results appear to have a positive bias on premium (as theory would predict). Using the IV estimates, we see that characteristics that should add value such as gap coverage, branded drugs coverage in the gap and the number of top 100 drugs on the formulary show results consistent with them adding value. Higher deductibles and premia reduce value as expected. These are all attributes that are easily observable, and important in choosing an insurance plan. Prior authorization (Auth_100) and co-pays under $20 (Under 20_100) have counterintuitive signs, possibly raising the question of how aware seniors were of these (perhaps more obscure) attributes when they made their decisions as suggested by Kling et al (2008). The analysis that follows utilizes our IV estimates, and we discuss the robustness of our findings and the results from alternative model specifications in Section 6.3.

We begin our analysis by quantifying the value of the plan attributes to consumers, which is an important exercise given that the design of the plans is heavily influenced by policy. We find that consumers value a $250 decrease in the annual deductible by approximately $46 per year (250*(0.002/0.130)*12).[21] An extra top 100 drug added to the formulary is worth approximately $11, and gap coverage of generics is valued at about $3 on average. The coverage of branded drugs appears to be what seniors value the most with an estimated annual value of $443.

Using the estimates from our baseline model, we can calculate own- and cross-price elasticities for the different plans using the following formulas:

$$\eta_{j,j} = \frac{\partial s_j}{\partial p_j}\frac{p_j}{s_j} = -\alpha p_j s_j + \alpha p_j \left(\frac{1}{(1-\sigma)} - \frac{\sigma}{(1-\sigma)} s_{j|g}\right) \tag{13}$$

$$\eta_{j,j} = \frac{\partial s_j}{\partial p_k}\frac{p_k}{s_j} = -\alpha p_k s_k \text{ if } j \neq k \quad k \notin g \quad j \in g \tag{14}$$

$$\eta_{j,j} = \frac{\partial s_j}{\partial p_k}\frac{p_k}{s_j} = -\alpha p_k s_k \left(\frac{\sigma}{(1-\sigma)}\frac{s_{j|g}}{s_k} + 1\right) \text{ if } j \neq k \quad j,k \in g \tag{15}$$

where: g is the group (enhanced or not enhanced).

The first formula is the own price elasticity; the second is the cross-price elasticity for plans j and k that do not belong to the same nest g; and the third is the cross-price elasticity for products that belong to the same nest. Given the large number of plans, we can only present a sample of our estimated elasticities. We are able to capture the intuitive result that enhanced plans are closer substitutes to each other than to non-enhanced plans. Table 4 shows a sample of our estimated elasticities for the players with the largest market shares.[22] The elasticities in the table show that enhanced plans, denoted by (1), are closer substitutes to each other than non-enhanced plans, and vice versa. It is

[21] The coefficient on premium is the estimate for a household's marginal utility from money. Therefore, to determine the monetary value of a given characteristic, we must divide its coefficient by the coefficient on premium. Also, our data are monthly, requiring us to multiply by 12 to get annual estimates.
[22] The table containing all the plans is available upon request.

also interesting to note that the two largest players (Humana and United) chose to have their plans in different nests. These elasticities are calculated from estimated parameters, and therefore, they also have standard errors. To get the standard errors, we repeatedly sampled from the asymptotic distribution of parameters and recalculated elasticities for each set of parameters. This exercise shows that our calculated elasticities are fairly accurate.[23]

Our estimates also allow us to calculate important welfare measures of this market. In particular, we can calculate producer and consumer surplus for the current market environment, and then recalculate and compare these measures in our counterfactuals. The formulas for these measures are as follows:

$$(16) \qquad PS = \sum_t \sum_j (p_{jt} + subs_t - mc_{jt}) * Size_t * s_{jt}$$

$$(17) \qquad CS = \frac{12}{\hat{\alpha}}(1-\hat{\sigma})\ln(D_0 + D_1 + 1)$$

where D_0 and D_1 are the sum of the exponential of the estimated utility generated by non-enhanced and enhanced plans, respectively.

Here, $Size_t$ is the number of potential customers in market t and $subs_t$ is the subsidy provided in market t[24]. The first column of Table 5 contains our estimates for these measures for the PDP market as it was in 2006. Using (16), we find producer surplus was \$952 million. Then, using (17), we find that consumer surplus was \$1.15 billion. It is interesting to see that the distribution of surplus between consumers and producers is fairly even, and very different from what it used to be under the Medicare HMO market structure, as documented by Town and Liu (2003). We follow the same approach as we did with the elasticities to calculate the standard errors shown in the first column of Table 4.

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[23] These results are also available upon request.

[24] We calculate the subsidy as (74.5/25.5) times the mean of the premiums (post subsidy) for the non-enhanced plans. This is because the enhancements are not subsidized by the government. Marketsize is defined as the sum of those who are enrolled in PDPs in the region plus those who remain uninsured for prescription drugs in the market.

6.2. Policy Experiments

Having recovered the structural parameters, we perform two counterfactuals to inform future policy about the likely effects on classic measures of producer and consumer surplus from limiting the number of choices of PDP plans. We then provide a lower bound for the size of the search costs (that are argued to exist via survey-based research) necessary to justify implementing these limits.[25]

Before conducting our two counterfactuals concerning limitation of choice, we seek to validate our model by simulating the impact of the merger of two important participants in this market, United and Pacificare, whose effect occurred between the first year and second year outcomes. In this counterfactual, the bids in 2006 are treated as being submitted by two separate firms, and after 2006 they are treated as behaving as one firm.[26] We implement this counterfactual by perturbing the ownership matrix $\Delta(p, X; \theta)^{-1}$ above as in Nevo (2000) and Town (2001). As shown in the third column of Table 5, our model predicts that the increase in market power due to this merger would result in a 4.1 percent increase in average premia for the merged firms and a 0.7 percent increase in premia for other firms. Consumer surplus would decline by 2.8 percent while producer surplus would increase by 1.7 percent.

We then use post-merger data to provide some validation for our predictions about premium change (this is the only dimension for which actual data exists for validation). Because our model is static, it is not informative of the nominal premium the merging firms will charge post-merger, but it does provide information about their relative premium with respect to the average market premium. We observe from the 2007 equivalent of our CMS landscape file that the actual 2007 premia show a 4.0 percent increase of this ratio, whereas our model predicts a 3.5 percent increase. These results not only illustrate the effects of a merger of this magnitude on this market, but also demonstrate our model's ability to produce sensible counterfactual results, consistent with economic theory and out-of-sample predictions.

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[25] A direct calculation of search costs will be done in a follow-up paper, when individual-level data is available.

[26] The merger took place after the 2006 plans bids had been placed and the 2006 offerings decided by CMS. In announcing the merger, the CEO of Pacificare is quoted as saying: "This merger will enhance our resources, strengthen our product offerings…" (Press release from UnitedHealth, July 6th 2005). The actual merger took place late 2005, before the 2007 plan bids were due (Cubanski and Neuman, 2006).

We now present the results for our two policy experiments focusing on the effects of removing plans from the market. The first of these policy experiments involves the removal of plans offering gap coverage[27]. This policy would reduce the number of plans by 18 percent. We perform this experiment to assess the welfare losses that would have occurred, had the government not allowed gap plans to be offered, and also to find the consequences of a small intervention that not only limits the number of choices, but also decreases product differentiation. As shown in column 4 of Table 5, we find that consumer and producer surplus decrease by 3.9 percent and 2.6 percent respectively. We decompose the total effects by premium and product substitution (including the outside option). We find that, in this counterfactual, the premium response is fairly limited, and that most of the loss in both consumer and producer surplus comes from substitution to less preferred plans. This result is consistent with theory, given that we would expect limited premium responses when a reduction in competitors is coupled with the elimination of a dimension along which products can be differentiated (which would help soften price competition if it remained). At the bottom of the table, we show that the effect of this policy on equilibrium premia is very small in the aggregate (0.9 percent). However, it has a bigger impact on the premia of the remaining enhanced plans without gap coverage (2.0 percent), and practically no effect for the plans in the other nest (0.1 percent). Enrollment is also moderately affected (-2.7 percent).

The second of these policy experiments explores what would be the effect of a more universal limitation in the number of options. In particular, we consider the effect of restricting firms to a maximum of two plan offerings per region. When imposing this rule in our model, we assume firms keep the plans that had the largest enrollment. This experiment reduces the number of plans by 21 percent. As shown in column 5 of Table 5, we find that this counterfactual has a larger impact on both consumer and producer surplus. We find that consumer surplus falls by approximately 25 percent and producer surplus falls by about 14 percent. Enrollment falls by 14 percent. Decomposing the

[27] Both of these counterfactuals should be interpreted under the assumptions that firms do not change the design of their contracts when one of their own or competitors' product is removed, and further exit or entry do not occur if a nest becomes more or less competitive.

effects, we find that most of the consumer welfare loss comes from premium increases, which on average increased by 7 percent (as shown at the bottom of the table).[28]

The two policies we consider result in similar-sized reductions in plans, but have drastically different effects on welfare and premia. By eliminating a dimension of product differentiation, the former forces the remaining plans to still compete heavily on price. In contrast, the latter policy still allows firms to offer plans that cover the gap, preserving a dimension of product differentiation that allows firms to significantly soften price competition. When we calculate the loss in surplus (per capita) for both policy experiments, the former results in only a reduction of \$3.70, while the latter results in a loss of \$24.40 (approximately 2/3 of the average monthly premium). Along with the loss of participation, these losses must be weighed against the expected gain due to reduced search costs when evaluating policies that reduce choice. Our findings strongly suggest that policies designed to reduce the number of plans will have significantly lower welfare costs if they also restrict firms' abilities to differentiate their products.

6.3. Robustness of the Results

In this subsection, we discuss the robustness of our findings, particularly with regard to our counterfactual results on choice size – the main focus of our analysis. In particular, we address possible concerns about: 1) Our choice of nest structure and 2) The validity of instruments. To address concerns about nest structure, we consider a completely different, but also natural, nesting structure for Part D plans. Specifically, we consider a nesting structure based on the existence of a deductible instead of the existence of enhanced features (i.e., we have two nests, one consisting of plans with no deductible and one consisting of plans with positive deductibles). Using this nest structure, we re-calculated the above estimates. While there are some quantitative differences, our results with respect to counterfactual removals of plans are qualitatively identical to our original model. While one could certainly envision other nesting structures, these findings

[28] It should be noted that the new equilibrium premiums are calculated based on the structure recovered for our Bertrand game, which is an abstraction of the real bidding mechanism. For example, we hold the subsidy fixed at the level implied by the actual equilibrium prices, meaning we assume firms do not account for the effects of their own prices on the ultimate subsidy. This is a simplifying assumption, without which, the equilibrium prices would be higher as the perceived marginal benefits to raising price would be greater.

increase our confidence that our choice of nesting structure is not driving our primary conclusions.

The validity of our instruments may pose a concern since it could be argued that characteristics of Part D plans (that are used as instruments) are easier to adjust in the short-run than, say, automobile characteristics. We address this concern in several ways. First, we note that the change in our results when moving from OLS to IV estimation is extremely similar to that seen in other analyses where product characteristics are more obviously exogenous (e.g., automobiles). Second, we note that the striking accuracy of our out-of-sample validation in the merger analysis is consistent with a well-specified model. Third, since 2006 was the first year this market existed, it seems firms would have had relatively little demand information on which to condition their product offerings that year. Finally, taking advantage of the fact that most firms offer their plans in several regions, we implement our estimation using brand-specific dummy variables as in Nevo (2000). The dummy variables will capture the utility of the characteristics that do not change by market, $X_j\beta + \xi_j$, and therefore, there is no need to instrument for price since the unobserved product quality is controlled for with the dummy variable (however, we still need to instrument for the inside nest market share in our nested logit specification). We calculate the consumer and producer surplus for the baseline situation and each of our counterfactuals using this alternative approach, and our results are qualitative robust to this estimation method as well. Again, the above observations and analysis cannot eliminate all concerns about the validity of our instruments; however, we believe they do serve to increase confidence in the robustness of our findings.

7. Conclusions

This paper studies the impact of a proposed change in regulation of a government-created market. We used discrete choice methods for aggregate data to estimate the demand for stand-alone PDP plans, where each plan is a bundle of attributes to which consumers attach value. We provided evidence of the relative value of various features of the plan's design. Assuming a Bertrand game with differentiated products, we were able to identify marginal costs for each plan, and provide welfare calculations. Our primary analysis focused on two easily implementable, and fundamentally different, policy experiments concerning reductions in the number of Part D plans, results of which may help guide future policy in the area of choice limitation. We find that regulating down the number of plans could have a large impact on consumer (and producer) surplus, depending on how the reduction of plans is made. We found that reducing choice will have a notably smaller welfare cost if it is coupled with a decrease (e.g., restriction) in product differentiation.

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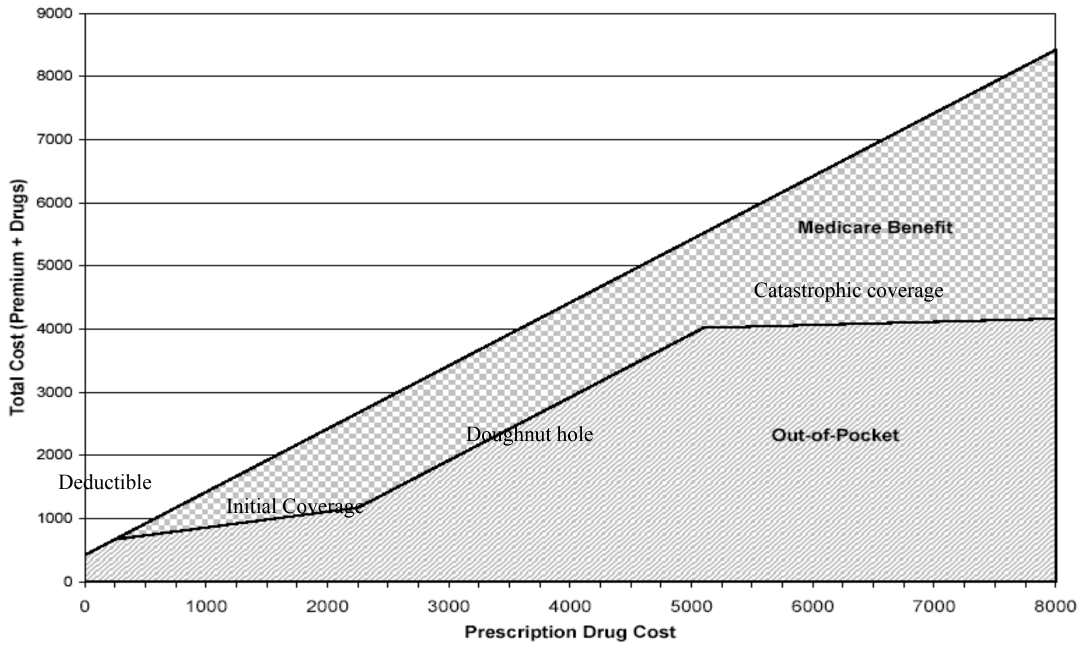
Figure 1: The Design of Part D Drug Coverage



Note:
The graph above shows how the insurance benefit translates prescription drug costs to total out-of-pocket costs for a beneficiary. Source: Authors depiction of standard plan details announced by CMS.

Figure 2

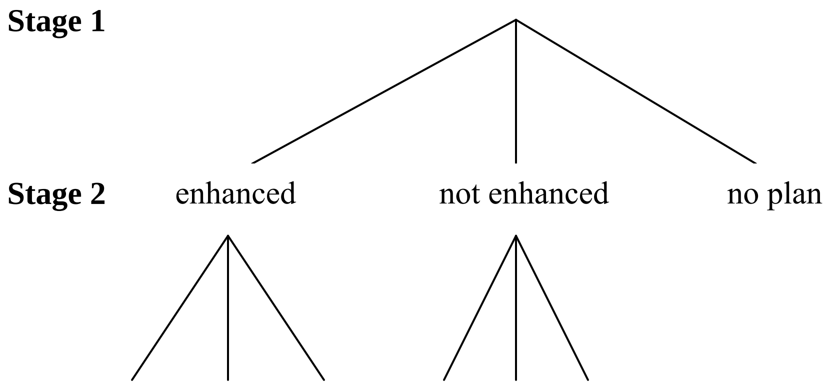


Table 1

Variable Definitions

Variable	Definition
Premium	Measured in dollars per month
Deductible	Measured in dollars per year (annual deductible)
Form_100	Measures the number of drugs, of the top 100 drugs taken by seniors, that are on the plan's formulary
Auth_100	Measures the number of drugs, of the top 100 drugs for seniors, for which the plan requires prior authorization*
Under20_100	Measures the number of drugs in the top 100 list that have copays of under $20 during the initial coverage zone of the plan
Gapgen	Means that the plan covers generics in the donuthole portion of the plan
Gapgenb	Means the plan covers generics and brand name drugs in the donuthole portion of the plan

* Prior authorization is a utilization hurdle whereby the physician must call the plan for prior approval before prescribing that drug for the senior. The number of drugs with these requirements rising means less generous coverage.

Table 2

Summary Statistics

Variable	Mean	Stdev	Min	Max
Enrollment	9462.9	23560.58	10	327541
Market share	0.015	0.029	0.000	0.245
Premium	38.46	12.25	4.91	73.17
Deductible	74.4	108.8	0	250
Form_100	93.21	6.78	75	100
Auth_100	9.64	9.38	0	44
Under20_100	61.37	13.18	20	95
Gapgen	.148	.36	0	1
Gapgenb	.025	.15	0	1

Note: sample size is 1251 when limited to plans that report all the variables above.

Table 3*

Parameter estimates for Medicare Plan D demand models

	OLS	t	IV	t
Constant	-5.127	-11.611	-11.075	-9.421
Premium	-0.029	-11.549	-0.130	-9.476
Deductible	0.004	18.767	-0.002	-2.218
Form_100	0.053	13.012	0.110	9.076
Auth_100	0.010	2.859	0.062	6.133
Under20_100	-0.013	-9.165	-0.008	-2.482
Gapgen	-0.294	-5.754	0.029	0.235
Gapgenb	1.155	7.708	4.802	8.388
Sigma			0.246	2.746

* Dummies for firm and region fixed effects omitted.

Table 4: Average price elasticities

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. United AARP (0)	-3.685	0.107	0.330	0.039	0.019	0.144	0.090	0.127	0.003	0.003	0.011	0.192	0.013
2. United MedAdvance (0)	0.892	-5.043	0.330	0.039	0.019	0.144	0.090	0.127	0.003	0.003	0.011	0.192	0.013
3. Memberhealth Basic (0)	0.892	0.107	-4.940	0.039	0.019	0.144	0.090	0.127	0.003	0.003	0.011	0.192	0.013
4. Memberhealth Choice (0)	0.892	0.107	0.330	-6.630	0.019	0.144	0.090	0.127	0.003	0.003	0.011	0.192	0.013
5. Memberhealth Gold (1)	0.497	0.059	0.184	0.022	-7.273	0.536	0.332	0.071	0.016	0.017	0.051	0.107	0.007
6. Humana Complete (1)	0.434	0.049	0.161	0.022	0.068	-8.397	0.332	0.060	0.010	0.009	0.039	0.093	0.005
7. Humana Enhanced (1)	0.434	0.049	0.161	0.022	0.068	0.536	-2.181	0.060	0.010	0.009	0.039	0.093	0.005
8. Unicare Rewards (0)	0.892	0.107	0.330	0.039	0.019	0.144	0.090	-3.956	0.003	0.003	0.011	0.192	0.013
9. Unicare Plus (1)	0.483	0.058	0.179	0.022	0.079	0.518	0.321	0.070	-5.239	0.017	0.050	0.104	0.007
10. Unicare Premium (1)	0.483	0.058	0.179	0.022	0.079	0.518	0.321	0.070	0.016	-6.988	0.050	0.104	0.007
11 Pacificare Comprehensive (1)	0.497	0.059	0.184	0.022	0.081	0.536	0.332	0.071	0.016	0.017	-7.683	0.107	0.007
12. Pacificare Saver (0)	0.892	0.107	0.330	0.039	0.019	0.144	0.090	0.127	0.003	0.003	0.011	-4.462	0.013
13. Pacificare Select (0)	0.892	0.107	0.330	0.039	0.019	0.144	0.090	0.127	0.003	0.003	0.011	0.192	-6.949

Note: (0) denotes non-enhanced plan, (1) denotes enhanced. Numbers at the top of the table correspond to the number in the first column, therefore the diagonal elements correspond to own price elasticities, the off-diagonal elements are the cross price elasticities between the row and column product.

Table 5: Welfare and Policy Experiments

	Baseline	**Merger**	**Gap Plans Policy**	**Two Plan Maximum**
Consumer Surplus	1,154,167,682.66	1,122,128,772.63	1,109,388,030.27	864,929,942.15
Se	120,544,422.41			
Diff from Baseline		-2.8%	-3.9%	-25.1%
Diff from Baseline – premium fixed			-3.7%	-1.6%
Diff from Baseline – due to new eqm. premia			-0.2%	-23.5%
Producer Surplus	952,378,019.33	968,142,698.20	927,178,773.98	820,597,948.63
Se	80,990,379.12			
Diff from Baseline		+1.7%	-2.6%	-13.8%
Diff from Baseline – premium fixed			-2.8%	-30.7%
Diff from Baseline – due to new eqm. premia			+0.2%	+16.9%
Enrollment	11,838,069.39	11,687,614.84	11,514,899.36	10,185,428.60
Avg. Non-gap Premium	36.20		36.53	
Avg. Premium Enhanced	39.60		40.41	
Avg. Premium Non-enhanced	34.18		34.22	
Avg. Premium	38.46			41.12
Avg. Premium merging firms	33.43	34.82		
Avg. Premium non-merging firms	39.26	39.54		