Measuring Welfare and the Effects of Regulation in a Government-Created Market:

The Case of Medicare Part D Plans

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Abstract

In this paper, we estimate the demand and supply for stand-alone Medicare prescription drug (Part D) plans, a market created via an act of government intervention. There are three main parts to our analysis. First, we provide evidence on the relative utility that the elderly derive from different features of Medicare Part D plans. Since these features are heavily dictated by policy, it is important to know how Medicare beneficiaries value them. Second, we estimate the welfare (consumer and producer surplus) created through this market. Finally, using our demand- and supply-side estimates, we conduct several policy experiments to understand the implications of regulatory choices already made or that may be changed in the future. Specifically, we assess the effects on equilibrium prices and welfare from: a recent, major merger, removing plans that cover "the gap," and further limiting the number of plans each firm can offer per region. Our counterfactuals regarding removal of plans provide an important assessment of the losses to consumers (and producers) resulting from government limitations on choice – these must be weighed against the widely discussed expected gains from limiting options due to reduced consumer search costs.

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1. Introduction

With the enactment of the Medicare Prescription Drug, Improvement, and Modernization Act of 2003 (MMA), a new prescription drug benefit was added to Medicare, constituting the largest expansion of benefits since Medicare's creation in 1965. Through the MMA, the government created a new market for prescription drug insurance, where private plans deliver the benefits and the elderly pay a subsidized premium to obtain them. The active role of the government in creating and subsidizing this market was a response to the absence of appropriate prescription drug coverage for the elderly due to adverse selection and a response to difficulties faced by low-income seniors in paying for drugs. The implementation of the program started in January 2006 with massive entry of private plans; 22.5 million Medicare beneficiaries enrolled by the end of the first open enrollment period (CMS 2006).[2] The elderly have the option of either adding a stand-alone prescription drug plan (PDP) to their Medicare fee-for-service coverage, or enroll in a managed care plan that is part of Medicare Advantage (MA) that offers drug, inpatient and outpatient Medicare coverage. Since the MA market is a composite good where it is impossible to uncouple the drug coverage components in price from other services, our analysis is limited to the PDP market. In 2006, the most popular options were the PDP plans, with 16.5 million enrollees, and 1429 plans offered in 34 geographic regions. MAPDP plans had 6 million enrollees (CMS 2006), most of whom were enrollees in MA plans prior to Part D as well (HHS, 2006).[3] As of January 2008, there are 25 million beneficiaries enrolled in Medicare Part D, with 17.4 million in PDPs.[4] We focus our analysis on the market for PDP plans because Medicare Advantage is a smaller market, existed prior to MMA albeit without standardized drug coverage, and most importantly, is a composite good; thus, it is not possible to separate the other plan features from the Rx plan features.

The Medicare prescription drug program is new, and no micro data currently exists in the public domain linking individuals and their plan choices. However, there is an immediate need to understand the functioning of this program to better inform policy as changes are already under consideration. For example, there is currently legislation under consideration in Congress

[2] This includes 6 million seniors who were already receiving prescription drug coverage through Medicaid who were automatically enrolled in Medicare part D stand-alone plans. Source: CMS 2006, Enrollment as of 6/11/06 from http://www.cms.hhs.gov/PrescriptionDrugCovGenIn/

[3] MA plan enrollment in 2005 was 6.1 million (Kaiser Family Foundation, 2007)

[4] CMS, 2008. "2008 Enrollment Information" available at http://www.cms.hhs.gov/PrescriptionDrugCovGenIn/

that would require the government to negotiate drug prices with manufacturers.[5] In addition, in an analysis of opinions of seniors done by the Kaiser Family Foundation, one summary states: "Beneficiaries want fewer Part D choices." (Kaiser Family Foundation 2006a). Another report finds that 44% of beneficiaries strongly favor and 24% somewhat favor "Simplifying the new benefit by reducing the number of available plans." (Kaiser Family Foundation, 2006b). 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, our paper makes several contributions. First, we provide evidence on the relative utility that the elderly derive from plan design features such as the existence of the coverage gap. The features are heavily dictated by policy, so it is important to know how they are valued. Second, we analyze the welfare impact of this governmental intervention by seeing what consumer surplus and producer surplus has been created by the program. Third, using our demand- and supply-side estimates, we conduct several counterfactuals regarding regulation practices for this market. Specifically, we assess the effects on equilibrium prices and welfare from: a recent, major merger, removing plans that cover "the gap," and limiting each firm to two plans per region (as opposed to three). Our counterfactuals regarding removal of plans provide an important assessment of the losses to consumers (and producers) resulting from government limitations on choice – these must be weighed against the expected gains due to reduced consumer search costs.

For our empirical work, we use discrete choice methods pioneered by Berry (1994) to recover structural estimates of parameters of the demand and cost functions for the differentiated PDPs. This method is especially appealing since it requires only aggregate data at the plan level, which is publicly available for PDP plans (e.g., plan market shares and characteristics). The estimates from this procedure allow us to measure the value of plan characteristics (to households), price elasticities of demand for each plan, and the consumer surplus created by the market. In addition, we model the supply side of the market, taking into account the expected subsidy received by firms. Combining the supply model with the demand model, we can 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.

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[5] (S3 Medicare Prescription Drug Price Negotiation Act of 2007 and Part D Medicare Drugs Price Bill of HR4 Act of 2007, available at http://www.opencongress.org/bill/110-s3/show and http://www.opencongress.org/bill/110-h4/show)

Using this approach, we have several key findings. First, we summarize results from our assessment of how consumers value various plan attributes. We find that the elderly value a decrease in the annual deductible from $250 to $0 at approximately $46 (per year). They value increasing the number of top 100 drugs (by popularity) on the formulary by one at approximately $11 and obtaining coverage in the gap by $447. We find counterintuitive results for a couple of the more subtle plan characteristics, suggesting seniors did not fully account for these attributes. These results can be useful to guide future policy-making in terms of the plan design.

Second, we estimate the welfare impact of this new government-created market. The estimation approach we follow allows us to calculate both consumer and producer surplus, so we can determine whether the benefits of the program are captured mainly by the elderly or by the private plans. We find that the program results in (annual) consumer surplus of $1.154 billion and producer surplus of $0.952 billion. We find that government expenditure in subsidizing stand-alone prescription drug coverage is $14.1 billion. While the consumer and producer surpluses clearly do not outweigh the government expenditures, the effect of the subsidy on overall participation (which may have positive externalities and/or extra private benefits about which consumers are not aware) may justify its existence. For example, Lakdhawalla and Sood (2007)[6] estimate that the welfare created by Medicare part D, by reducing the distortions in pharmaceutical incentives that exists due to limited length patents, is $3.5 billion a year. Therefore, we view our particular analysis not as a definitive assessment of the program's value relative to cost, but primarily as a precursor to our subsequent counterfactuals.

Finally, because we recover the structural parameters from the demand and supply sides of the market, we can compute the new equilibrium prices and welfare in several counterfactual scenarios. We begin by assessing the impact of a recent merger between United Health Care and Pacificare. We find that the increase in market power due to this merger resulted in a 4.1% increase in average prices for the merged firms and a 0.7% increase in prices for other firms. In addition, consumer surplus declined by 2.8% while producer surplus increased by 1.7%. 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.

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[6] The welfare effects of public drug insurance. NBER Working Paper No. W13501

Our primary counterfactuals deal with regulated reductions in the number of plans offered. As mentioned above, a controversial issue in the implementation of Part D is the existence of "too much choice." Although we do not model search costs (in that a consequence of reducing plans is the reduced cost from considering fewer options), our analysis can inform us about the costs from 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 premiums due to reduced competition. We consider both the case where plans covering the gap are removed and where each firm is limited to two plans in each region.

When plans covering the gap are removed, average prices for other "enhanced" plans (i.e., 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) rise by 2% while average prices for non-enhanced plans rise by only 0.1%. We find that consumer surplus and producer surplus fall by about 4% and 3%, respectively. In addition, participation drops by 2.7%. When firms are limited to two plans in each region (as opposed to three), we find more extreme results. In this case, average prices rise by about 7%, resulting in lower participation – a reduction of nearly 14%. Further, both consumer and producer surplus fall, by 25% and 14%, respectively.

These last 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 two plans per region suggest that the reduction in search costs from this regulation must outweigh the a loss of $12.60 in consumer surplus for those who still participate plus lost welfare resulting from a 14% loss in participants.

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 MMA 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).[7] Medicare beneficiaries can enroll in these plans by paying a 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. In subsequent years, open enrollment takes place from November 15th-December 31st of the previous year. Dual eligible beneficiaries 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.[8] 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. As noted, rules differ for dual eligible and other low income beneficiaries who face very minimal out of pocket costs (Appendix 2). 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% for the next $2,000 spent in total prescription drug expenditure (initial coverage zone, ICZ),[9] 0% between $2,250 and $5,100 (so the next $2,850) of total drug expenditure, the doughnut hole zone, and 95% 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). Beneficiaries may buy their drugs at pharmacies (the insurer may have a network of preferred pharmacies, outside of which cost sharing is higher), and the plan may also

[7] 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% of the total Medicare enrollees in 2000 and 12% in 2005. (Kaiser Family Foundation, 2005)

[8] 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.

[9] Recall that spending on drugs not on the formulary does not count towards this $2,000 or any other amounts.

allow the use of mail order purchasing which may often be cheaper. Plans are allowed to use utilization controls such as prior authorization, quantity limits[10] and step therapy for drugs (Hoadley, 2005). Formularies can be closed (allowed to exclude any payment for certain drugs) or open in the sense that all drugs are covered by not on the same terms. Formularies are reviewed by CMS to ensure that there are no egregious attempts to discriminate against certain illnesses, that almost all drugs in certain classes are covered, and to make sure that at least two drugs from each class are included on the formulary, but it is not known to what extent these rules were enforced.[11]

Insurance companies can deviate in plan design from the standard benefit described above and offer a variety of plans as long as they satisfy certain requirements.[12] 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% coinsurance rate.[13] Private insurers have taken advantage of the ability to offer modified plans and only nine percent of the 2006 plans have the standard benefit design. 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. In fact, firms could design up to three benefit packages per region, as long as one of them was standard or actuarially equivalent to a standard plan (Hoadley et al, 2006).[14]

To implement the new Medicare benefit, the country was divided into 34 regions in the case of PDPs.[15] To participate in these markets, the insurance companies submit bids (separate bids for each region, even if they design just one plan to be offered nationally) stating their

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[10] To clarify, a quantity limit does not mean that there is a maximum amount of the drug that can be dispensed for the year. A quantity limit is the maximum amount that can be dispensed at one time.

[11] CMS asked US Pharmacopeia to develop a new set of classes for this specific purpose (Hoadley, 2005).

[12] These are a) they should provide the same catastrophic coverage as the standard benefit (same cost sharing rule of 5% 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 (eg if they remove the deductible, the cost sharing in the initial coverage zone should be set higher than 25%), 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

[13] For example, a company cannot offer a plan with higher 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.

[14] 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 per month 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.

[15] The regions are composed of one or more 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, one consists of four states, and one consists of seven states.

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% of drug costs that are incurred in the catastrophic zone.[16] 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.[17] 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% of the total cost of providing this new coverage.

Types of plans:

Plans can be

- Defined standard (*9% of plans, 22.0% of PDP enrollees in July 2006*)
- Actuarially equivalent (21%, 17.1%)
  - Same deductible, different cost sharing
- Basic alternative (27%, 44.2%)
  - Smaller deductible with or without different cost sharing
- Enhanced benefits (43%, 16.7%)
  - Additional premiums associated with more generous coverage which is not subsidized by CMS. This can be gap coverage, or lower deductible and lower cost sharing, or addition of non-Medicare covered drugs.[18]

Insurers can offer maximum of 3 plans per region.

- Must offer one basic plan in a region before an enhanced plan can be offered
- May have more than two plans in a region if one plan includes benefits in the coverage gap

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

[17] MMA also calls for 'risk corridors' (which will be explained later) to further reduce adverse selection fears and incentives to cream skim.

[18] 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.

We focus on the Stand-Alone plans, which enrolled 16.5 million of the 22.5 million Part D enrollees in 2006. A total of 1,429 different insurance plans owned by approximately 70 different companies were available in 34 regions into which the country is divided; 2007 has seen even more plans enter with a new total of 1,918 plans across all regions. MMA sets standards for plan design but plans have considerable freedom. There is substantial variation in the premiums charged, and in the design of the benefits. While certain features of plan design such as the deductible are evident when plans are selected by consumers (and are observable in a summary file released by CMS), plans can differ in other aspects such as prices negotiated with pharmaceutical companies and the co-payments required from the beneficiaries for different drugs. These are attributes researchers and consumers can only observe through web queries and an examination of the plan's formulary (Hoadley et al, 2006).[19] We also obtained data on less visible plan features (drug prices, formulary design and cost sharing) for each PDP plan by repeatedly querying the plan finder tool implemented by Medicare in the Summer of 2006, for ten sets of drugs. We processed the source code of each resulting web page to create a database of plan attributes to supplement data provided by CMS to researchers. In this preliminary analysis, we use a generosity index based on the top 5 drugs taken by seniors.

3. Previous literature

The relevant literature can be classified into two categories, the studies that evaluate the welfare impact of public insurance programs (and Medicare in particular), and the studies that describe and analyze the post-implementation of Medicare Part D.

Among the first category, Finkelstein and McKnight (2005) study the impact of the Medicare program as a whole on mortality and out-of-pocket expenditure of the elderly. Their results suggest that Medicare did not have a big effect on mortality of the elderly, however, the direct insurance benefits are substantial if compared to the costs of the Medicare program. Cawley, Chernew and McLaughlin (2005) study the Medicare HMO market and find that the payments made to private plans not optimally set in many cases as CMS does not have information about the local health care costs. Moving to a bidding system by 2006 is expected to remedy this

[19] These are price data upon which consumers actually made decisions during 2006 and which have been analyzed in all reports of Part D drug prices so far.

situation, as this is a mechanism for revealing private information about the cost structure. Khwaja (2005) using a dynamic programming approach evaluated the impact of Medicare by means of a counterfactual that assumed Medicare was disbanded. He also concludes that Medicare provides considerable benefits to the elderly through insurance against medical expenditures, a small impact on improved mortality and health status, and increases of medical care consumption of about 32% to 54%. 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 (45%) comes from making available prescription drugs to the elderly through these plans. In a different policy context, they performed similar counterfactuals to ours, and provide early evidence that broad prescription drug coverage for the elderly could be achieved through private managed care plans.

In the category of papers that study the post-implementation of Part D, the literature has produced a number of descriptive papers. Cubanski (2006) provides an analysis of firm-specific market shares for both PDP and MA-PD plans, and finds that 10 firms captured 72% of the total enrollment, primarily in their low-premium plans. Gold (2006) and Hoadley et al. (2006) provide evidence that most of the plans offered are provided by 10 national insurers and 4 near-national insurers. There have been some surveys of seniors to find out their opinions about Medicare Part D plans. Heiss, McFadden and Winter (2006) surveyed seniors through Webtv devices and report on satisfaction with plan characteristics. They find, for example, that seniors were dissatisfied with the donuthole provision of the plan. A Kaiser Family Foundation-Harvard School of Public Health poll conducted during the open enrollment period 2006 (Kaiser Family Foundation, 2006) finds that seniors favor simplification, removing the donuthole etc-only 11% strongly favored keeping the program as is. Lakdhawalla and Sood (2007) estimate the welfare created by Medicare drug insurance in terms of how it corrects distortions that discourage innovation currently. If there is drug insurance, then the fact that consumers face the lowered marginal cost gives an added incentive for innovation, correcting the disincentive that exists because of limited patent lengths. They estimate that along this dimension alone Part D increases welfare by $3.5 billion a year (through reduction in existing deadweight loss).

4. Empirical method

For our empirics, we estimate the structural parameters of the demand and supply sides of the market. The approach follows that of, e.g., Berry et al. (1995), Bresnahan et al. (1997), Nevo (2000), 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, price, a set of parameters, and unobservables. Next, given this utility function, we derive an analytical formula for the market share that should result in equilibrium 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 that make the analytical market shares closest to the actual market shares.

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:

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

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

where y_i is the income of individual *i*, p_{jt} is the price 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:

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

where ξ_{0t} has been normalized to 0. The outside option represents the choice of no 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[20].

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} are distributed i.i.d., type I extremum, 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) $$s_{jt}(\delta) = \frac{\exp(\delta_{jt})}{1 + \sum_{k=1}^{J} \exp(\delta_{kt})}$$

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

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

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

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

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

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

Written this way, we can use a 2SLS estimator using proper instruments to get estimates for α and β. If we assume X_{jt} and p_{jt} are uncorrelated with ξ_{jt}, we will get proper estimates by simply performing OLS.

In practice, we estimate α and β using two different assumed distributions for the idiosyncratic error terms. We first assume they are i.i.d., type I extremum random variables, producing the aggregate logit as described above. 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 also 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.

To incorporate the nest structure in Figure 2 and allow for correlated error terms within nests, we augment our formulation for utility (from equation (1)) to get:

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

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 extremum.

Given this utility formulation, we follow the same procedure as described above for the logit and arrive at the following analog to equation (7)[21]:

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

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 assume 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:

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

which leads to the following first-order condition:

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

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

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

[21] Full details of the intermediate steps are in Berry ('94), page 253.

where mc, p, and s are vectors of marginal costs, prices, 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 and their outcomes in Section 6.

5. Data

This paper uses data on enrollment and plan characteristics of stand-alone Part D plans offered during 2006. 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.), [22] but there are many other ways in which plans may differ in generosity. Notably, the Landscape file does not tell us about the cost of drugs faced by consumers under different plans. There is wide variation in this regard as already shown in Hoadley et al (2006), thus we add a measure of plan generosity that is the simulated out of pocket drug expenses (not counting the premium) for beneficiaries taking the drugs considered the top 5 among seniors. (We have calculated these generosity indices in a number of other ways that will be used in future work).

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 Eligible, and were automatically assigned enrollees in the region who were previously qualifying for 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, and they are able to do so at any time unlike others who are locked in by the

[22] This is available for download from [http://www.medicare.gov/medicarereform/map.asp] {access date May 2006}.

annual enrollment period. In the enrollment file, it is impossible to tell what number is due to Medicaid duals as opposed to others. We use the total enrollment.

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.

Variable definitions

"Premium" is measured in dollars per month.

"Deductible" is measures in dollars per year (annual deductible).

"Form_100" measures the number of drugs that are on the plan's formulary, of the top 100 drugs taken by seniors. Being on the formulary is preferred to being off the forumulary; being off formulary means there is no insurance coverage for that drug.

"Auth_100" measures the number of drugs, of the top 100 drugs for seniors, for which the plan requires prior authorization. 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.

"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.

Table 1
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.

6. Results

6.1. Economic Measures

In Table 2, 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 nested logit model appears to be more accurate since its estimated coefficients have mostly the expected sign. 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 add value. Higher deductibles and premiums reduce value as expected. These are all attributes that are easily observable, and important in choosing and insurance plan. Prior authorization and under 20_100 have counterintuitive signs, raising the question of how aware were seniors of these (perhaps more obscure) attributes when they took their decisions. Overall, the parameter estimates look reasonable and we focus on the IV nested logit as our baseline model for the remainder of our analysis.

Table 2[23]

Parameter estimates for Medicare Plan D demand models

Coefficient	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

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 decrease in the deductible by $250 at approximately $46 per year

[23] + significant at 10%; * significant at 5%; ** significant at 1%. Constant term and dummies for firm (when applicable) and region fixed effects omitted.

(250*(0.002/0.130)*12).[24] An extra top 100 drug added to the formulary is worth approximately $11, and gap coverage of generics is worth about $3. 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:

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

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

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

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 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. Our estimates are consistent with previously estimated elasticities (Maruyama (2005), Feldman et al.), and we are able to capture the intuitive result that enhanced plans are closer substitutes to each other than to non-enhanced plans. Table 3 shows a sample of our estimated elasticities for the players with the largest market shares.[25] 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 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. We repeatedly sample from the asymptotic distribution of parameters and recalculate elasticities for each set of parameters to calculate the standard errors. This exercise shows that our calculated elasticities are fairly accurate.

[24] The coeficient 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.

[25] The table containing all the plans is available upon request.

Table 3: 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

Our estimates also allow us to calculate important welfare measures of this market. In particular, we can calculate producer and consumer surplus, and compare those to government expenditure on subsidization. The formulas for these three measures are as follows:

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

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

$$(18) \qquad GovSpend = \sum_t subs_t * (1 - s_{0t}) * Size_t$$

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*. The first column of Table 4 contains our estimates for these three 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. Finally, using (18), we find that government expenditure on subsidies was $14.12 billion. These numbers should not be interpreted as a reduction in welfare by the creation of this market by the government, because the appropriate comparison is with respect to the status quo. In ongoing work we intend to provide those calculations. Our welfare measures are also calculated from estimated parameters, and we follow the same approach as we did with the elasticities to calculate the standard errors shown in the first column of Table 4.

6.2. Policy Experiments

We now perform three policy experiments that are conducted as counterfactuals by taking advantage of the structure of our model. First, we simulate the impact of the merger of two important participants in this market such as United and Pacificare, which occurred contemporaneously to the creation of the market. We find that the increase in

market power due to this merger resulted in a 4.1% increase in average prices for the merged firms and a 0.7% increase in prices for other firms. Consumer surplus declined by 2.8% while producer surplus increased by 1.7%. 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.

Our remaining two policy experiments focus on the effects from removing plans from the market. The first of these policy experiments involves the removal of plans offering gap coverage. We perform this experiment to assess the welfare losses if the government had not allowed this variation in design, and also to find the consequences of a small intervention to limit the number of choices. We find that consumer and producer surplus decrease by 4% and 3% respectively. The effect of this policy on equilibrium premia is very small in the aggregate (0.9%). However, it has a bigger impact on the premia of the remaining enhanced plans (2.0%), and practically no effect for the plans in the other nest (0.1%). Enrollment is also moderately affected (-2.7%).

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 limits the number of plans to 78.5% of the baseline levels. The premia of the remaining plans increases by approximately 7%.[26] We find that both consumer surplus falls by approximately 25% and producer surplus falls by about 14%. Enrollment falls by 14%. Under the assumption that the equilibrium we find is actually played after this policy is implemented, the loss in surplus per person (approximately $12.60) along with the loss of participation must be weighed against the gain due to reduced search costs when evaluating such a policy.

[26] It should be noted that the new equilibrium premia are calculated based on the structure recovered for our Bertrand game, which is an abstraction of the real bidding mechanism. We are currently modifying this assumption to capture the effect of our counterfactuals under a more accurate regulatory framework.

Table 4: 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			
Producer Surplus	952,378,019.33	968,142,698.20	927,178,773.98	820,597,948.63
Se	80,990,379.12			
Govt. Expenditure	14,123,332,465.55	13,947,105,648.09	13,732,927,320.12	11,964,168,883.73
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		

7. Discussion and Conclusion

This paper studies the welfare impact of a government intervention to create a market that did not exist due to adverse selection. 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 that consumers attach value to. We provided evidence of the relative value of each feature of the plans' design. Assuming a Bertrand game with differentiated products, we were able to identify marginal costs for each plan, and provide welfare calculations. In addition, we performed several counterfactual experiments to guide future policy in choice limitation and antitrust.

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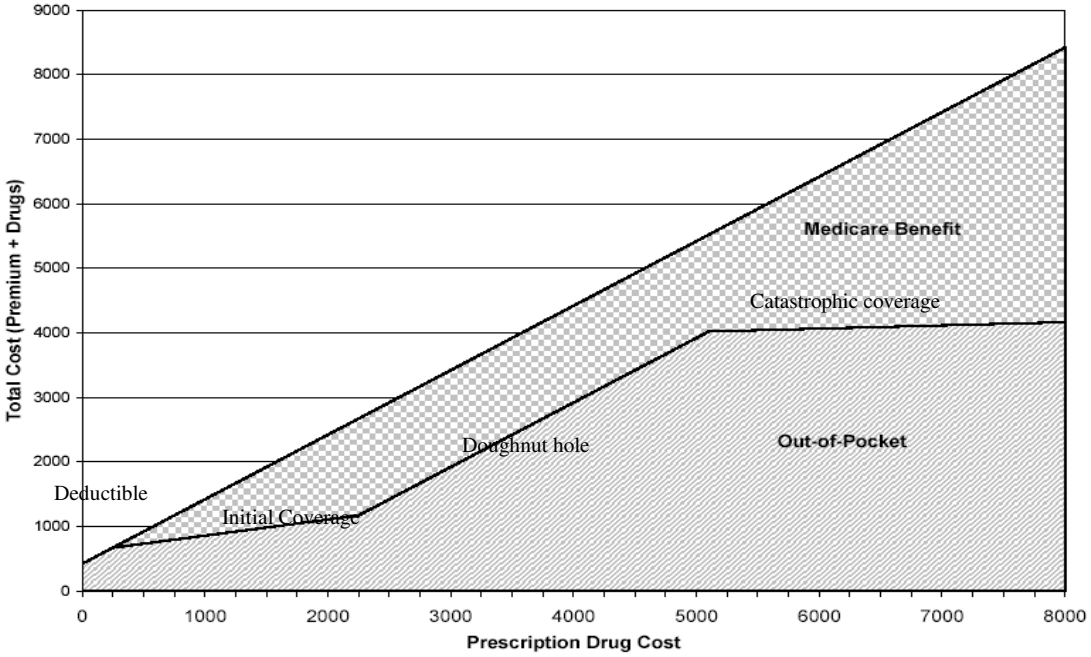
Figure 1: The Design of Part D Drug Coverage



Note:
The graph above shows how the insurance benefit translates total prescription drug costs (x axis) to out of pocket costs for a beneficiary (y axis). Source: Author depiction of standard plan details announced by CMS.

Figure 2