The Consequences of a Public Health Insurance Option: Evidence From Medicare Part D Prescription Drug Markets

Daniel P. Miller
Clemson University
Jungwon Yeo
Singapore Management University*

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Abstract

This paper examines a public option competing alongside private insurers in Medicare Part D. We estimate a random coefficient demand system and oligopoly supply-side model with endogenous premium subsidies and risk adjustment payments. If the public option does not affect health risk sorting, counterfactual results show modest competitive benefits. However, increased subsidy payments eliminate welfare gains regardless of the public option’s cost position. If the public option adversely selects—facilitating insurers’ ability to cream-skim favorable risk—the risk adjustment mechanism creates a downward pricing distortion, amplifying competitive benefits. Despite greater selection, total surplus may increase, but the division favors insurers.

1 Introduction

In 2010 US legislators passed a major health insurance reform bill: the “Patient Protection and Affordable Care Act.” A controversial and political divisive provision that was ultimately struck from the bill is the “Community Health Insurance Option”¹, colloquially known as a “Public Option.” When fully enacted in 2014, the reformed health care system will have a strong reliance on private health insurance markets. If the public option had been included in the bill, the government would have offered a basic coverage health insurance plan, priced at cost, to sell alongside private plans in regulated health insurance exchanges.

There are pros and cons of a public option. Supporters advocate the benefits of more choice and increased competition from a public option priced at cost. They also hope the public

¹First Draft February 2011. Author correspondence: dmille7@clemson.edu and jwyeo@smu.edu.sg
²House of Representatives Bill H.R. 3590 Section 1323, struck from bill Sec 10104.
option will further drive down cost by leveraging a strong negotiating position over fees with providers (physicians, hospitals, drug manufacturers). They advocate the budgetary benefits of lower prices because many subsidy payments and tax breaks in health insurance markets are pegged to market prices. Finally, they stress fairness. The legislative proposals adhere to the principle that the public option must compete on a level playing field with private plans. It will not receive subsidies over and above what private plans receive, is subject to the same regulations as private plans, has no special mandates on coverage, and negotiates provider fees without statutory pricing rules set in law. With a true level playing field, the advocates claim a strong public option will simply be another plan added to make markets more competitive.

Critics argue that health insurance markets already have sufficient competition and fear the public option could significantly crowd out private plan enrollment without any competitive benefits. Moreover, they are concerned that greater negotiating power could distort providers’ supply-side incentives: for example, pharmaceutical manufacturers’ incentives to develop new drugs or physicians’ willingness to accept patients. They also have budgetary concerns related to subsidies and tax provisions; the public option could draw in new enrollees from less subsidized health insurance programs. To another set of critics, who believe that government provision of services is less cost-efficient than private provision, the public option would simply be a fringe plan that has little impact on competition.

Finally, critics argue that a true level playing field cannot be legislated. It may not be possible for a public option to operate just like any other private plan. In particular, they can look towards the market design issues facing the Medicare Advantage (MA) market, where private plans are offered as alternatives to the government’s traditional fee-for-service (FFS) Medicare. In MA markets, private insurers’ profit motives give them incentives to design their plans and marketing activities in such a way to “cream skim” relatively low cost enrollees, while leaving the high cost enrollees to the government’s plan. As shown in Brown et al. (2011), the sophisticated risk adjustment mechanisms designed to thwart cream skimming may actually be contributing to the risk selection issues. In the public option context, a government plan lacking profit incentives could end up as a “dumping ground” for the relatively high cost enrollees and introduce more selection to the market.

These pros and cons certainly contributed to the decision to forego a public option. Looking back, we feel it’s important to assess the consequences of a public option to evaluate the merits of the decision. Looking forward, as new health insurance exchanges are being created and existing ones reformed, the results in this paper can shed light on how competition and selection affects insurance markets. As reform debates continue, it is conceivable that the public option could enter the public dialogue again.

In this paper, we quantitatively evaluate the consequences of a public option being introduced to the existing Medicare Part D prescription drug insurance market. As part of the
2003 “Medicare Modernization Act” (MMA), Medicare introduced Part D, that for the first time would cover prescription drugs. Unlike FFS Medicare, where the government is the sole insurer, Part D is a regulated insurance exchange. By mandate, senior citizens enroll in plans subsidized and regulated by the government but sold by competing private insurers. In many respects the 2010 health reform legislation resembles that for Medicare Part D. Our results thus give insights into how market outcomes would be affected if a public option were to be introduced in the health insurance exchanges coming online in 2014.

Two stylized facts about Part D markets fuel the debate over a public option. On one hand, individuals have lots of choices. The typical enrollee can choose from over 40 plans offered by about 20 insurers. On the other hand, it is a concentrated industry. The Herfindahl-Hirschman concentration index (HHI) for the average market is 2376, in the range the Department of Justice labels “moderately concentrated,” just shy of the “highly concentrated” threshold of 2500.\(^2\) At the national level, the two largest insurers (United Healthcare and Humana) together have a 50% market share. Taking these two facts together, it’s not immediately obvious whether a public option would have a minor or major competitive effect.

The Part D market has never had a public option; we cannot conduct a retrospective program evaluation. Instead, we use data from 2006-2009 to specify and estimate an equilibrium supply/demand model for insurance plans based on the method in Berry (1994) and Berry, Levinsohn, and Pakes (1995) (BLP). We then conduct policy counterfactuals that recompute the market equilibrium with the inclusion of a public option. We assess many competitive outcomes such as the effect on enrollment for the government plan and private plans, monthly premiums, consumer welfare, industry profits, and risk adjustment and subsidy payments linked to the Part D program.

We model plans as differentiated products. Per regulation, private insurers must offer at least one plan meeting a basic, minimum coverage standard, but they are also allowed to offer enhanced plans with more generous coverage, the so-called “Cadillac” plans. Coverage characteristics such as deductibles, drug copays, and drug formularies (the list of covered drugs) differentiate plans. We use a flexible random coefficients discrete choice model of plan demand. Our model captures heterogeneity in consumers’ preferences for plans, driven by factors such as health risk and idiosyncratic differences across enrollees’ drug regimens.

We model the supply of plans as an imperfectly competitive oligopoly market while incorporating endogenous premium subsidies and the risk adjustment mechanism. Medicare’s payments to plans are risk adjusted according to a risk scoring model of enrollee’s expected drug expenditures calibrated to demographics and disease categories. However, it is an imperfect predictor of risk, which gives insurers incentives to design their plans to select enrollees with lower risk than that predicted by the risk scoring model. We model the insurer’s problem

\(^2\)See table 5 for these market level statistics.
through a two stage game. In the first stage, insurers compete over the composition of their risk pools by tweaking drug formularies to cream skim “good” risk enrollees and deter “bad” risks. In the second stage, insurers set monthly premiums in Bertrand oligopoly fashion taking as fixed plan characteristics as well as the expected composition of their risk pools.

In the second stage, two government payment schemes—risk adjustments and premium subsidies—distort pricing decisions. First, the risk adjustment mechanism distorts pricing when there is selection. Even if two insurers have the same expected per enrollee cost but different risk scores (for example insurer A favorably selects 80 year olds with 70 year old health, insurer B selects 70 year olds with 70 year old health), the insurer with favorable risk selection prices lower. The intuition is that insurers with favorable selection earn part of their rents off of risk adjustment payments and want to expand their base of enrollees with low prices, whereas an insurer with no (relative) risk selection only earn rents by marking up premiums. Risk corridors, a sharing scheme between insurers and Medicare of profits/losses incurred relative to risk scores, dampens the distortion. The second pricing distortion stems from the premium subsidy rules, which determine subsidy payments using a formula pegged to market prices and past enrollment, rather than being made as lump-sum payments.

We do not model how the optimal level of cream skimming is determined, given the lack of necessary data on plans’ risk pools. Instead, we write down the first stage game so that competition in cream skimming is perfectly competitive, and no plan gains a selection advantage. This allows us to estimate cost parameters using the first order conditions from the second stage Bertrand oligopoly pricing model as if there were no selection.

The counterfactual exercises consider two cases. The first case assumes the public option employs the same cream skimming practices used by private plans. As a result of perfectly competitive cream skimming, no additional selection is introduced to the market. The second case assumes the public option does not cream skim, perhaps because it does not have a profit incentive to do so or is prohibited by legislation. As a result, the public option selects a high risk pool of enrollees, leaving private plans with a low risk pool. The selection counterfactuals hold insurers’ costs fixed to isolate the effects of selection induced pricing distortions. Returning to the example, the thought exercise is that an insurer who formerly enrolled 70 year olds with 70 year old health will now enroll 80 years olds with 70 year old health. We lack data to predict the degree of selection in the counterfactual. Instead we calibrate the counterfactual to match the amount of selection reported in Brown et al. (2011) for the MA/FFS Medicare market. Despite the limitations, the exercise illustrates how selection induced pricing distortions affect the competitive outcomes of a public option.

For both counterfactuals, we follow the 2009 “Medicare Prescription Drug Coverage Improvement Act” which is the most explicit proposal about how a public option would be introduced. The government would offer a single basic plan—no enhanced plans. The proposal uses
language stating that the government plan competes on a level playing field, and gives many specific guidelines adhering to this principle. The law would not impose a statutory pricing structure for drug reimbursements, such as reference pricing used by Medicaid and Medicare.\(^3\) Just like private plans, the public option would construct a drug formulary, set copay and coinsurance rates, and negotiate discounts with drug manufacturers. Unlike profit-driven insurers, it sets monthly premiums to avoid running a profit and cannot operate at a loss. It receives premium subsidies following the same rules as private plans and is subject to the same risk adjustment mechanism.

We construct the public option’s coverage characteristics to match the basic benefit structure, and, as our starting point, assume that it has cost equal to that of the average private plan. We explore the possibility that the government could offer a more or less desirable plan by varying the plan’s cost. For instance, the government plan could have a low cost if it has the ability to negotiate deep discounts with drug manufacturers. We consider a case where the government plan has a 25% cost advantage, comparable to the drug discounts negotiated by other government programs such as Medicaid, Veterans Affairs, and the Canadian provinces in Medicare Canada.\(^4\) We also consider the case that the government has a cost disadvantage, representing either poor drug price negotiations or inefficient management.

In the no-selection counterfactuals, an average cost government plan is just that—an average plan. There are modest competitive effects in terms of market shares, pricing responses, and total surplus. These results follow in part because the market is already highly competitive and insurers have low markups: estimated markups average just 7% to 10% over cost. The effect is negligible if the government plan has a 10% cost disadvantage. The results are more pronounced if the government plan has a 25% cost advantage. It becomes the number one plan, crowds out a significant amount of private plans’ market share (25%), but has a small effect on prices. The crowd out effects are large for basic plans—the closest in product space to the government plan—and modest for enhanced plans. The differing response is driven by a higher estimated cross price elasticity of demand amongst basic plans, than between basic and enhanced plans.

The results in the selection case are quite different. The no profit/loss condition requires

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\(^3\)Another version of the bill (H.R. 3962) proposed by Nancy Pelosi included reference pricing clauses, but the passed law H.R. 3590 does not. Another key difference is that the Pelosi bill did not have a clause permitting states to opt-out of the public option.

\(^4\)Danzon and Furukawa (2008) constructs a price index comparing brand name drug prices in Canada to those in the US and finds 20% to 40% lower prices in Canada. The advocacy group, Families USA, compared Part D drug prices to the Veterans Affairs (VA) negotiated Federal Supply Schedule prices for the top 20 drugs in 2007. They found the VA negotiates a median 58% lower price than the lowest price that a Part D plan negotiated. source: www.familiesusa.org/assets/pdfs/rhetoric-vs-reality.PDF (accessed 8/12/10). Most recently, a 2011 study conducted by the department of Health and Human Services that was commissioned under section 3313(b) of the “Patient Protection and Affordable Care Act”, compared drugs prices in the Part D program to those in Medicaid. They found 34% lower prices on average in Medicaid.
the public option to set its premium above cost to overcome risk adjustment deductions. As a result it captures a smaller market share and puts less competitive pressure on private plans. Despite this, the selection induced pricing distortions cause private plans to lower prices, more so than in the no-selection case.

The final part of our counterfactual analysis considers welfare consequences. In the no-selection case, all surplus gains from having a new product are wiped out regardless of the government plan's cost position. This follows because enrollees “crowd-in” to the highly subsidized Part D program from other drug insurance programs with lower subsidies. This crowd-in effect overwhelms a minimal reduction in per-enrollee subsidy payments brought about by slightly lower market prices. In the selection case, there are surplus gains from having a new product and from selection inducing lower private insurer prices. However, there are distributional consequences favoring insurers that earn additional rents off of risk adjustment payments at the expense of tax payers who fund the Medicare program. In the counterfactuals, we vary the parameters of the risk adjustment mechanism to explore the effect on total surplus and the distribution of surplus.

The remainder of the paper is organized as follows. In section 2 we relate our work to the existing literature. Section 3 provides background and institutional details of the Medicare Part D market. Section 4 introduces the demand and supply model. Section 5 describes the data. Section 6 reports our supply and demand estimates. Section 7 conducts the counterfactual exercises. Section 8 concludes.

2 Contribution to Existing Literature

This paper relates to a broad literature on health insurance and, more specifically, the Medicare Part D market. An important issue is the debate about public-vs-private provision of insurance. Several papers address this topic for a variety of government insurance programs. Examples include Medicaid (Cutler and Gruber, 1996), the Supplemental Children’s Health Insurance Program (Lo Sasso and Buchmueller, 2004), and Medicaid’s long-term care insurance (Brown and Finkelstein, 2008). These papers focus on households’ decisions to enroll in public insurance, crowd out effects of private insurance, and budgetary effects. We consider these three effects but also consider the competitive effects that the public option has on private insurers through our supply-side analysis of the market. The competitive effects are largely ignored in this literature, and we feel they are of first order importance to the debate about the public option.

Another difference is that we use a structural IO approach whereas they use program evaluation and calibration techniques to assess outcomes using data from after the enactment of the government program. Such approaches are not feasible for our case because there has never been a public option. Our equilibrium supply/demand model, however, enables us to fore-
cast outcomes in counterfactual scenarios. In particular, we conduct a comprehensive welfare evaluation that takes into account consumers, insurers, and the government budget.

Methodologically, our paper is most similar to Lucarelli et al. (2011) and Town and Liu (2003). They estimate equilibrium models of Part D and Medicare Advantage markets and examine a variety of counterfactual scenarios. Our estimation method contributes by specifying how the endogenously determined premium subsidy payments distort pricing decisions. This enables us to compute equilibrium subsidy payments for the counterfactual analysis, which is crucial to address budgetary concerns. To the best of our knowledge, this paper is the first to recognize pricing distortions arising from the premium subsidy rules in Medicare markets.

Given our focus on the competitive consequences of a public option, we also add to the IO health literature about the effects of market structure on competition in insurance markets. The reduced form work in Dafny et al. (2011) shows that mergers resulting in much higher concentration only cause a modest increase in health insurance premiums. Structural approaches include Dranove et al. (2003) that estimates the competitive effects of product differentiation and Ho (2009) that considers the role of bargaining between insurers and health care providers.

More specifically, our work contributes to an emerging literature on the Medicare Part D market. Much of that literature focuses on the demand side to examine whether enrollees make rational choices (Kling et al., 2012; Abaluck and Gruber, 2011; Ketcham et al., 2011). They find the chosen plan is often more costly than other alternatives, even accounting for uncertainty about drug expenditures. Moreover, enrollees appear to systematically overvalue certain plan characteristics such as low deductibles.

We use aggregate market share data which is more suitable to estimate an equilibrium model of the Part D market. We estimate a random coefficient demand system that captures consumer heterogeneity in preferences and flexible substitution patterns observed in individual level data. In our particular context, random coefficients account for consumer heterogeneity stemming from various sources such as health status, risk aversion, and institutional features specific to the Part D market design. As the prior literature suggests, our model allows for the possibility that consumers overvalue characteristics like the deductible.

An important issue in the health insurance literature is adverse selection and specifically risk adjustment mechanisms designed to mitigate selection. Risk adjustments are appealing in principle as a way to decouple an insurer’s plan offering and pricing decisions from the risk profiles of its enrollees (Glazer and McGuire, 2000). However, they are not a perfect tool for handling adverse selection. McAdams and Schwarz (2007) cites specific concerns in

\footnote{In our model, there are advantages to supplementing consumer-level data. The extra data would allow us to untangle the various sources of consumer heterogeneity and apply a less restricted random coefficient model. However, the survey and pharmacy claims data used in the prior literature may not be representative of the population because they omit large parts of the population (in particular low income subsidy enrollees) and the pharmacy claims data only represent the preferences of customers of those particular pharmacies.}
Part D, regarding how insurers construct drug formularies to cream skim. Brown et al. (2011) documents how risk adjustments have aided private insurers in cream skimming relatively low cost enrollees away from the government’s FFS Medicare plan. On the demand side, several papers (Bajari et al., 2012; Einav et al., 2013; Carlin and Town, 2009; Cardon and Hendel, 2001; Handel, 2013) measure adverse selection in employer-sponsored settings and include rich features such as switching costs and moral hazard.

We contribute to the selection literature by modeling how an imperfect risk adjustment mechanism distorts pricing decisions made in imperfectly competitive markets. The prior work assumes both pricing and cream skimming occurs in an environment with either perfect competition or no competition. The exception is Lustig (2010) who uses a model of imperfect competition to measure the degree of adverse selection in Medicare Advantage markets; however, his model does not explicitly include risk adjustment payments. The limitations of our approach are that we assume perfect competition in cream skimming and that we calibrate the degree of selection in the counterfactual exercises.

Our model is static on both the supply and demand side which brings up two qualifications. On the supply side, we do not model plan’s entry and exit to determine if a government option would cause plans to exit. We cannot identify this effect in a meaningful way because there is no entry or exit by major firms over the sample period. We believe ignoring what little churn exists will have negligible effect on our results. Second, our model does not account for dynamic features of the demand for health insurance plans. For employer sponsored health insurance plans, Carlin and Town (2009) document strong persistence in demand across time. For Part D plans, Miller and Yeo (2012) estimate a dynamic model of demand with switching costs, Ericson (2011) considers the effect of switching costs on insurers’ pricing decisions, and Decarolis (2012) documents how low income subsidies create large premium changes across years. High demand persistence or switching costs could possibly bias our demand estimates and would likely blunt the penetration of a public option.

3 Medicare Background

Medicare is the United States’ entitlement program that provides health insurance to the over 65 population and some categories of disabled people. The original programs established in 1965 (Part A and B) only cover hospital and doctor services. They use a single payer system where the government provides a single fee-for-service insurance plan.

Medicare reforms have introduced privatized insurance. The first major reform in 1997 created the Medicare Part C market, currently called Medicare Advantage (MA) to cover hospital and doctor services. The 2003 Medicare Modernization Act (MMA) created the Part D market to cover prescription drugs. In both the MA and Part D markets, competing private insurers
offer plans in a regulated, risk adjusted, and subsidized health insurance exchange.

The Part D legislation established guidelines for Medicare beneficiaries and rules for the operation of the exchange. Beneficiaries are required to obtain prescription drug coverage that meets or exceeds a minimum coverage standard. There is a penalty for foregoing drug coverage in the form of higher premiums paid in later years. They can obtain coverage by purchasing an individual insurance policy from a private insurer offering plans in the Part D health insurance exchange. Part D policies come in two varieties: stand-alone drug coverage and bundled with a MA plan (MA+Part D). The plans on the exchange are the primary channels for obtaining coverage; in 2009 46% of the Medicare population enrolled in a stand-alone plan and 28% in MA+Part D. There are other channels to receive coverage: a group plan offered by an employer/union under the Retiree Drug Subsidy (RDS) program (also established in the MMA) or another government program such as Veterans Affairs insurance. In our model, we only endogenize the market for stand-alone Part D plans, but we use enrollment data and subsidy payments for MA+Part D plans and the RDS program in our counterfactual analysis.

Insurers can freely enter Part D markets which are geographically separated into 39 regions drawn around state borders. Each insurer must offer at least one basic plan meeting the minimum coverage requirement and may also offer enhanced plans with more generous coverage. The portion of the premium attributable to basic coverage is subsidized; the portion attributable to enhanced coverage is not. Plans set monthly premiums and must charge the same amount to all enrollees regardless of age, demographics, disease, or prior experience. All enrollees receive a premium subsidy. It is a market determined amount in the sense that it is based on the average price set by insurers in the market.

Medicare uses a risk adjustment mechanism to adjust payments to plans based on the risk and cost profile of enrollees. The first component of the mechanism, which we refer to simply as risk adjustments, compensates plans that enroll a higher than average risk profile of enrollees and deducts payments from plans with lower than average risk. Risk profiles are calculated using a regression model that predicts drug expenditure based on demographic factors (age, gender, institutional status) and disease categories (diabetes, hypertension, kidney failure, etc). The second component of the mechanism is called a risk corridor. It is a profit sharing scheme between insurers and the government. Insurers are (partially) compensated by the government if their actual costs incurred exceed those predicted by the risk adjustment formula, and they pay back profits if their costs are lower.\textsuperscript{6}

The premium subsidy and two components of the risk adjustment mechanism are crucial parts of our supply side model, and our counterfactual analysis considers how these payments

\textsuperscript{6}Risk corridors were originally intended to be a temporary measure to insure insurers against the risks of an unfamiliar and potentially biased risk adjustment formula. However, risk corridors still exist today, albeit with a lower degree of profit sharing.
could change in response to the public option.

The Low Income Subsidy (LIS) program provides an additional premium subsidy and reduces the deductible and copay amounts for low income households. It is a large program. Approximately 20% of the Medicare population meets the eligibility requirements, and they compose a disproportionate share of enrollees in stand-alone Part D plans, 45%. Like the premium subsidy for all households, the LIS premium subsidy is tied to insurers’ prices. It is capped at a threshold determined by the average premium set by insurers. The subsidy amount phases in based on poverty status; households below 135% of the Federal Poverty Line receive the full subsidy, and households between 135% and 150% receive fractional subsidies. Some households, deemed “dual eligibles” who have both Medicare and Medicaid, are automatically and randomly assigned to a plan if they do not actively enroll in a plan. Only basic plans with a premium set below the LIS threshold are eligible to receive randomly assigned enrollees. We do not explicitly model the LIS program, but our demand model implicitly captures the key features of the LIS program; the subsidies affect demand elasticity estimates and the auto-enrollment feature shifts out demand for eligible plans.

3.1 Medicare Part D Plans as Differentiated Products

Medicare Part D plans are differentiated products. They differ with respect to cost sharing (deductibles, copays/coinsurance rates), the list of covered drugs on the formulary, and the drug price discounts negotiated with manufacturers. They also differ along non-financial related dimensions, such as the set of pharmacies in the plan’s network, advertising and marketing activities, and customer service quality.

Medicare regulations set a minimum standard for coverage generosity. Figure 1 depicts this benefit structure. It describes the out-of-pocket price an enrollee pays as a function of the enrollee’s annual drug expenditures. The price schedule can be thought of as a five part tariff. The first region is the premium; it is paid even if the enrollee has no drug expenditures. Next, an enrollee pays 100% of drug expenditures out-of-pocket until he reaches the deductible threshold ($250 in 2006). For the next $2000 of expenditures, coverage begins, and the enrollee pays 25% out-of-pocket. This is called the initial coverage region. After that, coverage ends, and the enrollee pays 100% of expenditures. This is the so-called donut hole region. Finally, for very high expenditures above $5100, coverage resumes with an out-of-pocket price of just 5%. This is called catastrophic coverage.

Plans classified as “basic” meet the minimum standard or are actuarially equivalent to it. “Enhanced” plans provide more generous coverage by offering some combination of a lower deductible, lower out-of-pocket costs in the initial coverage zone, or added coverage in the donut hole.
Plans have a lot of scope in selecting what drugs to include on their drug formularies and setting copay/coinsurance rates on a drug-by-drug basis. The regulations require plans to include some drugs from all of the major therapeutic classes, but plans have the discretion to choose exactly which drugs to include. Indeed, some plans offer almost the entire universe of Part D drugs, and some restrict the set of covered drugs. On a drug-by-drug basis, plans can set out-of-pocket cost sharing rules that differ from the basic benefit structure. They differentiate by placing drugs on pricing tiers such as preferred, non-preferred, specialty. Higher tiered drugs may have higher cost sharing rates. Plans can price using coinsurance rates that cover a percentage of drug expenditures, copay rates denominated in fixed dollar amounts, or a combination of both. Across all drugs on the formulary, copay and coinsurance rates must be approved by Medicare as being "actuarially equivalent" to the basic benefit structure. Despite this requirement, idiosyncratic differences in cost sharing rules create a lot of variation at the aggregate level, even amongst the most popular drugs.

Drug prices are determined through a bargaining process between insurers, drug manufac-

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7Medicare’s formulary review board determines the set of drugs that are considered Part D drugs and classifies them into therapeutic categories. Some drugs, such as prescription sleep aids, are not considered Part D drugs. Plans may include non-Part D drugs, but then the plan is classified as enhanced and the portion of the premium attributable to the coverage of those drugs is not subsidized. To fill a prescription for an off-formulary drug, an enrollee would have to purchase it on his own or in some cases the enrollee may be able to go through an appeals process with the insurance company.

8Prior authorization requires the plan’s approval before filling a prescription at the pharmacy. Step therapy routines require enrollees to try another drug first, and if it is ineffective then the plan provides coverage.
urers, wholesalers, and pharmacies. Negotiated drug prices matter for enrollees’ out-of-pocket expenses because the regulations require plans to pass on all discounts and rebates to enrollees. Even if two plans have identical coinsurance rates, enrollees face lower out-of-pocket expenses for the plan that negotiates lower drug prices. On one hand, restrictive formularies, tiered copays, and usage restrictions give insurers bargaining levers to negotiate discounts and rebates (Duggan and Scott-Morton, 2010). On the other hand, formulary flexibility provides tools for insurers to cream skim relatively low cost enrollees by targeting drugs for specific conditions (McAdams and Schwarz, 2007; Hsu et al., 2009).

Pharmacy networks introduce another dimension of horizontal product differentiation. Plans contract with both mail-order and brick-and-mortar pharmacies to build a network of pharmacies where enrollees can fill prescriptions. Drug prices and copay/coinsurance rates can differ across pharmacies in a plan’s network. Typically, mail-order and “preferred” pharmacies offer lower out-of-pocket prices.

The above plan characteristics are certainly important determinants of plan choice, but there are other non-pecuniary factors that differentiate plans. Marketing and advertising activities are important determinants of enrollees’ choices (Starc, 2012). As an example, the market leader, United Healthcare, pays royalties to AARP to endorse their plans. Finally, plans are differentiated with respect to service characteristics, such as the accuracy of plan information, leniency in appeals procedures, and customer service quality.

4 Model

We model the supply and demand system for plans using the discrete choice framework of Berry (1994); Berry et al. (1995). We separately introduce the demand and supply side.

4.1 Demand

Every calendar year $t$, a consumer, indexed by $i$, can enroll in one prescription drug plan. Consumers choose amongst the $j = 1, \ldots, J_{mt}$ differentiated plans offered in their home market $m$ in year $t$. There is a very clean market definition because consumers cannot enroll in plans outside their region, nor switch plans within a calendar year. They may also choose an outside option, $j = 0$. Following the convention in the demand estimation literature, we normalize the utility from the outside option to zero. The outside option includes going without drug coverage, enrolling in a MA+Part D plan, getting coverage from another government program, or RDS group plan.

Enrollees pay a premium $p_{jmt}$ set by the plan. They derive utility from plan characteristics and income left over after paying the premium. Define the conditional indirect utility of
consumer $i$ choosing plan $j$ in market $m$ as:

$$U_i(X_{jmt}, p_{jmt}) = -\alpha_i p_{jmt} + X_{jmt}' \beta_i + \xi_{jmt} + \epsilon_{ijmt}$$

(1)

where $X_{jmt}$ is a vector of observable plan characteristics which includes the deductible, a measure of copay/coinsurance rates in the initial coverage zone and donut hole, and pharmacy coverage. We also include formulary fixed effects to control for the quality of drug formularies. $\xi_{jmt}$ represents an index of unobservable (to the econometrician) plan qualities such as marketing activities, and $\epsilon_{ijmt}$ is a term capturing idiosyncratic differences in consumers’ preferences over plans. The terms $\alpha_i$ and $\beta_i$ are random coefficients that represent consumer $i$’s marginal utility over income and over product characteristics. The random coefficients are distributed iid normal across consumers and markets with mean $\bar{\alpha}$ and $\bar{\beta}$ and variance $\Sigma$. Consumers choose the plan yielding the highest conditional indirect utility in equation (1).

### 4.2 Discussion: Demand Modeling

In this section we discuss the two sources of consumer heterogeneity in the model: random coefficients, $\{\alpha_i, \beta_i\}$, and the idiosyncratic logit error term, $\epsilon_{ij}$. We also consider how two additional features of the Part D program design—the late enrollment penalty and LIS program—affect demand.

Our most flexible demand specification includes random coefficients on the monthly premium, deductible, and copay/coinsurance rates. The random coefficient $\alpha_i$ captures heterogeneity in consumers’ marginal utility over income, driven by differences in income and intrinsic price sensitivity. Heterogeneity in preferences for the deductible and copay/coinsurance rates are driven by heterogeneity in enrollees’ risk aversion and underlying demand for drugs, which is largely a function of health factors such as age and disease conditions. All enrollees (weakly) prefer lower deductibles and copay/coinsurance rates. “Healthy” enrollees have a relatively low (in magnitude) marginal utility with respect to the deductible because their drug expenditures may not exceed the deductible. “Sick” enrollees have a higher marginal utility because they would expect to spend through the deductible with high probability. By the same reasoning, health status affects preferences over copay/coinsurance rates in the initial coverage and donut hole regions. In addition, more risk averse enrollees may place a higher preference on the deductible and copay/coinsurance rates.

The LIS program and late enrollment penalty—although not explicitly modeled—will be reflected in the random coefficients. The low income subsidy truncates price sensitivity with respect to the posted premium. For example, $\alpha_i$ is zero for those receiving a 100% premium subsidy and half of what it would otherwise be for an individual receiving a 50% subsidy.\footnote{Strictly speaking, the truncation is only proportional for basic plans priced below the LIS threshold because...
enrollees that face lower deductibles and copay/coinsurance rates have reduced sensitivity to these characteristics. By similar reasoning, the price sensitivity of enrollees subject to the late enrollment penalty—1% per month not enrolled—increases in proportion to the duration of late enrollment. The random assignment of auto-enrolled dual eligible LIS households shifts out the demand for LIS eligible plans. Because only basic plans are LIS eligible, the shift will be captured in the random coefficients of product characteristics that distinguish basic plans from enhanced plans, such as the deductible. The term $\xi_{jmt}$ also captures a part of the shift.

In our model, the idiosyncratic preference terms, $\epsilon_{ijmt}$, play an important role and reflect preferences over the idiosyncracies in plans’ formularies. Enrollees have stronger preferences for plans that cover their specific drug regimen at low out-of-pocket prices. Thus, idiosyncratic differences across consumers’ drug regimens, in conjunction with drug-by-drug idiosyncratic differences in formulary composition and copay/coinsurance tiers, give rise to idiosyncratic preferences for plans. Figure 2 illustrates such differences in formulary composition across the universe of over 5300 prescription drugs; a similar visual representation of copay/coinsurance rates shows the same pattern. In addition, the logit terms can rationalize auto-enrolled LIS enrollees’ random assignments with high draws for the plans they are assigned to.

Ackerberg and Rysman (2005) and Berry and Pakes (2007) have critiqued this model because the dimensionality of $\epsilon_{ij}$ increases as products are added. This implies consumer welfare increases with the introduction of a public option, even if it has a high premium and undesirable average characteristics. The concerns are most acute in applications with many choices, like ours with over 40 choices, where the product space of unobservables may become congested. However, the justification for the extra $\epsilon_{ij}$ term for the government plan is well grounded in our application. We assume the government plan constructs its formulary, copay/coinsurance rates, usage restrictions to exhibit the same sort of idiosyncratic differences found amongst the privately offered plans. The public option proposals explicitly instruct the government plan to use formulary management techniques for bargaining purposes and to manage clinical effectiveness. Considering the enormous number of formulary combinations $2^{5300}$—going from a mere 40 to 41 plans will not congest the space of formularies.

4.3 Supply

We model the supply side as a two stage game. In the first stage, insurers engage in cream skimming competition to screen risk by adjusting their formularies. In the second stage, insurers make pricing decisions. We start by describing the setting for pricing decisions.

A set of $F$ multiproduct insurers compete by setting prices in a Bertrand-Nash fashion. In year $t$, each plan $j$ offered in market $m$ submits a bid $b_{jmt}$. Insurers submit separate bids in the enhanced component of the premium and basic component over and above the threshold are not subsidized.
each market, even if the plans offered in different markets are otherwise identical.

To formalize the supply side model it is necessary to define consumer types and cost. The type for person $i$ is defined by the tuple $(\nu_i, r_i, a_i)$, where $\nu_i = (\alpha_i, \beta_i)$ are the random coefficients defined in the demand model. Each individual in the population is assigned a risk score $r_i > 0$. The score is the predicted value of drug expenditures for person $i$ as determined by Medicare’s risk adjustment formula.\(^{10}\) The predicted expenditures are normalized to $r_i = 1$ for the average Medicare beneficiary. It is a prospective risk adjustment model in the sense that predictions are based on data from prior years and the risk scoring parameters are known by insurers at the time of bidding. The term $a_i$ is called the selection factor which we describe in what follows.

We use the notation $F(r_i, a_i, \nu_i)$ to denote the joint distribution of types in the population. Let $c_{ij}$ denote the cost that plan $j$ expects to incur from enrolling a person of type $i$.\(^{11}\) We parameterize expected costs as

$$c_{ij} = c_j(r_i + a_i).$$

The selection factor $a_i$ measures the expected cost difference of an enrollee from that predicted by his risk score $r_i$. The parameter $c_j$, common for all enrollees in a plan, scales costs across plans. For example, an enhanced plan would have a higher value of $c_j$ than a basic plan because the share of drug costs incurred by an enhanced plan is higher. The term can also capture differences across plans in administrative costs. Note that $a_i$ does not depend on $j$, and likewise $c_j$ does not depend on $i$. This assumption rules out selection on moral hazard described in Einav et al. (2013).

There are three payment components in the insurer’s revenue. First, a plan receives a monthly payment for each enrollee equal to its bid, $b_{jmt}$. We call this the base payment. Part of the base payment is made by enrollees in the form of the premium, $p_{jmt}$, and the remainder is subsidized by the government. Second, the base payment is adjusted up or down based on the risk profile $r_j$ of the plan’s enrollees. We call these risk adjustment payments/deductions. Medicare computes plan $j$’s risk profile, $r_j$ as the average risk score of its enrollees; that is, $r_j$ is given as $r_j = \frac{\int r_i s_j(\nu_i, r_i, a_i; b) dF(r_i, a_i, \nu_i)}{\int s_j(\nu_i, r_i, a_i; b) dF(r_i, a_i, \nu_i)}$ where $s_j(\nu_i, r_i, a_i; b)$ denotes the probability a consumer of type $(\nu_i, r_i, a_i)$ chooses plan $j$ given the bid vector $b$. For example if plan $j$ ’s risk profile $r_j = 1.1$, Medicare pays an additional 10% above the base payment $b_j$. Payments are deducted for a risk profile less than 1.

\(^{10}\)The predicted drug expenditure comes from a regression model of drug expenditures regressed on demographics and diseases categories. Earlier versions of the model included 84 disease categories. See (Newhouse et al., 2012) for details on how the model was initially implemented and how it changed in later years.

\(^{11}\)We pose the model in terms of ex-ante expected costs and profits instead of ex-post realized cost and profits. Assuming insurers are sufficiently large to pool away idiosyncratic risk, risk-neutral insurer decisions will not be affected by idiosyncratic differences between ex-post costs and ex-ante expectations of costs. We also assume there are no aggregate risks affecting the Part D market.
Finally, the payment is adjusted at the end of the year according to risk corridor profit splitting payments/deductions that are based on actual costs incurred by the plan in relation to costs predicted by the risk adjustment formula. The risk adjustment model is not a perfect predictor of drug expenditures. The R-squared value from the drug expenditure regression is commonly used to gauge the predictive ability of the model. It is about 0.25 for the models used in Medicare Part D (Hsu et al., 2009). Because enrollees’ drug expenditures may not be aligned with risk scores, it is possible that a plan could attract a pool of enrollees with drug expenditures deviating from those predicted by the risk adjustment model. Plans that attract high cost enrollees ($c_{ij} > c_j r_i$) are partially compensated by Medicare for lost profits, and Medicare partially recoups excess profits made off of low cost enrollees ($c_{ij} < c_j r_i$). The fraction of profit/loss splitting is given by the parameter $\theta \in [0, 1)$ which was set high in early years to provide insurers with more risk sharing and reduced in later years. Medicare uses claims data collected at the end of the coverage year to verify the cost $c_{ij}$ for each of plan $j$’s enrollees in relation to cost predicted by the risk scoring formula $c_j r_i$. The records process to reconcile payments takes two years to finalize.

The expected profit function for plan $j$ in market $mt$ with market size $M_{mt}$ is

$$
\pi_{jmt} = M_{mt} \int \left( \begin{array}{c}
\frac{b_j}{\text{base payment}} \\
+ \frac{b_j (r_j - 1)}{\text{risk adjustment}} \\
+ \frac{\theta (c_j (r_i + a_i) - c_j r_i)}{\text{risk corridor}} \\
- \frac{c_j (r_i + a_i)}{\text{cost}}
\end{array} \right) s_j(\nu_i, r_i, a_i; b) dF(r_i, a_i, \nu_i)
$$

The profit function is the sum of the three payments, less the cost, integrated across the share of enrollee types choosing plan $j$.

To simplify the expression for the profit function, we average selection factors across enrollee types in a plan. Define $a_j$ as the average selection factor among plan $j$’s enrollees: $a_j \equiv \frac{\int a_i s_j(\nu_i, r_i, a_i; b) dF(r_i, a_i, \nu_i)}{\int s_j(\nu_i, r_i, a_i; b) dF(r_i, a_i, \nu_i)}$ and let $s_{jmt}(b) = \int s_j(\nu_i, r_i, a_i; b) dF(r_i, a_i, \nu_i)$ denote the market share of plan $j$. The cost term of the above expected profit function is

$$
\int c_j (r_i + a_i) s_j(\nu_i, r_i, a_i; b) dF(r_i, a_i, \nu_i) = c_j (r_j + a_j) s_{jmt}(b)
$$

The expected profit function can be written in terms of average revenue and cost:

$$
\pi_{jmt} = [(b_j r_j + \theta c_j a_j) - c_j (r_j + a_j)] s_{jmt}(b) M_{mt}
$$
As multiproduct firms offering plans in many regions, expected profits for insurer \( f \) are given by,

\[
\Pi_{ft} = \sum_m M_{mt} \sum_{J_{fmt}} (\pi_{jmt}) s_{jmt}(b)
\]  

(5)

where \( J_{fmt} \) indexes the set of plans offered by insurer \( f \) in market \( m \).

In this model, selection occurs when consumers with differing \( r_i \) and \( a_i \) select different plans as shown by the dependence of the choice probabilities, \( s_j(\nu_i, r_i, a_i; b) \), on all three components of the type: \( \{\nu_i, r_i, a_i\} \). Recall that in the demand model, however, the choice probabilities, \( s_j(\nu_i; b) \), are written to only depend on the random coefficients \( \nu_i \), not on risk scores or selection factors. This implies that selection in our model only affects the composition of enrollees across plans and does not have any direct effect on market shares. Although this is restrictive, relaxing it requires specification and estimation of a selection mechanism, which is not feasible as we lack necessary data. We present the above, general but parsimonious, model of plans’ cost and revenue to illustrate the framework underlying the counterfactual analysis. For estimation, we assume there is no selection on \( a_j \); \( a_j = 0 \) for all plans, which is the outcome in the perfectly competitive cream skimming game described below.

### 4.4 Cream Skimming

As can be seen in the profit equation (4), a plan earns higher profits, all else equal, by enrolling a pool of low cost, low \( a_i \) enrollees. The incentive to attract low cost enrollees, (or detract high cost enrollees) is called “cream skimming.” There is an important distinction. Plans profit by cream skimming low cost enrollees in terms of the selection factor \( a_i \), not in terms of risk scores \( r_i \) because risk adjustment payments fully account for cost differences predicted by risk scores.

Plans have at their disposal an array of formulary management techniques—drug exclusions, tiered copays, usage restrictions—that they use to cream skim (McAdams and Schwarz, 2007; Hsu et al., 2009; Brown et al., 2011). The techniques target specific drugs within therapeutic categories.\(^{12}\) For example, the plan could favorably cover rapid acting insulins that are indicated for active lifestyle adults who regularly check blood sugars (presumably low \( a_i \) types) and raise the copays on regular insulins that are sufficient for the remaining group of diabetics. Selective marketing activities, such as direct to consumer advertising and plan information events, are also used as tools to cream skim.

In a market with many insurers, there will be competition to cream skim low \( a_i \) enrollees. We model cream skimming as a binary game of insurers deciding to cream skim or not to

\(^{12}\)It is not sufficient to entirely deter costly diseases such as diabetes, because doing so just changes the plan’s risk profile \( r_j \) without affecting \( a_j \). Nor is it sufficient to change a broad plan characteristic, like the deductible, as that will simply shift \( r_j \).
cream skim. As a binary game, we assume there is no differentiation in the intensity of cream
skimming across plans. We further assume a symmetric zero-sum game where cream skimming
is a strictly dominant strategy.\footnote{The symmetry assumption implies the elasticity of \(a_j\) with respect to cream skimming strategies is identical for all plans. These two assumptions contrast with Brown et al. (2011) who show there are higher marginal returns to cream skimming for high \(r_j\) plans than low \(r_j\) plans because of heteroskedasticity in risk scoring models.}

We define the payoffs such that each plan attracts average cost \(a_j = 0\) enrollees if no plans
cream skim. If an insurer deviates by cream skimming, it attracts a pool of \(a_j < 0\) enrollees
and earns higher profits, leaving the non-cream skimming insurers with \(a_j > 0\) enrollees. In a
dominant strategy equilibrium, all plans engage in cream skimming, but, as a zero-sum game,
all plans will have average cost \(a_j = 0\) enrollees.

The zero-sum property implies two market clearing conditions on \(r_j\) and \(a_j\),
\[
\begin{align*}
\sum_j r_{jm} s_{jm} + r_{0m} s_{0m} &= 1 \\
\sum_j a_{jm} s_{jm} + a_{0m} s_{0m} &= 0
\end{align*}
\]
which are assumed to hold for all possible bid vectors and choices of cream skimming strategies.
The first condition that the \(r_j\) terms average out to 1 is given by the normalization in Medicare’s
risk scoring formula. Given how we parameterize cost, the second condition holds if the risk
scoring formula is an unbiased predictor of drug expenditures.

Our model of cream skimming makes many simplifying assumptions: notably regarding
perfect competition in cream skimming and no selection on moral hazard. We also assume that
a plan’s cream skimming behavior only affects the composition of enrollees. Cream skimming
does not directly affect market shares; however, it indirectly affects market shares through the
selection induced pricing distortion, which we explain in the following section. Another note-
worthy assumption is that the finer details of formulary management at the disease level are the
main cream skimming tools, while broad plan characteristics like the premium and deductible
do not affect the sorting of \(a_i\) types across plans. This assumption isolates the cream skimming
game from the pricing game so that insurers take as given product characteristics, formularies
(hence cream skimming strategies), risk scores \(r_j\), and selection factors \(a_j\) when making pric-
ing decisions. The simple model serves as an illustration of the underlying mechanism for a
counterfactual scenario in which the government plan does not cream skim and attracts high \(a_i\)
types, leaving the cream skimming private insurers with low \(a_i\) types. In the counterfactuals,
\(a_j\) is set based on some stylized facts borrowed from the Medicare Advantage/Medicare FFS
market.

In the appendix, we modify the model following the approach in Lustig (2010) to allow risk
sorting to depend on pricing and broad product characteristics. The bottom line is that our
cost estimates for basic plans may be overstated, and understated for enhanced plans. But, the
bias is likely quite small due to the high degree of price competition.

4.5 Pricing Distortions From Risk Adjustments

Taking as given the strategies played in the cream skimming game and the resulting \( a_j \)'s and \( r_j \)'s, the equilibrium in pricing is given by the solution to the first order conditions with respect to bids \( b_{jmt} \),

\[
s_{jmt} + \sum_{k \in J_{fmt}} \left[ b_k - c_k - \frac{a_k}{r_k} (1 - \theta) c_k \right] \frac{\partial s_k}{\partial b_{jmt}} = 0
\]

(7)

for all plans across all markets. To understand the first order conditions, first consider the case in which there is no selection \( (a_j = 0) \). The first order conditions reduce to

\[
s_{jmt} + \sum_{k \in J_{fmt}} (b_k - c_k) \frac{\partial s_k}{\partial b_{jmt}} = 0
\]

(8)

Without selection, this first order condition is identical to that of the standard Bertrand pricing model, showing that the markup \( b - c \) is proportional to the inverse elasticity of demand. Note also that the risk score \( r_j \), does not affect pricing decisions. This is how risk adjustments are intended to work. Insurers price with respect to the average cost enrollee in the population, irrespective of whether they attract high or low \( r_j \) enrollees.

Next consider the first order conditions when there is selection \( (a_j \neq 0) \). The extra term \( \frac{a_k}{r_k} (1 - \theta) c_k \) distorts pricing decisions. Without loss of generality, consider two cases with costs, \( c_j(r_j + a_j) \), fixed: a no-selection case with \( a_j = 0, r_j = 1 \) and a favorable-selection case with \( a_j < 0, r_j = 1 - a_j \). In the selection case, the plan faces more elastic residual demand and submits a lower bid. The intuition behind this distortion is that insurers selecting (relatively) low cost pools earn part of their rents off of risk adjustment payments that remain after risk corridor deductions, and hence want to expand their base of enrollees with low prices. In contrast, an insurer with no (relative) risk selection only earn rents by marking up premiums. The distortion amplifies as the ratio of \( a_j \) to \( r_j \) moves farther from 0, and attenuates as the risk corridor parameter approaches 1. Even though the bid is lower in the selection case, profits are higher because of risk adjustment payments. With unfavorable-selection \( (a_j > 0) \), the plan bids higher and profits are lower.

It is interesting that selection (in the \( a_j < 0 \) case) can reduce welfare losses from imperfect competition by creating an incentive for insurers to lower prices. In spite of this gain in market efficiency, there are distributional consequences. With \( a_j < 0 \) selection, both insurer and enrollee surplus increases, but CMS makes additional risk adjustment payments which comes
at the expense of tax payers.\textsuperscript{14} In the selection counterfactual, there are counteracting welfare consequences. One on hand, there is a welfare reduction because the budget neutral public option (with \( a_j > 0 \) enrollees) must price above cost to overcome risk adjustment deductions. On the other hand, private insurers (with \( a_j < 0 \) enrollees) price lower. We consider these pricing and welfare consequences and compare results across a variety of risk corridor (\( \theta \)) parameters.

4.6 Premium Subsidies

Because the demand model is expressed in terms of premiums and the supply model, in terms of bids, we need to account for premium subsidies. The regulation sets the rules for determining the size of the subsidy. The government subsidizes a fixed proportion, \( \lambda_t \), of the enrollment weighted average basic bid of all plans in the country (\( \lambda_t \approx 65\% \)). The enrollee pays the balance as its premium. Thus, each enrollee gets the same subsidy amount regardless of plan choice.

The formula to map a bid \( b_{jmt} \) to a premium \( p_{jmt} \) is

\[
p_{jmt} = b_{jmt} - \lambda_t \bar{b}_t. \tag{9}
\]

The determination of the weighted average bid, \( \bar{b}_t \), is complicated by the distinction between basic and enhanced coverage. Only the portion of the bid attributable to basic coverage is included in calculation of the weighted average bid. The portion attributed to enhanced coverage is not subsidized. A bid \( b_{jmt} \) separates into a basic component \( b_{jmt}^{\text{basic}} \) and enhanced component \( b_{jmt}^{\text{enhanced}} \), where \( b_{jmt} = b_{jmt}^{\text{basic}} + b_{jmt}^{\text{enhanced}} \). The formula for the weighted average bid is

\[
\bar{b}_t = \sum_{jmt} \tilde{w}_{jmt} - 1 b_{jmt}^{\text{basic}}. \tag{10}
\]

where the summation is across all stand-alone Part D plans and select MA+Part D plans in the entire nation.

The weights, \( \tilde{w}_{jmt} - 1 \), are based on the previous year’s enrollment, \( E_{jmt-1} \):

\[
\tilde{w}_{jmt} - 1 = \frac{E_{jmt-1}}{\sum_{jmt} E_{jmt-1}}. \tag{11}
\]

The weight is zero for plans that are new entrants to the market. In the first year, 2006, the weights were equal for all plans. The shift from a simple average to the weighted average method was gradually phased in through 2008.

In the model, we only have plans submitting total bids, \( b_{jmt} \). We do not model plans’ decisions about how to allocate the total bid across the basic and enhanced components of the

\textsuperscript{14}All of our welfare claims throughout the paper assume CMS subsidy payments are transfer payments. We don’t attempt to quantify any deadweight loss from the taxation funding CMS subsidies.
bid because they have limited discretion to do so. The allocation must satisfy an actuarial calculation that takes into consideration the plan’s coverage characteristics. In the data, we observe both $b_{jmt}^{\text{basic}}$ and $b_{jmt}^{\text{enhanced}}$ and assume the plans must set them in accordance to a fixed, exogenous ratio:

$$\gamma_{jmt} = \frac{b_{jmt}^{\text{enhanced}}}{b_{jmt}^{\text{basic}}}. \quad (12)$$

For example, $\gamma_{jmt}$ is zero for basic plans and is larger for an enhanced plan that eliminates the deductible and provides donut hole coverage than for an enhanced plan that only eliminates the deductible.\(^{15}\) We can thus use the enhancement ratio equation (12) to express the weighted average bid formula in equation (10) in terms of the total bid, $b_{jmt}$:

$$\bar{b}_t = \sum_{jmt} \tilde{w}_{jmt}^{-1} \frac{b_{jmt}}{1 + \gamma_{jmt}}. \quad (13)$$

### 4.7 Pricing Distortions From Premium Subsidies

The subsidy distorts insurers’ residual demand elasticities and hence price-cost markups because it is endogenously determined by insurers’ bids and is not an exogenous lump sum amount. For ease of notation, we use a non-random coefficient specification (fixed $\alpha$) to illustrate how the subsidy rule distorts insurers’ residual demand elasticities. The market share for plan $j$ in region $m$ in year $t$ is given by:

$$s_{jmt} = \frac{M_{jmt}}{1 + \sum_k M_{kmt}}$$

where

$$M_{jmt} = \exp\left(-\alpha (p_{jmt}) + X'_{jmt} \beta + \xi_{jmt}\right)$$

$$= \exp\left(-\alpha \left(b_{jmt} - \lambda_t \sum_k \tilde{w}_{kmt}^{-1} \frac{b_{kmt}}{1 + \gamma_{jmt}}\right) + X'_{jmt} \beta + \xi_{jmt}\right).$$

The second line follows by substituting bids in for premiums using the subsidy rules given in equations (9) through (13).

There are three relevant price elasticities in equation (14): own price, cross price with a plan offered in the same market $m$, and cross price with a plan offered in a different market $m'$.

**Residual Demand Elasticities**

\(^{15}\)There is evidence in the data that some enhanced plans have particularly high and others particularly low enhanced bid components relative to their plan characteristics. They likely do not bias our estimates because there are few such plans.
\[ \begin{align*}
\eta_{jjmt} = \frac{\partial s_{jmt}}{\partial b_{jmt}} b_{jmt} s_{jmt} &= -\alpha b_{jmt} \\
\eta_{kjm} = \frac{\partial s_{kmt}}{\partial b_{jmt}} b_{jmt} s_{kmt} &= -\alpha b_{jmt} \\
\eta_{kjm't} = \frac{\partial s_{kmt}}{\partial b_{jmt'}} b_{jmt'} s_{kmt} &= -\alpha b_{jmt'} \\
(14)
\end{align*} \]

The first terms inside the parentheses are standard for the logit model; the second term captures the distortion in residual demand elasticities caused by the subsidy. The distortion makes own price elasticities more inelastic and cross price elasticities more elastic relative to a market with either no subsidy or an exogenous lump sum subsidy. The intuition is that when plan \( j \) in market \( m \) increases its bid, the subsidy increases for all plans across the nation. This distortion would be more severe if the subsidy fraction \( \lambda_t \) were higher or if Medicare subsidized the enhanced component of bids (this would be equivalent to setting \( \gamma_{jmt}=0 \) for all plans). Without subsidies, cross price elasticities with plans in different markets would be zero, but they are positive because the subsidy is determined by the bids of all plans in the nation.

Note that the outside market share, \( s_{0mt} \), not the plan’s own market share, enters the subsidy distortion. With a larger subsidy, inside goods become more attractive relative to the outside option. Insurers internalize the subsidy distortion and will have higher markups, more so for large national insurers with high enrollments (those with high weights \( \tilde{w}_{jmt} \)) that offer plans in many markets. Small insurers with low weights effectively treat the subsidy as exogenous.

In our supply side results, we quantify the impact of the subsidy rule on markups by comparing estimated markups from the model with an endogenously determined subsidy to estimates from a model where all insurers treat the subsidy as an exogenous lump sum amount. We also compute equilibrium subsidy payments in our counterfactuals. When the public option enters and plans reduce their bids, the subsidy amount will also fall.

In this paper, we do not explicitly endogenize the LIS premium subsidy. It is determined by insurers’ bids and calculated in a similar way to the premium subsidy that all enrollees receive.\(^\text{16}\) However, modeling it on both the supply and demand side is more complicated because not all consumers receive the same LIS subsidy amount, it is capped by the plan premium, and bidding

\(^{16}\)The LIS subsidy threshold is the weighted average of the basic component of the bids, where the weights are based on the previous year’s enrollment of LIS enrollees. It is calculated market-by-market.
decisions are driven by the auto-enrollment provision. While it may be interesting to explicitly include these factors using data that could separate LIS and regular enrollees, the LIS subsidy is not the primary focus of this paper. Moreover, our model implicitly captures these factors in the demand side (see the discussion in the demand section) which will be translated to the supply side estimates through the residual demands.

4.8 Estimating Cost

To estimate cost we assume the market is in equilibrium with all plans cream skimming and hence no selection: \( a_j = 0 \) for all plans. The system of first order conditions in equation (8) can be inverted to solve for marginal cost.

\[
c_t = b_t + \Delta^{-1}s_t
\]

where \( \Delta \) is a matrix of own and cross price share derivatives appropriately defined for a multiproduct firm. It has elements \( \frac{\partial s_j}{\partial b_j} \) for own share derivatives along the diagonal, \( \frac{\partial s_j}{\partial b_k} \) as off diagonal terms if the same firm offers plans \( k \) and \( j \), otherwise zero. The boldface terms, \( c_t \), \( b_t \), and \( s_t \) are vectors of marginal costs, bids, and shares for all plans and markets in year \( t \).

Under the assumption that the market is in equilibrium, the inversion allows us to estimate cost without any data on cost. We only need data on bids, market shares, and demand elasticity estimates from the demand model. Note that the first order conditions in equation (8) show that a plan’s average risk score, \( r_j \), does not matter for the bid. Thus we estimate the parameter \( c_j \), not non-risked adjusted cost \( c_j r_j \).

5 Data

We collected publicly available data from the Center for Medicare and Medicaid Services (CMS) on plan level enrollment and bids for all stand-alone Part D plans offered since the the programs inception in 2006 through 2009. We also purchased detailed data on plan characteristics from CMS. There are four files. The formulary file lists all drugs on a plan’s formulary, the beneficiary cost file describes cost sharing rules, the pharmacy network file lists all preferred and non-preferred pharmacies, and the pricing file reports average drug transaction prices for every drug and plan. The pricing file was first published in 2009, the other files are available in all years. The reported prices measure the average transaction price net of all rebates for a 30 day supply filled at the plan’s preferred pharmacies in Q3 2009.\(^{17}\) These prices are used to calculate

\(^{17}\)Plans report all transactions, called Prescription Drug Events (PDE) to CMS. A PDE includes information on prices and all rebates/discounts with manufacturers, wholesalers, and pharmacies. Rebate details are proprietary, only the net, after rebate price is available to researchers. Some pharmacies charge a dispensing fee,
enrollee drug expenditures. It’s worth noting that enrollees may not know the exact drug price during the enrollment period because drug prices and rebates vary throughout the year and prices reported by the “Plan Finder” tool on Medicare’s website are not necessarily accurate.

5.1 Enrollment and Premiums

Table 6 reports summary statistics on enrollment and premiums. Most insurers offer 1, 2, or 3 plans per market, with at least one being a basic plan. There is a nearly equal number of basic and enhanced plans. Basic plans attract about 3 times as many enrollees. Average market shares are small (1.1% for basic and 0.4% for enhanced), but there is a lot of variation and skew. The largest plans command up to an 18% share. The market penetration of insurers is also quite skewed; 18 national firms offer plans in all states, while 44 regional insurers offer plans in just one market. Monthly premiums, \( p_{jmt} \), average about $30 for basic plans and are much higher, $50 on average, for enhanced plans. There is a lot of variation in premiums which helps identify demand elasticities. The subsidy amount, \( \lambda_t \), is about $53 in 2007-2009 and $60 in 2006.

5.2 Plan Characteristics

Our primary plan characteristic variables measure the generosity of plans’ coverage. Our first variable is the deductible. It highly differentiates basic and enhanced plans: 95% of enhanced plans have a $0 deductible, while 2/3 of basic plans have the full deductible. The second and third variables are intended to measure the generosity of coverage in the initial coverage and donut hole regions. The challenge is to convert our rich drug-level data on copay/coinsurance rates and prices into meaningful plan-level characteristics.

We construct price indices for the top 100 most popular drugs ranked by prescriptions filled.\(^{19}\) Our first price index reflects the out-of-pocket cost for an enrollee to fill a 30 day supply for a basket of the 100 drugs when they are in the initial coverage zone. Our second price index reflects out-of-pocket costs in the donut hole. The basket of drugs evenly weights each drug (1/100th). These measures capture a plan’s average coverage generosity across drugs.

---

\(^{18}\)Every two weeks plans are required to submit a separate pricing file to CMS that is used in the plan finder database. The database is not constructed from PDE records. If the plan never submits a price, the finder reports a price 30% below the average wholesale price for generic drugs, 10% below for brand name drugs. Even if a plan submits a price, it may not get updated every 2 weeks, so the prices can be outdated. Recently, Medicare began reporting survey results that ask enrollees to rate the accuracy of drug prices paid at the pharmacy relative to prices reported on the plan finder. Many plans get very poor ratings.

\(^{19}\)CMS published a report ranking the top 100 drugs by number of prescriptions filled by Part D enrollees in 2006.
Constructing out-of-pocket costs is straightforward for drugs covered by a copay. For drugs covered by coinsurance, it is necessary to know the price of the drug. We use the 2009 pricing file. For off-formulary drugs, enrollees do not receive coverage, therefore the out-of-pocket cost is the full retail price. We set the retail price to the average price in the region. We do not construct a price index for the catastrophic region because there is virtually no variation across plans.\(^{20}\)

Table 7 reports statistics on out-of-pocket price indices for the top 100 drugs and separate indices for brand and generic drugs. Average prices are higher in the donut hole than the initial coverage zone because many plans do not have donut hole coverage. Like the deductible, donut hole coverage is an important factor differentiating basic and enhanced plans. There is a lot of variation in the initial coverage zone despite the requirement that all plans must offer coverage that is actuarially equivalent to a 25% coinsurance rate. Much of the variation stems from differences in copay and coinsurance rates. Comparing brand and generic drugs, the variation is larger for brand name drugs.

Besides copay and coinsurance rates, there are two other sources of variation in the price index variables: negotiated drug prices and the composition of drugs on the formularies. Figure 3 shows a histogram of negotiated prices in 2009 for the entire universe of Part D drugs, over 5300. To compare across drugs, we record prices as percent deviations from the drug’s average price. There is a lot of price dispersion. To give a sense of magnitude, 10% of drugs are priced 25% below the average, and 10% are priced 15% above average. The dispersion is quite remarkable considering drugs are perfectly homogenous products.

Table 8 reports statistics on the composition of drug formularies measured by counting the number of top 100 drugs (42 brand and 58 generic) included on formularies. Omitting drugs from the formulary raises the price index variable because enrollees must pay full retail price. On average plans cover most of the drugs (more than 90%). But there is significant variation that appears to have grown over the years, indicating plans are more differentiated now than in 2006. There is little difference between enhanced and basic plans.

Figure 2 depicts the drugs covered by formularies in 2009 across the full spectrum, not just the top 100. The most comprehensive formularies include almost all drugs while the least comprehensive cover less than half. All else equal, enrollees (weakly) prefer more comprehensive formularies. There is substantial idiosyncratic variation in formularies. Gaps in the figure show that less comprehensive formularies are not strict subsets of more comprehensive formularies. Note also that insurers typically share formularies for their plans. Across all four years and regions there are 6679 plans and 400 formularies offered by 75 insurers.

\(^{20}\)The Part D regulations do not allow plans to use a tiered copay/coinsurance structure in the catastrophic region. Out-of-pocket payments are capped at $5 per prescription or 5% of drug cost. There is little variation across plans. Moreover, few enrollees, only 8% in 2006 reached the catastrophic region.
From our data on pharmacy networks, we construct a measure of network coverage by counting the number of in-region network pharmacies per eligible Medicare beneficiary in the region. We group preferred and non-preferred pharmacies because many plans do not make a distinction.

6 Estimation

In this section, we first discuss identification of the demand model and then report demand estimates and supply-side cost estimates.

6.1 Identification of Demand Model

In our model, the monthly premium is an endogenous variable that is potentially correlated with omitted plan characteristics in $\xi_{jmt}$. We account for endogeneity using formulary fixed effects and instrumental variables. One important omitted characteristic is the quality of a plan’s formulary across the full spectrum of 5300 drugs. Plans that cover many high quality, high cost drugs with few usage restrictions will tend to have higher premiums. The formulary fixed effects control for this source of omitted variable bias. Note also that formulary fixed effects capture the extent to which cream skimming practices reduce the average desirability of a plan. There is sufficient within formulary variation in the data to estimate the model because insurers share formularies across their plans. Formularies are distinct across years and thus absorb year fixed effects.

We use the instruments proposed in BLP to instrument for the monthly premium: the sum of the observable product characteristics offered by rival firms and by the firm’s other plans. These instruments measure a plan’s isolation in product space. They provide valid exclusion restrictions because only own-plan characteristics enter the utility specification in equation (1) and are correlated with price through the Bertrand supply-side model of competition. Plans located in a densely populated region of the product space will have lower premiums than plans in an isolated region.

These instruments are valid if the observed product characteristics are themselves exogenous and not correlated with plan-year specific demand shocks, $\xi_{jmt}$. There are four issues that could raise concern: strategic product positioning, cream skimming, drug price negotiating positions, and plan entry/exit. The instruments are constructed from the deductible and out-of-pocket price indices, which measure the benefit design, and the pharmacy network variable. To a first-order, the benefit design (depicted in figure 1) is exogenous because it is regulated by Medicare not chosen by insurers. This regulation limit insurers’ abilities to strategically reposition their products. They are further limited because each insurer must offer at least one basic plan.
and insurers cannot change enhanced plans into basic plans. Large adjustments are made infrequently in a lumpy matter, typically coinciding with a merger event (Chorniy et al., 2013).

If demand shocks are correlated with insurers’ cream skimming incentives, there is concern that coverage characteristics are adjusted to facilitate cream skimming. We follow the view in the literature (McAdams and Schwarz, 2007; Hsu et al., 2009) that changes to the broad benefit design—used to construct instruments—only affect risk scores $r_{jmt}$, not selection factors. Risk adjustment payments eliminate incentives to cream skim with respect to risk scores. The formulary management techniques that matter for selection factors are controlled for in the formulary fixed effects.

Demand shocks that boost enrollment could improve an insurer’s ability to negotiate drug prices which would then impact the out-of-pocket price indices. However shocks at the plan-year level likely have a negligible effect because negotiating power is determined by enrollment at an aggregated, national level. Moreover, negotiated prices in Part D are influenced by the external activity of insurers’ (and the pharmacy benefit managers they contract with) in markets outside Part D (Lakdawalla and Yin, 2010).

The final concern, relevant for the own-insurer instruments, is whether demand shocks to $\xi_{jmt}$ affect the entry and exit of plans and hence the number of plan offerings. Our data suggests this is unlikely. Many extremely low enrollment (low $\xi_{jmt}$) plans survived in the market, and a mass exodus of plans didn’t occur until 2011 (after our sample period) when new regulations forced insurers to drop or consolidate substantially similar and low enrollment plans.

With aggregate market share data, the random coefficients are identified off of variation in choice sets and product characteristics across markets. There is some variation as indicated by the standard deviation on the number of plan offerings in table 5, but the variation is limited because the product space is fairly dense in the observable characteristics. Formulary fixed effects amplify these concerns because the estimates rely on within formulary variation. We overcome the limitation by using a large number of markets pooled across the years 2006 through 2009. We specify a Normal distribution over the random coefficients with a block diagonal covariance matrix. We experimented with other specifications—non-zero random coefficient correlations and mixtures with discrete type models (Berry and Jia, 2010)—that would allow for correlation in the random coefficients. In principle these models may be identified with aggregate data, however the BLP algorithm indicated numerical instability as small perturbations caused the correlation to swing between 1 and 0.

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As in Marsh (2010), kinks in the tariff schedule at the deductible and donut hole induce bunching and gaps in drug expenditures that could be captured with discrete types.
Table 1: Demand Estimates

<table>
<thead>
<tr>
<th></th>
<th>Non-Random Coefficient</th>
<th>Random Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No IV FE</td>
<td>IV No FE</td>
</tr>
<tr>
<td>Monthly Premium</td>
<td>-.042 (.002)</td>
<td>-.049 (.005)</td>
</tr>
<tr>
<td>Std Dev (Premium)</td>
<td></td>
<td>(.056)</td>
</tr>
<tr>
<td>Annual Deductible/12</td>
<td>.005 (.002)</td>
<td>-.002 (.003)</td>
</tr>
<tr>
<td>Std Dev (Deductible)</td>
<td></td>
<td>(.135)</td>
</tr>
<tr>
<td>Initial Coverage</td>
<td>Price Index</td>
<td>-.084 (.011)</td>
</tr>
<tr>
<td>Std Dev (Index)</td>
<td></td>
<td>(.038)</td>
</tr>
<tr>
<td>Donut Hole</td>
<td>Price Index</td>
<td>-.024 (.006)</td>
</tr>
<tr>
<td>Std Dev (Index)</td>
<td></td>
<td>(.015)</td>
</tr>
<tr>
<td>Pharm per Eligible (×1000)</td>
<td>1.65 (.09)</td>
<td>1.65 (.11)</td>
</tr>
<tr>
<td>N Obs</td>
<td>6679</td>
<td>6679</td>
</tr>
<tr>
<td>N Sims</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>GMM Obj Func</td>
<td>—</td>
<td>731.07</td>
</tr>
<tr>
<td>Formulary Fixed Effects</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>IV</td>
<td>N</td>
<td>Y</td>
</tr>
</tbody>
</table>

Standard errors in parentheses. The estimates on the 400 formulary fixed effects are suppressed. We pool the years 2006 to 2009 for a total of 6679 plan observations. The random coefficient specifications use 70 simulated households. The IV and random coefficient specifications use BLP instruments for the monthly premium. See appendix for further details on the estimation.

6.2 Demand Estimate Results

Table 1 reports estimates across several specifications. The first three columns report results for non-random coefficient specifications and the last two with random coefficients. In all specifications the signs on the coefficients are as expected. The average household prefers lower premiums, more generous coverage with respect to the deductible and coverage in the initial coverage zone and donut hole, and larger pharmacy networks.

The first three non-random coefficient specifications illustrate the importance of using both instrumental variables and formulary fixed effects. With both, the coefficient on monthly premium is -0.136, substantially larger in magnitude than the specification that drops fixed effects (-0.049) and the specification that doesn’t instrument (-0.042). We would expect omitted variable bias to attenuate in this direction. The estimated coefficients on coverage characteristics are also higher in the specification with fixed effects. This suggests the fixed effects may be purging correlation between unobserved formulary composition and the measured coverage gen-

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Table 2: Select Own and Cross Price Elasticities

<table>
<thead>
<tr>
<th>Firm</th>
<th>Benefit Type</th>
<th>Deductible</th>
<th>Plan</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humana</td>
<td>Enhanced</td>
<td>0</td>
<td>1</td>
<td>-7.19</td>
<td>.139</td>
<td>.034</td>
<td>.011</td>
<td>.111</td>
<td>.079</td>
</tr>
<tr>
<td>Humana</td>
<td>Enhanced</td>
<td>0</td>
<td>2</td>
<td>.346</td>
<td>-14.78</td>
<td>.045</td>
<td>.014</td>
<td>.111</td>
<td>.100</td>
</tr>
<tr>
<td>Humana</td>
<td>Basic</td>
<td>295</td>
<td>3</td>
<td>.035</td>
<td>.019</td>
<td>-6.18</td>
<td>.306</td>
<td>.009</td>
<td>.010</td>
</tr>
<tr>
<td>United</td>
<td>Basic</td>
<td>295</td>
<td>4</td>
<td>.027</td>
<td>.021</td>
<td>.730</td>
<td>-4.40</td>
<td>.007</td>
<td>.007</td>
</tr>
<tr>
<td>United</td>
<td>Enhanced</td>
<td>0</td>
<td>5</td>
<td>.345</td>
<td>.138</td>
<td>.027</td>
<td>.009</td>
<td>-6.53</td>
<td>.080</td>
</tr>
<tr>
<td>United</td>
<td>Enhanced</td>
<td>0</td>
<td>6</td>
<td>.337</td>
<td>.171</td>
<td>.039</td>
<td>.012</td>
<td>.110</td>
<td>-11.08</td>
</tr>
</tbody>
</table>

This table reports select own and cross price elasticities for the largest insurers in the 2009 South Carolina market. It illustrates that cross price elasticities are higher amongst plans of similar characteristics. In the non-random coefficient logit model, the cross price elasticities would be constant down the columns and would not depend on product characteristics.

The last two columns report results for specifications with random coefficients. The final column is our most flexible specification that has random coefficients on the premium and all of the coverage generosity variables. We use it for the supply-side estimates and counterfactual exercises. Consider the various sources of preference heterogeneity. Most of the heterogeneity comes from the deductible as indicated by the large standard deviation. There is less heterogeneity with respect to the premium and two out-of-pocket price indices, but they are nonetheless important to include in the model. A Wald joint hypothesis test that they are statistically zero is rejected at the 5% significance level (p-value=0.036).

Examining demand elasticities is informative for interpreting the results. Table 2 reports a demand elasticity matrix with respect to premiums (not bids) for the two largest national insurers, Humana and United Healthcare, in the 2009 South Carolina market. This is a snapshot of the elasticities but is representative of all markets and plans. Each company offers two enhanced plans that have zero deductible and one basic plan that has the 2009 deductible of $295. For all plans, own price elasticities are relatively elastic which suggests insurers should have low markups. Cross price elasticities are more interesting. The boxed entries are cross price elasticities for both insurers’ basic plans. They are much larger than the cross price elasticities with enhanced plans by a factor over 10 (compare up and down the columns). There is a similar difference in magnitude in enhanced-enhanced vs. enhanced-basic cross price elasticities. The elasticities are important for the counterfactuals because they drive the substitution patterns and pricing responses when the government plan is introduced. Random coefficients are needed to get cross price elasticities that depend on product characteristics. Under the non-random coefficient specification cross price elasticities would be constant down the columns.

Because the deductible is such an important factor for demand it is worthwhile examining the random coefficient results in more detail. There are two peculiarities. First the mean value of the coefficient on the deductible (-.284) is nearly double that of the premium (-.162). This
doesn’t make rational sense because it implies people are willing to pay approximately two additional dollars in premium to reduce the deductible by one dollar. Second, the standard deviation on the deductible (.355) is very large relative to the mean value (.284). On one tail, a large proportion of the population prefers higher deductibles, and, on the other tail, a large proportion has a very strong distaste for deductibles. There are two explanations that reconcile these peculiarities. First, the results could be driven by the sort of choice inconsistencies found in Abaluck and Gruber (2011) who document that enrollees are not rational with respect to the deductible. The second explanation is the LIS program. A high distaste for the deductible relative to the premium can be rationalized for households receiving a premium subsidy, yet still facing a deductible. For example, a 75% premium subsidy could rationalize a 4 to 1 ratio of the deductible to the premium random coefficient. A positive preference for the deductible can be rationalized by the auto-enrollment provision. Because only high deductible plans are LIS eligible, the auto-enrollment demand shift is being reflected in the deductible term as a positive preference.

6.3 Cost Estimates

After obtaining demand estimates, we separately estimate marginal cost using the inversion given in equation (15). Table 3 reports enrollment weighted averages for marginal cost and markups, measured as $b - mc / mc$. We report all four years for the model with an exogenous subsidy and only 2009 for the model with an endogenously determined subsidy. Markups and marginal costs are fairly stable across time. Enhanced plans are more costly, by about $15. Despite being a concentrated industry, markups are modest, on the order of 7 to 10 percent. Interestingly, our estimates are in-line with Congressional Budget Office markup estimates for non-prescription drug plans. Basic plans have higher markups than enhanced plans. This is in part due to the enhanced component of an enhanced plan’s bid not being subsidized.

The 2009 estimates differ for the two models, indicating the importance of endogenizing the effect of bids on the subsidy payment. Markups are higher under the endogenously determined subsidy model for both basic and enhanced plans because the subsidy rules make residual demand more inelastic. Cross price elasticities are also higher which further amplifies multi-plan insurers’ incentives to markup. The increase in markups is greater for basic plans than enhanced plans because basic plans contribute more to the weighted average bid amount, $\bar{b}$. Basic plans have higher lagged enrollment on average $\bar{w}_{jmt-1}$ and only a portion $\frac{1}{1+\gamma_{jmt}}$ of the bid on enhanced plans counts towards the determination of the subsidy. The difference in

\cite{22}Due to data limitations we cannot estimate the model with endogenously determined subsidies for the years 2006-2008. See appendix for details.

\cite{23}Source: CBO July 22, 2010 letter “Analysis of a Proposal to Offer a Public Plan Through the New Health Insurance Exchanges.” They estimate 5 to 7 percent markups for non-prescription drug health plans.
Table 3: Marginal Cost and Markup Estimates

<table>
<thead>
<tr>
<th></th>
<th>Avg MC ($)</th>
<th>Avg Markup (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Basic</td>
<td>Enhanced</td>
</tr>
<tr>
<td>Exogenous Lump Sum Subsidy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>76.06</td>
<td>87.81</td>
</tr>
<tr>
<td>2007</td>
<td>69.46</td>
<td>86.58</td>
</tr>
<tr>
<td>2008</td>
<td>72.08</td>
<td>86.60</td>
</tr>
<tr>
<td>2009</td>
<td>77.67</td>
<td>92.14</td>
</tr>
<tr>
<td>Endogenously Determined Subsidy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>77.26</td>
<td>91.93</td>
</tr>
</tbody>
</table>

This table reports enrollment weighted averages of our estimates for marginal cost and markups $\frac{b-mc}{mc}$. The top panel reports estimates for the model that treats the subsidy as an exogenous lump sum amount, and the bottom panel reports for the model that has an endogenously determined subsidy amount. We lack data to estimate cost with the endogenously determined subsidy in earlier years.

markups between the two models is not large, but nonetheless suggests there could be some small reductions in prices with an equal sized exogenous lump sum subsidy.\(^{24}\)

These estimates are potentially biased if there is selection on observable plan characteristics and price. The model in the appendix suggests our marginal cost estimates might be biased downward for basic plans and biased upward for enhanced plans. But, we believe the bias is small due to the high degree of competition.

7 Counterfactuals: Introducing a Government Plan

In our counterfactuals, the government introduces a basic plan that sells alongside the existing plans offered by private insurers. The first set of counterfactuals represent a world in which the government plan cream skims and does not induce selection. These counterfactuals isolate competition and market power effects with endogenous premium subsidies. The second set of counterfactuals assumes the government plan does not cream and thus induces selection. The government plan attracts high $a_i$ enrollees, leaving private insurers with low $a_i$ enrollees. These counterfactuals show how the risk adjustment mechanism alters pricing when there is selection.

7.1 Counterfactuals: No-Selection Case

We conduct the counterfactuals for 2009. We construct the government plan characteristics to match those of basic plans. The deductible is set according to the basic plan guidelines: $\$295

\(^{24}\)This claim is only suggestive because we do not run a counterfactual that recomputes bids with an exogenous equal-sized subsidy based on the marginal cost parameter estimates from the endogenously determined subsidy model.
in 2009. The other observable characteristics, initial coverage and donut hole price indices and pharmacy network size, are set equal to the national average of basic plans. The unobservable component of plan quality, $\xi$ and cost $c$ are also set equal to the average for basic plans. Without selection, we assume $a = 0$ for the government plan and all private plans and, without loss of generality, assume $r = 1$ for all plans. An additional $\epsilon_{ijmt}$ for the government plan is justified by idiosyncratic differences in its formulary such as composition, negotiated drug prices, and copay/coinsurance tiers.

We vary the government plan’s cost to explore the possibility that the government may have a strong bargaining position with drug manufacturers (low cost), or manage its plan inefficiently (high cost). Whereas private plans choose bids to maximize profits in equation (5), the government plan sets its bid to make zero profits. In the no-selection case, this implies setting $b = c$. The government plan’s premium is subsidized according to the same rules as private plans. In the spirit of the legislation (competing on a level playing field), the government plan gets a weight of zero in the calculation of $\bar{b}$, as is the case for all new entrants. We base the counterfactual on the cost estimates from the endogenously determined subsidy model and use the random coefficient specification in the last column of table 1. To calculate the new equilibrium, we numerically solve for the bid vector that satisfies the system of first order conditions in equation (7).

Table 4 summarizes our key findings. The columns represent four different scenarios about the government’s cost. They range from a very low cost plan with a marginal cost $\$20$ lower than the average privately offered basic plan, to a high cost plan with a $\$10$ higher cost. The very low cost scenario sets the government plan cost about 25% lower than the average private plan and is comparable in magnitude to the drug discounts negotiated by the other government programs such as Medicaid, Veterans Affairs, and Medicare Canada. Our cost estimates indicate that about 1% of private plans have cost $\$20$ lower than average. Alternatively, these four scenarios can be interpreted to represent different levels of the average desirability, $\xi_{jmt}$, of the government plan.

Consider the effect on enrollment. If the government plan has average cost, it captures 1.41% of potential enrollees across the nation, which is about average. In most markets it would be a top 10 to 15 plan (out of 40 to 50). National enrollment in stand-alone Part D plans (private + government) increases minimally, 0.32 percentage points. The government gains most of its enrollment by crowding out private plan enrollment, it steals 1.09% of potential enrollees from private plans. A high cost government plan would be a fringe plan with 0.46% of potential enrollees.

---

25 Even if there is heterogeneity in $r$ across plans and the introduction of the government plan shifts the distribution of $r$ across plans, bid setting will not be affected in the no-selection case, and aggregate risk adjustment payments will not change.

26 The effects of a low $p_j$ and a high $\xi_j$ would be identical if the variance on the price random coefficient is zero. Our estimated variance in table 1 is relatively low.
Table 4: Counterfactual: Introducing a Government Plan, No-Selection Case

<table>
<thead>
<tr>
<th>Govt plan MC difference from avg</th>
<th>Very Low</th>
<th>Low</th>
<th>Average</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$-20</td>
<td>$-10</td>
<td>$0</td>
<td>$+10</td>
</tr>
<tr>
<td><strong>Govt Plan's Cost Position</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$-20</td>
<td>$-10</td>
<td>$0</td>
<td>$+10</td>
</tr>
<tr>
<td>Govt Plan (%)</td>
<td>8.59</td>
<td>3.85</td>
<td>1.41</td>
<td>0.46</td>
</tr>
<tr>
<td>Private Plans w/ Govt (%)</td>
<td>26.60</td>
<td>30.39</td>
<td>32.43</td>
<td>33.32</td>
</tr>
<tr>
<td>Private Plans w/out Govt (%)</td>
<td>33.52</td>
<td>33.52</td>
<td>33.52</td>
<td>33.52</td>
</tr>
<tr>
<td>Δ Govt+Private (%)</td>
<td>1.67</td>
<td>0.64</td>
<td>0.32</td>
<td>0.16</td>
</tr>
<tr>
<td><strong>Basic vs Enhanced</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>avg Δ Monthly Bid ($)†</td>
<td>-1.16</td>
<td>-0.11</td>
<td>-0.04</td>
<td>-0.01</td>
</tr>
<tr>
<td>Δ Enrollment (%)</td>
<td>-15.04</td>
<td>-4.45</td>
<td>-1.69</td>
<td>-0.64</td>
</tr>
<tr>
<td><strong>Welfare Calculations</strong> (at national level, annual basis)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CV ($ mil.)</td>
<td>565.7</td>
<td>221.2</td>
<td>78.4</td>
<td>28.0</td>
</tr>
<tr>
<td>Δ Industry Profit ($ mil.)**</td>
<td>-310.9</td>
<td>-145.8</td>
<td>-53.1</td>
<td>-15.4</td>
</tr>
<tr>
<td>Δ Total Surplus (CV+PS) ($ mil.)</td>
<td>254.8</td>
<td>75.4</td>
<td>25.3</td>
<td>12.6</td>
</tr>
<tr>
<td>Δ Monthly per Enrollee Subsidy ($)</td>
<td>-0.022</td>
<td>-0.041</td>
<td>-0.0208</td>
<td>-0.0067</td>
</tr>
<tr>
<td>Δ Total Subsidy ($)</td>
<td>258.5</td>
<td>105.4</td>
<td>47.2</td>
<td>24.8</td>
</tr>
<tr>
<td>Δ Total Surplus (CV+PS-Subsidy) ($ mil.)</td>
<td>-3.7</td>
<td>-30.0</td>
<td>-21.9</td>
<td>-12.2</td>
</tr>
</tbody>
</table>

* 45 million potential enrollees
** $1.4 billion estimated industry profits without govt plan
† Enrollment weighted average

enrollees and have a negligible effect on private plans.

The results are more interesting if the government plan has a cost advantage. With a $10 cost advantage, it is a top 5 plan in most markets, and nationally it captures 3.85% of potential enrollees. Total enrollment in stand-alone Part D plans increases modestly, 0.64 percentage points. In this case, the government plan is a major player, but the crowding out of private plan competition remains modest (3.21%). The effects amplify for a very low cost government plan, with a $20 cost advantage. It is the number 1 plan. Nationally it captures 8.59% of potential enrollees, which corresponds to an inside market share of 24.4%. Most of its market share comes from enrollees substituting out of existing plans: total enrollment in stand-alone Part D plans increases 1.67 percentage points, while private plans lose about 7 percentage points of market share. A common pattern in all of the cases is that there is relatively little gain in overall enrollment in stand-alone Part D plans, but rather relatively large shifts in market shares from private plans to the government plan.

The middle panel of table 4 breaks down the private plans’ pricing response and enrollment changes for basic and enhanced plans. The primary effect on competition comes not in the form of lower prices, but rather crowding out of private plans’ market shares. On average, plans
make minor adjustments to their bids. In the most extreme case of a very low cost government plan, basic plans—the closest in product space to the government plan—reduce their monthly bids by an average of 19 cents. This is a small adjustment considering the average bid is $90. Enhanced plans adjust even less, just over a penny. Despite the government plan having similar observable plan characteristics, $X_{jmt}$, to privately offered basic plans, insurers sustain their markups because they maintain a sufficient degree of product differentiation through formulary differentiation as captured in the $\epsilon_{ijmt}$ terms. The small adjustment in pricing is also an artifact of the premium subsidy rules that makes residual demand relatively inelastic. With a lump sum subsidy private insurers would have lowered prices by a larger amount.

Most of the differences between basic and enhanced plans are found in enrollment. Competing against an average cost government plan, basic plans lose 3.5% of their enrollees. Enhanced plans lose just .3%. Against a low and very low cost government plan, basic plans lose 12% and 15%. Enhanced plans lose much fewer, 1.7% and 4.5%. These differing effects illustrate the importance of modeling a differentiated products market with substitutions patterns that depend on product characteristics. The market is effectively separated into one for basic plans and one for enhanced plans.

Consider the effect on consumer surplus and industry profits. Following the convention in the literature, we measure consumer surplus using compensating variation (CV): the dollar value of income consumers would have to be compensated to give up the option of a government plan. Consumer gains stem from having a product added to the market (an extra $\epsilon_{ijmt}$ for the government plan) and lower prices. Insurers lose profits from the combination of lower prices and lower market shares. For an average cost government plan, the effects are small. Consumer surplus increases by $78.4 million, while industry profits decrease by $53.1 million. Net, total surplus (CV+$\Delta$ profits, excluding subsidies) increases just $25.3 million. With 45 million eligible Medicare beneficiaries, per capita consumer surplus increases less than $2 a year. Profit losses are about 4% of the estimated $1.4 billion industry profits in 2009. The effects are almost nil for a high cost government plan.

The welfare effects are substantial for a low and very low cost government plan. For a low cost plan, consumer surplus increases $221 million, industry profits fall by $146 million. That works out to an average of about $5 per consumer, and a profit decline of about 10%. Total surplus increases by just $75 million. The effects amplify with a very low cost government plan. Consumer surplus increases $565 million, about $12 per person, and industry profits fall $310 million, a 22% drop. This is a significant shift in surplus from industry to consumers, with an appreciable $255 million increase in total surplus.

For a complete picture of welfare it is necessary to consider government subsidies tied to the Part D program. Although the government plan is budget neutral (bid set at cost), its

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27See Nevo (2000b) for the formula and further explanation of calculations.
introduction impacts equilibrium premium subsidy payments. Note, in the no-selection case we do not need to consider risk adjustment and risk corridor payments because they do not change. There are two margins to consider for determining the change in premium subsidies paid by Medicare. The intensive margin regards the change in the per-person subsidy amount, and the extensive margin regards the change in the number of people receiving a subsidy. The per enrollee premium subsidy, \((1 - \lambda)\bar{b}\) falls as private plans lower their bids in response to the entry of the government plan, but by a small amount. It falls $0.0208 per month with an average cost government plan and $0.0922 with a very low cost government plan. Along the intensive margin, the public option generates cost savings for the Part D program that apply to enrollees in both stand-alone Part D plans and MA+Part D plans. These cost savings will further expand in the following year when a public option’s bid, set at cost, is directly included in computation of the subsidy amount.

On the extensive margin, the number of enrollees in Part D plans increases with the introduction of a government plan. Because the per-enrollee premium subsidy for stand-alone Part D plans is high relative to the less subsidized outside options, the crowding-in of enrollees to Part D causes total subsidy payments to rise. Households from three groups in the outside option will substitute in: MA+Part D, Retiree Drug Subsidy (RDS) program, and other non-Part D subsidized options (non-enrollees and those covered by plans outside the Part D legislation). To compute the change in subsidies it is necessary to gauge the per-person subsidy amounts for the three groups. MA+Part D enrollees receive the largest subsidy (equal to the Part D subsidy 64%); RDS enrollees much less (28%); non-subsidized receive zero. Enrollees switching from MA+Part D plans to stand-alone plans have no net effect on subsidies, while non-subsidized and RDS households switching in cause subsidies to rise. We calculate the change in subsidies along the intensive margin using our estimated substitution patterns with the outside option and data on the number of people in each of the three groups. But, due to some data limitations these calculations should be regarded as approximate.\(^{28}\)

The premium subsidy payments decrease slightly on the intensive margin, yet increase a lot on the extensive margin. Interestingly, the net increase completely wipes out all gains in total surplus regardless of the government’s cost position. For an average cost government plan, subsidy payments increase $47.2 million which causes a decrease in total surplus \((CV + \Delta\text{profits}-\Delta\text{subsidy})\) of $21.9 million. For a very low cost government plan subsidies increase $258.5 million resulting in a total surplus loss of $3.7 million. Although these calculations are approximate and do not include all subsidies (notably LIS subsidies), this exercise illustrates the importance of accounting for the many, and somewhat convoluted, subsidies and taxes built into a government health insurance program.

\(^{28}\)See appendix for details about the calculations.
7.2 Counterfactuals: Selection-Case

The next set of counterfactuals recomputes the market equilibrium under the assumption that the introduction of the government plan induces selection. Specifically, we assume the government plan does not cream skim. According to the cream skimming game, the government plan will have a selection factor of $a_{govt} > 0$ and private plans, that continue to cream skim, have selection factors $a_{private} < 0$. Nothing in our data allows us to specify the degree of selection that might occur, so we calibrate the degree to match that found in the Medicare Advantage/FFS Medicare market. Brown et al. (2011) show that, conditional on risk scores, enrollees in private MA plans are $1218$ less costly than enrollees in FFS Medicare. Given an average per enrollee cost of $6491$, there is a $20\% \ (\approx 1218/6491)$ difference in selection factors. For our counterfactuals, we impose the same difference in selection such that $a_{govt} - a_{private} = 0.2$ for all markets.

For the selection counterfactuals, we hold the government plan and private insurers costs’ $c(r+a)$ fixed and only vary selection factors. We set cost $c(r+a) = c$, for any possible value of $a$ by normalizing $r = 1 - a$ for all plans (private and government). We make this normalization of risk scores to make it easier to compare results in the selection and no-selection counterfactual cases and to isolate the pricing response caused by changes to the selection factor $a$, not changes in cost. Following the symmetry assumption of the cream skimming game, we let $a_{private}$ be the same for all private plans in a market.

The cream skimming game imposes the additional requirement that the $a_j$ terms must average out to zero as given by the market clearing equation (6). Therefore, while the difference between $a_{govt}$ and $a_{private}$ is set at 0.2, the actual values of $a_{govt}$ and $a_{private}$ depend on market shares and vary across markets. For example, in markets where the equilibrium market share of the government plan, $s_{govt}$, is very small, its $a_{govt}$ will be near 0.2, and the private plans’ $a_{private}$ will be a hair below 0. We fix the selection factor for the outside option $a_0 = 0$, so that selection only occurs amongst inside options.

We maintain the condition that the government plan makes zero profit. However, with selection, this does not imply setting the bid at cost. The public option has to overcome risk adjustment deductions by setting its bid $b$ above cost $c$. Holding fixed $a$ and $r = 1 - a$, the profit equation (5) shows the zero profit bid in a market is given by

$$b = c \frac{1 - \theta a}{1 - a}.$$ 

The bid increases as the selection factor $a$ increases, yet that increase is tempered by the risk corridor parameter $\theta$. In equilibrium the zero profit requirement implies the public option will have less of a competitive effect due the fact that it has to price high. But with a high price, it will have low enrollment, which through the market clearing condition in equation (6) moves
Table 5: Counterfactual: Introducing a Government Plan, Selection Case

<table>
<thead>
<tr>
<th>Risk Corridor Parameter (θ)</th>
<th>No Sct, (θ = 1)</th>
<th>θ = 0.5</th>
<th>θ = 0</th>
<th>θ = phased</th>
</tr>
</thead>
<tbody>
<tr>
<td>Govt plan MC ($-20 from average)</td>
<td>$60.97</td>
<td>$60.97</td>
<td>$60.97</td>
<td>$60.97</td>
</tr>
<tr>
<td>Govt plan Bid</td>
<td>$60.97</td>
<td>$66.32</td>
<td>$72.73</td>
<td>$67.00</td>
</tr>
<tr>
<td>avg Selection Factor (a_private)†</td>
<td>0 (-0.0404)</td>
<td>-0.0246</td>
<td>-0.0136</td>
<td>-0.0220</td>
</tr>
</tbody>
</table>

| Enrollment (as percentage of potential enrollees in nation)* |
|---------------|---------|---------|-------|-------|
| Govt Plan (%) | 8.38 | 5.08 | 2.82 | 4.72 |
| Private Plans w/ Govt (%) | 27.12 | 30.78 | 33.37 | 32.08 |
| Private Plans w/out Govt (%) | 33.52 | 33.52 | 33.52 | 33.52 |
| Δ Govt+Private (%) | 1.98 | 2.34 | 2.67 | 3.28 |

| Basic vs Enhanced |
|-------------------|--------|-------|-------|-------|
| avg Δ Monthly Bid ($/month)† | -0.64 | -0.20 | -1.44 | -1.29 | -1.44 | -1.43 | -1.83 | -1.65 |
| Δ Enrollment (%) | -23.89 | -5.27 | -11.92 | +2.68 | -2.38 | +5.20 | -8.00 | +6.39 |

| Welfare Calculations (at national level, annual basis, in ($ mil.)) |
|--------------------------|---------|-------|-------|
| CV ($ mil.) | 571.9 | 426.8 | 364.6 | 526.1 |
| Δ Industry Profit** | -331.7 (-289.0) | -151.9 | -52.3 | -53.3 |
| Δ Total Surplus (CV+PS) | 240.2 (282.9) | 274.9 | 312.2 | 472.8 |

| Subsidy Calculations (at national level, annual basis) |
|-----------------|--------|-------|-------|
| Δ Premium Subsidy | 244.9 | 162.1 | 366.8 | 417.3 |
| Δ Monthly per Enrollee Subsidy ($/month) | -0.27 | -0.71 | -0.24 | -0.40 |
| Δ Risk Adjustment Subsidy | 0 (174.4) | 92.4 | 35.1 | 79.2 |
| Δ Risk Corridor Subsidy | 0 (-131.8) | -46.2 | 0 | 84.9 |
| To Govt Plan | 0 (367.7) | 127.4 | 0 | 103.7 |
| From Private Plans | 0 (-499.5) | -173.6 | 0 | -18.8 |
| Δ All Subsidies (Prem+R. Adj.+R. Cor.) | 244.9 (287.6) | 208.4 | 401.9 | 581.4 |
| Δ Total Surplus (CV+PS-Subsidy) | -4.7 | +66.5 | -89.6 | -108.6 |

| * 45 million potential enrollees |
| ** $ 1.4 billion estimated industry profits without govt plan |
| † Enrollment weighted average |

The results of the selection counterfactual are presented in table 5. We only report for the $20 cost advantage case because there are pronounced results. This case can alternatively

With no cost advantage, the public option sets its price about $9 above cost. It achieves a similar market share to the no-selection case shown earlier where the public option had a $10 cost disadvantage and otherwise has little appreciable effect on the market.

a_private towards zero; hence, generating a smaller selection induced pricing distortion by private insurers. For the implementation of the counterfactual, the public option sets the same bid in all markets, such that across the nation profits are zero. It is possible that it runs a profit surplus or deficit on a market-by-market case. Apart from the differences in selection factors and the zero profit bid, we conduct the selection counterfactual cases under all of the same conditions as in the no-selection case.
be interpreted as the government plan appealing to a broader population and hence achieving a high average desirability (high $\xi_{\text{govt}}$) from not restricting its formulary for cream skimming purposes.

For computational ease we shut off the cross market premium subsidy effects by setting cross market, cross price elasticities to zero. The first column duplicates the no-selection case under this assumption. The results are close to those in table 4. This case also corresponds to the limiting case where the risk corridor parameter, $\theta = 1$, in terms of bids, market shares, CV, and total surplus. The differences (shown in parentheses) occur with respect to selection factors, risk related subsidy payments and insurer profits. The second column reports results for $\theta = .5$; in the third column $\theta = 0$. The last column represents the closest approximation to the actual risk corridor system: cost sharing phases in. For cost differences within +/- 5% there is no cost sharing; for differences between +/- 5% and +/- 10% the marginal rate of cost sharing is 50%. Beyond that the rate is 80%.

The public option bids higher in all risk corridor specifications than in the no-selection case. It prices the highest (20% above cost) when there are no risk corridor payments. It only needs to prices 10% above cost with 50% risk corridors because Medicare partially compensates the public option for its unfavorable selection of enrollees. Because of the high prices, the government plan captures a smaller market share.

The pricing distortion caused by the risk adjustment mechanism can be seen by examining the bids of private insurers. Two counteracting factors determine pricing in equilibrium. First, the government plan has to price higher at low values of $\theta$ to overcome risk adjustment deductions. The reduced competitive pressure from the higher priced government plan implies private plans’ prices will rise as $\theta$ approaches zero. Second, the first order condition in equation (7) shows the level of the selection induced pricing distortion depends on both $\theta$ and $a_{\text{private}}$. There is a direct effect of $\theta$ on pricing: private plans’ prices fall as $\theta$ approaches zero at any fixed value of $a_{\text{private}}$. However, there is an indirect effect via the market clearing condition for $a_{\text{private}}$ in equation (6). The condition requires $a_{\text{private}}$ to be closer to zero ($a_{\text{govt}}$ closer to 0.2) as $\theta$ approaches zero because the high priced government plan has a low market share. In other words, the degree of selection itself lessens as $\theta$ approaches zero, which causes private plans’ prices to rise. Combining the direct and indirect effects, the level of the selection induced pricing distortion may not be monotonic in $\theta$. Although the competitive pressure is highest at $\theta = 1$ (no selection), private plans’ bids are the lowest at $\theta = 0$ when the selection induced pricing distortion is at its highest. Basic plans bid an average of $1.44 lower, enhanced plans $1.43 lower. Pricing is very similar in the $\theta = 0.5$, just slightly higher than the $\theta = 0$ case. With lower prices in the selection cases, private plans experience less crowding out of enrollment. Overall enrollment in Part D plans (private+govt) increases by a larger amount than in the no-selection case.
In the phased-in risk corridor case, an asymmetry between private insurers and the government plan induces both to submit relatively low bids and boosts overall enrollment. The government plan bids low—comparable to the $\theta = 0.5$ case—because it receives relatively large risk corridor payments, reaching the 80% risk corridor in most markets. On the margin, most private insurers face 0% risk corridors, inducing low bids. Their favorable selection (low $a_{\text{private}}$) further lowers bids.

The market clearing condition plays a critical role in determining the counterfactual equilibrium values of $a_{\text{private}}$ and $a_{\text{govt}}$ under the assumptions that the difference is fixed at 0.2 and that $a_0 = 0$. The condition states that there is no aggregate risk selection amongst stand-alone Part D plans.\textsuperscript{30} This implies that private insurers’ collective selection advantage is limited by the size of the government plan where bad risks are enrolling. As this may be restrictive, caution should be taken when comparing results across risk corridor parameters. Also, the difference in selection factors ($a_{\text{govt}} - a_{\text{private}}$) could vary with the risk corridor parameter if insurers cream skim more intensively at low values of $\theta$.

The welfare and subsidy calculations further explore the consequences of selection. Consumers surplus increases from having a new product and lowered private insurer prices; however the benefit in each of the risk corridor cases is not as large as the no-selection case because the public option prices higher. Insurer profits fall but the drop is much less than the no-selection case. They uphold their profits by earning rents of off risk adjustment payments and they lose fewer enrollees to the government plan. The surplus split most favors insurers in the 0% and phased-in risk corridor cases.

The lower panel in table 5 tabulates subsidy payments. First consider premium subsidies in the 50% risk corridor case. With selection, subsidy payments increases along the extensive margin by a larger amount than the no-selection case because more enrollees crowd-in to the Part D market from outside options. On the intensive margin, the per-person subsidy amount falls by a larger amount because insurers submit much lower bids. Overall, premium subsidies increase by less than in the no-selection case. In the 0% and phased-in risk corridor cases, the extensive margin dominates and overall premium subsidies increase by large amounts. The per enrollee subsidy falls by a lesser amount than the 50% corridor case because lagged enrollment enters the premium subsidy computation. With a high priced basic government plan, enhanced plans face little direct competition. Therefore, insurers raise prices on enhanced plans with high lagged enrollment to keep premium subsidy payments high.

\textsuperscript{30}There are also individuals in the outside option who forgo drug coverage. If they forgo drug coverage because of cream skimming it is possible for both stand-alone and the other outside options plans to have selection factors averaging to less than zero in the cream skimming game. However, only a small proportion of the Medicare population forgoes coverage because Part D is very beneficial entitlement and the late enrollment penalty encourages enrollment (Heiss et al., 2010); behavioral phenomena on plan choice suggest factors such as inattention during the enrollment period, not matters of cream skimming, explain why individuals do not enroll (Heiss et al., 2006).
The next set of subsidy payments include risk adjustment and risk corridor payments. Additional risk adjustments are paid out to private plans that have higher risk scores and collected from the public option that has a lower risk score. Medicare is a net payer in all risk corridor specifications. Risk corridor payments are the reverse: collected from private plans, paid out to the public option. Medicare is a net collector of risk corridor payments with a 50% and 100% corridor, and net payer with a phased-in corridor because most private insurers are within the +/- 5% threshold. Even with cost $c_j(r_j + a_j)$ held fixed at $c_j$ for all plans (private + government), net risk corridor + risk adjustment payments increase because of greater enrollment. Factoring in all of the subsidies—premium, risk adjustment, and risk corridor—total subsidies increase the most with phased-in risk corridors ($581$ million) and the least with 50% risk corridors ($208$).

The complete welfare picture of the public option takes into account changes in consumer surplus, producer surplus, and all types of subsidy payments. As discussed previously, total surplus changes (CV+PS-subsidies) are a wash if there is no selection. When the public option introduces selection, there are potential welfare gains with an appropriately tuned risk corridor parameters—$+67$ million with a 50% corridor. The welfare gain is primarily driven by the selection induced pricing distortion lowering private insurer prices, not from the decrease in market power caused by the extra competition of a public option. The welfare gains are tempered, but not eliminated, by the fact that the public option prices above cost. The risk corridor parameter is critical for the welfare results—our results show total surplus falls $-90$ million with zero risk corridors. The loss is even greater with a phased-in corridor, $-108$ million. Despite relatively large gains in consumer surplus and minimal insurer losses, large premium subsidy payment increases and risk corridor payments going to the government plan generate a net welfare loss.

Although selection can increase total surplus, there are large differences in how surplus is split. Consumers gain the most from a public option when there is no selection, but, given selection occurs, they most prefer phased-in risk corridors, then 50% corridors. Insurers prefer low marginal risk corridor rates; profits dip the least with 0% and phased-in risk corridors. The preferences of tax payers, who finance the subsidies, are the opposite of insurers. They favor high risk corridor rates for private insurers. The most balanced distribution of surplus is the 50% risk corridor case, which also corresponds to case delivering a net gain in total surplus. Although the quantitative exercise should be regarded with caution due to the limitations, the results illustrate that the parameters of the risk adjustment mechanism have a large effect on total welfare and how it is distributed.

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31 The total surplus change in the $\theta = 1$ is the same as the no-selection case despite more risk adjustments being paid. The reason is that only prices and enrollment matter for welfare. The additional risk adjustment subsidies represents transfers to insurer profits. Risk adjustment payments (proportional to bids) exceed risk corridor deductions (proportional to costs) because private insurers markup their bids over cost.
8 Conclusion

In this paper, we quantitatively evaluate the consequences of a public health insurance option. We consider the existing Medicare Part D prescription drug market, which, through its similarities to the health insurance exchanges coming online in 2014, will give a glimpse of the outcomes we could expect if a public option is introduced. We estimate a flexible random coefficient discrete choice demand system for Part D plans. We find that plan characteristics separating basic plans from enhanced plans, such as deductibles and copay rates, are important demand determinants. We model an oligopoly supply-side with endogenous premium subsidy and risk adjustment payments to show how they affect pricing and to account for budgetary consequences of a public option.

In our counterfactual exercises, we introduce a basic government plan to match actual Congressional proposals for Part D. In the first exercises, we vary its cost to explore the possibility that the government has a cost advantage over private plans. These result focus on the market power distortions in an oligopoly market with premium subsidies. There are consumer surplus gains from having an additional product in the market, however, there are minimal competitive benefits. Premiums and the per-enrollee subsidy payments linked to premiums fall by a small amount. Regardless of the government plan’s cost position, the welfare gains are completely washed away by increasing subsidy payments as enrollees crowd-in to the already heavily subsidized Part D market.

The second counterfactual considers scenarios in which the public option affects the level of selection faced by private insurers. If a profit motive cannot be legislated, it is plausible that a public option won’t design its formulary in a way to cream skim. As such, it attracts relatively high cost enrollees (relative to risk scores), leaving the cream skimming private insurers with a favorably selected pool of enrollees. To satisfy the zero profit condition, the government plan has to set its price above cost to overcome risk adjustment deductions. Even if private insurer costs are unaffected by the public option, the risk adjustment and risk corridor mechanism induces private insurers to lower prices and expand market share because they earn part of their rents off of risk adjustment payments.

We explore outcomes in our counterfactual exercises calibrated to match the degree of selection observed in the MA/FFS Medicare market. The overall welfare consequences are mixed because the public option prices high and the private insurer side of the market prices lower. For appropriately tuned risk corridor parameters, it is possible to achieve welfare gains in terms of total surplus. Policy makers may also want to purposefully bias the risk scoring formula to seek out efficiency gains from the selection induced pricing distortion. However, the gains from more selection come with distributional consequences that favor private insurers.

We choose not take a stance on the public option: none of our scenarios represent Pareto
improvements over the status quo. But, we can use our results to claim that a public option is not a panacea for health insurance markets. Despite the prospects of heightened competition, the benefits to consumers are modest at best and come with the cost of increased subsidy payments and extra budgetary pressures. Matters are further complicated if the public option induces more selection. Although there can be welfare gains from selection induced pricing distortions, the gains and distribution of surplus are sensitive to the design parameters of the risk adjustment mechanism.

There are several avenues for extending this work in the future. First, a similar analysis could be conducted when data become available on the health insurance exchanges coming online in 2014. The competitive effect may be stronger in health insurance markets for hospitals and physicians because they are more localized and concentrated than for prescription drugs. Second, there are ways to extend the supply side. With individual level data on risk scores and drug usage, our model could be extended to estimate endogenous cream skimming and its interaction with pricing decisions in a full equilibrium model of imperfect competition. We also believe the bargaining process between insurers and drug manufacturers is an important cost determinant. Our counterfactual scenarios hold insurers’ costs fixed, but the introduction of a public option could alter bargaining dynamics, perhaps weakening the bargaining position of private insurers. Incorporating a bargaining model into the framework would allow us to endogenize insurers’ costs and perhaps provide guidance about the relative cost position of the government plan.

References


A. Lo Sasso and T. Buchmueller. The Effect of the State Children’s Health Insurance Program


### A Supply-side with Selection

The expanded model allows the selection factor \( a_j \), hence marginal cost \( mc_j = c_j(1 + a_j) \) of enrolling the next individual, to depend on the bids of all plans offered in a market, \( mc_{jmt}(b_{mt}) \). For the purposes of illustration assume the risk corridor parameter is set to zero, and risk scores are fixed at 1. Modifying the first order conditions in equation (7), we get

\[
\sum_{r \in J_{fmt}} \left(1 - \frac{\partial mc_r}{\partial b_{jmt}}\right) + \sum_{r \in J_{fmt}} (b_r - mc_r) \frac{\partial s_r}{\partial b_{jmt}} = 0 \quad (A.1)
\]

where the difference now is that we include the term \( \frac{\partial mc_r}{\partial b_{jmt}} = c_j \frac{\partial a_r}{\partial b_{jmt}} \) that endogenizes the impact of bidding decisions on marginal cost. Inverting the system of first order conditions market-by-market yields\(^{32}\)

\[
mc_{mt} = b_{mt} + \Delta_{mt}^{-1}s_{mt} + \Delta_{mt}^{-1}\Delta_{mt}^{MC}s_{mt} \quad (A.2)
\]

\(^{32}\)To account for adverse selection bias we do not need to consider the cross market effects caused by the subsidy, and for the purposes of illustration assume the cross market, cross price elasticities are zero.
where $\Delta_{mt}$ is the matrix of own and cross price share derivatives defined in equation (15) for market $m$ in year $t$ and $\Delta_{MC}^{MC}$ is a matrix of partial derivatives of marginal cost with respect to bids. In equation (15) the matrix of marginal cost derivatives is the zero matrix. That is, bids don’t affect marginal cost.

To derive the bias for the marginal cost estimates, we follow the intuition in Lustig (2010) to illustrate how $\Delta_{MC}^{MC}$ depends on bids.

Consider as a baseline a market with one basic plan and one enhanced plan. High $a_i$, costly to insure enrollees are also those with a high marginal utility for insurance coverage. Given their preferences, they select into enhanced plans, while the less costly enrollees select into basic plans. Selection is thus adverse. Consider the effects of the enhanced plan increasing its bid. The plan’s marginal consumers that would switch to the basic plan are those that are the least costly to insure. Only the highest cost enrollees remain, resulting in an increase in marginal cost. With this substitution pattern, the basic plan’s selection factor and marginal cost also increases in response to the enhanced plan’s bid increase. Next consider the effects of the basic plan increasing its bid. The marginal consumers that would switch to the enhanced plan are the most costly to insure. The selection effect decreases the selection factor and marginal cost for both the enhanced and basic plan.

Now, consider a market with many plans in the basic and enhanced categories and an outside option. Most substitution occurs amongst plans in the same category, not across categories. If there is heterogeneity in generosity amongst plans within a category, the selection effects are driven by a product’s position in relation to its closest substitutes. But, for the most part, the generosity of plans within a category are homogenous. The biggest generosity differences are found across categories. For example, almost all basic plans have a $250$ deductible, and almost all enhanced plans have a $0$ deductible. Thus, substitution within a category does not alter risk profiles.

Finally, consider substitution towards non-enrollment. Presumably, the absolute lowest cost, low $a_i$, individuals are on the margin of selecting non-enrollment versus basic plans. A bid increase by a basic plan not only causes some of its highest cost enrollees to switch to an enhanced plan, but also causes some of its lowest cost enrollees to switch to non-enrollment. The net selection effect dampens for basic plans.

In summary, table A.1 presents our predictions about the effect of bids on marginal cost (elements in $\Delta_{MC}^{MC}$) in the presence of adverse selection. The top panel reports the predicted effect that a bid increase has on a plan’s own cost; the bottom panel reports the effect that a bid increase has on other plans’ costs. The table distinguishes basic and enhanced plans.

Applying the predictions to the inverted FOCs in equations (15) and (A.2) allows us to sign the bias in our marginal cost estimates. We illustrate for the typical insurer that offers one basic plan, $j$, and two enhanced plans, $k$ and $l$. Recall the regulations require all insurers to
Table A.1: Effect of Bids on Cost under Adverse Selection

<table>
<thead>
<tr>
<th>Type of Plan</th>
<th>Own Plan Cost Effect $\frac{\partial MC_j}{\partial b_j}$</th>
<th>Cross Plan Cost Effect $\frac{\partial MC_r}{\partial b_j}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\frac{\partial MC_j}{\partial b_j}$</td>
<td>$&lt; 0$</td>
<td>$&gt; 0$</td>
</tr>
<tr>
<td>$\frac{\partial MC_r}{\partial b_j}$</td>
<td>$= 0$</td>
<td>$&gt; 0$</td>
</tr>
<tr>
<td>$\frac{\partial MC_r}{\partial b_j}$</td>
<td>$&lt; 0$</td>
<td>$= 0$</td>
</tr>
</tbody>
</table>

For the basic plan, all three terms are positive, therefore our marginal cost estimate that doesn’t account for adverse selection, $\hat{mc}_j$ from equation (15) will be lower than the true marginal cost $mc_j$ in equation (A.2). For an enhanced plan, the first and second terms are negative and the third term is zero; overall our marginal cost estimate will be higher than the true marginal cost.

Basic plan $j$

$$bias = mc_j - \hat{mc}_j = s_j \left( \frac{\partial s_j}{\partial b_j} \frac{\partial mc_j}{\partial b_j} + \frac{\partial s_j}{\partial b_k} \frac{\partial mc_j}{\partial b_k} + \frac{\partial s_j}{\partial b_l} \frac{\partial mc_j}{\partial b_l} \right) > 0$$

Enhanced plan $k$

$$bias = mc_k - \hat{mc}_k = s_k \left( \frac{\partial s_k}{\partial b_k} \frac{\partial mc_k}{\partial b_k} + \frac{\partial s_k}{\partial b_j} \frac{\partial mc_k}{\partial b_j} + \frac{\partial s_k}{\partial b_l} \frac{\partial mc_k}{\partial b_l} \right) < 0$$

For the basic plan, all three terms are positive, therefore our marginal cost estimate that doesn’t account for adverse selection, $\hat{mc}_j$ from equation (15) will be lower than the true marginal cost $mc_j$ in equation (A.2). For an enhanced plan, the first and second terms are negative and the third term is zero; overall our marginal cost estimate will be higher than the true marginal cost.

As for magnitudes, we expect the overall bias to be small for both basic and enhanced plans and especially small for basic plans. The overall bias is mitigated for two reasons. First, the product space is densely packed with many basic and enhanced plans which limits substitution across categories. Second, Medicare’s risk adjustment payments dampen the selection effects caused by broad plan characteristics. The bias is especially small for basic plans because selection towards non-enrollment counteracts selection towards enhanced plans. The bias is relatively high for enhanced plans because Medicare does not make risk adjustment payments for the enhanced component of the bid.
Table 5: Market Level Statistics

<table>
<thead>
<tr>
<th>Year</th>
<th>All Plans</th>
<th>Basic</th>
<th>Enhanced</th>
<th>Insurers</th>
<th>c1</th>
<th>c2</th>
<th>c4</th>
<th>HHI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>avg s.d.</td>
<td>avg s.d.</td>
<td>avg s.d.</td>
<td>avg s.d.</td>
<td>avg s.d.</td>
<td>avg s.d.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>37 14</td>
<td>21 8</td>
<td>16 6</td>
<td>14 5</td>
<td>37.5</td>
<td>58.2</td>
<td>75.7</td>
<td>2587</td>
</tr>
<tr>
<td>2007</td>
<td>46 16</td>
<td>23 8</td>
<td>20 7</td>
<td>18 6</td>
<td>37.7</td>
<td>57.6</td>
<td>75.3</td>
<td>2558</td>
</tr>
<tr>
<td>2008</td>
<td>48 15</td>
<td>24 7</td>
<td>24 8</td>
<td>18 6</td>
<td>34.0</td>
<td>52.0</td>
<td>70.0</td>
<td>2154</td>
</tr>
<tr>
<td>2009</td>
<td>43 12</td>
<td>20 6</td>
<td>23 7</td>
<td>18 5</td>
<td>34.6</td>
<td>50.1</td>
<td>70.2</td>
<td>2196</td>
</tr>
<tr>
<td>All</td>
<td>43 15</td>
<td>22 8</td>
<td>21 8</td>
<td>17 6</td>
<td>36.0</td>
<td>54.7</td>
<td>72.9</td>
<td>2376</td>
</tr>
</tbody>
</table>

There are a total of 39 markets in 2006-2007 and 38 in 2008-2009. Concentration measures averaged across markets. c1, c2, c4 represent the inside market share of the top 1,2,4 insurers in a market. According to DOJ guidelines, a HHI between 1800-2500 is “moderately concentrated”. Above “2500” highly concentrated.

Table 6: Enrollment and Premium Summary Statistics

<table>
<thead>
<tr>
<th>Subsidy</th>
<th>Basic Plans</th>
<th>Enhanced Plans</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mean s.d. min max obs</td>
<td>mean s.d. min max obs</td>
</tr>
<tr>
<td>2006</td>
<td>60.10 33.9 11.9 1.9 70.8 825</td>
<td>12.3 4.9 99.9 606</td>
</tr>
<tr>
<td>2007</td>
<td>53.08 27.6 6.4 1.9 49.0 914</td>
<td>16.4 17.1 135.7 890</td>
</tr>
<tr>
<td>2008</td>
<td>52.59 29.4 9.4 2.6 72.0 897</td>
<td>22.2 12.9 107.5 929</td>
</tr>
<tr>
<td>2009</td>
<td>53.97 33.7 10.0 1.0 112.7 734</td>
<td>22.0 10.3 136.8 884</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Region Level Market Shares (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>mean s.d. min max</td>
</tr>
<tr>
<td>2006</td>
</tr>
<tr>
<td>2007</td>
</tr>
<tr>
<td>2008</td>
</tr>
<tr>
<td>2009</td>
</tr>
</tbody>
</table>

The top panel reports summary statistics on monthly premiums for basic and enhanced plans. The subsidy column reports the per enrollee subsidy in each year. The bottom panel reports market share statistics, expressed as a ratio of the total number of eligible Medicare Beneficiaries in the plan’s region. These are not inside market shares.

B Data Tables and Figures
Table 7: Out-of-Pocket Drug Price Indices

<table>
<thead>
<tr>
<th>Year</th>
<th># plans</th>
<th>avg top100</th>
<th>s.d.</th>
<th>min</th>
<th>max</th>
<th>avg Brand(top42)</th>
<th>s.d.</th>
<th>avg Generic(top58)</th>
<th>s.d.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>1446</td>
<td>67.9</td>
<td>9.8</td>
<td>41.0</td>
<td>90.7</td>
<td>70.6</td>
<td>22.1</td>
<td>52.9</td>
<td>10.7</td>
</tr>
<tr>
<td>2007</td>
<td>1909</td>
<td>62.7</td>
<td>9.9</td>
<td>44.1</td>
<td>83.5</td>
<td>48.7</td>
<td>15.7</td>
<td>56.7</td>
<td>18.0</td>
</tr>
<tr>
<td>2008</td>
<td>1877</td>
<td>58.6</td>
<td>10.9</td>
<td>29.0</td>
<td>78.7</td>
<td>56.2</td>
<td>16.3</td>
<td>60.4</td>
<td>16.0</td>
</tr>
<tr>
<td>2009</td>
<td>1650</td>
<td>55.6</td>
<td>11.0</td>
<td>24.0</td>
<td>73.0</td>
<td>71.9</td>
<td>18.4</td>
<td>50.5</td>
<td>9.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th># plans</th>
<th>avg Donut Hole</th>
<th>s.d.</th>
<th>min</th>
<th>max</th>
<th>avg Brand(top42)</th>
<th>s.d.</th>
<th>avg Generic(top58)</th>
<th>s.d.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>1446</td>
<td>101.2</td>
<td>5.9</td>
<td>54.9</td>
<td>107.6</td>
<td>185.3</td>
<td>17.4</td>
<td>68.6</td>
<td>10.7</td>
</tr>
<tr>
<td>2007</td>
<td>1909</td>
<td>99.8</td>
<td>6.0</td>
<td>53.0</td>
<td>113.1</td>
<td>188.1</td>
<td>16.5</td>
<td>86.9</td>
<td>10.2</td>
</tr>
<tr>
<td>2008</td>
<td>1877</td>
<td>100.0</td>
<td>5.2</td>
<td>78.9</td>
<td>113.1</td>
<td>167.6</td>
<td>44.3</td>
<td>84.0</td>
<td>16.3</td>
</tr>
<tr>
<td>2009</td>
<td>1650</td>
<td>99.9</td>
<td>5.8</td>
<td>82.0</td>
<td>113.1</td>
<td>160.4</td>
<td>39.8</td>
<td>64.1</td>
<td>23.9</td>
</tr>
</tbody>
</table>

The top panel reports summary statistics for the out-of-pocket drug price indices for top 100 drugs in the initial coverage zone. The bottom panel reports for the donut hole. The price is what a consumer pays out-of-pocket for a 30 day supply. For on-formulary drugs, we first locate the copay or coinsurance rate corresponding to that drug from the beneficiary cost file. The out-of-pocket price is either the copay or coinsurance rate times the negotiated drug price found in the 2009 Q3 pricing file. For 2006-2008 we match to the plan’s negotiated price in 2009. If a plan did not exist in 2009, we use the average negotiated price in the region, or if there aren’t enough observations, the national average price. For off-formulary drugs, the consumer pays full retail price which we set equal to the regional or national average negotiated price in 2009. Our proxy for the full retail price may be understated because the pricing file reports prices after rebates and discounts. All drugs are evenly weighted in the index.

Table 8: Formulary Comprehensiveness

<table>
<thead>
<tr>
<th>Year</th>
<th># plans</th>
<th>avg top100</th>
<th>s.d.</th>
<th>avg Brand(top42)</th>
<th>s.d.</th>
<th>avg Generic(top58)</th>
<th>s.d.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>1446</td>
<td>90.5</td>
<td>5.9</td>
<td>38.7</td>
<td>3.9</td>
<td>51.5</td>
<td>3.2</td>
</tr>
<tr>
<td>2007</td>
<td>1909</td>
<td>92.1</td>
<td>6.0</td>
<td>39.0</td>
<td>3.4</td>
<td>53.2</td>
<td>3.1</td>
</tr>
<tr>
<td>2008</td>
<td>1877</td>
<td>89.2</td>
<td>7.5</td>
<td>37.6</td>
<td>4.1</td>
<td>51.6</td>
<td>3.9</td>
</tr>
<tr>
<td>2009</td>
<td>1650</td>
<td>86.8</td>
<td>9.1</td>
<td>35.6</td>
<td>5.5</td>
<td>51.2</td>
<td>4.2</td>
</tr>
</tbody>
</table>

This table reports statistics on the number of top 100 drugs on a formulary. The top 100 drugs are ranked by prescriptions filled. The table also breaks the statistics down for the 42 brand name drugs and 58 generic drugs composed in the top 100.

Table 9: Network Pharmacies

<table>
<thead>
<tr>
<th>Year</th>
<th># Network Pharmacies per Eligible Beneficiary</th>
<th>mean</th>
<th>s.d.</th>
<th>min</th>
<th>max</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>.00141</td>
<td>.00024</td>
<td>0</td>
<td>.00376</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>.00137</td>
<td>.00021</td>
<td>0</td>
<td>.00193</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>.00135</td>
<td>.00020</td>
<td>0</td>
<td>.00189</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>.00136</td>
<td>.00018</td>
<td>0</td>
<td>.00186</td>
<td></td>
</tr>
</tbody>
</table>

Summary statistics about the number of network pharmacies per eligible Medicare Beneficiary. We include both preferred and non-preferred pharmacies because many plans don’t make a distinction. These are brick-and-mortar pharmacies located in the region. We exclude out of region network pharmacies and mail order pharmacies.
The figure depicts the drugs covered on a formulary for a 1/15 sample of the 5400 drugs and a 1/3 sample of the 315 insurers offering plans in 2009. The sample includes both Part D and MA+Part D insurers. Whitespace indicates off-formulary drugs. Notice the idiosyncratic differences in formularies; that is, less comprehensive formularies are not strict subsets of more comprehensive formularies. Generic drugs, with multiple manufacturers, are counted once. Different package sizes of the same drug appear as distinct drugs.
**Figure 3: 2009 Drug Price Dispersion, Deviation from Avg Negotiated Drug Price**

This histogram displays the price dispersion in negotiated drug prices. The x-axis is the percent difference in price $p_{jd}$ for a drug $d$ offered by plan $j$ from the average price for that same drug $\bar{p}_d$ ($\frac{p_{jd} - \bar{p}_d}{\bar{p}_d}$). There are 16,781,151 drug-plan observations, 5330 drugs defined by a unique NDC (national drug code), and 4228 plans (including MA+Part D plans).
C Online Appendix: Computational Details

In this appendix we describe the computational details related to estimation and the counterfactuals.

C.1 BLP Demand Estimation

We use the simulated GMM method in Berry et al. (1995) to estimate the random coefficient demand specifications. We use 70 simulated consumers drawn identically across markets. In the inner loop contraction mapping, we set a loose convergence tolerance when far from the optimal parameters in the other loop, and then increase the tolerance when near the optimal. This saves a significant amount of computational time. We experimented with tolerance levels until we were confident the contraction mapping convergence error did not propagate to the outer loop. We minimized the GMM objective function using a simplex minimization algorithm. The algorithm converges too soon for some starting values. We used 50 random starting values which converged to 6 different sets of parameter values. Of those, we selected the one yielding the lowest value of the objective function. See Nevo (2000a) for more on the estimation algorithm.

C.2 Cost Estimation

To estimate marginal cost in the endogenously determined subsidy model we need to know the subsidy fraction $\lambda_t$, weights, $\tilde{w}_{jmt-1}$, and both the basic and enhanced components of the bid, $b_{jmt}^{\text{basic}}$ and $b_{jmt}^{\text{enhanced}}$.

Every year Medicare releases an official press announcement of the average bid amount $\bar{b}_t$ and the average basic component of the premium $\bar{b}_t - \lambda_t \bar{b}_t$. From these numbers we can calculate the subsidy fraction $\lambda_t$. The figures are reported in table C.1.

Equation (C.1) decomposes the weighted average bid calculation by stand-alone and MA+Part D plans.

$$
\bar{b}_t = \frac{\sum_{jmt} E_{jmt-1} b_{jmt}^{\text{basic}} + \sum_{kmt} E_{kmt-1} b_{kmt}^{\text{basic}}}{\sum_{jmt} E_{jmt-1} + \sum_{kmt} E_{kmt-1}}
$$

(C.1)

To calculate weights, $\tilde{w}_{jmt-1}$, for stand-alone Part D plans we use lagged enrollment, $E_{jmt-1}$, for stand-alone Part D plans and the aggregate lagged enrollment, $\sum_{kmt} E_{kmt-1}$, for the select MA+Part D plans that enters the denominator of equation (C.1).
Table C.1: Official Average Bid and Premium

<table>
<thead>
<tr>
<th></th>
<th>avg premium</th>
<th>avg bid</th>
<th>λ</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>32.20</td>
<td>92.30</td>
<td>0.651</td>
</tr>
<tr>
<td>2007</td>
<td>27.35</td>
<td>80.43</td>
<td>0.660</td>
</tr>
<tr>
<td>2008</td>
<td>27.93</td>
<td>80.52</td>
<td>0.653</td>
</tr>
<tr>
<td>2009</td>
<td>30.36</td>
<td>84.33</td>
<td>0.640</td>
</tr>
</tbody>
</table>

The avg bid and avg premium values are collected from official Medicare data releases. They are not calculated from our bid and enrollment data. We calculate the subsidy ratio as $\lambda = \frac{\text{avg bid} - \text{avg premium}}{\text{avg bid}}$.

We use data on the basic and enhanced components of the bid, $b_{jmt}^{\text{basic}}$ and $b_{jmt}^{\text{enhanced}}$, to calculate the total bid $b_{jmt}$ and enhancement ratio $\gamma_{jmt}$. These bid data are only available for stand-alone Part D plans. Table C.2 reports these statistics. CMS does not publish data that would allow us to determine the basic component of the bid for MA+Part D plans. Disentangling that part of the bid is more complicated because the plans also have MA coverage. This data omission does not prevent us from being able to estimate marginal cost for stand-alone Part D plans.

In the counterfactuals, we re-calculate $\bar{b}_t$ as stand-alone plans change their bids. Recalculating requires knowledge of $\sum_{kmt} E_{kmt-1} b_{kmt}^{\text{basic}}$ for MA+Part D plans which our model assumes does not change in the counterfactuals. Although bids are not known for individual MA+Part D plans, the summation can be recovered through inversion of equation (C.1).

We can only estimate cost in the endogenous subsidy model for 2009 because we lack a simple, yet subtle piece of information for 2006-2008. 2009 was the first year that the average bid was calculated solely based on lagged enrollment. Prior years calculated the average bid using a blend of a simple average and lagged enrollment. Below is the text from CMS describing the calculation of weights for the first year 2006.

In 2006, under section 1860D-13(a)(4)(B)(ii), CMS assigned equal weighting to plan sponsors and assigned MA+Part D plans included in the national average monthly bid amount a weight based on their prior MA enrollments on March 31, 2005.

The missing information from this text is the weight assigned to the simple average component (equal weights for plan sponsors) and the weight assigned to the lagged enrollment component (prior MA enrollment).

Under an amendment to the MMA legislation passed in mid-2006, CMS gradually introduced the lagged enrollment methodology. For 2007 and 2008 CMS blended the 2006 weighting methodology with the lagged enrollment methodology in equation (C.1). Although we know the blending ratio of the two methodologies for those years (80/20 in 2007, 60/40 in 2008), we...
Table C.2: Bid Summary Statistics

<table>
<thead>
<tr>
<th></th>
<th>Monthly Bid</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mean</td>
<td>s.d.</td>
<td>min</td>
<td>max</td>
</tr>
<tr>
<td>2006</td>
<td>97.3</td>
<td>12.6</td>
<td>62.0</td>
<td>160.0</td>
</tr>
<tr>
<td>2007</td>
<td>89.5</td>
<td>15.3</td>
<td>55.0</td>
<td>188.8</td>
</tr>
<tr>
<td>2008</td>
<td>92.2</td>
<td>19.9</td>
<td>55.2</td>
<td>160.1</td>
</tr>
<tr>
<td>2009</td>
<td>99.6</td>
<td>20.7</td>
<td>55.0</td>
<td>190.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Monthly Basic Bid Component</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mean</td>
<td>s.d.</td>
<td>min</td>
<td>max</td>
</tr>
<tr>
<td>2006</td>
<td>92.5</td>
<td>11.2</td>
<td>62.0</td>
<td>127.3</td>
</tr>
<tr>
<td>2007</td>
<td>81.5</td>
<td>7.5</td>
<td>55.0</td>
<td>111.4</td>
</tr>
<tr>
<td>2008</td>
<td>83.9</td>
<td>12.5</td>
<td>55.1</td>
<td>133.8</td>
</tr>
<tr>
<td>2009</td>
<td>90.7</td>
<td>15.0</td>
<td>55.0</td>
<td>166.7</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Monthly Enhanced Bid Component</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mean</td>
<td>s.d.</td>
<td>min</td>
<td>max</td>
</tr>
<tr>
<td>2006</td>
<td>4.8</td>
<td>9.1</td>
<td>0</td>
<td>55.3</td>
</tr>
<tr>
<td>2007</td>
<td>8.0</td>
<td>11.8</td>
<td>0</td>
<td>96.4</td>
</tr>
<tr>
<td>2008</td>
<td>8.3</td>
<td>11.8</td>
<td>0</td>
<td>55.0</td>
</tr>
<tr>
<td>2009</td>
<td>8.9</td>
<td>10.7</td>
<td>0</td>
<td>55.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Enhanced/Basic Bid Ratio</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mean</td>
<td>s.d.</td>
<td>min</td>
<td>max</td>
</tr>
<tr>
<td>2006</td>
<td>.056</td>
<td>.118</td>
<td>0</td>
<td>.716</td>
</tr>
<tr>
<td>2007</td>
<td>.097</td>
<td>.140</td>
<td>0</td>
<td>1.32</td>
</tr>
<tr>
<td>2008</td>
<td>.094</td>
<td>.134</td>
<td>0</td>
<td>.670</td>
</tr>
<tr>
<td>2009</td>
<td>.096</td>
<td>.117</td>
<td>0</td>
<td>.764</td>
</tr>
</tbody>
</table>

This table reports summary statistics on bids $b$, the basic component of bids $b_{\text{basic}}$, and the enhanced component of bids $b_{\text{enhanced}}$, where $b = b_{\text{basic}} + b_{\text{enhanced}}$. The bottom panel reports the ratio of the enhanced component to the basic component, corresponding the parameter $\gamma$ in our model. This table only includes the bids of stand-alone Part D plans.

cannot overcome the data limitation for the component that uses the 2006 weighting methodology.

### C.3 Counterfactual Subsidy Calculations

We are missing data to exactly calculate changes in premium subsidy payments when the public option is introduced, but can make two assumptions that allow us to approximate the effect on subsidies. First, we do not have data on RDS program subsidies, but we can estimate subsidies from the legislative rules. RDS plans are only subsidized for the cost component of the plan that meets the guidelines for a basic Part D plan. The cost of enhanced coverage is not subsidized. We assume an average cost for an RDS plan equal to the the average Part D basic bid, $\bar{b}$. The subsidy rate is 28% which can be compared to 64% for Part D plans. Second, we do not have market level data on the composition of the outside option for 2009, the year of our counterfactual, but we do for 2010 aggregated at the national level. The 2010 statistics
are sufficient for the purposes of our welfare calculation. In the logit model, substitution from the individual components of the outside option to inside goods is proportional to the shares of the components in the outside share. We assume those shares are the same in 2010 and 2009 and are equal across markets. There were 9.93 million enrollees in MA+Part D, 6.36 million in RDS, and 7.79 million in non-subsidized.