The workings of a private health insurance market: Enrollment decisions, plan choice, and adverse selection in Medicare Part D

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Abstract: One of the most controversial issues in health policy is whether private, non-statutory health insurance schemes succeed in providing comprehensive coverage. Overcoming adverse selection poses a major challenge to the designers of such policies. For instance, to encourage healthy individuals to enroll, the new Medicare Part D prescription drug benefit involves a combination of large subsidies and a penalty for non-enrollment. In this paper, we model enrollment and plan choice in such an environment as a discrete dynamic decision process. We then confront the predictions from our behavioral model with data on individual enrollment and plan choice from the first three years of Medicare Part D and perform counterfactual policy simulations. Our model correctly predicts high enrollment rates among the currently healthy. We thus confirm that Part D as a whole was a success in countering adverse selection at the enrollment stage. However, our simulations also show that adverse selection is nevertheless strong when it comes to choosing the level of plan generosity. In particular, our model also predicts correctly the disappearance of an entire class of enhanced plans which offer better coverage than the Part D standard plan. We find that a targeted 16 percent increase in the government subsidy of Part D would be required to preserve consumer choice in plan generosity.

Keywords: Medicare; prescription drugs; health insurance demand; consumer-directed healthcare.

JEL classification: I11; C25; D12; H51; I18.

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1 Introduction

Most developed countries have mixed "universal coverage" health-care systems with mandated health insurance financed from some combination of consumer, employer, and government sources. The United States is the only developed country without universal coverage; about 18% of the non-elderly population are currently without health insurance (Gruber, 2008). The elderly are universally covered under the Medicare program. However, historically Medicare did not cover prescription drugs – a major public concern prior to the introduction of Medicare Part D in 2006. Part D now provides the Medicare-eligible population with universal access to standardized, heavily subsidized prescription drug coverage through government-approved contracts sponsored by private insurance firms. In addition to providing access to affordable drug coverage to all Medicare beneficiaries (in particular to the chronically ill), a second policy goal was to create a "competitive, transparent marketplace offering a wide array of benefits" (Bach and McClellan, 2005). The institutional design of Medicare Part D exemplifies the current trend towards "consumer-directed healthcare" as it relies on consumer behavior and competition among insurance firms to attain satisfactory market outcomes with limited government regulation.[1]

Providing consumers with freedom of choice allows them to self-select into insurance contracts. The market for Medicare Part D contracts is thus potentially affected by all the well-known problems induced by asymmetric information among consumers, providers, and third-party insurers in health insurance markets (for a comprehensive review, see Cutler and Zeckhauser, 2000). Consequently, a number of mechanisms to mitigate adverse selection and assure broad access have been incorporated in Medicare Part D. This market is thus a bellwether for health care reforms centered on consumer choice.

Overall, the introduction of Medicare Part D has been viewed as a success story: high enrollment rates have been achieved[2], consumers face a broad menu of plans to choose from, and premiums are

[1] Policy makers around the world, and particularly in the United States, are increasingly stressing the role of consumer choice and provider competition in the provision of public services (see Newhouse, 2004; Buntin et al., 2006; Goodman, 2006; and references therein).

[2] In the first year of Medicare Part D, more than 90% of the eligible population had prescription drug coverage, either from a Medicare Part D plan or from some other source with

at levels lower than anticipated by policymakers and sponsors (Heiss, McFadden, and Winter, 2006, 2007; Goldman and Joyce, 2008; Duggan, Healy, and Scott Morton, 2008). However, as we show in this paper, the market for the most generous insurance plans has collapsed within the first three years after the introduction of Part D. Generous plans apparently have gone down a death spiral, as observed in other health insurance markets by, inter alia, Cutler and Reber (1998), and predicted for Medicare Part D by Pauly and Zeng (2004).

In this paper, we analyze enrollment and plan choice, and the success of specific regulations in countering adverse selection, during the first three years of Medicare Part D. Using a structural model of consumer choice, we show that key market outcomes – high enrollment rates and disappearance of generous plans – can be explained quite well by adverse selection in combination with the implemented risk adjustment scheme and other regulations. In particular, to encourage healthy individuals to enroll, Medicare Part D involves a combination of large subsidies and a penalty for non-enrollment. However, the consumer is free to choose between contracts with different levels of generosity (which we call "plan types" in this paper) and among different plans within each plan type. From an individual choice perspective, three opportunities for adverse selection arise: enrollment, plan type choice, and selection of plan. High overall enrollment rates thus provide only partial information about the force of adverse selection in the market for Medicare Part D plans. To our knowledge, our paper is the first to investigate the different stages of adverse selection in this market.

The degree to which an insurance market is distorted by adverse selection will depend on the degree of risk aversion of buyers and the precision with which they believe they can predict from their private information the benefits they will receive. Consumers who are risk neutral or who perceive little risk will buy policies only if they appear to be actuarially fair, and sales to these consumers will not add to sponsor profit or recover administrative cost. On the other hand, consumers who are risk adverse and perceive substantial risk will tolerate substantial loading and can be profitable for the sponsor. There is some evidence that healthy people are more risk adverse than sick people, leading to advantageous selection; see Buchmueller et al (2008), Fang, Keane, and

comparable coverage (Heiss et al., 2006).

Silverman (2006), Finkelstein and McGarry (2003), de Meza and Webb (2001), De Donder and Hindriks (2006), Mahdavi (2005), and Cutler, Finkelstein, and McGarry (2008). In our subsequent analysis, we will attribute high enrollment rates by healthy consumers in Medicare Part D to the subsidies and the option value induced by late enrollment penalties, but we should point out that they may also be in part due to advantageous selection. However, the predictability of drug benefits from past drug use implies that in the drug insurance market, adverse selection is likely to outweigh advantageous selection.

We present a structural model of enrollment and plan type choice of a rational, forward-looking consumer in an environment with uncertain future health outcomes and insurance plans characterized by a late-enrollment penalty, government subsidies, and risk adjustment (see section 2 for a discussion of these institutional features of the Medicare Part D market). Since the enrollment and plan type choice are made simultaneously, they are collapsed into a multinomial decision with outcomes "not enrolled", "enrolled in a standard plan", and "enrolled in a generous plan". (To keep the analysis tractable, we abstract from potential adverse selection at the final plan selection stage.) We calibrate the resulting discrete dynamic decision process with transition probabilities for the state variables (survival, latent health status, and prescription drug expenditure) estimated using a dynamic model of health and drug use which extends the analysis of Heiss (2008a). We then confront the simulation results with data on individual enrollment and plan type choice from the first three years of Medicare Part D, and we perform counterfactual policy simulations.

The advantages of specifying and calibrating a structural model of intertemporal choice in the context of Medicare Part D are first, that market demand for insurance plans can be predicted for counterfactual prices, and second, that alternative policies can be simulated (Rust, 1994). To our knowledge, this is the first paper that develops such a structural intertemporal model for a multinomial decision that allows for plan types with varying generosity for the Medicare Part D market, but also for insurance markets more generally. Most closely related to our dynamic discrete choice model of insurance demand is a paper by Yang et al. (2007) who analyze the choice of supplemental health insurance among Medicare beneficiaries, their medical care demand, and subsequent health outcomes. In terms of the modeling approach, a paper by Gilleskie (1998) that analyzes the decisions to visit a doctor and/or to miss work during an episode of acute illness as the sequential choices of individuals solving a discrete choice stochastic dynamic programming problem is also related to our work.

Our model correctly predicts high enrollment rates among the currently healthy. We thus confirm that Part D as a whole was a success in countering adverse selection at the enrollment stage. However, our simulations also show that adverse selection is nevertheless strong when it comes to choosing the level of plan generosity. In particular, our model also predicts correctly the disappearance of an entire class of enhanced plans which offer better coverage than the Part D standard plan. The counterfactual scenarios we consider concern the three institutional features of the Medicare Part D market mentioned above: the late-enrollment penalty, government subsidies, and risk adjustment.

The remainder of this paper is structured as follows. In section 2, we describe the new Medicare Part D prescription drug benefit and review the existing literature on Medicare Part D. We motivate our subsequent analysis with stylized facts on supply of, and demand for, Part D plans with different generosity in section 3. We then introduce our discrete dynamic decision model of enrollment and plan choice in Medicare Part D (section 4). Section 5 contains our simulation results. In section 6, we summarize our findings, draw policy conclusions, and discuss avenues for future research.

2 The Medicare Part D prescription drug benefit

Before 2006, roughly 25 percent of the U.S. elderly population (age 65 and above) had little or no insurance coverage for their prescription drugs, and 10 percent had annual pharmacy bills exceeding \$5600 (Winter et al., 2006). According to data from the U.S. Bureau of the Census (Current Population Survey, 2006, Annual Social and Economic Supplement) median per capita income in this population was \$15,700 in 2005, and 29 percent of this population had incomes below \$10,000. Uninsured prescription drug costs were thus a heavy burden on unhealthy elderly.

The Centers for Medicare and Medicaid Services (CMS) within the U.S. Department of Health and Human Services administer health insurance coverage for older Americans via the Medicare program. The Medicare Modernization Act of 2003 (MMA) was enacted to extend coverage for prescription drugs to the Medicare population. Beginning in 2006, the new Medicare Part D benefit reduced the financial burden of prescription drug spending for beneficiaries, especially those with low incomes or extraordinarily high ("catastrophic") out-of-pocket drug expenses. CMS administers this program, subsidizing outpatient prescription drug coverage offered by private sponsors of drug plans that give beneficiaries access to a standard prescription drug benefit. In the following, we describe those features of Medicare Part D that are relevant for our subsequent analysis of consumer behavior in this market. More details on the Medicare part D prescription drug benefit can be found on the CMS website and in Bach and McClellan (2005).

Critical parameters in determining Standard plan benefits are the plan formulary, the beneficiary's annual pharmacy bill for drugs in the plan formulary, the beneficiary's true out-of-pocket (TrOOP) payments for these covered drugs and threshold for catastrophic coverage, and the average monthly premium. In the benefits formula, expenditures for drugs not in the plan formulary are *not* counted in the pharmacy bill or in TrOOP payments. Part D premiums are also excluded from TrOOP payments. The Standard Medicare Part D plan had the following benefit schedule in 2006:

• The beneficiary has an annual deductible of $250.

• The beneficiary pays 25% of drug costs above $250 and up to $2,250. The TrOOP payment is then $750 for a beneficiary whose pharmacy bill has reached $2,250.

• The beneficiary pays 100% of drug costs above $2,250 and up to a TrOOP payment of $3,600; this is referred to as the *coverage gap* or *doughnut hole*. The TrOOP threshold of $3,600 is attained at a drug bill of $5,100.

• The beneficiary pays 5% of drug costs above a drug cost threshold of $5,100 at which the TrOOP threshold level is achieved; this is referred to as *catastrophic* coverage.

• Monthly premiums vary with plan sponsor and area, but a national average premium determined by CMS (and used in determining its subsidy) is a publically available indicator of plan cost to beneficiaries. Standard plan coverage in 2007, 2008, and 2009 has the same structure, with parameters being adjusted annually to reflect market base premiums and inflation in drug prices. Heiss, McFadden, and Winter (2007) provide a calculation of the actuarial value of Standard plan benefits, based on a projection by CMS in 2005, the year prior to the introduction of Part D, of the distribution of 2006 drug costs for the full Medicare-eligible population. This calculation shows that the 2006 expected drug cost in this population was $245.03 per month. If enrollment in the Part D Standard plan had been universal, the expected benefit would have been $128.02 per month, or $91.13 net of the monthly average premium of $37 anticipated in 2005, and the expected TrOOP cost would have been $117.01 per month. The actual monthly average premium of $32.20

in 2006 was lower than anticipated; this may have been the result of lower drug costs arising from pharmacy benefit management and drug price negotiations by sponsors.

The Medicare Part D plans sponsored by private insurance firms may differ from the Standard plan in their premiums and other plan features, provided that their benefits for any drug cost are on average at least as high as those of the Standard plan. Enhancements may include coverage for the $250 deductible and for the gap in the standard plan. CMS classifies the stand-alone prescription plans that are available under Medicare Part D in four categories, see Bach and McClellan (2006, p. 2313):

- The "standard benefit" is a plan with the statutorily defined coverage, deductible, gap, and cost sharing.
- An "actuarially equivalent" plan is one that has the same deductible and gap as the standard plan, but has different cost sharing (such as copayment tiers for preferred drugs and generic drugs rather than a percentage copayment). Actuarial equivalence to the standard plan may be achieved through restrictions in plan formularies, but all approved plans must have formularies that include at least two drugs in each therapeutic category.
- A "basic alternative" plan is actuarially equivalent to the statutorily defined benefit, but both the deductible and cost sharing can be altered. (Most of these plans have no deductible.)
- An "enhanced alternative" plan exceeds the defined standard coverage – for example, by offering coverage in the gap for generic drugs only, or both generic and branded drugs.

In our structural model, we distinguish two types of plans: The "Standard Plan", as defined above, and an "Generous Plan" which has no deductible and provides coverage in the gap for all drugs. The relation between the annual pharmacy bill and out-of-pocket spending for these two types of plans, with 2006 thresholds, is shown in Figure 1 (which also contains the situation without a plan, when pharmacy bill and out-of-pocket costs are identical). The kinks in the benefit schedule of the Standard Plan that are due to the deductible, the coverage gap, and catastrophic insurance. In contrast, the Generous Plan we consider in our analysis has only one kink at the point where catastrophic insurance kicks in.

One important feature of Medicare Part D is the penalty for late enrollment. Individuals who enroll after May 15, 2006 and do not have creditable coverage from another source face a late enrollment penalty fee of 1% a month for every month that they wait to join. The penalty is computed based on the average monthly premium of Part D standard plans in a given year. This rule was put in place to reduce adverse selection. As the analysis of an intertemporal discrete choice model by Heiss, McFadden, and Winter (2007) shows, the late-enrollment penalty provides a strong monetary incentive for eligible consumers to enroll in 2006 (or more generally, when they first become eligible for Medicare) rather than wait to join only later, should health problems develop and drug costs rise.

The mechanism used by CMS to subsidize Part D plan sponsors determines the premiums for the Standard plan, and affects the cost to sponsors of offering enhanced plans. Key features of the mechanism are established in the Medicare Prescription Drug Improvement and Modernization Act (MMA) of 2003. Detailed descriptions of the mechanism are given in CBO (2004), CMS (2005), Medpac (2006), Simon and Lucarelli (2006), and Heiss, McFadden, and Winter (2007). Basically, the CMS subsidy of plan sponsors has two components, a direct subsidy, paid prospectively, and reinsurance of a share of catastrophic benefits, paid retrospectively. The prospective payments include risk adjustments for the sponsor's enrollee mix that are intended to neutralize adverse selection, and premium subsidies for qualified low-income enrollees. A key feature of the subsidy mechanism is that sponsors submit bids annually to CMS for their anticipated costs of providing benefits to a representative Part D enrollee, including administrative costs and return on capital, but excluding reinsurance of catastrophic benefits. CMS then processes these bids to produce a national base premium that covers 25.5 percent of the prospective national average total benefits and administrative cost of a representative Part D enrollee (including reinsurance cost), and an associated base direct subsidy equal to the national average bid less the base premium. Premiums for individual plans are then set to the plan's bid less the base direct subsidy. As a consequence, each plan has a premium that when added to the base direct subsidy equals the plan's bid, and the plan bid determines its premium. The principle behind the Part D market design is that competition for enrollees should limit the ability of plan sponsors to profit from increasing their bids, encourage cost-saving, and drive bids toward actual long-run cost. Medicare Part D implements a risk adjustment between plan sponsors. It aims to neutralize the expected liability conditional on health conditions and a few demographic characteristics such as gender. The share variance predictable by those health conditions is around 24 percent. For details, see Robst, Levy, and Ingber (2007). For more details on risk adjustment, see Heiss et al. (2007).

3 Stylized facts on Part D plan and supply, 2006-2009

To motivate our subsequent analysis, we present in this section a few stylized facts about the dynamics of the market for Medicare Part D plans. First, we consider the evolution of plan supply in this market. Official CMS data allow us to classify all Part D plans that have been offered from 2006 through 2009 into four types: The Standard Plan, plans without deductible (but with a coverage gap), and enhanced plans with gap coverage, either only for generics or for both brand-name drugs and generics. Figure 2 shows that while the share and average premium of other types have remained relatively stable, the market for generous plans with coverage for at least some brand-name drugs in the gap has collapsed within the first three years. By 2007, almost half of these plans had disappeared and the other half had increased average premiums dramatically. In 2008 and 2009, there is virtually no supply for this type of coverage. A plausible interpretation is that sponsors have underestimated the costs of providing a generous plan, for example due to adverse selection.

Evidence for adverse selection is also provided by descriptive statistics on the pharmacy bill, stratified by enrollment status and plan type. Figure 3, which is based on survey data on from the Retirement Perspectives Surveys 2005 and 2006 (see Winter et al., 2006), shows that indeed individuals enrolled in generous plans have the highest risk, while there is no significant difference between the pharmacy bills of those who are not enrolled and those who are enrolled in a Part D standard plan. These facts suggest that adverse selection is not as important at the enrollment stage as when it comes to choice of plan type. We will explore this of adverse selection formally in the reminder of this paper.

4. A Structural model of Part D enrollment and choice of plan type

In order to understand adverse selection and its effect on the workings of the market for Part D insurances plans under different government interventions, we develop in this section a structural model which relates the features of the market to individual enrollment and plan choice decisions. The notation used in the following is summarized in Table 1.

4.1 The consumer's decision problem

Let $d_t \in \{1,...,D\}$ denote enrollment options including no enrollment at all and different insurance plans at age *t*. Individuals make a choice by maximizing expected utility which can be written as

$$\sum_{t=t_0}^{100} \delta^{(t-t0)} \mathrm{E}[s_t\ U_t^d]$$

where s_t is an indicator for survival to age t. The period-specific utility U_t^d depends on today's decision for the whole future since it affects potential future late enrollment penalties.

If survival probabilities and drug expenditures are related, expectations have to taken using the joint distribution of these two random variables. Arguably, the most important source of such a relation is the fact that both are driven by health: developing for example a cancer will dramatically increase both subsequent drug needs and the mortality risk. We take this into account by developing and estimating a joint model of health dynamics, drug use, and mortality.

In this paper, we ignore the fact that prescription drug use is itself a choice variable. While this is an important issue *per se*, it would affects our analysis only if individuals took into account the effect of enrollment on effective costs and use of drugs and thereby on subsequent health and life expectancy. Adding these effects and tradeoffs to a joint model would add a tremendous layer of complication. So we decide to model prescription drug coverage merely as an insurance against the financial risk of developing a need for medications.

4.2 Health and drug dynamics

We assume that when individuals make their enrollment decisions, they consider the financial consequences only and disregard potential feedback effects from the insurance choice on health and mortality. This makes it feasible to specify a model of health and drug use dynamics as well as mortality which is exogenous with respect to insurance levels. Through the late enrollment penalty (LEP), a rational enrollment decision today takes into account all future consequences. A rational individual therefore has to form expectations for the future evolution of health, drug needs, and mortality.

Assume that in addition to observable characteristics of an individual x_t and independent random shocks, self-reported health r_t, drug use b_t, and mortality m_t are all driven by an individual unobserved health state h_t. Since it captures health levels "relative to" observable covariates x_t, h_t is normalized to have a standard normal distribution, independent of x_t. Without selection from mortality, we assume that unobserved health h_t would evolve over time according to a stationary AR(1) process with a correlation of ρ. The actual distribution of h_t among survivors at more advanced ages will be shaped by selection.

Conditional on the sequence $\{h_1 ,..., h_T\}$ and the covariates $\{x_1 , ..., x_T\}$, all outcomes $\{r_1 ,..., r_T, b_1 ,..., b_T, m_1 ,..., m_T\}$ are assumed to be mutually independent. We specify fully parametric models for these probabilities. With $\Lambda(z)= 1 / (1 + \exp(-z))$ denoting the CDF of a logistic random variable, we specify the conditional mortality risk

$$\Pr(m_t = 1 \mid x_1 , ..., x_T, h_1 ,..., h_T) = \Lambda(x_t\beta_m + \gamma_m h_t)$$

For self-rated health, we specify for j=1,..,5

$$\Pr(r_t = j \mid x_1 , ..., x_T, h_1 ,..., h_T) = \Lambda(\theta^j_r + x_t\beta_r + \gamma_r h_t) - \Lambda(\theta^{j-1}_r + x_t\beta_r + \gamma_r h_t)$$

Drug bills are discretized into B=12 categories as documented in Table 2. The conditional outcome probabilities are for j=1,..,12

$$\Pr(b_t = j \mid x_1 , ..., x_T, h_1 ,..., h_T) = \Lambda(\theta^j_b + x_t\beta_b + \gamma_b h_t) - \Lambda(\theta^{j-1}_b + x_t\beta_b + \gamma_b h_t)$$

While $\theta^0_r = \theta^0_b = -\infty$ and $\theta^5_r = \theta^{12}_b = \infty$, all other parameters $\{\rho, \beta_m, \beta_r, \beta_b, \gamma_m, \gamma_r, \gamma_b, \theta^1_r, ..., \theta^4_r, \theta^1_b, ..., \theta^{11}_b\}$ are unknown parameters to be estimated.

Heiss (2008a) presents a similar model for health and mortality without prescription drugs and shows that it captures the evolution in the data well. For the estimation of this kind of state space model, see also Heiss (2008b).

We estimate this model using data from the Medicare Current Beneficiary Survey (MCBS). A detailed description of this dataset and the sample we use for our estimation can be found in the Appendix. In Table 3, we report the parameter estimates. The latent health component is highly correlated over time. Its estimated yearly correlation is .97 for males and .96 for females, but both parameters are highly significantly smaller than 1. This implies that ten years after a health shock, still .96^10=66 percent of it is still present. The latent health component highly significantly affects all three outcome equations leading to an inter- and intra-temporal correlation of SRHS, drug use, and mortality. High education is a consistently positive predictor of all outcomes while race differs. Non-whites report worse SRHS, non-white females use less drugs, and the mortality rate is slightly higher for non-white than for white males. Because of the nonlinearities of the model, the magnitude of the coefficients is difficult to interpret, so we refer to our simulations.

4.3 Optimal insurance choice given health and drug dynamics

Rational individuals take the model for health, drug needs, and mortality with its estimated parameters as given to make their enrollment and plan choices. When making a choice for age t, individuals are assumed to know their current health status h_{t-1}. For the calculations, we discretize latent relative health

$$h_t \in H = \{\Phi^{-1}(0.5/R), \Phi^{-1}(1.5/R), ..., \Phi^{-1}((R\text{-}0.5)/R)\}.$$

with R=1000 nodes, where $\Phi^{-1}()$ denotes the inverse CDF of the standard normal distribution.

Assume a constant absolute risk aversion (CARA) single period utility function in terms of permanent income w and drug-related spending $c(d,b,y)$ which depends on the drug bill b, the insurance state d, and through the LEP on the number of years previously not enrolled y

$$u(w\text{-}c(d,b,y)) = \text{-exp}(-\alpha(w\text{-}c(d,b,y)) / \alpha \;= \text{-exp}(-\alpha w)\exp(\alpha c(d,b,y)) / \alpha$$

With time-constant permanent income, utility can be normalized to

$$\mathrm{U}(c(d,b,y)) = u(w\text{-}c(d,b,y)) / \exp(-\alpha w) = -\exp(\alpha c(d,b,y)) / \alpha$$

The parameter α>0 captures risk aversion. With $\alpha \rightarrow 0$, this function becomes linear which corresponds to risk neutrality.

The decision problem corresponds to a finite horizon Markov decision processes and can be solved by backwards induction, see Rust (1994). First, consider the decision for the final age 100, made knowing the health status at age 99. Expected utility given insurance choice d and number of years previously uninsured Y_{99} :

$$E[u^{d}_{100} \mid h_{99}, y_{99}] = \sum_{h \in H} \Pr(h_{100}=h|h_{99}) \sum_{b=1}^{B} \Pr(b_{100}=b|h_{100})\, U(c(d,b,y))$$

Individuals maximize this expression by choosing the best insurance state $d^{*}_{100} \in \{1,...,D\}$. This yields the value function for the final year of life

$$V_{100}(h_{99}, y_{99}) = \max_{d} E[u^{d}_{100} \mid h_{99}, y_{99}]$$

For age t<100, the decision can be derived using backwards induction. In addition to the immediate effects also relevant for t=100, the present value of the future consequences have to be taken into account. The value function to be maximized is the expected discounted utility value over the remaining live given optimal decisions in the future. Given health status h_t, its value $V_{t+1}(h_t, y_t)$ is available from previous calculations. Note that the number of years without enrollment depends on today's choice which is indicated by $y_t(d)$ in this expression. Specifically, $y_t(d)=y_{t-1}$ if d represents some Part D plan and $y_t(d)=y_{t-1}+1$ if choice d is the no insurance option. Choosing the best alternative for age t given information available at t-1 yields the value function

$$V_t(h_{t-1}, y_{t-1})=\max_{d} \sum_{h \in H} \Pr(h_t=h|h_{t-1})\{(1-\delta)\Pr(m_t=0)V_{t+1}(h_t, y_t(d))+ \sum_{b=1}^{B} \Pr(b_t|h_t)U(c(d,b,y))\}$$

5. Simulation results

We use the dynamic decision model to simulate choices of the population in a stylized market for Medicare Part D plans. Individuals differ by gender, age, race, education, and current level of relative health h_0. For each combination of these characteristics, we simulate the optimal decisions by backwards induction given different government interventions (such as the LEP) and insurance premiums.

Aggregating the results using the population distribution of the characteristics will result in the distribution of drug expenditures by enrollment and plan type. This in turn implies together with the government interventions (such as subsidies and risk adjustment) profits of the plan sponsors given premiums. Assuming a competitive market, the equilibrium will be defined by zero profits.

For the simulations, we choose the discount rate δ=5%. We also present results for a perfectly myopic preferences (δ=100%) which are equivalent to not having a LEP. For the Arrow-Pratt measure of absolute risk aversion we use the values $\alpha = 0, 0.1, 0.2$, and 0.5.[3] For a 50 percent chance of winning $5000, these parameters imply a willingness to pay of $2500, $2191, $1899, and $1229, respectively.

5.1. A market with Standard Plans only

Consider a market in which only identical Standard Plans are offered. To abstract from formulary design, suppose that all prescription drugs are covered by these plans. Individuals decide whether to enroll into such a plan or remain uncovered. Figure 4 shows the share of the population who find it advantageous to enroll given different monthly premiums and levels of risk aversion with and without the LEP.

The speed at which enrollment decreases as premiums increase depends on the risk preferences and on whether a LEP in enforced. Without it, enrollment has reached around 60

[3]All monetary units are $1000/year. With an income of $20K, these parameters imply a relative risk aversion of RRA = ARA•20 = 0, 2, 4, and 10, respectively.

percent at a premium of $100/month and the risk aversion has little impact on the results. The LEP increases enrollment to around 75percent if individuals are risk neutral and 90 percent if they are extremely risk averse.

The individuals who rationally do not enroll are relatively healthy. The higher the premium, the more extreme is the adverse selection into Medicare Part D plans. Figure 5 depicts this effect. It shows the average drug bill of the individuals who decide to enroll. It increases from the population average of around $3000 to around $4400 without the LEP at a premium of $100 a month. The LEP mitigates the adverse selection. Depending on the risk aversion, the corresponding numbers will be between $3300 and $3900 a year.

The composition of the enrollees together with the government interventions and subsidies determine the profits for a given premium. Figure 6 shows simulated profits given different risk aversion parameters for the subsidies implemented in the actual Part D legislation.[4] For the insurance to be offered by private insurance companies, they have to be at least non-negative. In a competitive market, equilibrium premiums generate exactly zero profits.

For the high subsidies in Part D, risk aversion and the LEP do hardly affect the equilibrium premium. The standard plan is profitable at monthly premiums of around $35 and above. At this low premium, most rational individuals immediately find it advantageous to enroll and risk aversion or the LEP convinces only a few more individuals to enroll. The simulated equilibrium premium is strikingly close to actual premiums for Part D standard plans...

[4]We abstract from administrative cost.

In order to study the effects of the subsidies on the market equilibrium, Figure 7 shows profits for a risk aversion parameter of α=0.2, but in addition to the actual subsidies with no subsidies at all and with the 80% reinsurance for catastrophic drug bills only. In the absence of any subsidies, there is no premium at which insurance companies can offer a standard plan without incurring losses. This is a classic market failure due to adverse selection. With the reinsurance and the LEP, there is a market equilibrium with a monthly premium of around $125. According to Figure 4, around 70 percent of rational individuals will enroll at this premium.

5.2. A market with two plan types

In order to analyze the selection of individuals in different plan types, we augment the rational decision model by allowing individuals to choose between the Standard Plan and an enhanced plan depicted in Figure 1. The following figures show results with LEP where the Standard Plan premium is kept at $35/month and the premium of the enhanced plan differs.

As Figure 8 shows, the enrollment shares depend on the risk aversion parameter only weakly. The individuals who decide to switch from the enhanced plan to the Standard Plan as the premium increases, are among the best risks within the enrollees of the enhanced plan and among the worst risk within the Standard Plan enrollees. Therefore, as Figure 9 shows, the average drug bill of enrollees increases in both plan types as the premium of enhanced plans increase.

Figure 10 again looks at the implied profits for which now the risk adjustment matters. Without any risk adjustment, the Standard Plan makes positive profits at a premium of

\$35/month. Compared to the case with Standard Plans only in which this premium generated zero profits, this is due to the fact that the worst risks have moved to the enhanced plans. The enhanced plans incur losses at any premium, so there won't be a market for it. This is due to the fact that they draw the worst risks but the subsidies are the same as for the Standard Plans.

As discussed above, Medicare Part D implements a risk adjustment between plan sponsors. It is based on the estimated expected liability of a Standard Plan conditional on health conditions and a few demographic characteristics. Let a_i denote the Standard Plan liability associated with the spending on prescription drugs of an individual i and let $\hat{a}_i$ denote the predicted value of a_i given the characteristics of this individual. With μ denoting the average value of a_i, the risk adjustment payment for a plan in which individuals i=1,...,N are enrolled is equal to $\sum_{i=1}^{N} (\hat{a}_i - \mu)$.

Note that the variation of $\hat{a}_i$ is necessarily smaller than the variation of a_i, so risk adjustment is only partial. This can be seen in the classical formula for regression to the mean

$$E(\hat{a}_i | a_i) = \mu + r(a_i - \mu)$$

where r denotes the square root of $R^2 = \mathrm{var}(\hat{a}_i) / \mathrm{var}(a_i)$. In practice, R^2 is around 0.25 which means that there is considerable variation in risks which is not accounted for.

Since the enhanced plans draw the worst risks, on average they receive net payments from the risk adjustment, but not sufficient to compensate for the additional risks. In addition to that, the risk adjustment is only based on liabilities for the Standard Plan portion of the benefits and additional benefits are not compensated.

We add this risk adjustment scheme to our simulations using the formula for the conditional means of $\hat{a}_i$ from above. Figure 10 shows the profits with the implemented risk adjustment. Since the Standard Plans have a positive selection of enrollees, they are net payers for the risk adjustment an their profit decrease. But they are still positive since risk adjustment is imperfect. This and the fact that enhanced benefits are unadjusted leads to the result that profits for the enhanced plans increase but not nearly as much as needed to become non-negative for any premium.

Figure 10 also shows results using a "full" risk adjustment. This scheme undoes all effects of selection on profits per enrollee. Let a^S_i denote liabilities of a Standard Plan implied by the drug use of individual i and let a^E_i denote liabilities of an enhanced plan implied by the drug use of individual i. With N^S individuals enrolled into a Standard Plan and N^E in an enhanced plan, the risk adjustment payment per enrollee for the Standard Plan is

$$1/(N^S+N^E)\sum_i \ a^S_i - \ 1/(N^S)\sum_i \ 1[i \text{ in SP}]\, a^S_i$$

where 1[i enrolled in SP] is an indicator which is equal to 1 if individual i is enrolled in a SP. Likewise, the adjustment payment for enhanced plans is

$$1/(N^S+N^E)\sum_i \ a^E_i - \ 1/(N^E)\sum_i \ 1[i \text{ in EP}]\, a^E_i$$

With this "full" risk adjustment, there is a joint equilibrium in which both plan types generate zero profits at premiums of around \$35 and \$100 for the Standard Plans and the enhanced plans, respectively. Note that this risk adjustment is not budget neutral. At the equilibrium, total government spending would have to be increased by around 16%.

In practice, the government does not want to compensate sponsors fully for the spending of their enrollees in order to maintain the incentive to keep spending low. A practical version of the "full" risk adjustment scheme could define two plan types like those modeled here. Sponsors for a plan of one type would be compensated for the difference of average liabilities associated with the spending of the whole eligible population and the individuals who are enrolled in a plan of the same type. This would undo all selection effects into plan types while maintaining the competition of sponsors within each plan type.

6. Conclusions

In this paper, we analyze the demand for health insurance in a privately organized, competitive market for insurance plans that is tightly regulated and highly subsidized by a government whose goal is to achieve high enrollment rates without making insurance compulsory. We tailor our analysis specifically to Medicare Part D which offers prescription drug insurance for older Americans since 2006.

We motivate our analysis by two observations on enrollment and plan supply during the first four years of Medicare Part D: First, enrollment rates were very high, and premiums for standard plans as well as the number of plans among which consumers can choose remained reasonably stable over time. We and other observes interpret this result as a Medicare Part D having achieved its primary political goal of providing near-universal coverage, or put differently, Part D has effectively countered adverse selection into non-compulsory health insurance program. This appears to be due primarily to the government subsidy that makes a Part D plan a favorable lottery for most, but also for the healthy due to the option value of avoiding late enrollment penalties and advantageous selection resulting from higher levels of risk aversion among the healthy and wealthy. Second, plans with very generous coverage all but disappeared from the market within three years. We interpret this as adverse selection still being operational when it comes to plan choice (as opposed to enrollment where it as been effectively countered). Non-capitated extended plans contain an implicit tax due to the delayed onset of catastrophic reinsurance, and this load and the absence of any direct government subsidy for extended benefits reinforce the effects of adverse selection of sicker consumers into generous plans.

The main goal of our analysis was to understand the role of different government interventions in countering adverse selection. To this end, we develop a structural intertemporal decision model of enrollment and plan-type choice, and to use this model to simulate market demand under alternative institutional arrangements. In particular, this structural model allows us to distinguish the separate effects of four institutional features of Medicare Part D: direct government subsidies including premium subsidies for low-income enrollees, government catastrophic reinsurance, the late enrollment penalty, and risk adjustment.

Summarizing our baseline simulation results, our model successfully replicates two crucial features of Medicare Part D: A large proportion of the population enrolls, with only the healthiest individuals choosing not to purchase coverage. At the same time, adverse selection still operates when it comes to selecting between a basic coverage that is similar to Part D's standard plan (i.e., which has a deductible and a coverage gap) and a generous coverage (which has no deductible and no gap). In fact, the market for generous plans breaks down in our simulations since demand is zero at the premium that covers expected expenditure.

We then analyze the effect of subsidies. Our baseline simulation had subsidies similar to those provided with Medicare Part D. When we set subsidies to zero, our simulations confirm that premiums would be so high that too few healthy individuals enroll, shutting down also the market for standard plans. At an intermediate level of subsidies at which only reinsurance is provided by the government, the market would not break down, but premiums would be substantially higher, and enrollment rates would be much lower, so that the government would not reach its political goal of near-universal coverage.

Next, we analyzed the late enrollment penalty which was also intended to counter adverse selection by providing incentives for younger, healthy individuals to enroll. Ours simulations show that given the high level of subsidies provided in Medicare Part D, the late enrollment penalty has a negligible additional effect on enrollment rates. One of the more complicated and controversial features of Medicare Part D thus does not seem to be essential to counter adverse selection in enrollment. If in reality, consumers don't understand the penalty's intertemporal incentives, its effects will be even smaller.

Finally, we investigate alternative risk adjustment schemes. The implemented risk adjustment is not sufficient to make more generous plans profitable. We explore a “full” adjustment between plan types in the sense that the plans of a certain type are compensated for the difference between average liabilities within the type and the counterfactual situation with full enrollment into the corresponding plan type. This analysis confirms that also generous plans would be viable with this risk adjustment scheme.

We conclude by discussing avenues for future research. The most important limitation of our analysis is that we take drug use as given. In our model, consumers take all prescribed medications even if they are hit by a negative health shock that implies a very high drug bill. This is not realistic - in fact, non-adherence related to drug costs is well documented (Goldman, et al. 2004) and has been a major argument for the introduction of Medicare Part D. To address these effects in a structural model, one would need allow for drug use as a choice variable and specify (i) a utility function that depends not only on consumption (or disposable income net of drug and insurance costs as in our implementation) but also on health, and (ii) a technology that maps drug use into health outcomes so that current non-adherence may have negative health effects in the future. These are promising, but very demanding modeling issues which we leave to future research.

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Appendix: MCBS data on the dynamics of health and prescription drug use

(to be completed)

Table 1: Notation for the model of the discrete dynamic decision process

x_t	Vector of individual characteristics such as agesplines, gender, race, and education
h_t	Health capital state at age t
$b_t \in \{1,...,B\}$	Drug bill state at age t
$r_t \in \{1,...,5\}$	Self-reported health state at age t
$m_t \in \{0,1\}$	Mortality at age t, $m_t = 1$ if dies
$s_t \in \{0,1\}$	Survival up to age t, $s_t = s_{t-1} \cdot \mathbf{1}(m_t=0)$, $s_t = 1$ if survive
$d_t \in \{1,...,D\}$	Insurance state at age t
$y_t \in \{0,...,t\text{-}65\}$	Number of years not enrolled up to age t
$c(d,b,y)$	Spending (premium + LE penalty + OOP) with and insurance state i given bill b and y
$\Pr(h_t \mid h_{t-1})$	Transition probability of health states
$\Pr(b_t \mid h_t)$	Probability of bill j at age t given health at t (ordered logit probabilities) Note: $\Pr(b_t \mid h_{t-1}) = \int f(h_t \mid h_{t-1}) \Pr(b_t \mid h_t)\, dh_t$
ρ	Correlation of h_t over time
δ	Discount rate
α	Absolute risk aversion parameter
$U(c(d,b,y))$	Single period utility function in terms of drug-related spending
$V_t(h_{t-1}, y_{t-1})$	Value function: expected discounted utility at age t over the remaining life given optimal decisions in the future

Table 2: Discretization of yearly drug bill

Bill class	Share	Average bill
bill = \$0	6.9%	\$0
\$0 < bill ≤ \$250	4.3%	\$116
\$250 < bill ≤ \$1000	9.9%	\$647
\$1000 < bill ≤ \$1500	9.0%	\$1,236
\$1500 < bill ≤ \$2250	15.2%	\$1,888
\$2250 < bill ≤ \$3000	14.0%	\$2,597
\$3000 < bill ≤ \$4000	16.3%	\$3,471
\$4000 < bill ≤ \$5100	8.2%	\$4,476
\$5100 < bill ≤ \$7000	8.4%	\$5,925
\$7000 < bill ≤ \$10000	5.3%	\$8,256
\$10000 < bill ≤ \$20000	2.4%	\$12,327
bill > \$20000	0.1%	\$29,282

Source : MCBS

Table 3: Parameter estimates for the model of health dynamics

	Males		Females	
Mortality:				
Non-white	0.309*	(0.127)	-0.083	(0.117)
High education	-0.734**	(0.094)	-0.706**	(0.089)
Latent health γ	1336**	(0.061)	1.728**	(0.057)
Drug bill:				
Non-white	-0.271	(0.301)	-0.683**	(0.246)
High education	-1.133**	(0.209)	-1.232**	(0.185)
Latent health γ	6.124**	(0.175)	6.228**	(0.150)
SRHS:				
Non-white	0.370**	(0.065)	0.465**	(0.052)
High education	-0.914**	(0.044)	-0.847**	(0.039)
Latent health γ	0.877**	(0.025)	0.910**	(0.022)
Latent relative health:				
Correlation ρ	967**	-4	963**	-3

Notes: All equations also include age splines

Parameters significantly different from zero with **: p<.01, *: p<.05

Figure 1: Benefit schedules of the Standard Plan and a Generous Plan

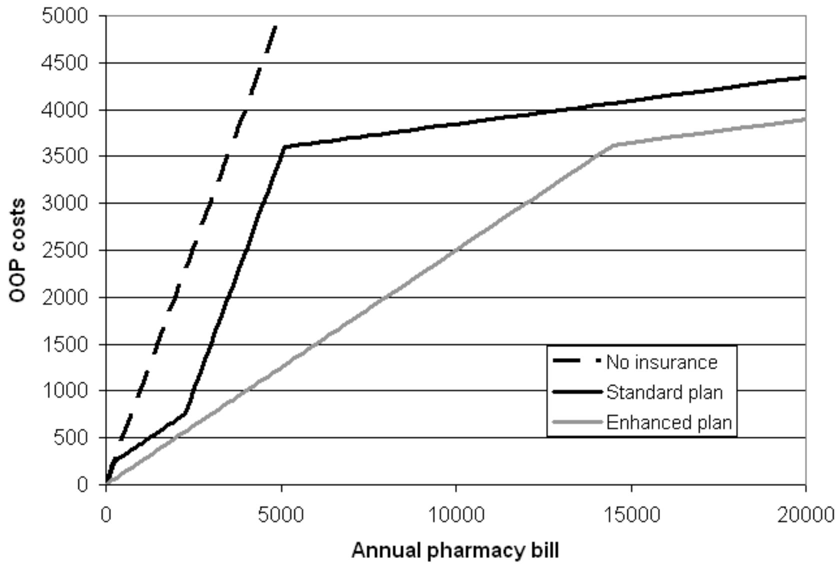

Figure 2: Evolution of plan offers (CMS data)

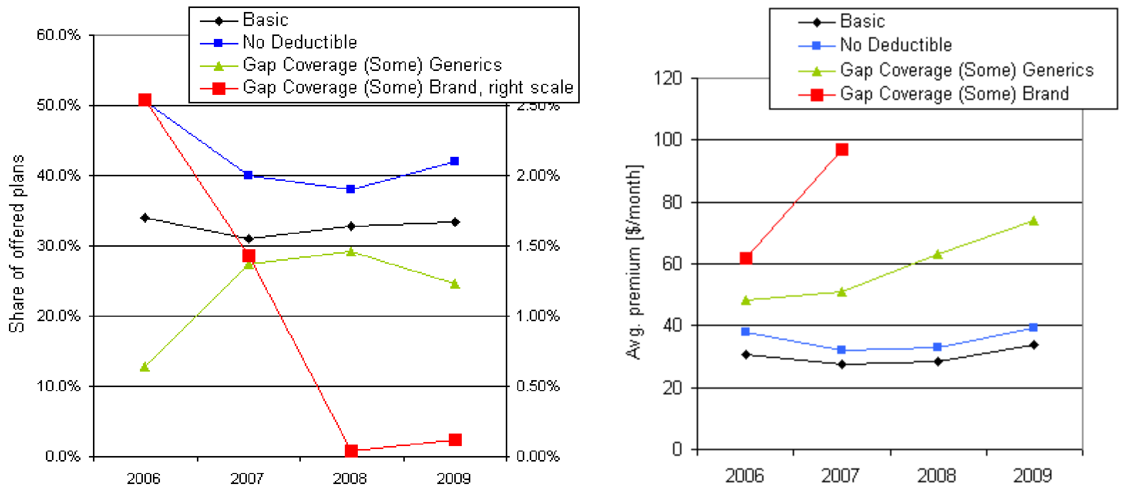

Figure 3: Average drug use by plan type (RPS 2005/06 data)

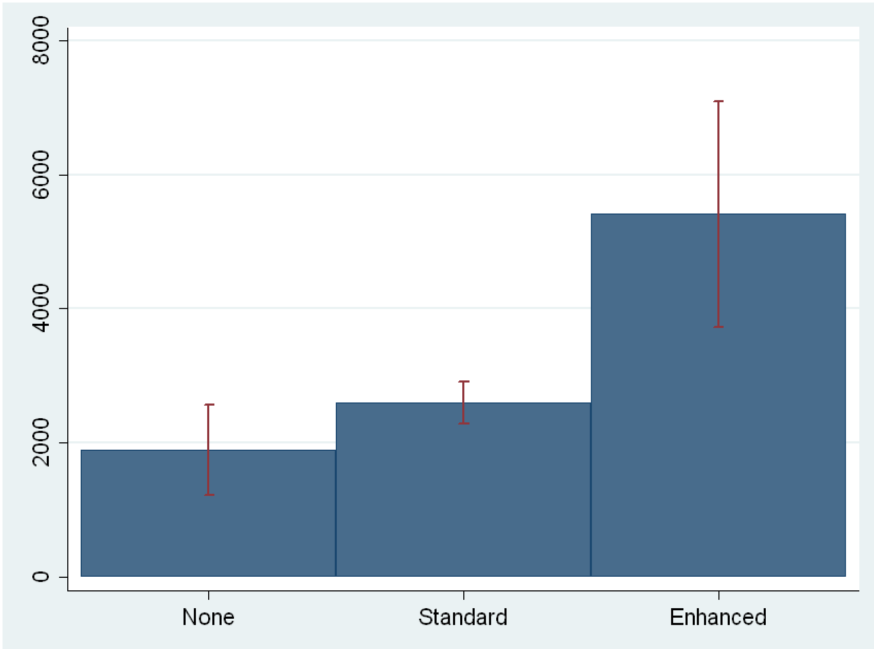

Figure 4: Simulation results with only the Standard Plan: Enrollment shares

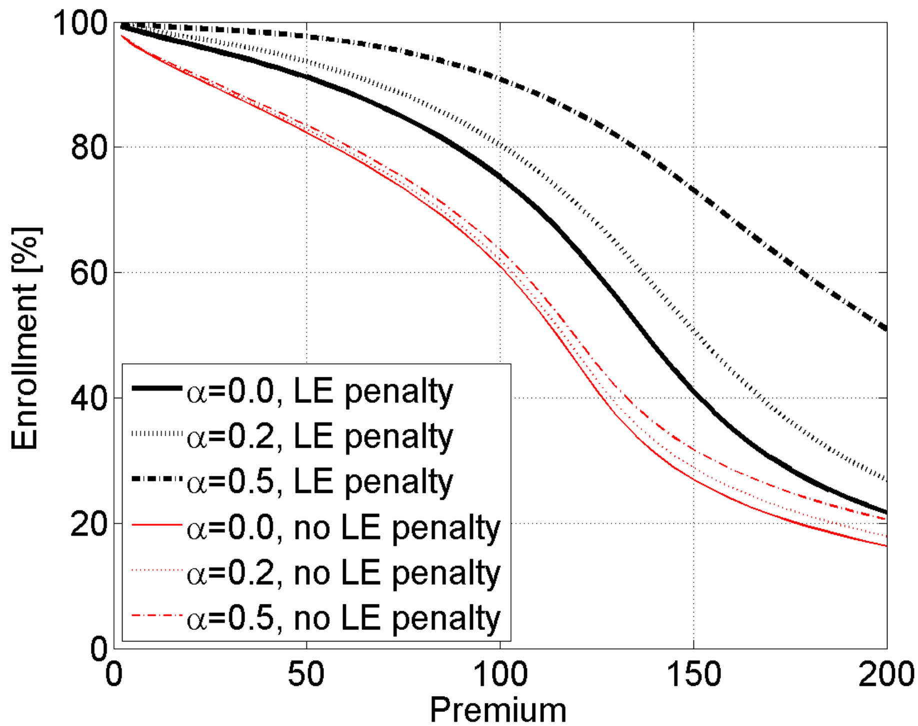

Figure 5: Simulation results with only the Standard Plan: Adverse selection

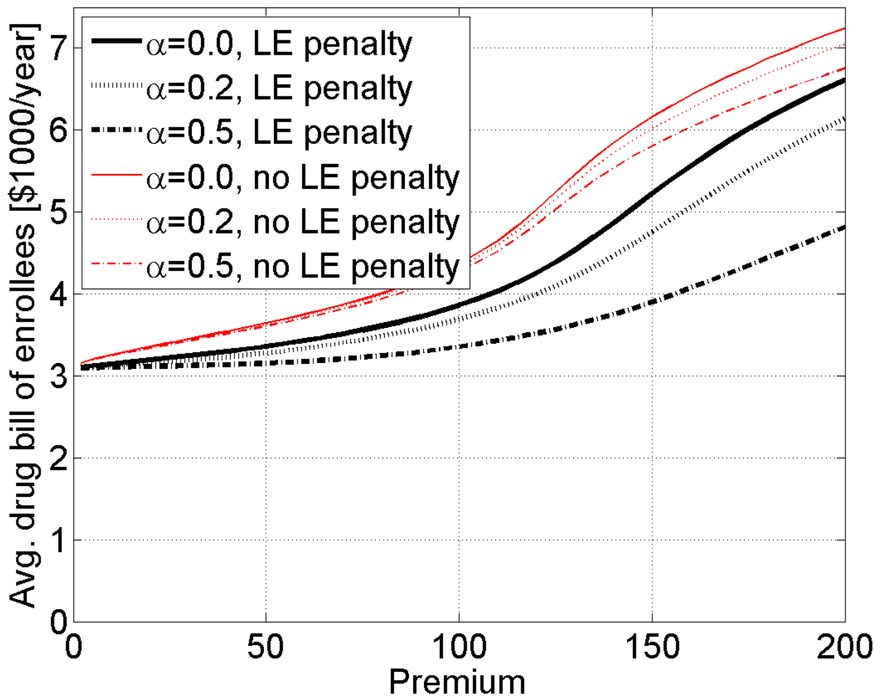

Figure 6: Simulation results with only the Standard Plan: Profits with actual subsidies

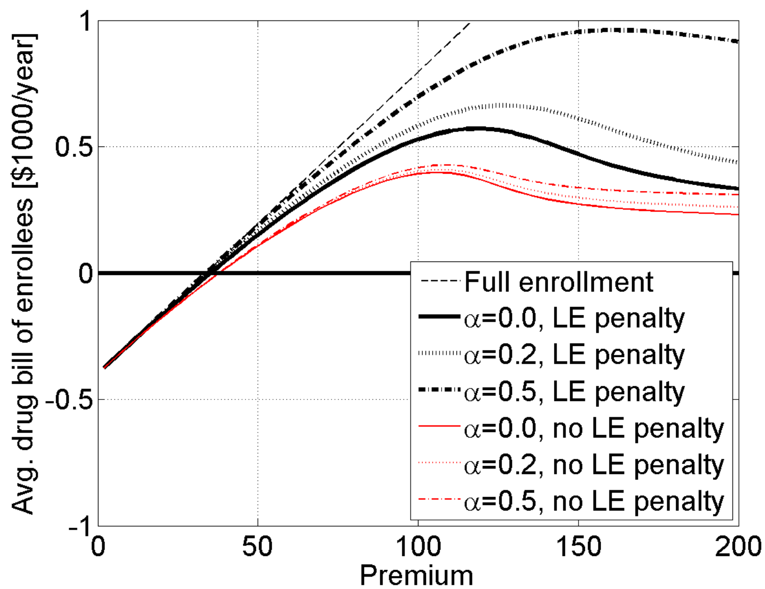

Figure 7: Simulation results with only the Standard Plan: Profits with different subsidies

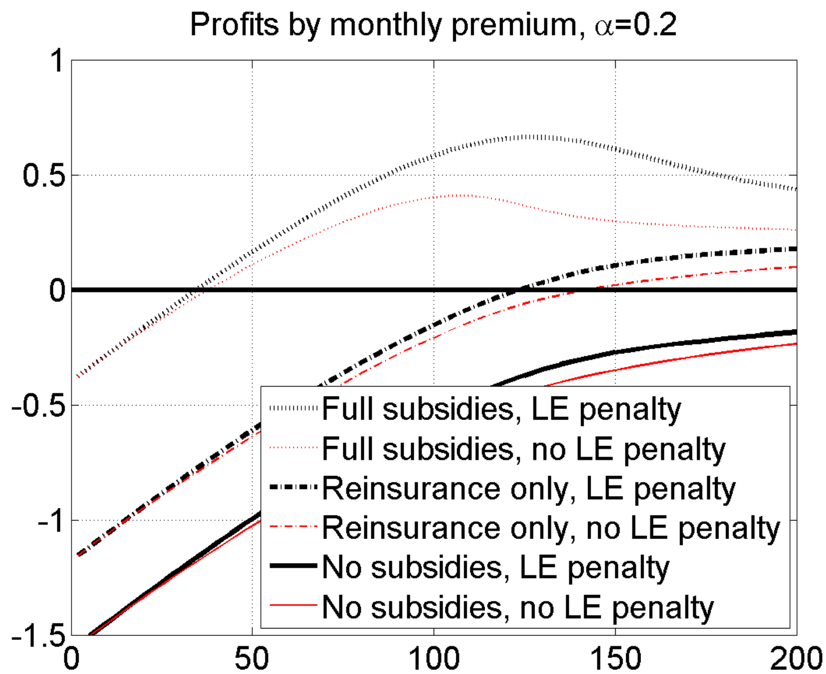

Figure 8: Simulation results with two plan types: Enrollment

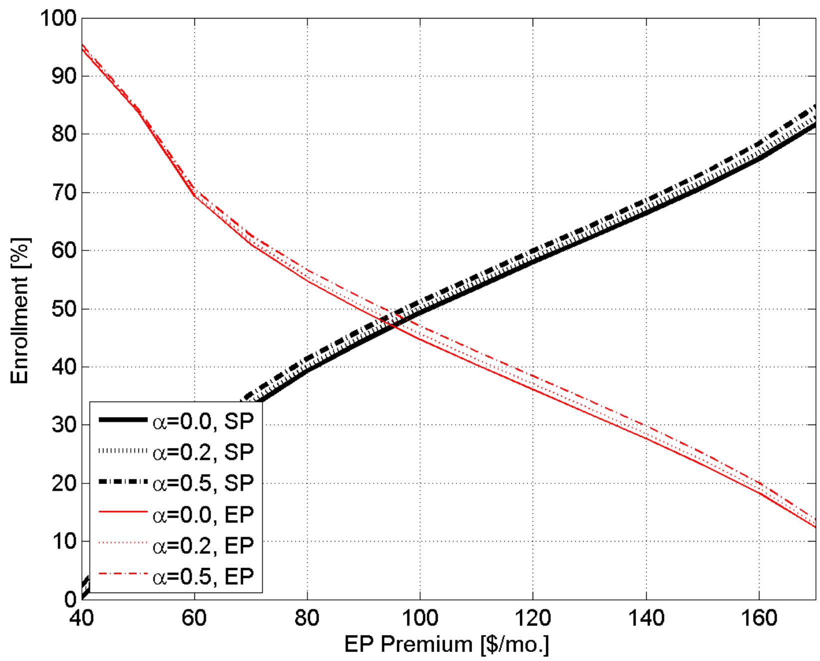

Figure 9: Simulation results with two plan types: Enrollees' avg. drug bill

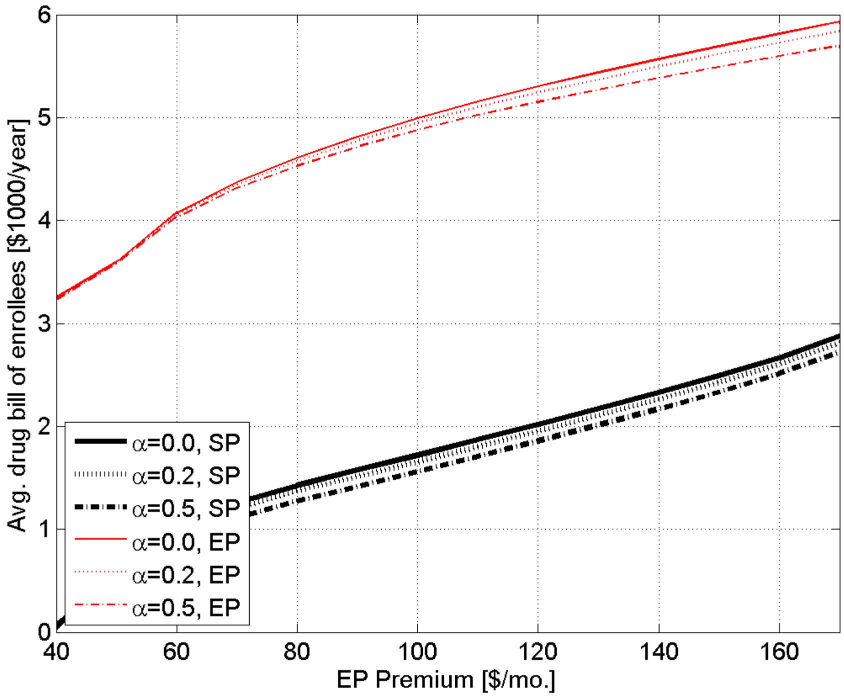

Figure 10: Simulation results with two plan types: Profits and risk adjustment