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INSURERS' NEGOTIATING LEVERAGE AND THE EXTERNAL EFFECTS OF MEDICARE PART D

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ABSTRACT

Public financing of private health insurance may generate external effects beyond the subsidized population, by influencing the size and bargaining power of health insurers. We test for this external effect in the context of Medicare Part D. We analyze how Part D-related insurer size increases impacted retail drug prices negotiated by insurers for their non-Part D commercial market. On average, Part D lowered retail prices for commercial insureds by 5.8% to 8.5%. The cost-savings to the commercial market amount to $3bn per year, which approximates the total annual savings experienced by Part D beneficiaries who previously lacked drug coverage.

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1. Introduction

The Medicare Modernization Act (MMA) of 2003 established prescription drug benefits for Medicare beneficiaries through Medicare Part D. The legislation tasked the private-sector with a substantial role, not unlike that played by Medicare health maintenance organizations (HMO's). The federal government prescribes a standard Part D benefit package and provides premium subsidies for Medicare beneficiaries. Private insurers compete among themselves to design, price, and administer insurance policies that are at least actuarially equivalent to this prescribed package.

Much of the existing literature has focused on quantifying the success or failure of private firms in efficiently disseminating drug insurance to Medicare beneficiaries. There exists general consensus that the private-sector has improved patients' access to drug coverage, while lowering drug prices (Lichtenberg and Sun, 2007; Duggan and Scott Morton, 2008; Ketcham and Simon, 2008; Yin et al., 2008). Specifically, Duggan and Scott-Morton (2008) observe that Part D lowers aggregate prices by providing previously uninsured seniors with Part D insurance, through which they benefit from the lower prices available to large private insurers.

The behavioral response of large private buyers imbues the program with an additional and unique capacity to project its effects *beyond* the confines of the Part D population. The MMA dramatically increased the number of Medicare beneficiaries with prescription drug coverage and injected new customers into the insurance market. Since this increase was absorbed primarily by existing insurance firms, not new entrants, the MMA generally increased the enrolled population in each firm. If growth in total enrollment—that is, buyer size—provides private payers with more bargaining power in their general pricing negotiations, the program may allow insurers to capture additional rents on behalf of patients who are insured privately outside the Part D program. These include both Medicare and non-Medicare aged individuals enrolled in commercial plans of insurers that participate in Medicare Part D.

More generally, this hypothesis suggests the possibility of external effects from policies that publicly subsidize private health insurance premiums. While Medicare Part D ended up covering much less than half the Medicare population, its effects may have been seen in even the non-Medicare population. Similarly, the recent passage of the Patient Protection and Affordable

Care Act (PPACA) extends premium subsidies to many uninsured Americans, but its effects on prices may yet extend well beyond the 45 million uninsured.

In the pharmaceutical context, the presence and size of this external effect depends on the structure and terms of the negotiations among payers, manufacturers, and pharmacies. Bargaining plays a major role in the pharmaceutical market, where oligopolistic insurers negotiate with oligopolistic pharmacies over the prices of drugs produced by both competitive and monopolistic manufacturers. The upstream and downstream prices of drugs are determined by bilateral negotiations among these various parties, who do not simply name a uniform linear price. Rather, prices are negotiated firm-by-firm and drug-by-drug. Conventional wisdom holds that increases in insurers' enrollment empower them to extract lower prices from drug manufacturers and retail pharmacies, since the failure to come to terms with a larger insurer leads to larger losses of volume. Even so, the impact of buyer size on upstream price negotiations is theoretically ambiguous (Stole and Zwiebel, 1996; Chipty and Snyder 1999).[1] The direction of the buyer size effect must be quantified empirically in order to assess the implications for the distribution of rents external to the Part D market.

We present empirical analyses designed to quantify the impact of Part D enrollment on prices and profits *outside* the Part D market. The analysis relies on claims data from a large national retail pharmacy chain that reports the drug prices negotiated between the pharmacy and every insurer with whom it contracts. An attractive feature of our approach is the absence of ex post rebates in agreements between pharmacies and insurers, making negotiated pharmacy prices readily observable and transparent.[2] Moreover, economic theory allows us to draw qualitative inferences for manufacturer profits from information about payer and retail pharmacy profits.

[1] In the simplest case where buyer and seller profit functions are linear in buyer size, the outside option for each side in the Nash game is zero. Non-cooperation penalizes the buyer and seller identically. Hence, the solution to the game is invariant to buyer size. A large theoretical literature offers a variety of explanations for why buyer size has an ambiguous effect on upstream negotiations. Recent work includes Stole and Zwiebel (1996), Chipty and Snyder (1999), and Raskovich (2003) who specify concavity conditions of the supplier's surplus function in order for larger buyers to extract larger rents in bilateral negotiations. Conditions in dynamic setting in which bargaining take place over repeated negotiations are studied by Snyder (1996).

[2] Negotiations between insurers and pharmaceutical firms offer a second setting in which to test how insurer market power affects bargaining outcomes. However, insurer-manufacturer negotiations typically involve complex pricing arrangements that include upfront pricing terms, or ex post rebates contingent on volume and other factors (Levy, 1999). And despite the policy importance of evaluating the rebates negotiated by manufacturers, the Centers for Medicare and Medicaid Services (CMS) has proscribed the release of this data, which are similarly unavailable from private data vendors. It is thus difficult to measure directly the effect of market power on price negotiations with manufacturers.

This strategy for indirect inference is valuable, because net prices received by manufacturers are almost never observed by researchers.

We find that insurers with larger enrollment increases are able to negotiate lower retail drug prices. Enrolling an additional 100,000 Part D beneficiaries enables an insurer to negotiate 2.1-percent lower prices for seniors, and 1.6-percent lower prices for non-seniors, who are enrolled in commercial plans of insurers that also participate in Medicare Part D. Consistent with economic theory, the vast majority of these reductions occur for generic drugs and branded drugs that face therapeutic competition. Theory also suggests that these gains should be accompanied by improved payer bargaining power in rebate negotiations with drug manufacturers. Since our estimates omit these, they serve as a lower bound for the effect of enrollment on *total* drug costs.

The magnitude of this external effect is substantial. Given the observed change in enrollment of insurers participating in Part D, the program lowered retail prices for their non-Part D non-elderly enrollees by 5.8%, and for their non-Part D elderly enrollees by 8.5%. These savings amount to $3bn per year. If passed onto enrollees, they would be almost equal to the size of the total cost-savings enjoyed by Part D enrollees who lacked any previous drug coverage. If the additional rents are retained primarily by the insurer – as may be suggested by the research demonstrating limited competition in the commercial insurance market (Dafny, 2008) – these price reductions represent a greater than 20% increase to an insurer's profits on commercial prescription drug coverage.

The paper proceeds as follows: Section 2 discusses the MMA, features of the drug market, and presents a simple Nash-bargaining model that describes how enrollment may impact profits for all parties. Section 3 lays out the empirical strategy for estimating how enrollment affects pharmacy profits and prices as a consequence of insurer enrollment increases due to Part D. Section 4 reports results of the empirical analyses. In Section 5, we decompose the effect of Part D on total prescription drug expenditure reductions into internal and external effects. Section 6 concludes.

2. Model of the Medicare Part D Prescription Drug Market

2.1 Background on the Pharmaceutical Market and the MMA

Medicare outpatient prescription drug coverage was established by the 2003 Medicare Modernization Act (MMA) through the creation of the Part D drug benefit. The federal subsidies required to finance the program are significant, and have led to recent work examining how the program has impacted pharmaceutical profitability (Frank and Newhouse, 2008; Friedman 2009). The high public cost of the MMA, and concerns over its impact on Medicare's long-term sustainability, have drawn attention to the Medicare Part D drug purchasing model.

Under the MMA, the government contracts with private insurers to administer drug plans. As a consequence, the responsibility of negotiating pharmacy drug prices and manufacturer rebates is left up to individual private insurers. The purchasing model is summarized in Figure 1. The black lines follow the flow of drugs; the dotted lines follow cash transfers and reimbursements. From the perspective of drug manufacturers, revenues are earned by selling drugs to wholesalers or directly to retail pharmacies at a price negotiated between each retailer and each manufacturer. Manufacturers also negotiate rebates to insurers (private insurers, government agencies and PBMs) in exchange for inclusion or preferential tiering of their drugs in the formularies of insurers. Rebates are negotiated in one-on-one settings between individual insurers and manufacturers.

Similarly, pharmacies negotiate with individual insurers over the amount they are to be paid when they dispense prescriptions for an insurer's enrollees. These negotiations are also done in a bilateral, take-it-or-leave-it, manner. How the negotiated payment to the pharmacy is then split between enrollee and insurer depends on the specific premium, copayment and deductible architecture of the enrollee's insurance plan.

In principle, Part D insurers are supposed to negotiate manufacturer rebates for Part D enrollees in a separate and "firewalled" manner. This separation is supposed to limit the relationship between Part D and commercial lines of business within the same insurer. In practice, however, an insurer with more Part D enrollees may possess more *de facto* negotiating leverage in all transactions. Moreover, no firewall exists for pharmacy retail price negotiations. Changes in retail prices directly impact insurer and pharmacy profits. They may also indirectly impact manufacturer profits, because they determine the quantity of surplus available for pharmacies and manufacturers to share. This indirect effect on manufacturer profits will obtain even if the rebate firewall is respected.

2.2 Overview of Theoretical Model

Arguments for the possible impact of firm size on negotiations with suppliers have been posited since Galbraith (1952), and studied more formally in recent theoretical and empirical work.[3] In the pharmaceutical industry, where the distribution of rents between manufacturers, retail pharmacies, insurers and enrollees has implications for health care costs, insurance coverage, and incentives to innovate, changes to the bargaining power of insurers can have a variety of impacts that have not been widely studied.[4]

We present a simple and conventional model of Nash-bargaining, similar in form and spirit to Chipty and Snyder (1999). We consider price negotiations between a retailer and buyers, as modeled by Chipty and Snyder. In addition, we include an upstream manufacturer who negotiates directly with the retailer and each buyer. The three-way Nash-bargaining model demonstrates three points.

First, buyer size has an ambiguous effect on the negotiations over rents shared by the manufacturer and buyer. The negotiating leverage of one side depends on the surplus it generates for its trading partners. If larger buyers generate more surplus per unit for their partners, they will receive better prices, and vice-versa. Formally, the effects of buyer size on unit surplus depend on the curvature of the supplier's surplus function—a general result derived in previous studies (Stole and Zweibel, 1996; Chipty and Snyder, 1999). If the seller's surplus function is convex in quantity, a larger inframarginal buyer generates less surplus per unit sold than would be generated by a smaller inframarginal buyer.

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[3] Among many theoretical studies on the topic, recent work includes Stole and Zwiebel (1996), Brooks et al (1997), Chipty and Snyder (1999), and Raskovich (2003), who specify concavity conditions that the supplier's surplus function must satisfy in order for large buyers to extract rents. Snyder (1996) studies this issue in dynamic settings. In the health literature, Sorenson (2003) studies the extent to which insurers' ability to exclude hospitals affect negotiated hospital (supplier) prices. In this paper, we estimate how bargaining power changes with the *size* of the buyer, holding constant its ability to steer its market. Indeed, consistent with Sorenson, our model suggests that buyer size affects bargaining power only when the buyer has some ability to steer its share across suppliers. We then explicitly test a model in which buyer size can either augment or diminish the impact of threats of network exclusion on negotiated prices in the pharmaceutical industry.

[4] The health care literature has primarily focused on how characteristics of providers affect negotiations with downstream payers (Town and Vistnes 1999). More recently, Ho (2009) studies how hospital performance and provider network structure affect bargaining outcomes with downstream payers. In the pharmaceutical industry, the complex market structure and paucity of negotiated price data makes these issues difficult to study. Exceptions include Ellison and Snyder (2008), who examine the extent to which larger pharmacies extract rents from wholesalers on purchases of generic antibiotics. That buyer size may differentially affect price negotiations across drugs of varying substitutability is a hypothesis we test in the context of negotiations by nearly every Part D insurer, over the price of each of the top 1000 selling drugs in this market.

Second, the manufacturer extracts all the rents in cases where it has all the market power. Hence, any increase in buyer size will have no effect on the surplus accruing to buyers or retailers. All downstream parties earn zero profits. Branded drugs that face no therapeutic substitutes may exemplify such cases.

Third, in cases where all sides have some degree of bargaining power, the changes in the profits of different players are positively correlated with external shocks that affect both. Among other things, this means that increases in the size of an insurer will have qualitatively similar effects on the profits of pharmacies and manufacturers. This property allows us to draw qualitative inferences about changes in the profits for manufacturers, given information on pharmacy profits. This is important, because manufacturer profits are unobserved.

All three qualitative implications obtain even if the Part D firewall necessitates parallel and independent sets of rebate negotiations. Regardless of how insurers negotiate with manufacturers, a change in insurer size will impact the surplus flowing to pharmacies; this surplus is ultimately shared with manufacturers. This creates a positive relationship between pharmacy and manufacturer profits that goes beyond the rebate negotiation. For this reason, it is simpler to develop the bargaining model without specifying particular assumptions about the firewall between the Part D and non-Part D markets.

2.3 Correlated Profits and Mark-ups

A monopolistic manufacturer with varying degrees of market power bargains with a monopolistic pharmacy to set the upstream price of drugs. Downstream, the pharmacy bargains with a set of insurers. For a given drug, pharmacy profit consists of payments received from n payers, $\sum_{i=1}^{n}\tau_i$, net of the lump-sum transfer T, payable by the pharmacy to the manufacturer, for sale of Q units of a given drug. In general, the payments will depend on the total quantity provided. In addition, the pharmacy may derive other benefits from selling Q units of drugs. For instance, drug sales may drive traffic to stores and produce sales of other merchandise. The net return to such activity is represented by $G(Q)$. In sum, pharmacy profits are given by

$$G(Q)+\sum_{i=1}^{n}\tau_i(Q)-T.$$

Profits of the manufacturer are given by $T-\sum_{i=1}^{n} r_i(Q)-C(Q)$, where T is the lump-sum pharmacy transfer, $\sum_{i=1}^{n} r_i(Q)$ the total lump-sum rebates paid to insurers as a function of aggregate quantity, and $C(Q)$ the cost of manufacturing and selling the drug.

The outcome of the bilateral negotiation between the manufacturer and the pharmacy maximizes the Nash product:

(1) $$\max_{Q,T}\left(T-\sum_{i=1}^{n} r_i(Q)-C(Q)\right)^{\gamma}\left(G(Q)+\sum_{i=1}^{n}\tau_i(Q)-T\right)^{1-\gamma}$$

The exponent γ captures the bargaining power of the manufacturer in negotiations over lump-sum transfers for a particular drug. It can be interpreted as the share of incremental surplus appropriated by the manufacturer.[5] The polar case $\gamma = 1$ is one of complete manufacturer market power, where it sells a drug that faces no competition from either perfect or imperfect within-therapeutic class substitutes. The opposite case $\gamma = 0$ obtains when the manufacturer produces a drug (e.g., a generic) that faces competition from perfect substitutes. This problem has the first-order conditions:

(2) $$\begin{aligned} &C'(Q)+\sum_{i=1}^{n} r_i'(Q)=G'(Q)+\sum_{i=1}^{n}\tau_i'(Q) \\ &T=\gamma G(Q)+(1-\gamma)C(Q)+(1-\gamma)\sum_{i=1}^{n} r_i+\gamma\sum_{i=1}^{n}\tau_i(Q) \end{aligned}$$

Substituting the expression for the equilibrium pharmacy transfer into the two surplus functions gives expressions for the profits of the manufacturer and pharmacy, as a function of aggregate quantity:

[5] This parameter is the focus of Ellison and Snyder (2008) who show empirically that the wholesale price of an antibiotic negotiated by manufacturers and pharmacies depends on the substitutability of that antibiotic. Another way to capture bargaining power in this negotiation is to explicitly model the pharmacy’s threat point in the expression of its surplus. The threat of non-cooperation comes from a) the legal right of the pharmacy to steer demand away from one drug to a therapeutic equivalent drug; and b) the pharmacy’s discretion over carrying a given drug at the risk of losing customers to competing pharmacies. Modeling bargaining power in this way generates the same qualitative results for correlated mark-ups and the impact of increased insurer size as when modeled by Nash exponents in equation (1). Similarly, exponents in the Nash product could be included to capture varying degrees of bargaining power in the negotiation between manufacture and insurers. For the purposes of this model, we can capture market power of a manufacturer through the manufacturer-pharmacy negotiation, although it is trivial to add Nash exponents in the manufacturer-insurer negotiation as well.

$$
(3) \quad \begin{aligned}
\Pi_M(Q) &= \gamma\left(G(Q) - C(Q) - \sum_{i=1}^{n} r_i(Q) + \sum_{i=1}^{n} \tau_i(Q)\right) \\
\Pi_P(Q) &= (1-\gamma)\left(G(Q) - C(Q) - \sum_{i=1}^{n} r_i(Q) + \sum_{i=1}^{n} \tau_i(Q)\right).
\end{aligned}
$$

These expressions illustrate two important points. First, changes in pharmacy profits (Π_P) are correlated with manufacturer profits (Π_M). Note that from equation 3, a literal interpretation of the model would suggest that any change in *log profits* will be identical for both the manufacturer and the retail pharmacy. Second, the market power of the pharmacy *vis-à-vis* the manufacturer plays an important role in determining the size of any impact on pharmacy markups. When pharmacies have little market power—that is, when $1-\gamma$ is small—a given change in total upstream surplus will have a smaller impact on their profits. We find evidence for both these results in our empirical analysis.

2.4 Downstream Negotiation and the Impact of Insurer Enrollment Size

Based on the solution to the upstream bargaining problem, the pharmacy bargains simultaneously downstream with each payer i. The outcome of each negotiation is a quantity and lump-sum transfer, (q_i, τ_i). Under the Nash framework, each payer believes that all other payers are playing optimally, and that it is the marginal payer in the negotiations.[6] The solution to the negotiation maximizes the product of payer surplus and the incremental profits to the pharmacy of contracting with the payer. Based on the expression for $\Pi_P(Q)$ from above, this can be written as:

(4)

$$
\max_{q_i,\tau_i} \left((1-\gamma)\left[\begin{array}{l} \left(G(q_i + \sum_{j\neq i} q_j^*) - C(q_i + \sum_{j\neq i} q_j^*) - (r_i + \sum_{j\neq i} r_j) + (\tau_i + \sum_{j\neq i} \tau_j^*) \right) - \\ \left(G(\sum_{j\neq i} q_j^*) - C(\sum_{j\neq i} q_j^*) - \sum_{j\neq i} r_j + \sum_{j\neq i} \tau_j^* \right) \end{array} \right] \right) \left(u(q_i) - \tau_i + r_i \right)
$$

This problem has the following first-order conditions:

[6] One could enrich this model by specifying it as an extensive-form game in which there is a set of probabilities that other players' negotiations break down. Chipty and Snyder (1999) note that the Nash-bargaining approach leads to a limiting perfect Bayesian equilibrium of the extensive-form game, in which the probability of breakdown approaches zero. Practically speaking, the Nash framework is both simple and likely relevant to the pharmaceutical context, where negotiations rarely break down entirely between the players.

$$
(5) \quad \begin{aligned}
&u'(q_i) = -G'(q_i + \sum_{j\neq i} q_j^*) + C'(q_i + \sum_{j\neq i} q_j^*) \\
&(\tau_i - r_i) = \frac{1}{2}\left[u(q_i) - \left(G(q_i + \sum_{j\neq i} q_j^*) - G(\sum_{j\neq i} q_j^*) \right) + \left(C(q_i + \sum_{j\neq i} q_j^*) - C(\sum_{j\neq i} q_j^*) \right) \right]
\end{aligned}
$$

The manufacturer bargains separately but simultaneously with each payer i. The outcome of each negotiation is a quantity and lump-sum rebate, (q_i, r_i). It is straightforward to show that this problem has first-order conditions identical to those in the pharmacy-payer negotiation, implying that separate expressions for equilibrium τ_i and r_i cannot be derived.

There are a number of ways to conceptualize an increase in enrollment for a firm. To economize on notation, we implement it as an amalgamation of two existing payers, h and i.[7] The total gross surplus earned by this combined payer is equal to $v(q_i^m + q_h^m) = u(q_i^m) + u(q_h^m)$, while the total tariff paid by the merged payer is denoted as τ_{hi}, and the rebate received by the merged payer denoted as r_{hi}. The linearity in the combined payer's gross surplus function implies that enrolling in a larger insurer confers no benefit to an insured, above and beyond any resulting impacts on quantity. The combined payer bargains with the pharmacy according to:

$$
(6) \quad \max_{q_i, q_h, \tau_{ih}} \left(\begin{aligned}
&\left(G(q_i^m + q_h^m + \sum_{j\neq i,h} q_j^{m*}) - C(q_i^m + q_h^m + \sum_{j\neq i,h} q_j^{m*}) - (r_{ih} + \sum_{j\neq i,h} r_j^m) + (\tau_{ih} + \sum_{j\neq i,h} \tau_j^{m*}) \right) - \\
&\left(G(\sum_{j\neq i,h} q_j^{m*}) - C(\sum_{j\neq i,h} q_j^{m*}) - \sum_{j\neq i,h} r_j^m + \sum_{j\neq i,h} \tau_j^{m*} \right)
\end{aligned} \right) * \left(u(q_i^m) + u(q_h^m) - \tau_{ih} + r_{ih} \right)
$$

This problem has the first-order conditions:

$$
(7) \quad \begin{aligned}
&u'(q_i^m) = u'(q_h^m) = C'(q_i^m + q_h^m + \sum_{j\neq i,h} q_j^m) - G'(q_i^m + q_h^m + \sum_{j\neq i,h} q_j^m) \\
&(\tau_{ih} - r_{ih}) = \frac{1}{2}\left[u(q_i^m) + u(q_h^m) - \left(G(q_i^m + q_h^m + \sum_{j\neq i} q_j^{m*}) - G(\sum_{j\neq i} q_j^{m*}) \right) + \left(C(q_i^m + q_h^m + \sum_{j\neq i} q_j^{m*}) - C(\sum_{j\neq i} q_j^{m*}) \right) \right]
\end{aligned}
$$

The impact of the merger on the division of rents is ambiguous. The net price paid by payers strictly falls if $C(Q) - G(Q)$ is strictly convex in Q. This result resembles the convexity condition derived by Chipty and Snyder (1999) in the context of a single seller.

[7] The analysis can easily be adapted to the case of uninsured consumers joining an insurer, but at the cost of some additional notation.

For all payers k, the first-order conditions for q_k^m are identical to the corresponding conditions for q_k^s. Therefore, it follows that $q_k^m = q_k^s$, for all k. This allows us to suppress the superscripts on the quantity variables for the rest of this section. For convenience, define $J(Q) \equiv C(Q) - G(Q)$. Exploiting this result, we can write the following:

$$(\tau_{ih} - r_{ih}) - [(\tau_i - r_i) + (\tau_h - r_h)] = \tag{8}$$
$$\frac{1}{2}\{[J(Q) - J(Q - q_i - q_h)] - [(J(Q) - J(Q - q_i)) + (J(Q) - J(Q - q_h))]\}$$

The expression above is strictly negative if J is strictly convex.

This result has a number of corollaries, which make clear the theoretical ambiguity of this prediction. First, increased payer size lowers prices if G is strictly concave, and C is weakly convex. Alternatively, if G and C are linear, size increase has no impact on prices. Finally, if J is strictly concave—e.g., due to increasing returns in the manufacture of pharmaceuticals—increased payer size actually leads to higher net prices paid by insurers. The effects of buyer size on prices may be non-monotonic and depend on the curvature of the surplus functions at the margin. These results are analogous to the conditions derived by Chipty and Snyder (1999) for the single seller model.

3. Data and Empirical Strategy

We empirically examine the impact of insurer enrollment on pharmacy prices and profits, along with insurer premiums. These findings, coupled with the theoretical insights from above, are used to draw quantitative and qualitative inferences about the distribution of rents among manufacturers, pharmacies, insurers, Part D enrollees, and commercial enrollees.

3.1 Data

Data on prescription drug utilization and expenditures come from a national retail pharmacy chain. As of January 1, 2006, when Medicare Part D was implemented, the pharmacy chain had retail presence in 45 US states; and prescriptions filled at its pharmacies account for approximately one-fourth of the US prescription market.

We obtained all pharmacy claims for a five percent random sample of unique pharmacy customers over the age of 60. For these individuals, we obtained data on claims for every prescription filled at the chain between September 1, 2004 and April 31, 2007. Each claim reports the National Drug Code (NDC) of the prescription filled, its therapeutic class, pill quantity, number of treatment days, and date dispensed, identification of the third-party payer, out-of-pocket and third-party payer expenditures, and the address of the pharmacy where the claim took place. The claims data also contain information on subjects' demographic characteristics (date of birth, sex, language preference, and zip code of residence).

The pharmacy claims data report drug utilization that is largely consistent with that reported in the Medical Expenditure Panel Survey (MEPS) for the same period. Table 1 lists the top 25 drugs by pharmacy revenues utilized by seniors between 2004 and 2006. The corresponding rank among drugs utilized by seniors in the MEPS between 2004 and 2005 is also reported. The drug ranking in the pharmacy claims tracks the MEPS rankings closely. Notable exceptions in the MEPS are listed in the table notes. These tend to be physician-administered drugs and are thus under-represented in out-patient retail pharmacy claims.

With these data, we are able to determine the drug prices negotiated between the pharmacy and each insurer for every drug that appears in the claims. Negotiated pharmacy profits vary considerably across insurers and across drugs. Figure 2a shows the distribution of average pharmacy profits per prescription for a given insurer and drug NDC code. The distribution of profits earned on generic drugs is everywhere to the right of the profit distribution for branded drugs. The mean profit on a generic drug prescription is $2.25 higher ($p < 0.001$) than that on a branded drug. This fact is consistent with greater surplus accruing to pharmacies when manufacturers have less market power, and is particularly striking given the much lower total prices of generic drugs.

A more subtle implication of manufacturer market power concerns the variance in profits within a drug, but across insurers. As an example, when manufacturers hold all the market power, economic profits for pharmacies (and payers) will be uniformly zero, and with zero variance. If not, pharmacy profits will vary depending on the pharmacy's negotiating leverage against a payer. This prediction about variance is borne out in Figure 2b, which depicts how the dispersion of pharmacy profits across insurers varies by drug. The empirical analysis examines whether differences in enrollment growth across insurers helps explains variation in negotiated drug prices.

Our database contains most large insurers that participate in Medicare Part D. In general, there are only two reasons why a Part D insurer would not appear in our claims database: (1) the pharmacy did not contract with the insurer; or (2) claims from the insurer are not sampled from the full pharmacy claims. Both these reasons suggest that smaller insurers are less likely to appear in the claims data. Table 2 shows the distribution of Part D insurers represented in our sample of pharmacy claims according to their 2007 Part D enrollment. In total, 86 Part D insurers appear in the claims data. While this list includes insurers that offer Part D Plan (PDP), Medicare Advantage plans, or demonstration plans, our analysis is eventually restricted to the set of insurers that offer at least one PDP. The columns parse the insurer universe by Part D enrollment. Note that the distribution of Part D enrollment by insurer is highly skewed. For instance, the median Part D insurer enrolls less than 6,400 Part D seniors, while the 90th percentile Part D insurer has more than 20-times greater Part D enrollment.

Data on enrollment, premiums and benefit design for Part D and Medicare Advantage plans come from the Centers for Medicare and Medicaid Services (CMS). Plan-level information also identifies the sponsoring insurance firm, so that enrollment can be aggregated to the insurer. Premium information is published annually, and corresponds to end-of-year open-enrollment premium pricing for coverage beginning the following year. Enrollment and Part D Landscape files are publicly available on the CMS website.

3.2 Empirical Strategy

3.2.1 *Insurer's Drug Cost Equation*

To test how enrollment affects prices and profits, we exploit the introduction of Part D, which brought about nearly 25 million new insured individuals to the rolls of existing insurers. We test whether insurers that experienced greater enrollment increases negotiated lower pharmacy drug prices. Since enrollment changes may be driven by unobserved changes in cost or bargaining leverage, we use geographic variation in insurer location to generate plausibly exogenous variation in their exposure to Part D enrollees.

Ideally, we would like to estimate how *total* insurer enrollment affects negotiated pharmacy drug prices. However, data on insurers' total prescription drug enrollees are not available.[8] We do, however, have Part D enrollment data from CMS. Therefore, we model the

[8] Data on insurers' *total medical* insurance enrollment are available from several sources. For instance, TheStreet.com (and previously Weiss Ratings), report enrollment, network size, assets and income for every medical underwriter annually. However, enrollment in drug insurance—the relevant measure of buyer size for drug price negotiations—is not reported separately. Further, enrollment of prescription benefits managers (PBMs) is not reported by these publishers.

impact of new Part D enrollment on changes in negotiated prices. Unobserved changes in commercial enrollment appear in the error term. Correlation with Part D enrollment could create a potential errors-in-variables problem, discussed below.

Framework

We estimate the following cost equation in first differences:

$$\Delta \ln(price_{d,i,t}) = \alpha + \beta \Delta Enrollment_{i,t} + \gamma \Delta X_{d,i,t} + \varepsilon_{d,i,t} \tag{9}$$

The dependent variable is the percent change in the log price per pill over all prescriptions of drug *d* filled by enrollees of insurer *i* between period *t-1* and *t*.[9] We define periods to be a half-year in length, where the second half of 2005 is the base year in each specification. Both the first and second halves of 2006 are used as the post-Part D-implementation comparison period in order to investigate the timing of any effect of enrollment on bargaining. Negotiated prices in the second half of 2004 are compared to prices in the second half of 2005 in our falsification tests, to assess whether there are any pre-existing trends that might contaminate our estimation. The key independent variable is the set of changes in each insurer's Part D enrollment due to the implementation of Medicare Part D in 2006. This serves as a proxy for changes in its total enrollment.

The vector of covariates, *X*, include a measure of each insurer's exposure to the pharmacy[10] and the average wholesale price of the drug.[11] Note that the first-difference specification necessarily differences out time-invariant drug, insurer, and market-level characteristics. Use of enrollment changes, rather than log changes, generates a semi-elasticity estimate that captures the average effect of enrollment increases on negotiated prices across

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[9] Price negotiations for drugs between insurers and pharmacies are conducted at the national level; hence, this study is conducted at the insurer-drug level. In a previous version of this paper, we conducted the analysis at the insurer-drug-state level in order to capture slight differences in factor costs (and hence, prices) across states. These differences are negligible and are averaged-out in the insurer-drug-state analysis. Indeed, conducting the analysis at the disaggregated level yields nearly identical results to those reported here. Also, while "pills" may represent larger or smaller units of treatment, our study of changes in the log unit price eliminates the need for consistent units across drugs.

[10] Theory suggests that greater exposure to the pharmacy may affect market power in bilateral negotiations. Each insurer's exposure to the pharmacy is calculated as the weighted average of the pharmacy's market share in markets where the insurer is present, where market weights reflect that each market's contribution to the insurer's total commercial business. Data on pharmacy market share was obtained from the Chain Store Guide, which reports annual sales and store counts of all pharmacies (total and by-chain) for local geographies in the US, for 2005 through 2008.

[11] We also include a measure of average number of pills sold per prescription for a given drug *d* and insurer *i*. Recall that the dependent variable is the price per pill averaged over all prescriptions observed in each cell. Given that prescriptions contain any number of pills, this measure controls for changes in the average number of pills per prescription in each cell over time, which may affect average price per pill through bulk-rate pricing.

insurers of all sizes. Throughout the analysis, we allow for nonlinear enrollment effects, as the theory makes no clear predictions about functional form. For ease of notation, however, we write down models for the simpler, linear case.

It is worth reiterating that the enrollment elasticity captures the change in the price paid to the pharmacy, and not literally the change in the price paid by the insurer, in response to enrollment changes. However, Nash-bargaining between pharmacy and manufacturer induces correlation between the changes in pharmacy and manufacturer *profits* that result from changes in insurer bargaining power.

Approach to Identification

A key concern in estimating equation (9) is the potential endogeneity of changes in enrollment to changes in negotiated drug prices. These prices represent the marginal cost of drug utilization to enrollees in the deductible and in any coverage gap, and serve as the base drug price in co-insurance corridors. Consequently, enrollment may respond directly to pharmacy drug prices, a behavior that would bias β_1 away from zero. Recent studies, however, suggest that this bias is unlikely to be large. Seniors' Part D plan choices often do not adequately account for the marginal cost of drug utilization; instead, seniors appear to weight plan premiums and non-monetary plan characteristics such as brand name heavily when choosing plans (Kling et al, 2008; Abaluck and Gruber, 2009). More threatening is the possibility that lower drug costs filter down as lower Part D plan premiums, which may encourage larger Part D enrollment. This possibility would result in estimates of β_1 that are biased away from zero. However, note that premiums are set in the month of July *preceding* the coverage year. Hence, while variation in premiums may reflect level differences in negotiated drug costs across insurers, bias occurs only if premium variation reflects differences in *anticipated changes* in negotiated drug prices for the following year—a mechanism for which we find little evidence.

Alternatively, sicker patients (and hence, those with greater expenditure risk) may be more sensitive to the marginal cost of drugs. Adverse selection into plans with low marginal cost of drugs may lead to higher premiums and lower total enrollment, resulting in a downward bias in the estimate of $\beta_{1.}$ Finally, as mentioned earlier, we do not observe changes in insurers' total enrollment; we only observe changes in their Part D enrollment. Correlation between Part D enrollment and commercial enrollment changes may also bias our estimate of β_1.

To address these potential sources of bias, we implement an instrumental variables strategy that exploits two predictors of insurers' initial 2006 Part D enrollment: each insurer's total potential Part D enrollment; and each insurer's "pure" price of coverage, a measure we call its "quality-adjusted premium." Intuitively, insurers may find themselves to be in stronger or weaker positions to capture Part D enrollees, purely as a function of their geographic presence several years prior to the implementation of Part D. This idea underlies the first instrument. In addition, insurers may vary in their levels of efficiency, or their desire to pursue greater or less Part D market share, as measured by the second instrument.[12]

These two instruments imply the following first-stage equation, which precedes the cost-enrollment equation:

$$(10) \quad \begin{aligned} \Delta Enrollment_{i,t} &= \gamma_0 + \gamma_1 Potential\ Part\ D\ Enrollment_i \\ &\quad + \gamma_2 Quality\ adjusted\ Premiums_{i,t} + \Gamma X_{i,t} + \eta_{i,t} \end{aligned}$$

An insurer's *Potential Part D Enrollment* is simply the count of seniors without private health insurance in 2005 (and hence, without prescription drug coverage) within markets (i.e. states) in which a given insurer is present in 2005, the year prior to Part D implementation.[13] That is, we define *Potential Part D Enrollment* as:

$$(11) \quad Potential\ Part\ D\ Enrollment_i \equiv \sum_m (Seniors\ w/o\ PHI_{m,t=2005} \cdot 1[insurer_i\ in\ m]_{t=2005})$$

Since insurance is regulated at the state-level, entry into a new state is costly. Labor and other capacity constraints may also compound the regulatory barriers. Hence, commercial underwriting presence in a state prior to Part D facilitates entry into that state's Part D market. Indeed, among Part D insurers, there is little difference between their 2006 Part D state penetration and their 2004 commercial presence.

Naturally, insurers with large potential Part D enrollment are on average likely to be large insurers with national commercial presence. A potential issue with validity arises if larger insurers are both more likely to be present in more markets *and* more likely to experience

[12] The exclusion restriction for validity of the quality-adjusted premium instrument is satisfied so long as the *level* of efficiency is uncorrelated with *changes* in the prices insurers will pay for drugs. We explicitly test this hypothesis later.

[13] This count includes seniors enrolled in Medicaid prior to Part D implementation. While seniors eligible for both Medicaid and Medicare received their drug coverage through state Medicaids prior to Part D, they are covered by private Part D insurers under the MMA, and thus constitute a large part of the increase in enrollment in private insurance rolls as a result of Part D implementation.

systematically different price changes. To test this hypothesis, we estimated the relationship between firm size and changes in drug prices, prior to Part D implementation. We found no relationship between the two quantities, as detailed in Appendix Table 1.

The second instrument captures pure price variation in the premium, or premium variation that is unrelated to plan generosity. To construct this measure of the quality-adjusted premium, we purge observed premium data of benefit design and plan generosity characteristics.[14] The result is a quality-adjusted price that more accurately reflects the effective load on a standardized insurance policy. Specifically, the instrument is constructed from the insurer fixed-effects in the following premium analysis run at the plan-level on Medicare Part D plan data from 2006:

(12) $$\ln(premiums_{p,i,m}) = \alpha + D_{p,i,m}\beta + \delta_i + \theta_m + \varepsilon_{p,i,m}.$$

Conceptually, the fixed-effects δ_i represent the quality-adjusted premiums charged by insurer *i*. We regress the log premium of plan *p* offered by insurer *f* in market *m* on plan design characteristics, D,[15] and indicators for each insurer. In equation (12), markets are demarcated by CMS-defined region. The region indicator variable, θ_m, eliminates premium variation across CMS markets.

A key issue for validity is whether the quality-adjusted premiums are uncorrelated with expected changes in drug prices from the time premiums are set (in mid-2005) to the time premiums are observed in 2006. If the two were in fact correlated – e.g., if more efficient firms at one point in time experience larger *changes* in drug prices—the instrument would not be exogenous with respect to changes in drug prices. We test this directly by regressing $\Delta BasketCost_i$, the changes in the insurers' negotiated cost of a market-weighted basket of drugs

[14] An advantageous feature of the Part D market is that CMS defines a standard (minimum benefits) coverage plan. The majority of Part D plans offered by private insurers are either standard plans, are plans that are actuarially equivalent to the standard plan—plans that are virtually identical to the standard design, however with small (and observable) differences in deductibles, co-payment design and formularies. Equation (12) is restricted to standard and actuarially equivalent plans offered in the *same* market, greatly reducing any source of bias due to unobserved plan characteristics. So-called "premium" plans (plans that offer greater levels of coverage set by the insurer, but are priced higher than standard plans) are omitted from estimation of equation (12). CMS data on plan design and premiums clearly identify plan type (standard, actuarially equivalent, or premium), and plan design. This is in large part due to the fact that CMS reimbursements to private insurer for Part D coverage is tied to plan type and benefit design, which necessitates development of a clear typology of all Part D plans in the market.

[15] Specifically, the vector *D* contains: the plan-level deductible for the year; whether the plan is a low income subsidy plan; whether the plan covers generics and branded drugs in the "coverage gap;" whether the plan covers generics and some branded drugs in the coverage gap; and whether the plan covers no drugs in the coverage gap.

between mid-year 2005 and the first half of 2006, on the δ_i terms.[16] We find no evidence of correlation between these terms.[17]

3.2.2 Insurer Enrollment and Pharmacy Profits

The impact of Part D on the profitability of commercially enrolled patients goes more directly to the heart of bargaining power, since firms ultimately bargain over rents, rather than prices. Moreover, impacts on the profits of pharmacies and insurers have a qualitatively predictable theoretical relationship with the profits of manufacturers, as demonstrated in the theory. This allows us to infer effects on rents flowing to all parties involved in price negotiations.

To estimate pharmacy profits, we require data on the acquisition cost of drugs to the pharmacy. In order to calculate pharmacy profits, we estimate the pharmacy's acquisition cost per drug using the minimum pharmacy price negotiated across all insurers for a given drug *d*. This methodology is similar to the minimum dependent variable estimator for the unobserved censoring point in Tobit models (Zuehlke, 2003; Carson and Sun, 2007).[18] We calculate:

$$(13) \qquad \begin{aligned} Cost_{d,t} &= \min_{\forall f}(price_{d,f,t}) \\ \overline{\Pi}_{d,f,t} &= price_{d,f,t} - Cost_{d,t} \end{aligned}$$

$Cost_{d,t}$ is the per-pill cost of a given drug *d* at time *t.* $\overline{\Pi}_{d,f,t}$ is the profit per-pill earned by the pharmacy for filling the prescription for drug *d* for an enrollee of insurer *f*. We average the profits over all prescriptions for a given drug-insurer to construct an average profit per pill over period *t.* Equation (14) estimates changes in log average profits per pill, $\overline{\Pi}_{d,f,t}$, on changes in each insurer's Part D enrollment:

$$(14) \qquad \Delta \ln(\overline{\Pi}_{d,f,t}) = \alpha + \beta \Delta Enrollment_{f,t} + \gamma \Delta X_{d,f,t} + \varepsilon_{d,f,m,t}.$$

[16] The basket comprises the top 1000 expenditure-weighted drugs from the national retail pharmacy claims data. Each drug's weight in the basket is pegged to drug-specific expenditure weight estimated from the 2005 and 2006 pharmacy claims.

[17] The coefficient estimate implies that a 10-percent increase in plan premiums relative to the market average for identical plans is associated with a $0.62 increase in cost of the standardized basket of drugs (mean normalized cost of the drug basket is $1365). The effect is economically small and statistically insignificant. The t-statistic on the estimated adjusted premium variable is 0.85.

[18] In these models, regression parameters are consistently estimated when the minimum value of the dependent variable is used as an estimate of the unobserved censoring point. While the current setting is not a Tobit, the motivation for the minimum dependent variable estimator is similar, particularly under the assumption that the estimate of the censoring point comes from an ordered statistics that converges to the true value as the number of groups increase (in our case, groups are the number of insurers).

As in equation (9), the analysis is conducted in first-differences, which sweeps out any time-invariant effects of each drug, insurer and market. Potential endogeneity of enrollment is addressed using the instrumental variables approach discussed earlier.

3.3 Understanding the Enrollment and Pricing Instruments

The two instrumental variables each play different roles across our sample of insurers. Table 3 illustrates the operation of the potential enrollment instrument. The table presents data on four insurers, approximately similar in the sizes of their total commercial enrollment, and ordered from smallest to largest in terms of commercial claims expenditures, reported in column (1). Observe, however, that their exposure to the Part D marketplace, reported in column (2), is not a simple function of size. Insurer A (the smallest) has the greatest potential Part D exposure, due to its heavy market penetration into states (such as Florida) with high elderly population shares. Column (3) reports actual Part D enrollment. The greatest Part D enrollment ends up accruing to Insurer A, as the potential enrollment variable predicts. The ranking of actual enrollment values tracks that of potential enrollment, except potential enrollment fails to distinguish between Insurers B and C, which have very similar potential enrollment values.

There are 33 insurers in our data for which we can calculate all the necessary covariates.[19] Figure 3 reports actual versus potential enrollment for 32 of these 33. While potential enrollment is not perfectly correlated with actual enrollment, there is a visual upward slope to the relationship. The "noise" in the relationship appears to come from some insurers who stay out of the Part D market, rather than insurers who secure far greater Part D enrollment than predicted. This suggests that potential enrollment creates option-value for insurers, which many (but not all) exercise.

The figure excludes one insurer, Humana, whose actual enrollment of 4.5M would skew the figure so much as to render the other points indistinguishable. Yet, Humana's potential enrollment figure of 13.85M is not substantially outside the range of observed variation, even

[19] The first-difference estimation framework outlined above requires repeated claims for each drug-insurer cell. 74 of the 89 Part D insurers observed in the claims data have repeated claims for at least one insurer-drug cell. 33 of these insurers offer at least one Part D plan (PDP), in addition to any plans offered through employer-based retirement coverage or Medicare Advantage plans. PDP premium data are required for the construction of the quality-adjusted premium instrument. Hence, the main analyses are based on claims data from the 33 private insurers for which we have stand-alone Part D plan premium data.

though it is quite large. This appears to threaten the credibility of the instrument, until we turn to Figure 4.

Figure 4 shows the distribution of the quality-adjusted premium variable for the 33 insurers for which this instrument can be calculated. The height of the bars reflects the relative size of each "bin" in the histogram, in terms of the number of firms. The numerical labels report mean Part D enrollment in the bin. Recall that the quality-adjusted premium measure is purged of differences in plan generosity, controlling for market fixed-effects. Therefore, this should be taken as pure price dispersion. There appears to be a relatively tight bell-shaped distribution of the quality-adjusted premium measure.

It is clear that Humana is an outlier in this distribution. With an enrollment of 4.5M, and a quality-adjusted premium that is fully 50% lower than its nearest competitor, it is atypical in the degree to which it under-prices its Part D plans and gained Part D enrollment. On average, this insurer prices plan premiums at a 70-percent discount relative to the average premiums for identical plans sold in the same market. The finding is consistent with Humana's widely publicized business strategy to rapidly gain Part D market share and subsequently switch enrollees into their highly profitable Medicare managed care plans (Krasner, 2006; BusinessWeek, 2006). Moreover, from 2006 to 2008, Humana quadrupled its Part D premiums from their baseline levels (Hoadley et al., 2008). To the extent that other insurers engage in similar, but perhaps less intensive, "loss-leader" pricing strategies, the quality-adjusted premium instrument should capture its effect on Part D enrollment. In general, both instruments capture distinct and substantive sources of plausibly exogenous variation in Part D enrollment, and are therefore included in all first stage specifications.

3.4 Specifying the Second-Stage Equation

The theoretical model does not specify the functional form that obtains between profits and enrollment. In principle, a flexible specification for insurer enrollment is preferred for the empirical analysis. Unless the true model is nearly or exactly linear, linear approximations to it are likely to produce misleading results, given the fairly wide distribution of Part D enrollment observed in the data. In the case of diminishing effects of enrollment on pharmacy profits, a linear specification will underestimate the true enrollment elasticity.

As an example, Humana is the single largest insurer with enrollment approximately 10 times larger than the median firm, and nearly 5 times larger than its nearest competitor. Potential non-linearity of the enrollment effect can be seen graphically. We calculate residuals from the change in log drug price equation (equation 14) including all covariates except the key explanatory variable: insurers' Part D enrollment. We then plot residuals from this regression against insurers' Part D enrollment. Figure 5a shows the scatter plot of residuals against Part D enrollment increases. If we ignore the firms with trivial numbers of Part D enrollees (as these have little influence on a weighted regression), a downward-sloping relationship is visually evident. But this relationship appears to weaken with enrollment size, particularly in light of the rightmost observation, Humana. This observation is dropped in Figure 5b in order to focus on the range of enrollment increases experienced by the rest of the insurer sample. The relationship is quite close to linear for insurers with non-trivial numbers of Part D enrollees.

In light of these facts, we pursue the following estimation strategy throughout our analyses:

1) Estimate simple linear models that exclude Humana.
2) Estimate more general nonlinear models that include all insurers in the sample in order to capture diminishing enrollment effects given large enrollment increases experienced by some insurers;

Both specifications produce very similar quantitative predictions for the mean and aggregate effects of Part D enrollment on prices and profits suggesting that Humana's unique strategic decision-making is not associated with substantially different effects of enrollment on the aggregate pharmaceutical market.

4. Results

We first examine the effects of insurer enrollment size on pharmacy profits in the commercial market. Our initial empirical focus on profits is motivated by the theory which directly points to a potential impact of buyer size on retailer profits. We then turn to the effect of insurer enrollment on retail prices in the commercial market in order to quantify the external buyer size effect on retail expenditures by insurers.

4.1 Enrollment and Retailer Profits in the Commercial, Non-Part D, Market

Table 4 reports enrollment effects on pharmacy profits-per-pill from estimation of equation (14) on all commercially insured, non-Part D claims. Recall, the retail pharmacy data includes claims for subjects ages 60 and above, as described in Section 3. Columns (1) and (2) report results from a linear model that includes all insurers, as well as Humana. The two instruments do a sufficient job predicting changes in enrollment, but the estimated effects are quite small. An extra 100,000 enrollees lowers profits per pill by just 0.2%. Taken at face value, these results suggest small effects of enrollment everywhere, even at the very top of the enrollment distribution. As an example, Humana's 4.*5M* enrollees would lower profits per pill by less than 8%, compared to an insurer with no additional enrollment. Specifically, this would suggest Part D enrollment has no external effects for the insurers other than Humana, and that all the results are driven by the difference between Humana and its competitors. In addition, the results also suggest that potential enrollment is a poor instrument, and that all the variation is driven by the adjusted premium instrument.

The other models, however, demonstrate the pitfalls of this interpretation. Humana's much greater than average enrollment increase highlights the possibility of diminishing enrollment effects on profits. Columns (3) and (4) report linear models that exclude Humana. Among the other insurers, enrollment does indeed impact profits. 100,000 additional Part D enrollees lower profits per pill earned by retailers in the commercial market by 2.7% in the OLS specification, and 4.3% in the IV specification. Potential enrollment is the primary driver of first-stage variation among these insurers. For the mean prescription, given the actual distribution of insurer enrollment increases, Part D is predicted to have lowered profits per pill by 15%. The median effect is 18%.

These results are robust to including Humana, provided we account for the possible nonlinearity of the enrollment effect. Columns (5) and (6) report results for a quadratic specification that includes all insurers. From an identification perspective, the nonlinear model differs in the strength of the adjusted premium instrument. This is likely due to the presence of Humana, whose large enrollment increase is explained almost entirely by its much lower quality-adjusted premium. Even so, it is striking that the quantitative implications of this model are similar to those of the linear model without Humana. Part D lowered profits for the mean prescription by about 18%, or 21% at the median. Including Humana raises the predicted effects slightly, but by much less than Humana's enrollment size would suggest. This is consistent with the view that enrollment's effects on profits are diminishing.

Table 5 presents some sensitivity analyses and validity tests using alternate comparison periods. Columns (1) and (2) present IV models that compare the second half of 2005 to the second half of 2006. This allows for a longer delay between the pre and post comparison periods. The effect of enrollment goes up somewhat. For the model with all insurers, Part D is predicted to have lowered retailer profits in the commercial market by 23%, as compared with 15% for the short-term comparison.

The last two columns of Table 5 present falsification tests that compare the second half of 2005 to the second half of 2004. We are relating retailer profit changes from 2004 to 2005, to Part D enrollment. If the effects reported in Table 4 and columns (1) and (2) of Table 5 are causal, then there should be no such relationship evident in the falsification test. However, if there are differential trends in profits per pill that are systematically correlated with firms' geographic distributions, these placebo regressions would turn up significant effects. Instead, we obtain fairly precise zeroes. The standard errors on the coefficients are about one-third to one-quarter the size as in our benchmark models, but the estimates are insignificant. This provides evidence against the concern that our main results are driven by long-term trends in price negotiations that happen to be correlated with changes in Part D enrollment.

The theory predicts that results might differ by the degree of market power held by the manufacturer. Recall that if manufacturers hold all the market power, enrollment will have no impact on prices or profits for pharmacies or insurers, because all the rents remain with the manufacturer. To assess this hypothesis, we repeat the analysis stratifying the sample by branded and generic drugs. Results are reported in Table 6. An enrollment increase of 100,000 lowers profits on generic drugs sold in the commercial, non-Part D, market by 10.4% but has no statistically significant impact on the profits of branded drugs. Stratifying the branded drug sample further reveals a continuum of effects that vary with the degree of market power held by the branded manufacturer.

We define a branded drug's degree of competition to be the number of substitutes for a given branded drug. Two conventional definitions are used: the number of generic drugs for the same compound (e.g., on-patent branded drugs face zero substitutes by this definition); and the number of generic manufacturers in the market within the same therapeutic sub-class.[20] Columns (3) and (4) of Table 6 stratify the sample of branded drugs into those that have zero within-compound substitutes, and those with one or more. For non-competitively manufactured drugs—i.e. on-patent drugs by this definition—the enrollment effect is negative, small in size and statistically insignificant. Notably, this set of drugs accounts for roughly 50-percent of all expenditures on pharmaceuticals in the US. In contrast, for drugs with one or more direct substitutes, the enrollment effect is approximately 10% per 100,000 enrollees.

Sub-classes provide for a broader categorization than unique compounds, and are able to capture competition from imperfect therapeutic substitutes that treat the same disease. Columns (5)-(7) repeat the analysis stratifying the sample of branded drugs into terciles based on the number of within-subclass therapeutic competitors faced by each drug. Here too, the enrollment effect for branded drugs facing the least competition is close to zero and statistically insignificant. As the number of substitutes increase, so does the magnitude of the estimated enrollment effect on unit profits earned by the pharmacy. For branded drugs in the highest tercile (column 7), we estimate that insurers experiencing an enrollment increase of 100,000 are able to negotiate away 4.01 percent of profits earned by the pharmacy on a drug prescription. For drugs in the lower or middle tercile, however, there is no statistically significant impact of enrollment. Results from the linear enrollment specification for the insurer sample excluding Humana are reported in Appendix Table 2. The results from all specifications are consistent with the notion that manufacturers appropriate nearly all available profits for molecules with few competitors, leaving little for pharmacies and insurers to bargain over, regardless of changes in their market power.

Theory suggests that pharmacy profits on a particular product are positively correlated with the profits of the corresponding manufacturer. These results suggest, therefore, that Part D health insurers experienced gains at the expense of pharmacies, who lose profits they were previously earning on drugs in competitive classes, including: generic drugs, off-patent brands, and other branded drugs facing considerable therapeutic competition. This also suggests gains in bargaining power versus manufacturers of those drugs.

[20] Therapeutic sub-class definitions are taken from the Multum drug class categorization used in the Medical Expenditure Panel Survey Prescribed Medicines file.

4.2 Enrollment and Negotiated Drug Prices in the Commercial, Non-Part D, Market

We next turn to the external effects of enrollment on retail drug prices in the commercial market, as presented in equation (9). Results can be interpreted as effects on insurer retail expenditures. The results are reported in Table 7, where standard errors are clustered at the level of the insurer. Columns (1) through (3) report the effects for the commercial population ages 65 and older, while columns (4) through (6) report the external effects on the non-elderly commercial market. Column (1) reports estimates of the enrollment effect for the entire sample of branded and generic drugs on changes in drug prices between the second half of 2005 and the first half of 2006. An additional 100,000 enrollees leads to an approximate 2.5% decline in retail prices observed for seniors in the non-Part D commercial market. This decomposes into a 5.4% decline in generic prices, but only a 0.3% decline in branded prices. On average, Part D lowered the price of the mean prescription by 19% for generic drugs, 0.9% for branded drugs, and 8.5% overall.

We repeat estimation of equation (9) using pharmacy claims associated with prescriptions filled by the non-elderly commercially enrolled (i.e., outside both Medicare and Medicaid). Results are reported in columns (4)-(6) of Table 7. An additional 100,000 Part D enrollees leads to roughly 1.8% lower prices overall for the non-elderly commercial enrollees; this can be decomposed into 3.7% lower generic prices and 0.35% lower branded prices. On average, the implementation of Part D lowered the mean prescription price by 5.8% overall, 12.4% for generics, and 1.1% for branded drugs. Results from the linear enrollment specification for the insurer sample excluding Humana are virtually identical, and are reported in Appendix Table 3.

Note these effects are smaller than the corresponding estimates for the elderly population. This would be true if Part D had the greatest impact on drugs used heavily by seniors, and if drug utilization patterns differed across age groups. This would dampen the overall effect of average price declines for the commercially enrolled non-elderly.

In any case, this result implies that on the margin, administering Medicare drug insurance under the umbrella of private insurers has both a direct benefit—e.g. effects on drug utilization, as found by Lichtenberg and Sun (2007), Yin *et al* (2008), Duggan and Scott-Morton (2008) and Ketcham and Simon (2008)—and an *external* benefit for insured outside of the Part D program.

5. Quantifying the Internal and External Effects of Part D

The results in the previous section allow us to decompose reductions in drug cost across enrollees inside and outside the Part D program, as shown in the following equation:

(15) $$\Delta Expend = \sum_i (\Delta p_i^{Cash/PartD} \cdot q_{Pre,i}^{Cash}) + \sum_i (\Delta p_i^{Com} \cdot q_{Pre,i}^{>65,Com}) + \sum_i (\Delta p_i^{Com} \cdot q_{Pre,i}^{<65,Com})$$

In equation (15), $q_{Pre,i}^{j}$ represents the total quantity of drug *i* purchased by individuals in group *j*; Δp_i^j represents the average decline in price of drug *i* due to Part D among individuals in group *j*. The three terms on the right hand side of the equation represent the expenditure reductions for: 1) Part D enrollees who were previously uninsured; 2) seniors who were commercially insured prior to Part D; and 3) non-elderly commercially insured enrollees. The savings in 1) represent the compositional effect of enrolling cash-paying seniors in commercial Part D plans. This is the direct "internal" effect of Part D. The expenditure reductions for the latter two groups represent an "external" effect of Part D: enrollment increases due to Part D enhance the bargaining power of insurers; consequent prices declines negotiated by insurers accrue to all enrollees of the insurer.

We estimate the components of equation (15) as:

$$\Delta Expend = Expend_{Pre}^{Cash}\gamma_1 + Expend_{Pre}^{>65,Com}\gamma_2 + Expend_{Pre}^{<65,Com}\gamma_3 .$$

$Expend_{Pre}^{j}$ represents total drug expenditures among individuals in group *j* prior to the implementation in Part D. γ_j represents the average Part D-related decline in log prices for individuals in group *j*. For all groups *j*, we estimate $Expend_{Pre}^{j}$ from the 2005 Medical Expenditure Panel Survey (MEPS). $Expend_{Pre}^{Cash}$ is the average out-patient prescription drug expenditure among seniors without health insurance coverage at any period during 2005. $Expend_{Pre}^{j,Com}$ is the average out-patient prescription drug expenditure among senior or non-seniors who report having private commercial insurance (or private Medigap) as the usual third-party payer for drugs purchased during 2005.

We use the pharmacy claims data to estimate the average decrease in the cash to coverage drug prices between 2005 and 2006, for the sample of drugs used in the enrollment elasticity analysis. Define this as β_1. In our data, we estimate that the average Part D enrollee who was previously uninsured experiences a 30% reduction in annual drug costs, holding quantity at pre-Part D levels. We take this as our estimate of β_1.

Since not every uninsured cash-paying senior in 2005 chooses to enroll in Part D, this number must be scaled to account for the fact that not every previously uninsured patient ended up with this decline in drug costs. We use the MEPS to estimate the expenditure-weighted share of uninsured patients who enroll in Part D. The coefficient of interest can be recovered as $\gamma_1 = \alpha_1\beta_1$, where α_1 is this expenditure-weighted share of uninsured patients enrolling. From the MEPS, we estimate that the fraction of uninsured seniors dropped from 24-percent to 8-percent of seniors between 2005 and 2006. This is virtually identical to estimates based on the Health and Retirement Survey (Levy, et al). We assume that the two-thirds of individuals who enrolled in Part D have the highest expenditures within this group.[21] This yields an estimate of $\alpha_1 = 0.94$. We thus estimate $\gamma_1 = (0.94) * (-0.30)$, and $Expend_{Pre}^{Cash} = \$13.4B$.

γ_2 is the average percentage change in price for commercially enrolled seniors, and γ_3 is the corresponding quantity for commercially enrolled non-seniors. We begin with our estimated declines in expenditure for each group due to observed insurer enrollment increases. Specifically, we use the models in columns (1) and (4) of Table 7, holding $q_{Pre,i}^{j,Com}$ and other regression covariates constant at 2005 levels. These estimates must be scaled to account for the fact that our sample is restricted to Part D insurers, rather than the entire commercially enrolled population. Hence $\gamma_j = \alpha_j\beta_j$, where α_j represents the fraction of the commercial market *j* that is covered by an insurer participating in Medicare Part D. We estimate the α terms using the pharmacy claims data and assume the β terms also apply to Part D insurers outside our sample. This approach yields $\alpha_2 = 0.40$, $\beta_2 = -0.085$, and $Expend_{Pre}^{>65,Com} = \$37.2B$; and $\alpha_3 = 0.40$, $\beta_3 = -0.058$, and $Expend_{Pre}^{<65,Com} = \$74.6B$.

These parameter estimates imply a total reduction in drug expenditures of \$6.78*B* (again, holding $q_{Pre,i}^{j}$ and other regression covariates constant at 2005 levels), of which \$3.78*B* (56-percent) can attributed to the direct effect of insuring two-thirds of the previously uncovered seniors. Importantly, 44-percent of the total effect of Part D on market-wide reductions in drug expenditures (\$3.00*B*) can be attributed to the external effect of greater insurer bargaining power from Part D enrollment increases. Note that these savings are *annual* savings, accruing to the insurer and enrollees in each year after the implementation of Medicare Part D.

[21] This generate an upper bound estimate for the internal effect of Part D on previously uninsured seniors, resulting in an underestimate of the relative size of the external effect.

It is not clear how much of this expenditure reduction is retained by insurers, and how much flows to the commercially insured. At a minimum, there is evidence of noncompetitive behavior in the group insurance market (Dafny, 2008). Regardless of where the rents end up, they are likely to have significant effects on the distribution of welfare in the market.

On the one hand, if they are passed through to commercial enrollees, the total savings would be relatively small on a per capita basis, but sizeable in the aggregate. The total savings of \$3.00B would imply that commercial enrollees of insurers that participate in Part D accrued total savings nearly equal to the savings enjoyed by the newly insured Part D beneficiaries.

If retained entirely by health insurers, we estimate this would have boosted the profitability of commercial prescription drug insurance operations by more than 20%. We arrive at this back-of-the-envelope estimate using the profit and cost margins reported by Aetna, the only major health insurer to break out health care costs and premia in sufficient detail to facilitate a calculation of this sort. Moreover, we have no reason to believe that margins are substantially different for Aetna than for other insurers. According to its 2008 annual report, Aetna paid out 81.5 cents of health care expenses on every dollar of premium earned, for a gross operating margin of 18.5%. Assuming these margins are similar for prescription drug coverage, a 5.2% reduction in drug costs would have boosted this margin by 23%. In other words, for a constant revenue base, Part D would have raised annual net income on commercial insurance by 23%.

6. Conclusion

Part D enrollment seems to have tilted market power in the favor of its participating health insurers. Gains in negotiating leverage came at the expense of pharmacies, generic drug manufacturers, and branded manufacturers facing generic or therapeutic competition. Branded drug manufacturers with a great deal of ex ante market power seem to have escaped losses. The total size of the price reduction in the commercially enrolled marketplace was quite significant in relationship to health insurer profitability, and in terms of its aggregate value to the commercially enrolled population.

Our results illustrate the interaction between insurer market power, and the competitive pressure faced by manufacturers. For molecules with little competition, insurer consolidation is unlikely to make significant price inroads, as manufacturers appear to hold all or nearly all the market power available. However, for drugs that have identical or therapeutically similar molecular equivalents, price-negotiation by insurers can have significant benefits for consumers. Naturally, the optimal degree of competitiveness faced by manufacturers depends both on efficient drug pricing, and the provision of sufficient incentives to innovate. Therefore, it is not clear whether policies to reduce manufacturer profitswould harm future welfare by more than they enhance current welfare.

More generally, our findings suggest an important external effect of public subsidies for private health insurance. Direct and indirect subsidies are becoming more prevalent in the US health care system, whether in the form of tax-exemption for employer-based health insurance premiums, or direct subsidies for insuring the poor. The welfare analysis of such policies should consider the pricing impacts on consumers outside the subsidized group. In our context, those external effects were quite significant, relative to the internal price effects of the program.

Finally, our results highlight an important, but little discussed effect of the Part D contracting model: its external effects on the non-Part D marketplace. If Part D confers competitive advantages on payers who write insurance outside the Part D environment, its social gains may extend beyond the Part D population. Indeed, given the concentration of the prescription drug insurance marketplace, these external effects have the potential to affect many outside the Part D program, and perhaps to rival the direct benefits of Part D to those participating in the program. It is significant to note that these external effects are present, in spite of the theoretical separation between commercial price-negotiations and Part D price-negotiations, and that these effects can only exist when Part D is administered through the private insurers with large commercial enrollment external to Medicare.

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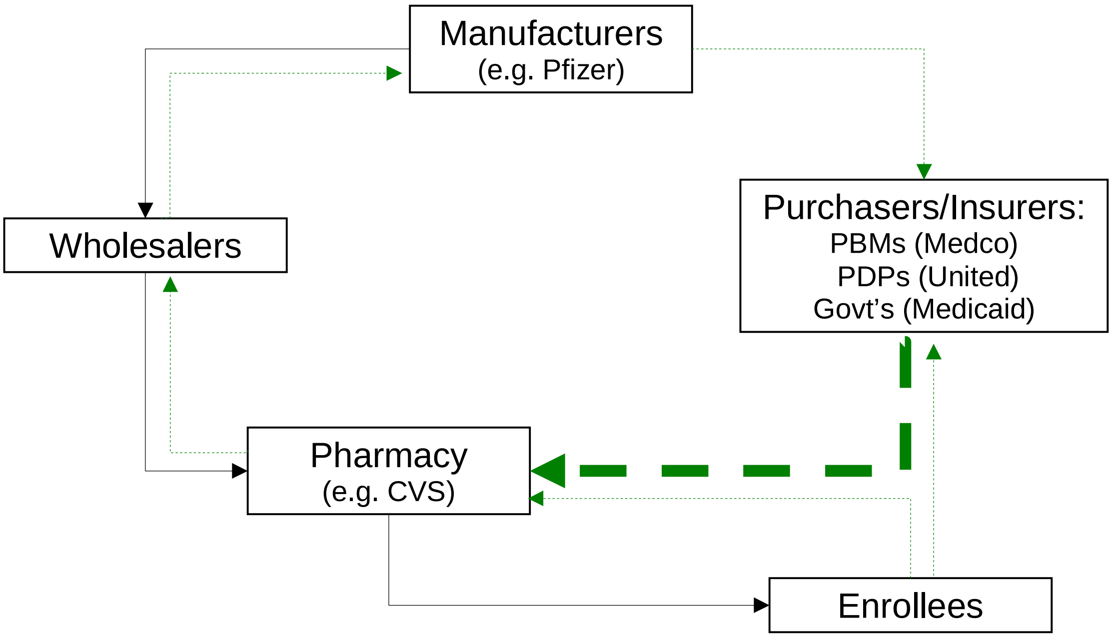
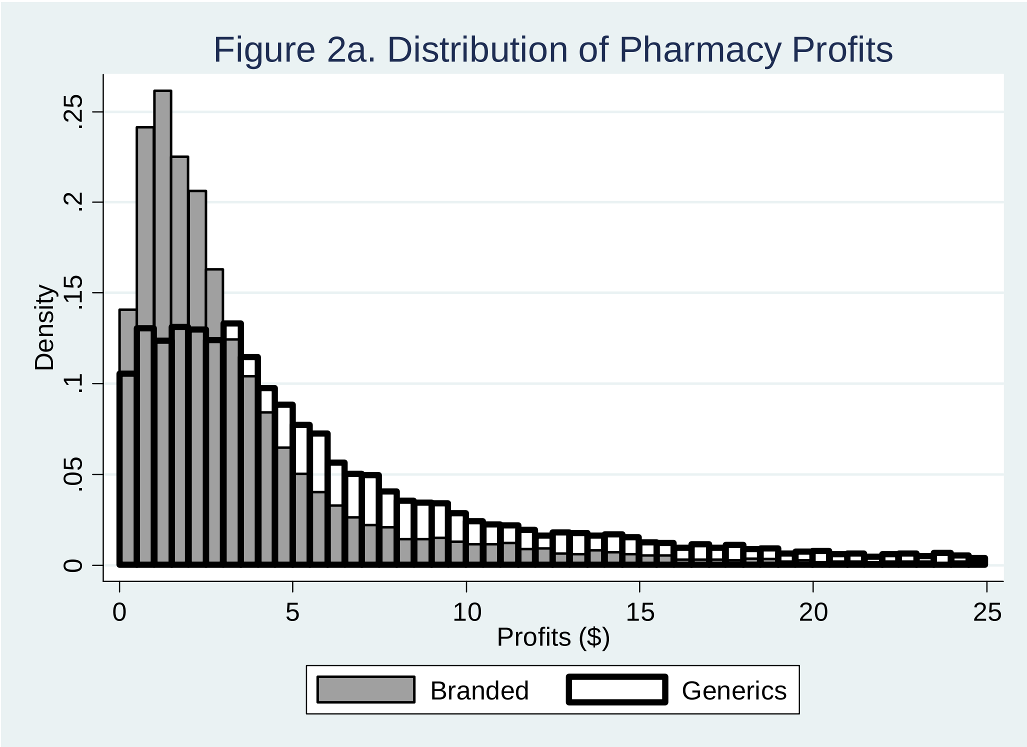
Figure 1. Transfers and Payments in the Prescription Drug Market





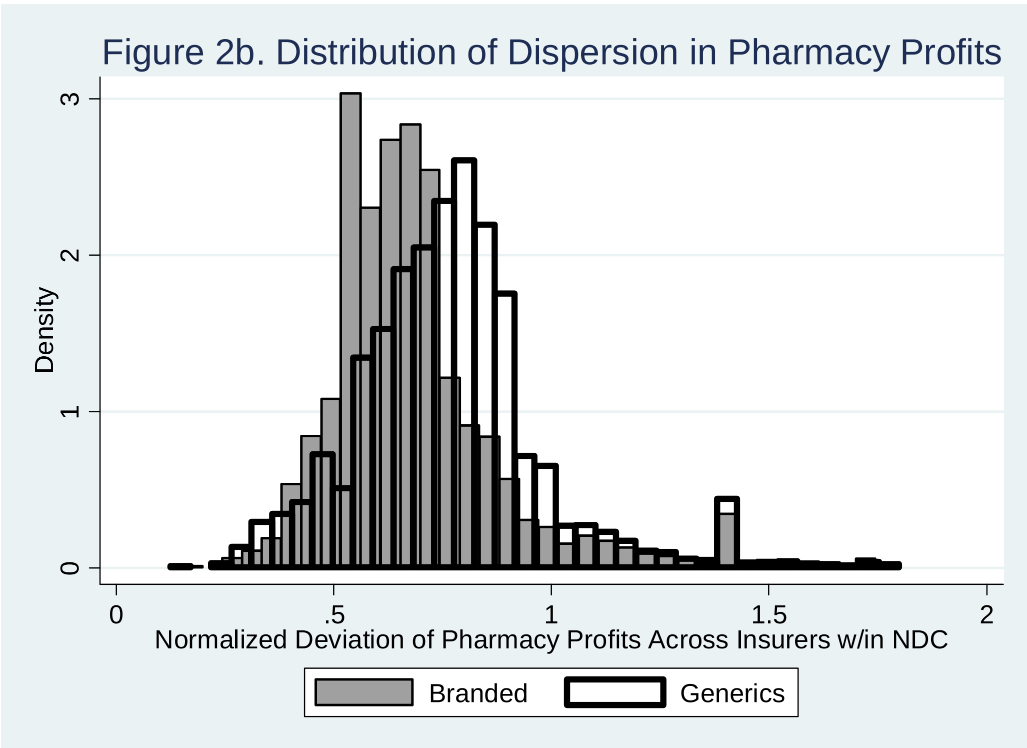
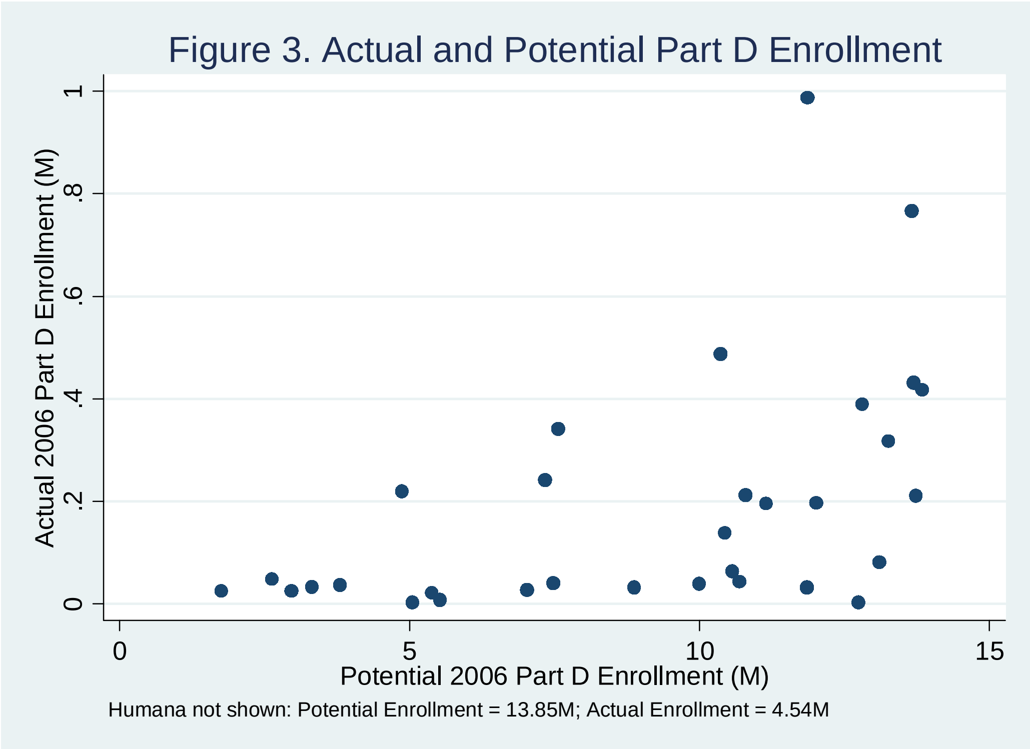
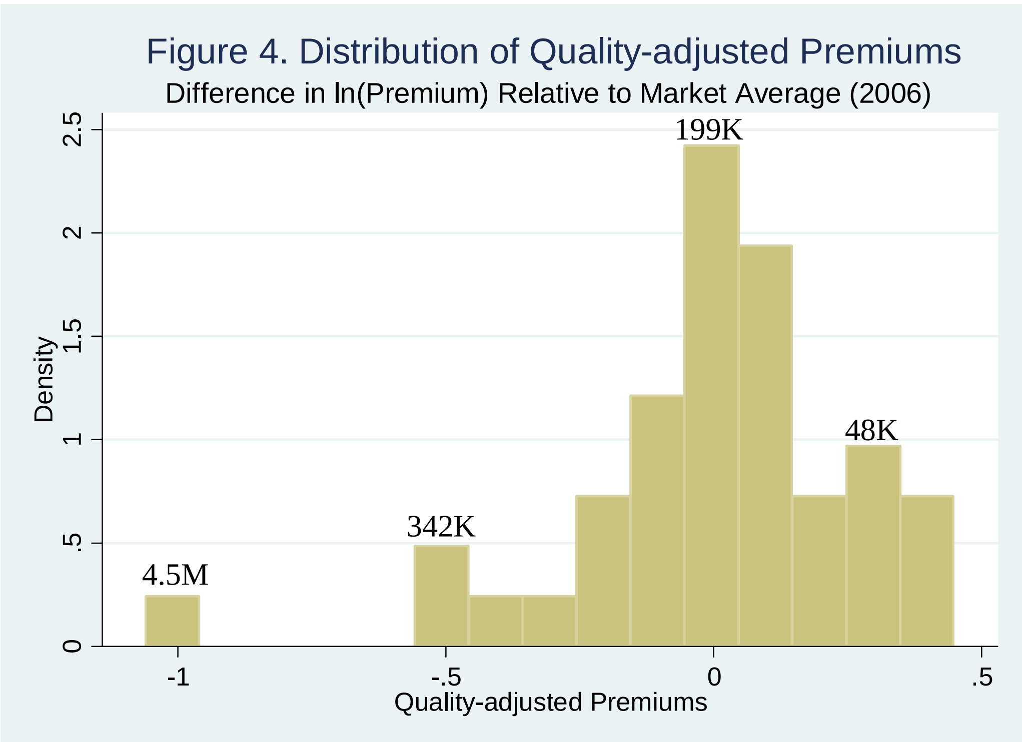


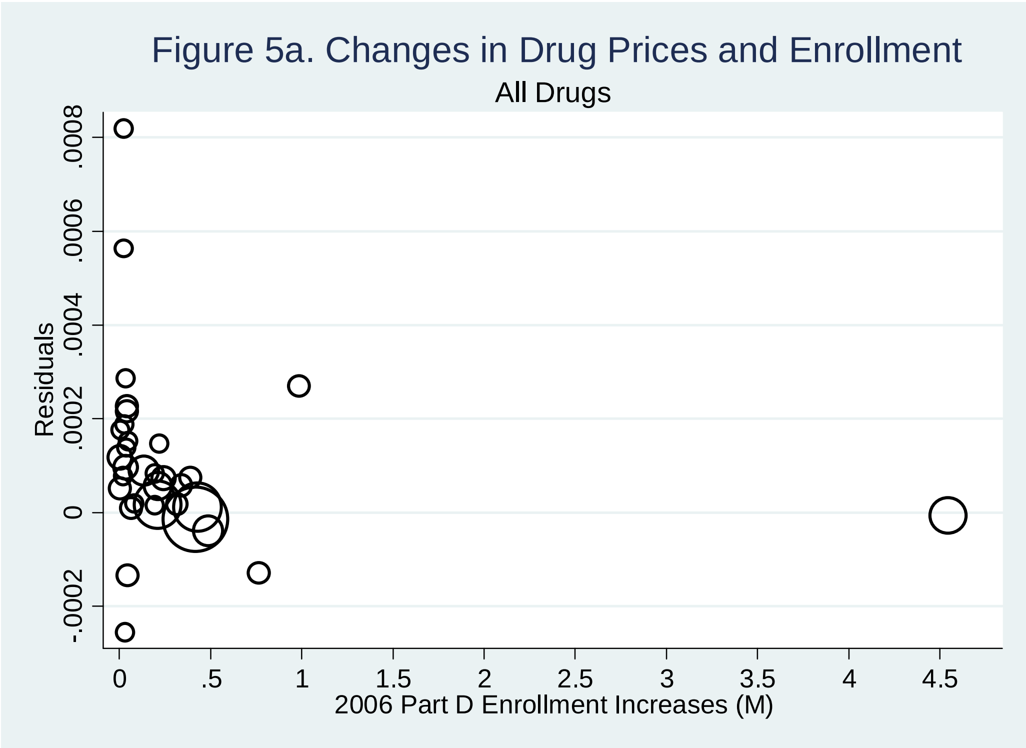
Figure 2a shows the distribution of average profits per prescription at the insurer-NDC level earned by the pharmacy. For illustrative purposes, data come from a single point in time, September 2005, so that all variation in pharmacy profits comes from variation across insurers and drugs in the cross-section. Figure 2b shows the distribution of standard deviations *within* NDC code, *across* insurers in the profits earned by the pharmacy, where standard deviations of profits within NDC code have been normalized by the mean profits earned by the pharmacy for that NDC.



Each dot on the figure represents a single insurer. "Potential Part D enrollment" measures the exposure of each insurer to the Medicare-eligible population in 2006, according to the insurer's geographic distribution prior to Part D. The detailed formula is provided in the text.



The figure shows the distribution of insurers' *quality-adjusted premiums*, which is used as an instrument for insurers' actual Part D enrollment. An insurer's *quality-adjusted premium* is calculated as the difference in log premiums between its standardized Part D plans and identical plans offered in the same market. Insurers' realized 2006 Part D PDP enrollment is labeled above key points in the distribution. Note that the enrollment figure listed for the peak bin is an average across all the insurers in the bin.



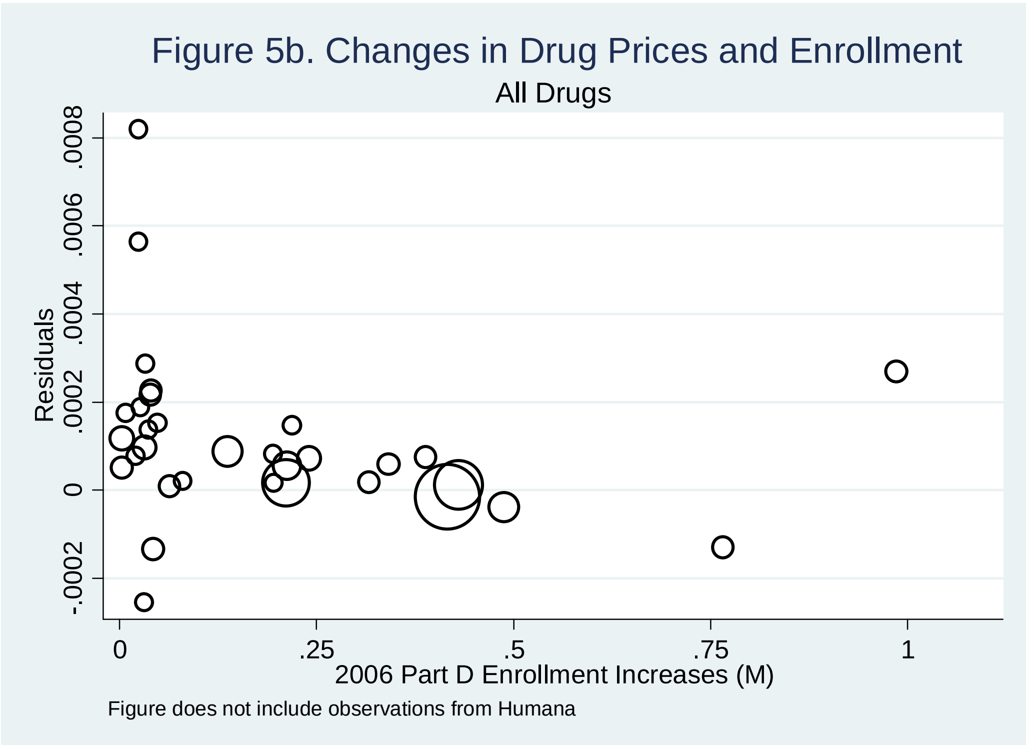


Figure 5a shows the scatter plot of average residual change in log drug prices against Part D enrollment increases. Residuals are calculated from the regression of log changes in drug prices against all model covariates *except* Part D enrollment increases, where residuals are averaged across all drugs to the insurer level. Figure 5a shows this scatter plot for all 33 insurers that are included in the main model specifications. Figure 5b shows the same scatter plot except that the observation from Humana is not shown. The size of circles reflects the size of insurers as measured by the number of observed claims in the data.

Table 1. Rank of Drugs by Sales among Seniors in Pharmacy Claims

Rank	Drug	MEPS Rank (Among Seniors)
1	LIPITOR	1
2	PLAVIX	4
3	ZOCOR	2
4	NORVASC	6
5	PREVACID	10
6	NEXIUM	5
7	FOSAMAX	8
8	ADVAIR	16
9	PROTONIX	15
10	PRAVACHOL	11
11	DIOVAN	14
12	ACTOS	17
13	CELEBREX	12
14	TOPROL XL	7
15	AVANDIA	18
16	COREG	21
17	AMBIEN	58
18	ARICEPT	20
19	ACTONEL	31
20	LEVAQUIN	98
21	ZETIA	19
22	ZOLOFT	22
23	FLOMAX	33
24	ACIPHEX	34
25	COSAAR	40

The table lists the top 25 drugs, ranked by expenditures during 2004 and 2005 in the pharmacy claims data for seniors aged 65 and above. Expenditures are measured as the sum of payments to the pharmacy made by the customer plus third party payers. The corresponding rank for these drugs among seniors in the 2004 and 2005 Medical Expenditure Panel Survey (MEPS) Prescription Medicines module. High ranking drugs in the MEPS that do not appear in the pharmacy claims data include Procrit (rank #3 in the MEPS, rank #79 in the pharmacy claims) and Atenolol (#9 in MEPS, #62 in pharmacy claims), both of which are largely physician administered and therefore less likely to appear in outpatient pharmacy claims. Other drugs ranked in the top 25 by the MEPS include ; Metformin (#13 in the MEPS, #29 in the pharmacy claims); Ranitidine (#23 MEPS, #122 claims); Evista (#24 MEPS, #33 claims); and Lotrel (#25 MEPS, #41 claims).

Table 2. Distribution of Insurers by 2007 Part D Enrollment

	Below Median	Above Median	50-75th Percentile	75-90th Percentile	90-95th Percentile	Above 95th Percentile
	(1)	(2)	(3)	(4)	(5)	(6)
Insurer's Part D Enrollment	< 6,400	> 6,400	6,400-28,000	28,000-126,000	126,000-354,000	> 354,000
No. of Insurers	124	124	62	36	13	13
No. of Insurers Appearing in Claims	15	71	29	21	9	12
Fraction of Insurers Appearing in Claims	0.22	0.87	0.46	0.54	0.70	0.95

The table shows the distribution of insurers by their Part D enrollment. For each enrollment bin, the table reports the number insurers participating in Part D, and among these insurers, the number of insurers that are observed in the pharmacy claims. The last row reports the fraction of Part D participating insurers that appear in the claims, weighted by their Part D enrollment.

Table 3. Illustration of the Potential Part D Enrollment Instrument

	Total Expenditures in 2005	Potential Part D Enrollment	Actual 2006 Part D Enrollment
	(1)	(2)	(3)
Insurer A	$4.6M	12.6M	986,108
Insurer B	$5.4M	3.4M	20,735
Insurer C	$6.8M	3.3M	37,388
Insurer D	$7.0M	8.2M	221,359

This table illustrates the explanatory power of the potential Part D enrollment instrument. The insurer-level variable is defined as the number of seniors in 2005 without private drug insurance (including those on Medicaid) residing in states in which the insurer is present in the commercial market, weighted by the insurer's commercial marketshare in those states. Data on drug coverage come from the 2005 Current Population Survey. The table lists four insurers that are similar in their commercial market size, as measured by the total reimbursesments to the pharmacy (column 1). Column 2 reports the wide variance in the potential Part D enrollment among these four insurers. Actual Part D enrollment in 2006 is reported in column 3.

Table 4. Enrollment Effect on Pharmacy Profits-per-Pill: Second Half 2005 vs First Half 2006

	Dependent Variable: Δln(Drug Profit per Pill)						
Model	OLS	IV	OLS	IV	OLS	IV	
	(1)	(2)	(3)	(4)	(5)	(6)	
ΔFirm's PartD Enrollment (1M)	-0.017*	-0.019*	-0.265**	-0.432**	-0.316**	-0.555**	
	(0.010)	(0.010)	(0.117)	(0.201)	(0.138)	(0.232)	
ΔFirm's PartD Enrollment^2 (1M)					0.062**	0.112**	
					(0.030)	(0.049)	
Δ Log Exposure to Pharmacy	-0.825	-0.807	-0.478	-0.578	-0.500	-0.643	
	(0.869)	(0.860)	(0.451)	(0.463)	(0.461)	(0.484)	
Δ Log Avg Quantity per Rx	0.407***	0.408***	0.392***	0.390***	0.364***	0.362***	
	(0.051)	(0.051)	(0.041)	(0.041)	(0.044)	(0.043)	
Δ Log AWP of Drug	0.084***	0.083***	0.017	0.016	0.015	0.013	
	(0.026)	(0.027)	(0.034)	(0.031)	(0.029)	(0.027)	
Constant	0.007	0.009	0.147***	0.198***	0.154***	0.220***	
	(0.082)	(0.082)	(0.033)	(0.047)	(0.032)	(0.053)	
First Stage		Endogenous Variable		Endogenous Variable		Endogenous Variable	
Excluded Instruments		ΔEnrollment		ΔEnrollment		ΔEnrollment	ΔEnrollment^2
Potential Enrollment (1M)		0.090**		0.037***		-0.058	-0.097
		(0.043)		(0.007)		(0.104)	(0.355)
Potential Enrollment^2 (1M)						0.005	0.007
						(0.005)	(0.017)
Adjusted Premium		-3.663***		-0.270		0.812**	5.737***
		(0.192)		(0.193)		(0.387)	(1.353)
Adjusted Premium^2						-4.446***	-23.588***
						(0.371)	(1.271)
F-stat for Excluded Variables		203.22		13.75		3849.75	9370.42
Predicted Δln(Drug Profit/Pill): 25th	-0.003	-0.004	-0.056	-0.091	-0.064	-0.112	
Predicted Δln(Drug Profit/Pill): 50th	-0.007	-0.008	-0.110	-0.180	-0.121	-0.212	
Predicted Δln(Drug Profit/Pill): 75th	-0.008	-0.009	-0.114	-0.186	-0.125	-0.218	
Overall Predicted Δln(Drug Profit/Pill)	-0.014	-0.015	-0.094	-0.153	-0.107	-0.184	
R-squared	0.027	0.025	0.027	0.025	0.021	0.018	
Insurer Observations	33	33	32	32	33	33	
Insurer-Drug Observations	9985	9985	9254	9254	9985	9985	

The table reports the effect of a change in insurer enrollment on the change in the log of profits earned by the pharmacy on prescriptions associated with commercial claims. The dependent variable is the change in the log of the average profit per pill earned on a given drug for prescriptions associated with a given insurer between the second half of 2005 and the first half of 2006. The key regressor is the change in the insurer's Part D enrollment between 2005 and 2006. Covariates include the change in the log average number of pills per prescription, the change in the drug's average per-pill wholesale price, and the change in each insurer's exposure to the pharmacy (calculated as the pharmacy's share of the pharmacy market in areas where the insurer is present). The sample of drugs comprises the top 1000 drugs, ranked by expenditures, observed in the claims. Instruments for Part D enrollment include potential Part D enrollment, calculated as the number of uninsured seniors in 2005 residing in states where the insurer is present in the commercial market, weighted by the insurer's commercial marketshare in those markets; and quality-adjusted premium, calculated the difference in log premiums between standardized Part D plans offered by one insurer relative to the average for identical plans in the same market. Columns (3) and (4) no not include observations from Humana. Changes in log profits earned by the pharmacy predicted by the model are reported for the insurer of the 25th, 50th and 75th percentile prescription, as ordered by the enrollment change of the associated insurer. Also reported is the overall predicted change in log profits given the observed distribution of enrollment increases. Parentheses report standard errors clustered at the insurer level. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 5. Enrollment Effect on Pharmacy Profits-per-Pill: Alternative Comparison Periods

Dependent Variable: ∆ln(Drug Profits per Pill)				
Model	IV	IV	IV	IV
Time Periods	Second Half 2005 vs Second Half 2006	Second Half 2005 vs Second Half 2006	Second Half 2005 vs Second Half 2004	Second Half 2005 vs Second Half 2004
	(1)	(2)	(3)	(4)
∆Firm's PartD Enrollment (1M)	-0.543**	-0.677**	0.088	0.065
	(0.263)	(0.315)	(0.085)	(0.086)
∆Firm's PartD Enrollment^2 (1M)		0.136**		-0.014
		(0.066)		(0.018)
∆ Log Exposure to Pharmacy	-0.893	-0.968	0.138	0.126
	(0.647)	(0.684)	(0.086)	(0.078)
∆ Log Avg Quantity per Rx	0.404***	0.379***	-0.426***	-0.397***
	(0.062)	(0.060)	(0.042)	(0.045)
∆ Log AWP of Drug	0.320***	0.315***	-0.072**	-0.102***
	(0.088)	(0.075)	(0.031)	(0.036)
Constant	0.193***	0.215***	-0.099***	-0.088***
	(0.062)	(0.072)	(0.031)	(0.031)
1st Stage F-stat on linear enrollment term	14.04	4309.95	13.17	4521.98
1st Stage F-stat on squared enrollment term		12325.15		9816.09
Predicted ∆ln(Drug Profit/Pill): 25th	-0.115	-0.137	0.019	0.013
Predicted ∆ln(Drug Profit/Pill): 50th	-0.226	-0.258	0.037	0.025
Predicted ∆ln(Drug Profit/Pill): 75th	-0.234	-0.267	0.038	0.025
Overall Predicted ∆ln(Drug Profit/Pill)	-0.193	-0.226	0.031	0.019
R-squared	0.030	0.024	0.017	0.013
Insurer Observations	32	33	32	33
Insurer-Drug Observations	8152	8849	9037	8383

The table reports IV estimates of the effect of a change in insurer enrollment on the change in the log of profits earned by the pharmacy on prescriptions associated with commercial claims. The dependent variable is the change in the log of the average profit per pill earned on a given drug charged to a given insurer between the time periods noted in the column headings. The key regressor is the change in the insurer's Part D enrollment between 2005 and 2006. The unit of analysis is the insurer-drug. The regressions control for the change in the log average number of pills per prescription, the change in the drug's average per-pill wholesale price, and the change in each insurer's exposure to the pharmacy (calculated as the pharmacy's share of the pharmacy market in areas where the insurer is present). The sample of drugs comprises the top 1000 drugs, ranked by expenditures, observed in the pharmacy claims. Instruments for Part D enrollment include potential Part D enrollment, calculated as the number of uninsured seniors in 2005 residing in states where the insurer is present in the commercial market, weighted by the insurer's commercial marketshare in those markets; and quality-adjusted premiums, calculated the difference in log premiums between standardized Part D plans offered by one insurer relative to the average for identical plans in the same market. Linear specifications in columns (1) and (3) do not include observations from Humana. Changes in log profits earned by the pharmacy predicted by the model are reported for the insurer of the 25th, 50th and 75th percentile prescription, as ordered by the enrollment change of the associated insurer. Also reported is the overall predicted change in log profits given the observed distribution of enrollment increases. Parentheses report standard errors clustered at the insurer level. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 6. Enrollment Effect on Pharmacy Profits-per-Pill for Branded Drugs, by Competitveness

Dependent Variable: Δln(Drug Profits per Pill)

Panel A: Second Half 2005 vs First Half 2006

Drug Sample	All Branded	All Generics	Branded: 0 Substitutes	Branded: >0 Substitutes	Branded: Low Tercile	Branded: Mid Tercile	Branded: High Tercile
Definition of Substitute			Generic Drugs w/in Compound		Drugs Within Therapeutic Sub-Class		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ΔFirm's PartD Enrollment (1M)	-0.175	-1.116***	-0.103	-1.083***	-0.030	-0.002	-0.421*
	(0.187)	(0.364)	(0.193)	(0.416)	(0.134)	(0.187)	(0.250)
ΔFirm's PartD Enrollment^2 (1M)	0.035	0.226***	0.021	0.213**	0.006	-0.000	0.085
	(0.039)	(0.076)	(0.040)	(0.085)	(0.028)	(0.039)	(0.052)
Predicted Δln(Drug Profit/Pill): 25th	-0.035	-0.225	-0.021	-0.219	-0.006	0.000	-0.085
Predicted Δln(Drug Profit/Pill): 50th	-0.067	-0.426	-0.039	-0.415	-0.011	-0.001	-0.161
Predicted Δln(Drug Profit/Pill): 75th	-0.069	-0.439	-0.040	-0.427	-0.012	-0.001	-0.166
Overall Predicted Δln(Drug Profit/Pill)	-0.056	-0.376	-0.034	-0.377	-0.010	-0.002	-0.138
R-squared	0.010	0.086	0.000	0.013	0.010	0.010	0.000
Insurer Observations	33	33	33	33	33	33	33
Insurer-Drug Observations	5372	4613	5009	363	650	2612	2110

Panel B: Second Half 2005 vs Second Half 2004

Drug Sample	All Branded	All Generics	Branded: No Substitutes	Branded: No Substitutes	Branded: Low Tercile	Branded: Mid Tercile	Branded: High Tercile
Definition of Substitute			Generic Drugs Within		Drugs Within Therapeutic Sub-Class		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ΔFirm's PartD Enrollment (1M)	0.114	0.051	0.158	-0.216	0.522	0.128	-0.006
	(0.130)	(0.121)	(0.136)	(0.241)	(0.507)	(0.140)	(0.128)
ΔFirm's PartD Enrollment^2 (1M)	-0.027	-0.008	-0.036	0.038	-0.103	-0.036	0.003
	(0.027)	(0.025)	(0.028)	(0.049)	(0.105)	(0.029)	(0.026)
Insurer Observations	33	33	33	33	33	33	33
Insurer-Drug Observations	4814	4223	4366	448	629	2313	1872

Panel A reports IV estimates of the effect of a change in insurer enrollment on the change in pharmacy profits per pill for branded drug prescriptions associated with commercial claims, stratified by degree of therapeutic substitutability. Columns (1)-(2) report enrollment elasticities separately for branded and generic drugs, respectively. Two conventional definitions of substitutes are used: columns (3)-(4) stratify branded drugs by the number of generic substitutes each faces; columns (5)-(7) stratifies branded drugs by the number of drugs within its Multum-defined therapeutic subclass. The dependent variable is the change in the log average profit per pill earned by the pharmacy on a given drug on prescriptions associated with a given insurer between the 2nd half of 2005 and the 1st half of 2006. The regressions control for the change in the log average number of pills per prescription, the change in the drug's average per-pill wholesale price, and the change in each insurer's exposure to the pharmacy (calculated as the pharmacy's share of the pharmacy market in areas where the insurer is present). The sample of drugs comprises the top 1000 drugs, ranked by expenditures, observed in the pharmacy claims. Instruments for Part D enrollment include potential Part D enrollment and quality-adjusted premium variables, described in the text and in previous tables. Changes in log profits earned by the pharmacy predicted by the model are reported for the insurer of the 25th, 50th and 75th percentile prescription, as ordered by the enrollment change of the associated insurer. Also reported is the overall predicted change in log profits given the observed distribution of enrollment increases. Panel B reports similar IV estimates of the effect of a change in insurer enrollment between 2005 and 2006 on the change in pharmacy profits per pill log change in profits between 2004 and 2005. Parentheses report standard errors clustered at the insurer level. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 7. Enrollment Effect on Pharmacy Prices-per-Pill for Branded Drugs: Second Half 2005 vs First Half 2006

Dependent Variable: Δln(Drug Price per Pill)						
Population	Commerically Insured Ages 65 and Over			Under 65 Commerically Insured		
Model	IV	IV	IV	IV	IV	IV
Drug Sample	All	Branded	Generics	All	Branded	Generics
	(1)	(2)	(3)	(4)	(5)	(6)
ΔFirm's PartD Enrollment (1M)	-0.262***	-0.027**	-0.564***	-0.183***	-0.035***	-0.382***
	(0.053)	(0.013)	(0.115)	(0.070)	(0.011)	(0.142)
ΔFirm's PartD Enrollment^2 (1M)	0.053***	0.005**	0.115***	0.037**	0.007***	0.077***
	(0.011)	(0.003)	(0.024)	(0.015)	(0.002)	(0.029)
Δ Log Avg Quantity per Rx	-0.117***	-0.042***	-0.207***	-0.175***	-0.042***	-0.301***
	(0.016)	(0.007)	(0.021)	(0.020)	(0.006)	(0.031)
Δ Log Exposure to Pharmacy	-0.177	-0.015	-0.330	-0.059	-0.095**	-0.021
	(0.158)	(0.036)	(0.313)	(0.272)	(0.038)	(0.549)
Δ Log AWP of Drug	-0.058***	0.146***	0.015	-0.035***	0.113***	0.032***
	(0.013)	(0.018)	(0.014)	(0.013)	(0.013)	(0.012)
Constant	0.036*	0.041***	0.026	0.032*	0.043***	0.012
	(0.019)	(0.004)	(0.037)	(0.019)	(0.003)	(0.037)
1st Stage F-stat on linear enrollment term	3869.87	4236.10	3444.72	3880.81	4123.53	3682.08
1st Stage F-stat on squared enrollment term	9491.00	11356.13	7948.32	10048.83	11190.82	9204.10
Predicted Δln(Drug Profit/Pill): 25th	-0.053	-0.005	-0.114	-0.037	-0.007	-0.077
Predicted Δln(Drug Profit/Pill): 50th	-0.100	-0.010	-0.215	-0.070	-0.014	-0.146
Predicted Δln(Drug Profit/Pill): 75th	-0.103	-0.011	-0.222	-0.072	-0.014	-0.150
Overall Predicted Δln(Drug Profit/Pill)	-0.085	-0.009	-0.189	-0.058	-0.011	-0.124
R-squared	0.037	0.072	0.063	0.059	0.074	0.116
Insurer Observations	33	33	33	33	33	33
Insurer-Drug Observations	10301	5639	4662	6835	3756	3079

The table reports IV estimates of the effect of a change in an insurer enrollment on changes in the log of drug prices for prescriptions associated with commercial claims. The dependent variable is the change in the log average price per pill of a given drug for prescriptions associated with a given insurer between the second half of 2005 and the first half of 2006. The key regressor is the change in the insurer's Part D enrollment between 2005 and 2006. The regressions control for the change in the log average number of pills per prescription, the change in the drug's average per-pill wholesale price, and the change in each insurer's exposure to the pharmacy (calculated as the pharmacy's weighted average share of the pharmacy market in areas where the insurer is present). The sample of drugs comprises the top 1000 drugs (ranked by expenditures) observed in the pharmacy claims. Instruments for Part D enrollment include potential Part D enrollment and quality-adjusted premiums (described in the text and in previous tables). Columns (1)-(3) report the price elasticity of insurer enrollment in the commercial market among pharmacy customers aged 65 and above. Columns (4)-(6) report the price elasticity of insurer enrollment in the commercial market among pharmacy customers below age 65. Changes in log profits earned by the pharmacy predicted by the model are reported for the insurer of the 25th, 50th and 75th percentile prescription, as ordered by the enrollment change of the associated insurer. Also reported is the overall predicted change in log profits given the observed distribution of enrollment increases. Parentheses report standard errors clustered at the insurer level. * significant at 10%; ** significant at 5%; *** significant at 1%

Appendix Table 1. Pre-Part D Trends in Drug Prices by Insurer Size

Dependent Variable: Δln(Drug Price per Pill)	
Model	OLS
	(1)
Medium Insurer	-0.014
	(0.015)
Large Insurer	0.010
	(0.013)
Δ Log Avg Quantity per Rx	-0.197***
	(0.027)
Δ Log Exposure to Pharmacy	-0.000
	(0.019)
Δ Log AWP of Drug	0.083***
	(0.023)
Constant	-0.007
	(0.013)
R-squared	0.076
Number of Insurers	33
Insurer-Drug Observations	9975

The table reports whether trends in negotiated pharmacy drug prices prior to the implementation of Part D differed according to the size of insurers. Insurer size is measured by the total expenditures during in 2005 on all prescriptions observed in the claims associated with that insurer. The insurer sample is partitioned into terciles based on size. The indicator for the smallest insurer size is the omitted insurer category. The median *Medium* (*Large*) insurer is approximately 5 (65) times the size of the median *Small* insurer. The dependent variable is the change in the log average negotiated price per pill paid to the pharmacy on a given drug by a given insurer between the second half of 2004 and the second half of 2005. The constant captures the change in negotiated drug prices for the omitted group, controlling for covariates. Controls include the change in the average per-pill wholesale price of the drug, and the change in each insurer's exposure to the pharmacy, which is calculated as the pharmacy's weighted average share of the retail pharmacy market in areas where the insurer is present, and the change in the log average wholesale price of a drug. The sample of drugs comprises the top 1000 drugs, ranked by expenditures, observed in the claims. Parentheses report standard errors clustered at the insurer level. * significant at 10%; ** significant at 5%; *** significant at 1%

Appendix Table 2.Linear Enrollment Effect on Pharmacy Profits-per-Pill for Branded Drugs, by Competitveness

Dependent Variable: ∆ln(Drug Profits per Pill)							
Panel A: Second Half 2005 vs First Half 2006							
Model	IV	IV	IV	IV	IV	IV	IV
Drug Sample	All Branded	All Generics	Branded: 0 Substitutes	Branded: >0 Substitutes	Branded: Low Tercile	Branded: Mid Tercile	Branded: High Tercile
Definition of Substitute			Generic Drugs w/in Compound		Drugs Within Therapeutic Sub-Class		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
∆Firm's PartD Enrollment (1M)	-0.071	-0.920***	-0.011	-0.939***	-0.158	0.052	-0.239
	(0.174)	(0.306)	(0.179)	(0.343)	(0.155)	(0.173)	(0.225)
Predicted ∆ln(Drug Profit/Pill): 25th	-0.015	-0.194	-0.002	-0.198	-0.033	0.011	-0.050
Predicted ∆ln(Drug Profit/Pill): 50th	-0.030	-0.383	-0.005	-0.391	-0.066	0.022	-0.099
Predicted ∆ln(Drug Profit/Pill): 75th	-0.031	-0.397	-0.005	-0.405	-0.068	0.022	-0.103
Overall Predicted ∆ln(Drug Profit/Pill)	-0.025	-0.332	-0.004	-0.344	-0.058	0.018	-0.085
R-squared	0.000	0.096	0.000	0.010	0.011	0.000	0.010
Insurer Observations	32	32	32	32	32	32	32
Insurer-Drug Observations	4948	4306	4618	330	596	2411	1941

The table reports IV estimates of the linear effect of changes in insurer enrollment on changes in pharmacy profits per pill for branded drugs prescriptions associated with commercial claims, stratified by degree of therapeutic substitutability, excluding observations from Humana. Columns (1)-(2) report enrollment elasticities separately for branded and generic drugs, respectively. Two conventional definitions of substitutes are used: columns (3)-(4) stratify branded drugs by the number of generic substitutes each faces; columns (5)-(7) stratifies branded drugs by the number of drugs within its Multum-defined therapeutic subclass. The dependent variable is the change in the log average profit per pill earned by the pharmacy on a given drug on prescriptions associated with a given insurer between the 2nd half of 2005 and the 1st half of 2006. The regressions control for the change in the log average number of pills per prescription, the change in the drug's average per-pill wholesale price, and the change in each insurer's exposure to the pharmacy (calculated as the pharmacy's share of the pharmacy market in areas where the insurer is present). The sample of drugs comprises the top 1000 drugs, ranked by expenditures, observed in the pharmacy claims. Instruments for Part D enrollment include potential Part D enrollment and quality-adjusted premium variables, described in the text and in previous tables. Changes in log profits earned by the pharmacy predicted by the model are reported for the insurer of the 25th, 50th and 75th percentile prescription, as ordered by the enrollment change of the associated insurer. Also reported is the overall predicted change in log profits given the observed distribution of enrollment increases. Parentheses report standard errors clustered at the insurer level. * significant at 10%; ** significant at 5%; *** significant at 1%

Appendix Table 3. Linear Enrollment Effect on Pharmacy Prices-per-Pill for Branded Drugs: Second Half 2005 vs First Half 2006

Dependent Variable: ∆ln(Drug Price per Pill)						
Population	Commerically Insured Ages 65 and Over			Under 65 Commerically Insured		
Model	IV	IV	IV	IV	IV	IV
Drug Sample	All	Branded	Generics	All	Branded	Generics
	(1)	(2)	(3)	(4)	(5)	(6)
∆Firm's PartD Enrollment (1M)	-0.233***	-0.023*	-0.491***	-0.154***	-0.028**	-0.326***
	(0.042)	(0.012)	(0.094)	(0.057)	(0.011)	(0.116)
∆ Log Avg Quantity per Rx	-0.121***	-0.043***	-0.202***	-0.175***	-0.039***	-0.291***
	(0.018)	(0.008)	(0.022)	(0.022)	(0.007)	(0.032)
∆ Log Exposure to Pharmacy	-0.162	-0.012	-0.296	-0.037	-0.088**	0.022
	(0.158)	(0.035)	(0.310)	(0.260)	(0.040)	(0.528)
∆ Log AWP of Drug	-0.060***	0.146***	0.009	-0.030**	0.116***	0.033**
	(0.015)	(0.021)	(0.016)	(0.013)	(0.014)	(0.014)
Constant	0.035**	0.040***	0.021	0.028	0.041***	0.006
	(0.017)	(0.004)	(0.032)	(0.017)	(0.003)	(0.034)
1st Stage F-stat on linear enrollment term	13.75	14.17	13.04	12.30	11.43	13.14
Predicted ∆ln(Drug Profit/Pill): 25th	-0.044	-0.006	-0.116	-0.032	-0.008	-0.074
Predicted ∆ln(Drug Profit/Pill): 50th	-0.080	-0.011	-0.212	-0.058	-0.015	-0.134
Predicted ∆ln(Drug Profit/Pill): 75th	-0.083	-0.012	-0.219	-0.059	-0.016	-0.138
Overall Predicted ∆ln(Drug Profit/Pill)	-0.082	-0.008	-0.177	-0.052	-0.009	-0.112
R-squared	0.040	0.073	0.058	0.061	0.073	0.114
Insurer Observations	32	32	32	32	32	32
Insurer-Drug Observations	10301	5639	4662	6259	3430	2829

The table reports the linear effect of a change in an insurer enrollment on changes in the log of drug prices negotiated between the pharmacy and the insurer for prescriptions associated with associated with claims from the commerical market. The samples for linear specifications exclude observations from Humana. The dependent variable is the change in the log average price per pill of a given drug for prescriptions associated with a given insurer between the second half of 2005 and the first half of 2006. The key regressor is the change in the insurer's Part D enrollment between 2005 and 2006. The regressions control for the change in the log average number of pills per prescription, the change in the drug's average per-pill wholesale price, and the change in each insurer's exposure to the pharmacy (calculated as the pharmacy's weighted average share of the pharmacy market in areas where the insurer is present). The sample of drugs comprises the top 1000 drugs (ranked by expenditures) observed in the pharmacy claims. Instruments for Part D enrollment include *potential Part D enrollment* , calculated as the number of uninsured seniors in 2005 residing in states where the insurer is present in the commercial market prior to Part D, weighted by the insurer's commercial marketshare in those markets; and *adjusted premiums* , calculated as the difference in logs between premiums for standardized Part D plans offered by an insurer relative to the market for identical plans in the same market. Column 1-3 reports the price elasticity of insurer enrollment in the commercial market among pharmacy customers aged 65 and above. Column 4-6 reports the price elasticity of insurer enrollment in the commercial market among pharmacy customers appearing in the claims below age 65. Changes in log profits earned by the pharmacy predicted by the model are reported for the insurer of the 25th, 50th and 75th percentile prescription, as ordered by the enrollment change of the associated insurer. Also reported is the overall predicted change in log profits given the observed distribution of enrollment increases. Parentheses report standard errors clustered at the insurer level. * significant at 10%; ** significant at 5%; *** significant at 1%