WORKING PAPER · NO. 2025-101

Pharmacy Benefit Managers and Vertical Relationships in Drug Supply

Zarek Brot, Catherine Che, and Benjamin Handel

AUGUST 2025

THE UNIVERSITY OF CHICAGO
BECKER FRIEDMAN INSTITUTE FOR ECONOMICS

5757 S. University Ave.
Chicago, IL 60637
Main: 773.702.5599
bfi.uchicago.edu

Pharmacy Benefit Managers and Vertical Relationships in Drug Supply*

Zarek Brot† Catherine Che‡ Benjamin Handel§

August 5, 2025

Abstract

The final delivery of many products depends in part on intermediaries who bargain with upstream manufacturers and then sell reduced-price product bundles to retailers downstream. In health care, pharmacy benefit managers (PBMs) fill a crucial role in the supply chain for drugs by creating drug formularies that include drugs in bundle that is sold to insurers downstream. We study the role of vertical integration between pharmacy benefit managers and insurers in driving access to drugs. Vertical integration allows the two integrated parties to share the rents accrued from the PBM's upstream bargaining effort, eliminating double marginalization and aligning incentives between these suppliers. However, this integration can also have anticompetitive effects, inducing the PBM to be less willing to deal with rival insurers, passing through a lesser portion of the accrued rebates. We study this empirically in the context of Medicare Part D, the public prescription drug insurance program for seniors. We develop a model of the industry, and use it to empirically to study the impacts of vertical integration. We find that consumers place a higher revealed value on premium reductions than cost savings due to drug tiering. Vertical integration does lead to integrated PBMs raising rivals' costs, but by a small amount because rival insurers can ultimately substitute to backup formularies at cheaper costs.

*We thank Sarah Frick, Frank Gaunt, and Afras Sial for excellent research assistance. We gratefully acknowledge support from Arnold Ventures and the Commonwealth Fund. We thank seminar participants at Berkeley-Stanford IO Fest for their feedback. All errors are our own.

†University of Chicago and NBER. Email: zarek@uchicago.edu
‡UC Berkeley. Email: cjche@berkeley.edu
§UC Berkeley and NBER. Email: handel@berkeley.edu

Prescription drug spending accounts for 10% of U.S. health care spending (Kakani et al. 2020). In contrast to other health care settings, the prescription drug market has a set of entities that act as intermediaries between payers and manufacturers: pharmacy benefit managers (PBMs). Health insurers outsource the design and implementation of pharmacy coverage to PBMs, who manage benefits on their behalf. While PBMs engage in several key functions, one of these functions is to negotiate with drug manufacturers on behalf of their insurer clients. PBMs request rebates from manufacturers (side payments from manufacturers to PBMs) in exchange for the PBMs convincing their insurer clients to provide favorable insurance coverage for the manufacturers' drugs. PBMs pass some of these rebates on to the insurer while pocketing some for themselves, a practice known as "spread pricing."[1]

Policymakers have been concerned about the role of PBM behaviors in driving up prices and reducing access to drugs. In particular, there are new worries about the vertical market structure of PBMs. Major health care markets in the U.S. are now dominated by three major players (CVS/Caremark, Express Scripts, and OptumRx), each of which is vertically integrated with a major insurer (Aetna, Cigna, and UnitedHealthcare). Vertical integration comes with both potential costs and potential benefits. A key benefit is reduced double marginalization in the supply chain. When an insurer is integrated with its PBM, it internalizes the full rebate (which accrues to the joint entity), a greater amount than it would otherwise get due to spread pricing. In turn, insurers will then pass this through to customers in the form of lower premiums. However, a key potential cost is that, since the integrated PBM internalizes its insurer's profits, it has the incentive to harm rival insurers to improve its own market standing (typically called "raising rivals' costs"). It may both exert less effort in bargaining with manufacturers on rival insurers' behalves and may withhold more of the rebates. This, in turn, will increase downstream premiums faced by rival insurers' clients. It is an empirical question which of these effects is stronger, i.e. if the costs of vertical integration outweigh the benefits.

We set up a conceptual framework that shows that, fundamentally, the welfare trade-off in permitting vertical integration depends on 1) the extent to which PBMs engage in spread pricing, which corresponds to the extent of double marginalization; and 2) the extent of competition on plan generosity in the insurance market, which corresponds to the PBM's incentives to raise rival insurers' costs for the benefit of their integrated insurer. Our model characterizes: (i) the nature of the conduct in PBM-manufacturer dealings; (ii) the nature of the conduct in PBM-insurer dealings; (iii) demand and competition in the market for

[1]Recent reports argue that PBMs no longer engage in spread pricing in the way that occurred in the time period we study. We think of our model as broadly representing any rents PBMs extract from manufacturer-insurer intermediation, regardless of how those rents are structured contractually (i.e., linear fees vs. fixed fees).

insurance; and (iv) consumer demand for prescription drugs. We follow recent work on vertical interactions by modeling conduct in rebate-sharing as Nash-in-Nash bargaining between PBMs and their counterparts, both upstream and downstream, with conduct summarized simply by a set of bargaining weights that govern the relative power of each party engaged in a bilateral transaction.

We then estimate this framework empirically in the context of the Medicare Part D prescription drug market for U.S. seniors. We employ granular insurer and claims data from Medicare Part D; data on upstream drug rebates from SSR Health; and data on contractual relationships between PBMs and insurers. We focus our analysis on oral anticoagulants (known colloquially as "blood thinners"), a class of drugs prescribed to reduce the risk of a fatal stroke. This class of drugs saw an explosion of new innovative drugs in the early 2010s, with entry of three blockbuster drugs that are often referred to as DOACs (direct oral anticoagulants). These entrants had higher list prices than the existing generic alternative (warfarin), and, to compensate, high rebates, making it an important case study of PBM activities.

Our empirical approach proceeds in several steps. First, we estimate demand for oral anticoagulants conditional on plan enrollment. Each consumer in the data enrolls in a specific health plan with specific formulary coverage, giving terms for drug pricing and availability. We estimate consumer willingness-to-pay for two on-patent brands and generic warfarin, with an outside option of no drug purchase. Consumer purchases depend on their health conditions, health history, historical drug use, and other contextual / demographic variables. Our approach to estimating drug demand follows that in the contemporary literature on pharmaceutical drug markets (Dubois et al. 2022, Olssen and Demirer 2023, Brot et al. 2024, Feng and Maini 2024, Starc and Wollmann 2025).

Second, we use drug demand conditional on plan enrollment as an input into insurance plan demand estimation. Demand for plans trades off premiums against coverage, with the latter summarized as expected utility given a plan's formulary coverage, translated through our drug demand model. Demand also depends on other characteristics such as brand and other coverage determinants. This specification also builds on recent work in the literature (Abaluck and Gruber 2011, 2016, Polyakova 2016, Ho et al. 2017).

The next part of our implementation involves estimating bargaining weights for both sets of upstream relationships in our setting. This involves estimating the determinants of both manufacturer-PBM *and* PBM-insurer rebates. We take a Nash-in-Nash approach to both, and use a combination of average rebates from the SSR Health data and imputed rebates from Part D public reporting. We match our model to these moments, and invert it to estimate relative bargaining ability at each stage.

For drug demand, we find that, the two branded options face own-price elasticities of -0.3 (Xarelto) and -0.27 (Eliquis), both in line with prior research on demand for chronically used branded drugs. We find that these branded drugs compete with each other (and warfarin) to only a modest degree. We estimate that plan demand is relatively inelastic to premiums and especially inelastic to formulary value, implying that plans compete only weakly over coverage. Consumers value (by revealed preference) one dollar of up-front premium reductions by substantially more than the same dollar applied to reducing out-of-pocket prices for anticoagulants.[2]

We estimate that, on average (weighted by patients), PBMs have a relative bargaining weight (relative to manufacturers) of 0.58, implying they capture a substantial share of manufacturer surplus. In contrast, in dealing with insurers, they only have a relative bargaining weight of 0.1, implying that much of the manufacturer surplus they capture is passed through to insurers. On average, we estimate that insurers retain 82% of the rebates obtained by PBMs; integrated PBMs pass through 65%, less than the 85% passed through by standalone PBMs.

We use our demand estimates to study the consequences of vertical integration and dis-integration. Our current analysis focuses on the integration between CVS/Caremark and Silverscript. We study the impact of their integration on their own rebate negotiations, as well as Caremark's negotiations with First United American, a small third-party insurer. We estimate that, in the status quo world with vertical integration, Caremark passes through 59% of its rebates in the anticoagulant space to First United American. By assumption, it passes through 100% of this rebate to Silverscript, which is vertically integrated. We then simulate the scenario where Silverscript and CVS/Caremark are no longer vertically integrated. Under this arrangement, Caremark would pass through 61% of the rebate to First United American, suggesting that Caremark did indeed raise rival insurers' costs due to its integration with Silverscript. Further, we find the Silverscript benefits from the PBM's preferred formulary with or without the additional rebate. Thus, the incentive for Caremark and Silverscript to deal with one another is substantially weaker absent formal integration. This suggests that Silverscript benefits substantially from integration with Caremark, though this abstracts from important aspects of PBM competition.

We make several key contributions to the literature. We add to a recent literature focusing on the role of PBMs in the drug financing ecosystem, addressing a variety of angles. Most closely related are Olssen and

[2]Prior research highlights that consumers typically place a higher emphasis on premiums than on other plan features when choosing plans. See, e.g., Abaluck and Gruber (2011) and Gruber et al. (2020). In our context, it is also plausible that the degree to which consumers overweight premiums relative plan experience factors depends on specific assumptions we make, as we discuss later.

Demirer (2023) and Ho and Lee (2024), who both focus on the role of the PBM in formulary design, with subsequent implications for drug access, and pricing. These two papers assume that the insurer and PBM have fully aligned objectives, treating them as a single entity that intermediates between drug manufacturers and consumers. This contrasts with our work, which separately models PBMs and insurers in order to study vertical integration between these parties. Other recent work focuses on the consequences of PBM activities for list prices (Conti et al. 2021, Feng and Maini 2024, Che 2025) and innovative activity (Agha et al. 2022). Our study also closely relates to Gray et al. (2023), who retrospectively estimate the effect of UnitedHealthcare's acquisition of Catamaran on downstream premiums in Medicare Part D. They find that the acquisition results in higher premiums at Catamaran's other clients, consistent with the anti-competitive foreclosure of rivals (similar in spirit to our findings). They also find no improvement in the premiums of plans offered by UnitedHealthCare (different than our findings). This different latter result may arise from the fact that, pre-acquisition of Catamaran, UnitedHealthcare was already integrated with a PBM (Optum), lowering the potential gains from reducing double marginalization and raising the potential harms of foreclosure through upstream horizontal consolidation. In addition to this distinction, our approach estimates model-specific conduct parameters, unpacks some of the mechanisms underlying the effects of integration, and conducts new counterfactual policy analyses related to vertical integration.

We also add to the literature characterizing the trade-off between internal efficiency gains vs. external harms from vertical integration. A recent survey by Lee et al. (2021) covers a range of theoretical and empirical papers in this space noting the still limited empirical work in this area. Recent empirical papers include, e.g., Crawford and Yurukoglu (2012) and Crawford et al. (2018) on cable TV/channel integration, Brot-Goldberg and de Vaan (2018) on general practitioner/specialist physician integration, Cuesta et al. (2020) on hospital/insurer, and Lee (2013) on video game platform/manufacturer itegration. Relative to these prior papers, our context and model are notable in that they model *two* separate business-to-business interactions in the vertical supply chain (PBMs dealing with manufacturers upstream and insurers downstream), which imposes a more stringent set of constraints on behavior. While our policy questions and analyses focus primarily on the relations between and integration of PBMs and insurers, we also use our model to discuss the way that upstream relations between PBMs and drug manufacturers interact with the downstream relations.

The rest of the paper proceeds as follows. Section 2 describes the PBMs and the Medicare Part D context we study. Section 3 describes our model, the potential impacts of vertical integration, and our empirical model implementation. Section 4 describes our data and estimation approach. Section 5 presents our parameter estimates, and our analysis of the impact of vertical integration. Finally, Section 6 concludes and offers directions for future work.

1 Setting

1.1 Medicare Part D and Pharmacy Benefit Managers

Our empirical setting is Medicare Part D, the drug insurance component of Medicare. Under Part D, drug coverage is fully outsourced to private insurers contracted to provide coverage on the government's behalf. The Medicare program organizes a centralized market in which beneficiaries may select from one of these private plans, segmented by geographic service region. Plans have wide scope to differentiate themselves in terms of what drugs they offer insurance coverage for and to what extent they apply cost-sharing or utilization management policies (such as prior authorization) to each covered drug. Consumers choose from the plans offered in their service region (of which there are 34), with each plan charging a monthly premium for enrollment. Plans offered on the Part D market include substantial first-dollar cost-sharing, as well as (in the time period we study) a coverage gap colloquially known as the "donut hole" that applied substantial cost-sharing after the typical coinsurance phase of the insurance contract but before the region of "catastrophic" coverage phase.

Given the burden they face both through this cost-sharing as well as through monthly premiums, managing drug prices is incredibly important for insurers. Insurers typically outsource activities related to managing drug prices and coverage through PBMs, who specialize in securing upstream discounts from drug manufacturers in return for formulary inclusion and inclusion in preferred tiers. Drug manufacturers benefit from inclusion in a formulary or placement in preferred tiers because this increases consumer demand for drugs via differential cost-sharing. For example, if a given drug class has two branded competitors, with the drugs offering similar benefits, consumers are more likely, ceteris paribus, to choose a drug on a preferred formulary tier relative to another drug.

Conversely, insurers benefit from including drugs on their formularies because consumers demand drugs, and excluding a drug or placing a drug on a more expensive tier makes that insurance plan less attractive to consumers demanding that drug. In turn, because the Medicare Part D market has many competing insurers in a region, consumers may switch away from an insurer or choose a different insurer up front if that plan's formulary does not include drugs that a consumer cares about in a cost-effective way. When not

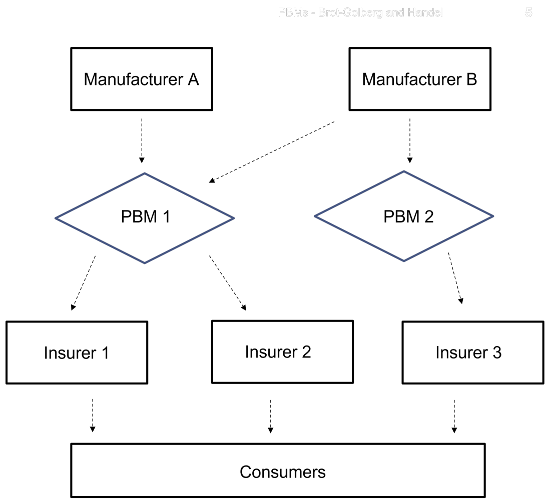

Figure 1: Stylized Model of the Vertical Financing Chain in Prescription Drugs

vertically integrated with an insurer, PBMs seek to maximize their own surplus by constructing and selling the formularies that provide them with maximum revenue from spread pricing, whereby the PBM passes through a higher drug price to the insurer than the one they receive from the drug manufacturer (see, e.g., Garthwaite and Scott Morton (2017) or FTC (2024) for discussions). When vertically integrated, the PBM leverages their upstream relationships to earn higher profits for their integrated insurer, while also seeking to benefit from spread pricing to non-integrated insurers.

Figure 1 shows a simple framework for thinking about the role PBMs play in drug delivery, with a focus on their two-sided interactions with drug manufacturers upstream and insurers downstream. Our model describes these relationships in detail.

The PBM marketplace has had significant horizontal and vertical consolidation over the past two decades. UnitedHealth Group formed OptumRx in 2011, combining several of its own underlying drug supply services. OptumRx has grown substantially since its inception, including via a horizontal acquisition of Catamaran for $13B in 2015. United offers insurance through UnitedHealthcare (UHC) and thus, with OptumRx, forms one of the large vertically integrated PBM-insurer pairs. CVS Health, together with its PBM Caremark, bought health insurer Aetna for $69B in 2018, setting up the second large vertically integrated PBM-insurer pair. Cigna, another large national insurer, acquired Express Scripts, a large PBM, in 2018, forming the third such pair. The PBMs from these three vertically integrated pairs accounted for roughly 80% of the national market (across different segments) in 2019, raising a variety of concerns from policymakers and industry participants.

Several recent studies document the rapid increase in vertical increase between insurers and PBMs in the Part D market over time. Gray et al. (2023) leverage data similar to those we use here (described momentarily) to show that vertically integrated insurers' market shares nationally for Part D plans increased from 30% in 2010 in 80% in 2018. A recent American Medical Association Study (Guardado (2024)) finds that 77% of individuals enrolled in Part D plans are covered by a vertically integrated insurer. Despite this major shift in industry structure, there have been very limited studies of this shift, in part due to the complexity of modeling vertical industry structures (Gray et al. (2023) is a notable exception).

1.2 Oral Anticoagulants

Following prior work in industrial organization on PBMs (e.g., Olssen and Demirer (2019) and Ho and Lee (2024) we focus our analysis on one drug class and use that as a structural input for assessing the implications of vertical integration. While these prior papers focus on statins (Lipitor and Crestor) we focus on oral anti-coagulants (Eliquis and Xarelto).

The main indications for oral anticoagulants are to prevent blood clots due to deep vein thrombosis (DVT) and atrial fibrillation (AF). Patients with AF, which is the most common type of irregular heart rhythm (onset is associated with aging), make up the main segment of consumers. Once a patient starts on an oral anticoagulant, they tend to continue taking the drug indefinitely. Moreover, drug switching is rare.

We focus on oral anticoagulants to study PBM-insurer interactions for several reasons. First, the main drugs in this class, Eliquis and Xarelto, are some of the most widely prescribed drugs in Medicare Part D ($\tilde{3}$ Million users in 2019), which helped them land on Medicare Part D's inaugural list for price negotiation under the Investment Recovery Act (IRA). Second, these important drugs are branded on-patent drugs: there are no generic equivalents available through the end of the study period. This rules out strategic rebating behavior in response to generic entry. The generic drug in this class, Warfarin, has a different active ingredient, is objectively lower performing, and requires careful physician supervision, with a high risk of adverse effects, all in contrast to the two branded drugs we study. Third, these branded drugs are some of the most heavily rebated drugs, with national average rebates of approximately 70% by 2019. Lastly, the timeline of when Eliquis and Xarelto entered the US market aligns with when the new data sources on drug pricing that we use became available to researchers. The drugs both entered market in the early 2010s, which is around the same time that national rebate data and PBM-insurer relations data are available for. While the statins studied in the papers mentioned above in the literature have many similar advantages to anti-coagulants, the timing and length of on-patent competition make oral anti-coagulants a better match for our study.

Crucially, all of these factors imply that competition between these two drug manufacturers for placement on PBM, and subsequently insurer, formularies has been strong and persistent. This gives us a great context to study the full drug supply chain we model, including upstream negotiations between manufacturers and PBMs, downstream negotiations between insurers and PBMs, downstream integration between PBMs and insurers, insurer pricing, and consumer drug and plan demand.

2 Model

We begin by proposing a stylized model of vertical conduct along the pharmaceutical financing chain. Manufacturers produce and sell drugs to consumers (patients). Insurers help patients to finance these drugs, and thus bear a large share of the cost of high drug prices. In turn, they contract with PBMs to extract concessions (in the form of rebates) from manufacturers in exchange for favorable formulary coverage. We model PBMs as profiting from "spread pricing," under which they pocket a share of the concession and pass it through incompletely to their insurer clients. This spread pricing is a potential form of market inefficiency.

We model the financing chain as a sequential game of complete information. First, manufacturers set list prices, which we assume are exogenous from the point of view of the model.[3] Next, PBMs propose a formulary to the manufacturers, and bargain over the rebate concession that will be paid. Next, PBMs and insurers divide the rebate. Finally, patients purchase insurance plans and then use their insurance coverage to purchase prescription drugs.

2.1 PBM-Manufacturer Negotiations

The game begins with the PBM k and manufacturer of drug d negotiating over the formulary placement of each drug. We assume that all PBM-manufacturer pairs negotiate simultaneously and engage in Nash-in-Nash bargaining. Effectively, one can conceptualize this as a game in which each PBM and manufacturer send an agent into a locked room to Nash bargain (i.e., maximize their independent joint Nash product), at the same time as all other agents, given a rational conjecture about the likely deals that will emerge in the other rooms. Upon finding an agreement, the pairs of agents emerge and verify that their conjectures are correct, i.e., that they have successfully maximized their joint Nash product given the outcomes in other rooms. If not, all parties must keep renegotiating until a Nash equilibrium is determined.

[3] See Che (2025) for an alternative approach that nests endogenous setting of list prices into a model of PBM activities.

The parties negotiate over a rebate fee that is linear in the quantity of patients enrolled in plans covered by the PBM who purchase the manufacturer's drug, given a formulary arrangement proposed by the PBM. We assume that, in the absence of an agreement, the PBM receives no rebate and puts the drug on the non-preferred tier.[4] The PBM's gains from an agreement with per-unit rebate R_{kd} are

$$GFT_{kd}^{PBM-M} = \underbrace{R_{kd} \sum_{j \in \mathcal{J}_k} Q_{jd}}_{\text{Rebate revenues}} + \underbrace{\sum_{d' \neq d} \sum_{j \in \mathcal{J}_k} R_{kd'} \Delta_{jd'}}_{\substack{\text{Recapture for } k \\ \text{from other drugs}}}$$

If the PBM and the manufacturer strike a deal, the PBM gets to earn rebates on each user of drug d who is enrolled in a plan j from the set of plans that the PBM has agreements with, $\mathcal{J}_k$. We denote q_{dj} as the quantity demanded of drug d from enrollees in plan j under agreement (when the drug is covered under the preferred tier). Moving drug d from non-preferred to preferred coverage will shift some patients towards it, away from other drugs d'. If the PBM has rebate agreements with those other drugs, some of the rebate revenues they gain from d will be offset by lost revenues from d', proportional to $\Delta_{jd'}$, the induced change in demand for those in plan j consuming d'. $\Delta_{jd'}$ is higher when d and d' are closer competitors. All else equal, the PBM will prefer to make a deal with all manufacturers when competition is weaker and thus this "recapture effect" (Ho and Lee 2017) is lower. When drugs are closer substitutes, preferencing more drugs does little to improve the PBM's revenues.

The manufacturer's gains from trade from the same agreement are

$$\begin{aligned} GFT_{kd}^{M-PBM} &= \underbrace{(p - R_{kd} - c) \sum_{j \in \mathcal{J}_k} Q_{jd}}_{\text{Profit on } k \text{ if agree}} - \underbrace{(p - c) \sum_{j \in \mathcal{J}_k} (Q_{jd} - \Delta_{jd})}_{\text{Profit on } k \text{ if disagree}} + \underbrace{\sum_{k' \neq k} \sum_{j' \in \mathcal{J}_{k'}} (p - R_{k'd} - c) \Delta_{dj'}}_{\text{Recapture for } d \text{ from other PBMs}} \\ &= -R_{kd} \sum_{j \in \mathcal{J}_k} Q_{jd} + (p - c) \sum_{j \in \mathcal{J}_k} \Delta_{jd} + \sum_{k' \neq k} \sum_{j' \in \mathcal{J}_{k'}} (p - R_{k'd} - c) \Delta_{dj'} \end{aligned}$$

The first two components are simple: If the PBM and manufacturer agree, since the out-of-pocket price for

[4] An alternative assumption would be to assume that the PBM excludes the drug from coverage completely. We do not use such an assumption for two reasons. First, our formulary data incompletely measures exclusion as an absence from the formulary; for innovative new drugs like the DOACs, non-inclusion may reflect a failure to update the listed formulary rather than true exclusion. In practice, many plans appear to (according to the claims data) pay for branded anticoagulant claims even when the drugs do not appear on the formulary, reinforcing this interpretation. Second, this might arise due to the rarity of "true" exclusion. For some "protected" drug classes, Part D forbids insurers from excluding *any* drug from coverage. In practice, these drugs do not appear to have different average rebates than non-protected classes, suggesting (albeit non-causally) that the inability to exclude drugs from coverage does not remove much bargaining power from PBMs.

d is lower, it sells more (by Δ_{jd} for each affiliated plan), but must pay a rebate of R_{kd} per unit. Note that since the disagreement path does not forbid patients enrolled in plans affiliated with k from getting d at all, there is some demand in the absence of an agreement. The third term refers to the fact that, if the two parties disagree, the manufacture forgoes some demand from plans affiliated with k, but since those plans will, due to the disagreement, provide worse coverage of d, some patients will switch to other plans, and, if they end up consuming d anyway, the manufacturer will not lose out as much. The implications of this mirror those of the PBM above: when plans are more competitive with each other on formulary coverage, manufacturers have weaker incentives to sign many deals with PBMs, since each one reduces their gains from trade for others.

Each PBM-manufacturer negotiating pair maximizes its joint Nash product, which is a weighted geometric average of the gains from trade for the two parties, weighted by their relative bargaining ability, with PBM relative bargaining ability parameterized as B_{kd}:

$$N_{kd}^{PBM-M} = \left(GFT_{kd}^{PBM-M}\right)^{B_{kd}} \left(GFT_{kd}^{M-PBM}\right)^{1-B_{kd}}$$

2.2 PBM-Insurer Negotiations

The game continues with PBMs k and insurers j negotiating over rebate splitting given a proposed formulary and agreed manufacturer rebate R_{kd}. We assume that they jointly set a "pass-through rate" $r_j \in [0, 1]$ such that, for every dollar in rebates generated by j's enrollees, the PBM pays r_j to the insurer. We will first focus on PBM-insurer pairs that are not vertically integrated.

We assume that the potential network of PBM-insurer arrangements is exogenous.[5] This is a nontrivial assumption, effectively shutting down horizontal PBM competition. We employ it since PBMs are, from an *ex ante* perspective, mostly horizontally undifferentiated from the perspective of the insurer. A PBM's ability to achieve rebates is, in our model, dependent only on its equilibrium set of downstream arrangements with insurers, rather than any other inherent attributes, such as improved bargaining ability or deals external to the model.[6] Therefore, in this model, PBMs' market power over insurers is only mediated by two factors: Relative bargaining ability of insurers, and insurers' outcomes on our modeled off-equilibrium path, which

[5]Note that we also do this in the PBM-manufacturer negotiation stage. This assumption is even more important at this stage since it prevents us from having to recompute the network at each possible agreement point, which would introduce severe nonlinearities in the Nash product.

[6]Since the PBMs are otherwise undifferentiated, insurers would have low gains from trade for dealing with any one of them, since their gains from replacing one PBM with another would leave them roughly no worse off.

is assumed to be getting no rebates for the modeled drug and putting all branded drugs on the non-preferred tier of the formulary.

PBMs and insurers engage in Nash-in-Nash bargaining over the pass-through rate. The PBM's gains from trade are

$$GFT_{jk}^{PBM-MCO} = \underbrace{\sum_d (1 - r_j) R_{kd} Q_{jd}}_{\text{Revenue from } j} + \underbrace{\sum_{j' \neq j} \sum_d (1 - r_{j'}) R_{kd} \Delta_{j'd}}_{\text{Recapture for } k \text{ from other plans}}$$

Similarly to its dealings with manufacturers, the PBM gains from making deals with plans proportionally to the rebate revenue that will accrue to it, a $(1 - r_j)$ share of the total rebate revenue, and loses if it has already made deals with other insurers and earns rebate revenues from them, to the extent that enabling j to receive a rebate simply results in business stealing from j's rivals who k deals with. This recapture effect is especially large for insurers who k is vertically integrated with, for whom, from k's perspective, r_j is effectively zero. We discuss this further in Section 2.5.

The insurer's gains from trade are

$$GFT_{jk}^{MCO-PBM} = -\left[\sum_d \underbrace{\left(p_d - r_j R_{kd} - OOP_j^A\right) Q_{jd}}_{\text{Anticoagulant costs when agree}} - \underbrace{\left(p_d - OOP_j^D\right)\left(Q_{jd} - \Delta_{jd}\right)}_{\text{Anticoagulant costs when disagree}}\right] + \underbrace{(\phi_j - C_j)\delta_j}_{\substack{\text{Gross other profits} \\ \text{for marginal enrollees}}}$$

The insurers costs change in three ways. First, by agreeing to the PBM's formulary, the out-of-pocket costs for anticoagulant d change from OOP^D to OOP^A, which is a change from non-preferred to preferred coverage for all drugs that pay rebates to k. Preferred status lowers out-of-pocket costs, increasing j's costs and reducing their gains from trade. Second, when a deal is struck, these costs are offset by rebate payments for the consumption of d. Finally, since agreement is making j's formulary coverage more appealing to enrollees, more enroll, thus increasing total costs. This enrollment effect not only changes the number of enrollees in j who consume d by Δ_{jd}, it also increases total enrollment, by δ_j. This need not be the same as the sum of Δ_{jd} since enrollees may enroll in j to insure themselves against possibly needing to consume an oral anticoagulant even if they do not actually do so. Increased enrollment is beneficial for j to the extent that its gross margins (excluding anticoagulant costs) $\phi_j - C_j$ (with ϕ_j as j's premium and C_j as their average costs excluding anticoagulant coverage) are positive and large.

For the insurer, making a deal with the PBM involves improving the quality of their plan (by improving formulary coverage), and thus the quantity of consumers they enroll, but while making their marginal costs higher, by providing more generous coverage. For a deal to arise, there must be some potential rebate that can sufficiently offset the cost increase to make this choice profitable.

We assume that bargaining is done to reach a Nash-in-Nash equilibrium, meaning there is a Nash equilibrium in the maximization of each pairwise Nash product, which is the weighted geometric average of each party's gains from trade, with weights proportional to relative bargaining power and with the PBM's bargaining power indexed as b_{jk}:

$$N_{kd}^{PBM-M} = \left(GFT_{jk}^{PBM-MCO}\right)^{b_{jk}} \left(GFT_{jk}^{MCO-PBM}\right)^{1-b_{jk}}$$

2.3 Drug Demand, Plan Demand, and Premium-Setting

While the next stage in the model sequencing is demand and supply in the marker for insurance plans, it will be useful to first cover demand for drugs. We assume that a consumer i chooses a single drug d within a class (or no drug, denoted as $d = 0$); we assume they (and their prescribing provider) engage in a choice process which admits a stable utility representation that is linear in arguments. They assign utility v_{id} to each potential drug option, as well as the option to take no drug $(d = 0)$. We assume that v_{id} includes both random and deterministic components, which we fully specify in Section 3.

Consumers choose a single insurance plan j. At this stage, we assume that consumers can anticipate the deterministic components of their future drug demand, but *not* the random components. That is, they know how much they prefer Eliquis to Xarelto in general, but not the specific choice they will make after becoming insured. We assume that plan choice is, like drug choice, governed by maximizing a stable utility function with utility u_{ij} for each plan option j. We assume that the consumer trades off the premium of the plan, ϕ_j, against the other characteristics of the plan, most notably their expected consumption utility from anticoagulants given the plan's structure, CS_{ij}, given by $CS_{ij} = E[\max_d v_{id}]$, an expectation taken over the random components of drug demand.

These two demand systems generate D_j, the share of consumers who choose plan j, q_{jd}, the share of consumers in plan j who choose drug d, and $Q_{jd} = q_{jd}D_j$, the share of all consumers who both choose plan j and drug d.

Given the demand system, we assume that plans compete Nash-Bertrand in premiums given their sunk formulary choice. They set premiums to maximize joint profits across their portfolio of plans:

$$\phi_j = \arg\max_{\phi_j} \sum_{\ell \in M(j)} \left[\underbrace{(\phi_\ell - C_\ell) D_\ell}_{\substack{\text{Gross profits} \\ \text{excluding} \\ \text{anticoagulants}}} - \underbrace{\sum_d (p_d - r_\ell R_{k(\ell)d} - OOP_{\ell d}) q_{\ell d}}_{\text{Net anticoagulant costs}} \right]$$

where $M(j)$ is the set of plans that share ownership with j (including itself).

2.4 Equilibrium and Intuition

Equilibrium in this model consists of: (1) A set of PBM choices of formularies, $\mathcal{F}_k$; (2) manufacturer-to-PBM per-unit rebate amounts R_{kd}; (3) PBM-to-insurer rebate pass-through rates r_j; (4) insurer plan premiums p_j; (5) individual plan choices D_{ij}; and (6) individual drug choices q_{ij}.

This model delivers an equilibrium division of surplus between manufacturers, PBMs, insurers, and consumers. Each is determined by the relevant price that links two parties across the chain; R_{kd} determines the division between manufacturers and the other parties; r_j determines the division of the remainder between PBMs vs. insurers and consumers, and ϕ_j determines the division of surplus between insurers and consumers. Since we assume no outside option in the insurance market, the primary source of *distortion* arising in inefficient equilibrium arises from changes in drug consumption, moving consumers away from their preferred drug or to no drug at all. This will arise when any negotiation in the chain breaks down; either that the manufacturer cannot find a rebate that compels the PBM to grant it preferred coverage; that the PBM's recapture from rival manufacturers or insurers prevents it from wanting to make rebate deals with another manufacturer or insurer; or that rebates are not high enough to compel the insurer to provide preferred formulary coverage to branded drugs.

In general, rebates arise in equilibrium in a particular intermediate range of insurer incentives. The insurers' main consideration in determining their willingness to deal is about their trade-off in attracting more consumers versus raising their costs due to providing more generous coverage. The sensitivity of plan demand to formulary generosity is the key primitive in determining this trade-off. If plan demand is sufficiently insensitive, then insurers will have no incentive to deal with the PBM, since the cost increase will outweigh the benefits of greater demand even for large rebates. On the other hand, if plan demand is very sensitive to generosity and thus plans must compete fiercely on coverage, manufacturers will have no incentive to offer a rebate, since they correctly predict that plans will cover their drugs on the preferred tier even without it.[7]

2.5 PBM-Insurer Vertical Integration

What does vertical integration between PBMs and insurers do? Consider a plan j and PBM k who merge. The integration changes three behaviors: 1) j and k's dealings with each other; 2) k's dealings with rival plans j'; and 3) j's dealings in competition with j'.

First, consider how rebate pass-through between j and k will change. In the absence of integration, j and k haggle over how to split the surplus. When integrated, (we assume that) they fully internalize each other's profits. Therefore, the actual realized rebate pass-through r_j is irrelevant; both j and k internalize the entire rebate R_{kd} regardless of whose hands the money ends up in. This reflects the typical "reduction of double marginalization" benefit of vertical integration: the insurer can operate as if it faces the wholesale rebate, rather than a fraction of that rebate.

Second, k's gains from trade change when dealing with rival plans j'. Now, k's gains from trade are

$$GFT_{j'k}^{PBM-MCO,VI} = \underbrace{\sum_{d}(1-r_j)R_{kd}Q_{j'd}}_{\text{Revenue from } j'} + \underbrace{\sum_{j''\neq j'}\sum_{d}(1-r_{j''})R_{kd}\Delta_{j''d}}_{\text{Recapture for } k \text{ from other plans}} + \underbrace{(\phi_j - C_j)\delta_j}_{\substack{\text{Gross other profits} \\ \text{for marginal enrollees in } j}}$$

Two parts of this equation have changed, both involving j. First, k now acts as if $r_j = 0$, since it fully internalizes the rebates earned by its integrated plans. Second, if making a deal with j' shifts demand away from j (i.e., if $\delta_j < 0$), then j will lose out on gross profits from enrollees. k now internalizes this harm fully. Both of these factors reduce k's gains from trade and thus will reduce the rebate it is willing to offer j'. This is the standard "raising rivals' costs" harm of vertical integration: to protect its integrated plan, k will offer worse deals to j'. This will either raise the premiums that j' sets by raising its marginal costs, *or*, if the reduction in gains from trade is sufficiently strong, j' and k will not deal, lowering the quality of the plan j' can profitably offer.[8] Either outcome will soften the competition that j faces, increasing the joint profits of j and k.

[7]We do not currently incorporate this second force into our model; we enforce that the off-equilibrium path is non-preferred coverage even when the insurer would offer preferred coverage in the absence of a rebate. In practice, if this constraint binds, we will estimate that PBM-insurer rebate pass-through is negative, since the insurer will be willing to pay to avoid being forced to offer non-preferred coverage. We discuss this further in our estimation section.

[8]As Rey and Tirole (2007) emphasize, foreclosure due to vertical integration need not be absolute–the vertically-integrated firm might optimally choose to only partially foreclose its rivals.

Finally, j's objective function for premium-setting changes. They now maximize

$$\phi_j = \arg\max_{\phi_j} \sum_{\ell \in M(j)} \left[\underbrace{(\phi_\ell - C_\ell) D_\ell}_{\substack{\text{Gross profits} \\ \text{excluding} \\ \text{anticoagulants}}} - \underbrace{\sum_d (p_d - R_{kd} - OOP_{\ell d}) q_{\ell d}}_{\text{Net anticoagulant costs}} \right] + \underbrace{\sum_{j' \notin M(j)} (1 - r_{j'}) R_{kd} q_{j'd}}_{\substack{k\text{'s rebate revenues} \\ \text{from other insurers}}}$$

Again, note two changes. First, the term r has dropped from j's (and its companion plans') net anticoagulant costs, since it now internalizes the entire rebate. This reduction of double marginalization, by reducing j's effective marginal costs, will induce it to lower the premium it sets. Second, there is a new term, reflecting the profits of the PBM from its deals that do *not* involve the integrated insurer. The PBM earns revenues from dealing with rival insurers. Since j now internalizes those revenues, its objective function now includes a term that is *increasing* in its rivals' market share. All else equal, this term will serve to increase the premiums that j sets. This effect can generate anticompetitive effects of vertical integration even if the PBM does not raise rivals' costs.[9]

3 Data and Estimation

The model we derived in the prior section has four sets of important unknown primitives. First, the demand system for drugs, which determines the potential producer surplus to be split between manufacturers, PBMs, and insurers. Second, the demand system for insurance plans, which, as we highlighted, is an important determinant of gains from rebate existence. Third, the relative bargaining ability between PBMs and insurers. Finally, the relative bargaining ability between PBMs and manufacturers. We begin by describing the data we use, then our estimation strategy.

3.1 Medicare Data

We use several administrative datasets from the Centers for Medicare and Medicaid Services (CMS). These data contain information on beneficiary program enrollment status, medical utilization, and prescription

[9]Note that this term relies on the functional form assumption that rebate-sharing contracts are written to be linear in q_{jd}. This is a convenient representation, but even in the presence of lump-sum contracts, this term reflects potential second-order effects (not accounted for in Nash equilibrium conduct) where if the total potential surplus gains from rebates for j' are diminished by j competing more aggressively, in the long run, the total rebates (and thus the profits of k) will fall.

drug utilization within the Medicare program. The data are nationwide in scope and extend from 2015 to 2019.

Beneficiary Demographics, Enrollment, and Choice Status. We obtain information on beneficiary demographic characteristics and Part D plan enrollment from the Medicare Beneficiary Summary File. This file provides demographic information such as age, gender, and geographic location. It additionally tracks enrollment status at a beneficiary-month level for different Medicare coverage programs, including Part D.

Plan Characteristics and Formulary Data. We obtain information on plan characteristics from publicly available CMS datasets, which cover all Part D plans offered during our sample period. We are able to observe the financial characteristics of the plan (such as its deductible), as well as the name of the insurance carrier it is offered by.

Importantly, this also includes information on the formulary arrangement for each plan in each year. For each covered drug, the data indicates the coverage tier that the plan covers it at, which details the required copayment a beneficiary faces for that drug. The formulary coverage data is imperfect in that it does not explicitly measure whether drugs were excluded from coverage, but non-inclusion is meant to signal that the drug is excluded. However, we often observe that drugs not explicitly included on the formulary nonetheless appear to be filled with insurance coverage. To correct for this, we follow Brot et al. (2024) and group all drugs (identified by National Drug Code, or NDC) by their active ingredient and branded/generic status, and, for each plan-year-drug tuple, assign the most generous coverage of any included NDC on each plan's formulary in that year.

Outpatient Prescription Drug Data. We track outpatient prescription drug fills for a random 20% sample of Part D enrollees whose claim-level data are available in the Part D Event files. Each claim represents an event where a beneficiary filled a single prescription of a given drug. For each claim, we observe the specific drug prescribed and filled (at the NDC code level), the quantity/days supply for the fill, as well as the date the fill occurred, and payment fields which include the reported price paid to the pharmacy, as well as the breakdown of whether this price was paid by the consumer or by their insurer.

PBM Bargaining and Rebate Data. To identify which PBM was contracted by each insurer in our data, we use Clarivate's Managed Market Surveyor (MMS).[10] The MMS dataset is constructed by surveying

[10] Gray et al. (2023) also use this dataset to identify PBM-insurer agreements.

insurers who offer drug coverage, and asking them which PBM they use for various categories of services, including formulary management, rebate negotiations, claims adjudication, and benefit design. We match this dataset to our plan identifiers through the text name of the carrier, and are able to link all plans within our data to the MMS data. Plans generally use only one PBM for any services listed when they use an external PBM; or they act as their own PBM. In the cases where there are multiple PBM actors, we assign the insurer the PBM who is responsible for rebate negotiations. We verify the vertical integration status of PBM-insurer pairs by hand by reading the 10-K filings of the PBM entities. In cases where the plan performs its own rebate negotiation, we treat it as if it is vertically integrated with its PBM.

We use data from SSR Health, which estimates the size of rebates paid by manufacturers by comparing gross and net revenue from public financial reporting. Unfortunately, since the SSR Health data is calibrated from 10-K filings, it is not able to reliably break down rebates across different market segments or PBMs. We use estimates of the PBM's share of rebates (relative to other rebate recipients, such as pharmacies) of two-thirds from Fein (2020) to deflate our rebate estimates.

3.2 Analytic Sample

We focus only on the use of oral anticoagulants. This requires us to limit our sample in two ways: First, to the relevant set of drugs, and second, to the relevant set of potential consumers.

We begin with the drugs. We focus our attention only to known oral anticoagulants. This importantly excludes non-oral anticoagulants, such as heparin. We identify warfarin, Eliquis, and Xarelto from their associated NDCs. Another branded NOAC, Pradaxa, was approved for use at this time, but garnered miniscule market share, so we exclude it so as to improve the speed of our estimation procedure.

Second, we include only patients with recorded conditions that indicate the potential use of an oral anticoagulant. The three primary indicating conditions are atrial fibrillation (irregular heartbeat), deep vein thrombosis (blood clot in deep vein), and pulmonary embolism (blood clot in pulmonary artery within the lungs). We include any beneficiary who had a medical claim filed on their behalf within the year with a recorded diagnosis code corresponding to any of these three conditions. In any given year, our denominator includes over 349 thousand individuals.

3.3 Summary Statistics

We first document the typical formulary placement of Eliquis and Xarelto by PBMs. In Table ??, we plot each PBM-year pair, along with the count of insurance plans sponsored by insurers who contract with that PBM who use a given formulary placement (along with the count of members enrolled in those plans, as well as the share of anticoagulant costs made up by the two branded options). We only see four unique formularies across these years: Putting both drugs on the preferred tier; putting only Xarelto on the preferred tier and Eliquis on the non-preferred tier; putting Xarelto on the preferred tier and excluding Eliquis; and putting Eliquis on the preferred tier and excluding Xarelto (used by only two PBM-year pairs). The preferred/preferred formulary is by far the most common, with the preferred/non-preferred formulary making up the majority of the remainder.

Next, we measure the use of different oral anticoagulants. We assign each beneficiary to the anticoagulant they fill. If they fill multiple, we assign them to the branded anticoagulant with the highest days supply in that year. That is, if they fill prescriptions for both warfarin and Xarelto, we assign them to having taken Xarelto that year. We do this since this behavior seems driven by permanent shifts from warfarin to the NOACs, often driven by step therapy requirements in some plans. We show the market shares for the three options in Table 2. The combined market share of the NOACs increases from 10% in 2014 to 31% by the end of our sample in 2019, primarily coming from the decline in warfarin use, but also some extensive margin increases in the use of any anticoagulant. Eliquis in particular experiences a sharp increase in utilization over this period.

3.4 Estimation

We solve and estimate our model backwards, from drug demand back through to the bargaining stage.

3.4.1 Drug Demand

We follow the approach of Brot et al. (2024) and Che (2025) in estimating demand for drugs. As described in the model section, we assume a stable utility function governing drug choice. We parameterize it as

$$v_{id} = \underbrace{\beta_{g(i)}\text{OOP}_{id} + \kappa_{g(i)d}}_{V_{id}} + \xi_i \mathbb{1}\{d \neq 0\} + \lambda_{g(i)}\epsilon_{id}$$

That is, we assume that the consumer has some mean preference for each drug κ and they disprefer a given drug when they pay more out-of-pocket for it (OOP_{id}). We assume that both $\xi_i \mathbb{1}\{d \neq 0\} + \lambda_{g(i)}\epsilon_{id}$ and ϵ_{id} follow a Gumbel distribution, such that drug demand follows the familiar nested logit form (Berry 1994), with all of the inside goods (choosing a drug) forming one nest and the outside good (choosing no drug) forming a second nest. In this way, λ parameterizes the extent to which a patient dissuaded from taking one drug due to high OOP cost will substitute to another drug relative to taking no drug at all. Consumers are pooled into groups g such that mean preferences and substitution patterns are homogeneous within g, with groups defined based on risk score (constructed following Decarolis et al. (2020)) and age.

We construct out-of-pocket prices as in Che (2025), by using both the consumer's plan information *and* their utilization of other drugs. The former specifies the tier each drug is placed on, as well as the plan's nonlinear coverage parameters (e.g. deductible, donut hole). The consumer's utilization of other drugs determines which coverage phase the consumer ends the year in (e.g. under the deductible, in the donut hole, etc.). We assign each consumer the out-of-pocket price for filling a 30-day supply of the anticoagulant in question at the end of each month, assuming no other anticoagulant was purchased throughout the year, and that the consumer's use of other drugs is independent of their anticoagulant choice.[11].

The core identification challenge is in identifying β and λ. β is identified from comparing the relative market share of a drug across consumers. Some consumers face higher out-of-pocket costs; others do not. Variation comes from differences in which plans consumers pick, and what other consumption they use, moving them around the benefit phase. Here, the fact that all of our estimation is effectively done within risk score group is critical, so that our variation in OOP prices is residual of underlying risk, therefore our estimate does not merely compare high-risk groups (who face low shadow prices) to low-risk groups (who face high shadow prices), which might be confounded with differences in underlying demand for anticoagulants. λ is similarly identified from the same variation, but comparing the market share of *other drugs* (holding their out-of-pocket prices fixed).

We assume that each consumer only chooses one anticoagulant (e.g. we do not allow for experimentation or explicit step therapy), to allow us to fit behavior within the model of discrete choice. As described prior in this section, we assign each consumer to a single chosen anticoagulant. The vast majority of consumers choose only one, making this assumption relatively innocuous.

We estimate the model using Poisson pseudo-maximum likelihood estimation. As Brot et al. (2024) demonstrate, this approach is isomorphic to logit demand estimation, while allowing us to take advantage

[11] This effectively assumes that there is no moral hazard in non-anticoagulant drugs. This is a standard assumption in the literature on insurance demand and market structure (Handel 2013, Olssen and Demirer 2023)

of recent improvements in high-dimensional Poisson regression (Correia et al. 2020). We compute standard errors by using the Bayesian bootstrap (which iteratively draws weights for each observation rather than resampling observations), to avoid failure to compute fixed effects in each bootstrap run.

3.4.2 Plan Demand

As in the model section, consumers choose a single plan, as is true in the Medicare Part D program. At this choice stage, we assume they do not yet observe their specific unobserved preference draws ξ_i, ϵ_{id}, but know the *ex ante* distributions of these terms. We assume that consumer plan choice is given by a stable utility function:

$$u_{ij} = \rho\phi_j + \gamma CS_{ij} + \alpha X_j + \kappa_{g(i)c(j)} + \epsilon_{ij}$$

The consumer trades off the premium of the plan ϕ_j against their expected consumption utility from anticoagulants after purchasing it, CS_{ij}, which is defined by:

$$CS_{ij} = E\left[\max_d v_{id}\right] = \log\left(1 + \left(\sum_{d\in\mathcal{D}} \exp(V_{id}/\lambda)\right)^\lambda\right)$$

This term is equal to the expected utility of i's most preferred option from the set of drugs (or no drug), given the formulary they face.

Additionally, we allow the consumer to value other plan characteristics X_j, including whether the plan has a deductible, whether it is an enhanced plan, its age, and the share of (non-anticoagulant) drugs it puts on different formulary tiers. We allow consumers of group g to have fixed mean preferences for plans under different carriers, serving as an effective brand preference for insurers to capture some degree of unmodeled preference heterogeneity.

We assume that there is no outside option, i.e., a consumer cannot choose to not enroll in a Medicare Part D plan. We think this is reasonable given that 1) since Part D is subsidized, it is rarely optimal to buy no plan; and 2) there are significant penalties (in terms of the removal of generous subsidies) for staying out of the program when eligible.

3.4.3 Bargaining

Given the demand systems for drugs and plans, we finish by estimating the parameters of our bargaining model. The remaining unknown parameters are the weights determining relative bargaining ability in PBM-manufacturer and PBM-insurer bargaining. We begin by reducing our dimensionality to a single parameter summarizing the relative weight at each stage. We assume that PBM-insurer relative bargaining weights are identical, i.e. $b_{jk} = b$. We assume that PBM bargaining weights in manufacturer-PBM bargaining are proportional to the number of consumers they cover who take the drug in question: $B_{kd} = \zeta \log \left(\sum_{j \in \mathcal{J}_{\|}} q_{jd} \right)$. We do this since we observe a small number of bilateral outcomes, limiting the dimensionality of the parameters we can feasibly estimate.

We begin by estimating the upstream manufacturer-PBM rebates. Ideally, we would observe each manufacturer-PBM-year rebate, and match those to the first-order condition implied by our bargaining model. Instead, we observe the average rebate amount across insurers and market segments. We assume that the SSR Health average rebate is representative for PBMs in Part D. We then invert the Nash bargaining problem to solve for the equilibrium rebate. We take the first-order condition for the Nash bargaining problem:

$$\frac{d \log N_{kd}^{PBM-M}}{dR_{kd}} = \frac{B}{GFT_{kd}^{PBM-M}} \frac{\partial GFT_{kd}^{PBM-M}}{\partial R_{kd}} + \frac{1-B}{GFT_{kd}^{M-PBM}} \frac{\partial GFT_{kd}^{M-PBM}}{\partial R_{kd}} = 0$$

The first-order condition implies a bijection between a potential relative bargaining ability parameters B and a set of manufacturer-PBM rebates R_{kd}. We choose the B that minimizes the distance between the implied weighted average over R_{kd} (weighted by individuals insured under plans dealing with k) and the SSR Health average rebate amount. This involves matching two moments, one for Eliquis and one for Xarelto.

Finally, we estimate the PBM-insurer bargaining parameter. We do not have an observed measure of these rebates, so we impute them. We assume that the rebate received by plans is proportional to their rebate share of costs given by public DIR (direct and indirect remuneration) data provided by CMS. This is a necessarily imperfect measure of actual rebates in level terms. In our context, the *relative* imputed rates correspond to *relative* ability across insurers to extract rebates from PBMs. With those in hand, we can take the first-order conditions for the PBM-insurer bargaining problem:

$$\frac{d\log N_{jk}^{PBM-MCO}}{dr_j} = \frac{b}{GFT_{jk}^{PBM-MCO}} \frac{\partial GFT_{jk}^{PBM-MCO}}{\partial r_j} + \frac{1-b}{GFT_{jk}^{MCO-PBM}} \frac{\partial GFT_{jk}^{MCO-PBM}}{\partial r_j} = 0$$

To estimate b, we plug in our imputed rebate values and minimize the weighted sum of squared values of the first-order conditions, weighted by patient enrollment for insurer j.

4 Results

4.1 Demand System Parameter Estimates

We produce the estimated drug demand parameters in Table 3. For drug demand, each consumer type (indexed by quintile of risk score and gender) has roughly similar magnitudes of dis-preference for higher prices. The nesting parameter, which is allowed to vary across years, rises substantially over the period. In our context, this means that the marginal non-user of warfarin at the earliest part of our sample is most likely to divert to no anticoagulant; by the end of our sample, they are substantially more likely to divert to a NOAC (and vice-versa). To understand the substitution patterns, in Table 4 we plot the own-price and cross-price elasticities between the drug options. The NOACs face own-price elasticities of 0.3 (Eliquis) and 0.27 (Xarelto), similar in magnitude to the average branded drug elasticity estimated (using different variation) by Einav et al. (2018). Cross-price elasticities are relatively small in magnitude. Warfarin demand is very inelastic relative to demand for branded drugs (0.01), suggesting that users there have limited options.

We display the plan demand parameter estimates in Table 5. We estimate relatively premium-inelastic demand for plans. Most importantly for our model is to compare the relative coefficients for changes in premiums and consumer surplus. A plan lowering its premium by \$1 increases plan utility by 0.03. In contrast, the same plan lowering the OOP payment for all anticoagulants by \$1 raises plan utility by 0.0009 (taking the contribution of OOP payments to drug utility, -0.0006, and multiplying by the contribution of expected drug utility to plan utility, 1.51). The ratio of these is 0.03, suggesting that consumers value a dollar reduction of premiums by much more than more generous insurance coverage. This means that formulary competition is relatively weak, anticipating that we will find weak gains from trade in bargaining.

4.2 Bargaining Parameter Estimates

We estimate that $\zeta = 0.055$ and $b = 0.10$. While we estimate that bargaining ability parameters are relatively uniform, this does not mean that *rebates* are uniform, since different PBMs, manufacturers, and insurers each have different extents of leverage. In Table 7, we plot the estimated rebates for Eliquis and Xarelto for each PBM, alongside the pass-through rate to insurers. Rebates ranges from \$0.13-0.37 per dollar for Eliquis, and \$0.06-0.41 for Xarelto, though these rebate amounts are only weakly correlated due to differences in underlying demand for the two drugs across insurers. Pass-through rates also vary considerably. For integrated entities or self-negotiation, they are 1 by construction. Interestingly, even though Catamaran was an unintegrated PBM, we estimate that it passes through the vast majority of rebates–nearly 1 for all insurers it deals with. This might arise from its lack of bargaining power relative to larger PBMs. Integrated PBMs dealing with rival insurers have much lower pass-through rates.

In Table 6, we show the implications of our bargaining model in upstream bargaining by measuring the effects of moving one drug for one PBM at a time from preferred status to non-preferred status, while holding all other formulary placements fixed at preferred status. with the exception of Aetna dealing with Eliquis, most removals of preferred status reduce the drug's own market share by 35-55%. The manufacturer is able to recapture roughly 2-3% of that demand from other PBMs it deals with, while the PBM is able to recapture 7-18% of the demand via substitution from the drug to its other branded rival.

In practice, our model predicts substantial *negative* gains from trade for many PBM-insurer pairs. This arises from the fact that adding additional coverage for NOACs is costly–moving a drug from the non-preferred to the preferred tier, on average, improves its actuarial value of coverage by roughly 30 percentage points. However, consumers are quite inelastic to coverage generosity, so the improvement in demand is small, and the profit gains are limited since net margins are relatively modest. Therefore even if plans were to be given the entire rebate negotiated by the PBM, they would not be able to offset the increase in their coverage costs, making preferred coverage financially unpalatable. The fact that plans *do* cover these drugs in a preferred way suggests that this result reflects issues with our estimation and modeling approach rather than fundamentals alone. One likely issue is that, since we model anticoagulants in isolation, the off-equilibrium path only degrades plan formularies for anticoagulants, meaning that it is not too large a deviation. In practice, if a plan and PBM fully disagree, the plan will certainly lose rebates on *all* of its covered drugs, not merely anticoagulants. As Bernheim and Whinston (1990) emphasize, interactions on multiple points of contact can sustain cooperation when it would otherwise falter. We are addressing different possibilities to link anticoagulant specific surplus to broader consumer drug surplus in a plan, in ongoing work.

4.3 The Impact of Vertical Integration

We use our model and data to measure the impact of PBM-insurer vertical integration. With our current model structure, since PBMs do not internalize future agency issues during upstream negotiations, manufacturer-PBM rebates are effectively held fixed, and vertical integration changes the allocation of rebates.

Since we face an issue where we have multiple PBM-insurer pairs with negative gains from trade, we focus on CVS/Caremark, a PBM that is 1) vertically integrated, with Silverscript[12] and 2) has modeled equilibrium dealings with its sole third-party insurer client, First United American. We estimate that, in 2015, First United American received 59% of the rebate delivered to Caremark. In contrast, Silverscript, by virtue of being vertically integrated, effectively received 100% of the rebate. We estimate that, in the absence of the CVS/Caremark-Silverscript vertical integration, First United American would receive a 2pp greater share of rebates, implying that Caremark was indeed "raising rivals' costs" by lowering the rebate it was willing to offer on account of its internalization of Silverscript's profits. In contrast, when we disintegrate Caremark and Silverscript, we estimate a negative rebate for Silverscript; i.e., Silverscript is willing to pay for the preferred formulary. This indicates that even in the absence of a rebate, Silverscript would offer a preferred formulary, since its net margins are sufficiently high that the demand increase outweighs the cost increase.

Interpreting the welfare consequences of these results is difficult. On the one hand, we find that incentives to raise rivals' costs are real, though they only reduce rebates offered to rivals by 3%. This arises from the fact that consumers are weakly formulary-sensitive, meaning that the threat by PBMs to push insurers into offering low coverage threatens them with a relatively smaller attack on their profits. On the other hand, reductions of double marginalization are potentially quite high if, in the absence of integration, a PBM would not offer *any* rebate pass-through to an insurer who would otherwise be integrated. In ongoing analysis, we are assessing different insurance plan surplus models and PBM benefits. These include (i) linking anticoagulant surplus to surplus for the entire set of drugs on a plan and (ii) allowing for additional services that PBMs provide to contracting insurers.

[12] And, later, with Aetna.

5 Conclusion

Pharmacy benefit managers have been at the heart of recent debates about rising drugs costs (FTC (2024)). They are complex entities that perform a variety of functions in the drug supply chain. One key function is to create drug formularies, i.e. bundles of drugs, by bargaining lower prices with drug manufacturers. PBMs sell these formularies to insurers downstream, which in turn determines insurer costs, drug costs and drug access for consumers.

Our project focuses specifically on vertical integration between PBMs and insurers, and whether this is ultimately good or bad for overall surplus or consumer surplus. There has been notable concern about vertical integration between insurers and PBMs, with over 80% of PBM market share now tied to 3 large PBMs that are vertically integrated with different insurers. The economic efficiency effects of vertical integration are often complex Lee et al. (2021) and these concerns are typically discussed at a high level, without digging into the economics of this specific vertical market structure. Without this kind of analysis, it is difficult to unpack the efficiency and distributional consequences of vertical integration, including answering the question of whether it is ultimately a net harm or net benefit.

We analyze this in the context of Medicare Part D, prescription drug insurance for seniors. We do so using (i) a model of interactions throughout the vertical supply chain and (ii) detailed data on drug use, insurer demand, drug rebates, and PBM-insurer relationships. We estimate consumer price sensitivity to tiering for Xarelto and Eliquis, find some price sensitivity, with inelastic demand overall. We show that plan choice emphasizes plan premiums more so than ex post cost-sharing and tiering, and find estimate bargaining weights between non-integrated insurers and PBMs that govern rebate pass through. We also estimate parameters that govern manufacturer-PBM bargaining over rebates.

We use our estimates to perform a counterfactual case study investigating the impact of the integration between CVS/Caremark and Silverscript. We study 2015 relations between these entities, as well as relations with and effects on First United American, a smaller insurer that Caremark contracts with. We find that vertical integration raises First United American costs: Caremark passes through a lower portion of rebates when integrated vs. when not integrated. On average, vertical integration potentially leads to lower premiums paid downstream in the insurance market in the short run, but also leads to lower competition in that market, potentially leading to consumer cost issues in the long-run.

While our analysis studies vertical integration between one PBM and one insurer, holding the rest of the market fixed, in the future it will also be useful to assess how a series of vertical mergers impacts the market. For example, it could be that having no vertically integrated firms is optimal, but that once there are already two vertically integrated firms, adding a third vertically integrated firm is incrementally valuable. The dynamics of competition are potentially important, and could lead to a vertical integration trap whereby successive vertical integration occurs because of, and is allowed because of, prior vertical mergers.

Additionally, we focus our analysis on one class of drugs, oral anticoagulants. While this follows prior work in the literature, and allows us to precisely illustrate the impacts of vertical integration through the whole supply chain, in future work it will be useful to develop methods to effectively include more drug classes together in one evaluation. This could generate both more precise economic estimates of whether or not specific mergers should be allowed and also lead to some interesting economic insights into what drives bargaining upstream and downstream in the drug supply space. Further, our current approaches doesn't allow for PBM competition to attract insurer clients, an important aspect that will be valuable to study in future work.

Finally, it will also be interesting in future work to think about the cross-market impacts of vertical mergers in drug supply. Conceptually, drug manufacturer and PBM bargaining could apply across all the markets the PBM sells in, including, e.g., Medicare Part D, Medicare Advantage, employer-sponsored coverage, and Affordable Care Act marketplace plans. A given PBM may primarily operate in certain markets, and a given insurer may operate in others, with different potential levels of overlap. The benefits and harms from integration depend on these cross-market details and will be interesting to assess going forward.

References

Abaluck, Jason and Jonathan Gruber, "Choice Inconsistencies Among the Elderly: Evidence from Plan Choice in the Medicare Part D Program," *American Economic Review*, 2011, *101* (4), 1180–1210. 2, 3

__ **and** __ , "Evolving Choice Inconsistencies in Choice of Prescription Drug Insurance," *American Economic Review*, 2016, *106* (8), 2145–84. 2

Agha, Leila, Soomi Kim, and Danielle Li, "Insurance design and pharmaceutical innovation," *American Economic Review: Insights*, 2022, *4* (2), 191–208. 4

Bernheim, B. Douglas and Michael D. Whinston, "Multimarket Contact and Collusive Behavior," *RAND Journal of Economics*, 1990, *21* (1), 1–26. 23

Berry, Steven T., "Estimating Discrete-Choice Models of Product Differentiation," *RAND Journal of Economics*, 1994, pp. 242–262. 19

Brot-Goldberg, Zarek C. and Mathijs de Vaan, "Intermediation and Vertical Integration in the Market for Surgeons," *Working Paper*, 2018. 4

Brot, Zarek, Samantha Burn, Timothy Layton, and Boris Vabson, "Rationing Medicine Through Paperwork: Authorization Restrictions in Medicare," 2024. University of Chicago Working Paper. 2, 16, 18, 19

Che, Catherine, "Countervailing Market Power and Misaligned Incentives in US Prescription Drug Pricing," 2025. 4, 8, 18, 19

Conti, Rena, Brigham Frandsen, Michael Powell, and James Rebitzer, "Common Agent or Double Agent? Pharmacy Benefit Managers in the Prescription Drug Market," May 2021. NBER Working Paper No. 28866. 4

Correia, Sergio, Paulo Guimarães, and Thomas Zylkin, "Fast Poisson Estimation with High-Dimensional Fixed Effects," *Review of Economics and Statistics*, 2020, *20* (1), 95–115. 20

Crawford, Gregory S. and Ali Yurukoglu, "The Welfare Effects of Bundling in Multichannel Television Markets," *American Economic Review*, 2012, *102* (2), 643–685. 4

_ , Robin S. Lee, Michael Whinston, and Ali Yurukoglu, "The Welfare Effects of Vertical Integration in Multichannel Television Markets," *Econometrica*, 2018, *86* (3), 891–954. 4

Cuesta, Jose Ignacio, Carlos Noton, and Benjamin Vatter, "Vertical Integration Between Hospitals and Insurers," *Working Paper*, 2020. 4

Decarolis, Francesco, Maria Polyakova, and Stephen P. Ryan, "Subsidy Design in Privately Provided Social Insurance: Lessons from Medicare Part D," *Journal of Political Economy*, 2020, *128* (5), 1712–1752. 19

Dubois, Pierre, Ashvin Gandhi, and Shoshana Vasserman, "Bargaining and International Reference Pricing in the Pharmaceutical Industry," Working Paper 30053, National Bureau of Economic Research May 2022. 2

Einav, Liran, Amy Finkelstein, and Maria Polyakova, "Private Provision of Social Insurance: Drug-Specific Price Elasticities and Cost Sharing in Medicare Part D," *American Economic Journal: Economic Policy*, 2018, *10* (3). 22

Fein, Adam, "The Gross-to-Net Bubble Hit $175 Billion in 2019: Why Patients Need Rebate Reform," 2020. 17

Feng, Josh and Luca Maini, "Demand inertia and the hidden impact of pharmacy benefit managers," *Management Science*, 2024, *70* (12), 8940–8961. 2, 4

FTC, "Pharmacy Benefit Managers: The Powerful Middlemen Inflating Drug Costs and Squeezing Main Street Pharmacies," July 2024. 6, 25

Garthwaite, Craig and Fiona Scott Morton, "Perverse Market Incentives Encourage High Prescription Drug Prices," November 2017. 6

Gray, Charles, Abby E. Alpert, and Neeraj Sood, "Disadvantaging Rivals: Vertical Integration in the Pharmaceutical Market," 2023. NBER Working Paper No. 31536. 4, 7, 16

Gruber, Jonathan, Benjamin Handel, Sam Kina, and Jonathan Kolstad, "Managing Intelligence: Skilled Experts and AI in Markets for Complex Products," *UC Berkeley working paper*, 2020. 3

Guardado, Jose, "Compeition in PBM Markets and Vertical Integration of Insurers and PBMs: 2024 Update," September 2024. 7

Handel, Benjamin, "Adverse Selection and Inertia in Health Insurance Markets: When Nudging Hurts," *American Economic Review*, 2013, *103* (7), 2643–2682. 19

Ho, Kate and Robin S. Lee, "Insurer Competition in Health Care Markets," *Econometrica*, 2017, *85* (2), 379–417. 9

_ and _ , "Fisher-Schultz Lecture: Contracting over Pharmaceutical Formularies and Rebates," 2024. 4, 7

_ , Joseph Hogan, and Fiona Scott Morton, "The Impact of Consumer Inattention on Insurer Pricing in the Medicare Part D Program," *The RAND Journal of Economics*, 2017, *48* (4), 877–905. 2

Kakani, Pragya, Michael Chernew, and Amitabh Chandra, "Rebates in the Pharmaceutical Industry: Evidence from Medicines Sold in Retail Pharmacies in the U.S.," Working Paper 26846, National Bureau of Economic Research March 2020. 1

Lee, Robin, Michael Whinston, and Ali Yurukoglu, "Vertical Market Structure and Industrial Organization," 2021. IO Handbook. 4, 25

Lee, Robin S., "Vertical Integration and Exclusivity in Platform and Two-Sided Markets," *American Economic Review*, December 2013, *103* (7), 2960–3000. 4

Olssen, Alex and Mert Demirer, "Drug Rebates and Formulary Design: Evidence from Statins in Medicare Part D," 2023. University of Pennsylvania Working Paper. 2, 3, 19

Olssen, Alexander L and Mert Demirer, "Drug rebates and formulary design: Evidence from statins in Medicare Part D," in "Massachusetts Institute of Technology Working Paper" 2019. 7

Polyakova, Maria, "Regulation of Insurance with Adverse Selection and Switching Costs: Evidence from Medicare Part D," *American Economic Journal: Applied Economics*, 2016, *8* (3), 165–195. 2

Rey, Patrick and Jean Tirole, "A Primer on Foreclosure," in Mark Armstrong and Robert Porter, eds., *Handbook of Industrial Organization*, Vol. 3, Elsevier, 2007, pp. 2145–2220. 14

Starc, Amanda and Thomas G. Wollmann, "Does Entry Remedy Collusion? Evidence from the Generic Prescription Drug Cartel," *American Economic Review*, May 2025, *115* (5), 1400–1438. 2

6 Figures

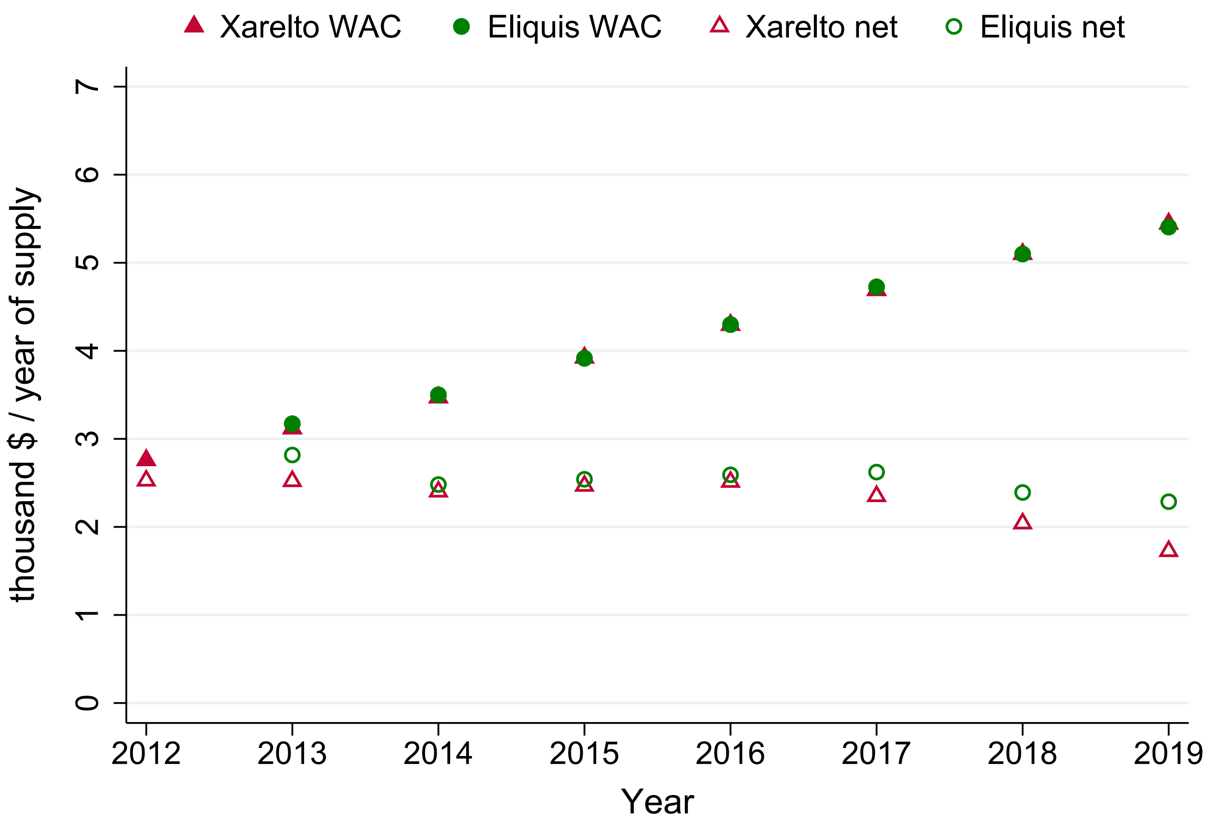

Figure 2: List and Net Prices for Direct Oral Anticoagulants

Notes: This figure plots a time series of the average Wholesale Acquistion Cost (WAC) and net price for Xarelto and Eliquis, the primary two branded direct oral anticoagulants on the market.

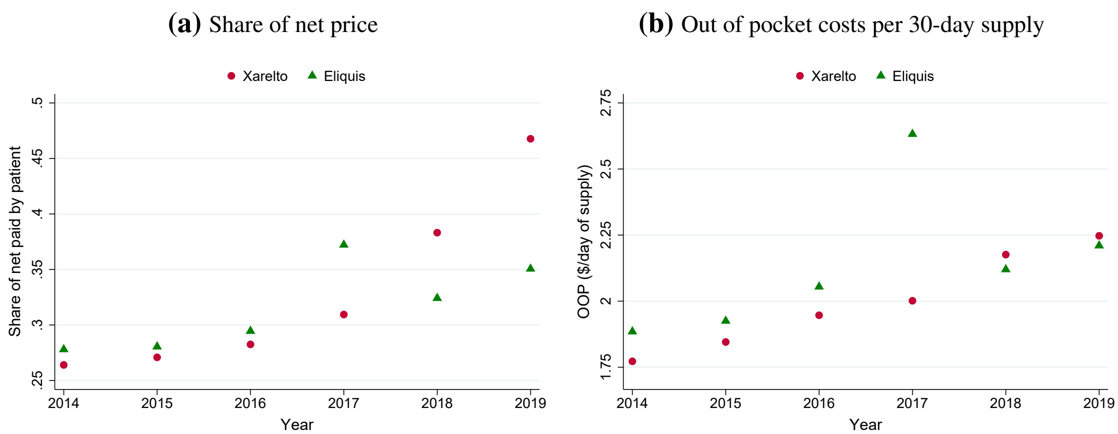

Figure 3: Cost-Sharing for Direct Oral Anticoagulants

Notes: This figure plots a time series of (a) the average rebate share of the net price and (b) the average patient out-of-pocket cost for a 30-day supply of Xarelto and Eliquis. These figures exclude prescription fills in the coverage gap phase, which was going through ACA-mandated changes in benefit design during this period. A large PBM put Eliquis on the non-preferred tier in 2017, leading to discontinuous jump in out of pocket costs.

7 Tables

Table 1: Drug/PBM Interaction Characteristics

			Cost share		Formulary placement for Xarelto and Eliquis			
Year	PBM	Member count	Xarelto	Eliquis	(pref,pref)	(pref, non-pref)	(pref, excl)	(excl, pref)
2015	Aetna	23133	0.11	0.48	0	81	0	0
2015	CVS/Caremark	48090	0.1	0.11	97	4	0	0
2015	Catamaran	33060	0.58	0.2	64	0	0	54
2015	Express Scripts	20923	0.15	0.15	69	0	0	0
2015	Humana	88740	0.19	0.2	96	0	0	0
2015	OptumRx	135857	0.13	0.13	72	0	0	0
2015	Prime Therapeutics	26720	0.1	0.21	6	14	4	0
2016	Aetna	35877	0.12	0.46	0	91	0	0
2016	CVS/Caremark	75016	0.12	0.12	142	0	0	0
2016	Express Scripts	22051	0.16	0.17	68	0	0	0
2016	Humana	97536	0.19	0.22	95	0	0	0
2016	OptumRx	150409	0.13	0.13	140	0	0	0
2016	Prime Therapeutics	26618	0.15	0.16	23	0	0	0
2017	Aetna	35881	0.11	0.45	0	88	0	0
2017	Cigna	10789	0.1	1	0	0	57	0
2017	CVS/Caremark	82509	0.11	0.47	2	120	0	0
2017	Express Scripts	25118	0.14	0.18	73	2	0	0
2017	Humana	106694	0.21	0.23	95	0	0	0
2017	OptumRx	144629	0.11	0.15	93	1	28	0
2017	Prime Therapeutics	26730	0.17	0.22	21	3	0	0
2018	Aetna	38367	0.09	0.1	88	0	0	0
2018	Cigna	10185	0.09	0.42	0	56	0	0
2018	CVS/Caremark	94443	0.1	0.1	124	0	0	0
2018	Express Scripts	27168	0.1	0.12	103	0	0	0
2018	Humana	109575	0.19	0.19	96	0	0	0
2018	OptumRx	142341	0.09	0.18	96	0	32	0
2018	Prime Therapeutics	28232	0.12	0.12	29	0	0	0
2019	CVS/Caremark	160363	0.09	0.09	246	0	0	0
2019	Express Scripts	37450	0.1	0.2	103	65	0	0
2019	Humana	100296	0.19	0.19	96	0	0	0
2019	OptumRx	138025	0.08	0.21	69	0	32	0
2019	Prime Therapeutics	27214	0.17	0.12	26	0	0	3

Notes: This table shows, for each PBM and year, the average out-of-pocket payment (as a share of list price) for Xarelto and Eliquis, and the number of Part D plans contracting with that PBM who use each of the enumerated formularies.

Table 2: Oral Anticoagulant Market Share by Year

	2014	2015	2016	2017	2018	2019
Xarelto	7	7	8	9	10	10
Eliquis	3	7	10	13	17	21
Warfarin	31	28	25	22	19	17
None	59	58	57	55	53	52
N	349,918	380,840	413,055	438,658	460,960	474,701

Notes: This table shows, for each year, the market share of each oral anticoagulant option among our analytic sample.

Table 3: Drug Demand Parameter Estimates

OOP:	Risk group 1	Risk group 2	Risk group 3	Risk group 4	Risk group 5
Male	-0.0006	-0.0007	-0.0007	-0.0006	-0.0005
Female	-0.0005	-0.0006	-0.0005	-0.0004	-0.0004
Nest parameter:	**2015**	**2016**	**2017**	**2018**	**2019**
λ	0.23	0.42	0.46	0.86	0.85

Notes: This table shows the point estimates of the parameters of our drug demand model.

Table 4: Price Elasticities of Drug Demand

	Change in price		
Change in demand	Eliquis	Xarelto	Warfarin
Eliquis	-0.30	0.05	0.02
Xarelto	0.05	-0.27	0.02
Warfarin	0.05	0.05	-0.01

Notes: This table shows the point estimates of own- and cross-price elasticities between drug options implied by the estimates of our drug demand model..

Table 5: Insurance Plan Demand Parameter Estimates

Variable	Coefficient estimate
Premium	-0.03
Has deductible	-1.14
Is enhanced	-0.14
CS	1.51
Plan age	0.21
Tier 1 share	10.03
Tier 2 share	24.90
Tier 3 share	48.96
Tier 4 share	2.05
Has copay tier 2	-0.63
Has copay tier 3	0.54
Has copay tier 4	0.67
Constant	-5.34

Notes: This table shows the point estimates of the parameters of our insurance plan demand model.

Table 6: Demand Changes and Recapture Under Threat of Bargaining Failure

	Eliquis			Xarelto		
Rebate entity	Own change	PBM recapture	Manufacturer recapture	Own Change	PBM recapture	Manufacturer recapture
Aetna	-8%	17%	3%	-53%	9%	3%
Catamaran	-45%	7%	3%	-35%	13%	3%
CVS/Caremark	-53%	18%	3%	-55%	16%	3%
Express Scripts	-49%	15%	3%	-51%	14%	3%
Humana	-46%	16%	3%	-48%	15%	3%
OptumRx	-51%	18%	2%	-53%	16%	3%
Prime Therapeutics	-45%	15%	2%	-55%	12%	3%

Notes: This table shows the estimated effects of moving Eliquis or Xarelto from being on the preferred tier of coverage to the non-preferred tier, assuming the other is on the preferred tier, which serves as the off-equilibrium option in rebate bargaining. "Own change" is the effect on demand for the drug, whereas the two recapture terms designate how much demand changes at other parties being contracted with (for the PBM, other drugs; for the manufacturer, other PBMs) due to that choice.

Table 7: Rebates for Insurer-PBM Dyads

Insurer	PBM	PBM Integration Status	Patients	Base Rebate Eliquis	Base Rebate Xarelto	Pass-Through Rate
Aetna	Aetna	Self	23905	0.13	0.33	1.00
BCBS (AZ)	Catamaran	Unintegrated	150	0.30	0.06	1.00
Cigna	Catamaran	Unintegrated	19155	0.30	0.06	1.00
Sterling	Catamaran	Unintegrated	134	0.30	0.06	1.00
Wellcare	Catamaran	Unintegrated	14672	0.30	0.06	0.97
Windsor	Catamaran	Unintegrated	143	0.30	0.06	1.00
Avalon	CVS/Caremark	Integrated	190	0.37	0.38	0.46
BCBS (SC)	CVS/Caremark	Integrated	700	0.37	0.38	0.51
First United American	CVS/Caremark	Integrated	303	0.37	0.38	0.59
Silverscript	CVS/Caremark	Joint Entity	41620	0.37	0.38	1.00
United American	CVS/Caremark	Integrated	5568	0.37	0.38	0.76
USAble Mutual	CVS/Caremark	Integrated	1093	0.37	0.38	0.48
Anthem	Express Scripts	Integrated	10296	0.31	0.32	0.67
BCBS (MA, RI, VT)	Express Scripts	Integrated	3210	0.31	0.32	0.74
HM Insurance Group	Express Scripts	Integrated	1719	0.31	0.32	0.26
Medco	Express Scripts	Joint Entity	5839	0.31	0.32	1.00
Wisconsin Physicians	Express Scripts	Integrated	802	0.31	0.32	0.45
Humana	Humana	Self	88620	0.35	0.36	1.00
Symphonix	OptumRx	Joint Entity	814	0.39	0.41	1.00
UnitedHealthcare	OptumRx	Joint Entity	135902	0.39	0.41	1.00
BCBS (AL, TN)	Prime Therapeutics	Unintegrated	1483	0.28	0.34	0.48
BCBS (FL)	Prime Therapeutics	Unintegrated	2980	0.28	0.34	0.41
BCBS (KS)	Prime Therapeutics	Unintegrated	781	0.28	0.34	0.82
BCBS (MN, MT, ND, NE, WY) / Wellmark (IA, SD)	Prime Therapeutics	Unintegrated	8716	0.28	0.34	0.86
BCBS (NC)	Prime Therapeutics	Unintegrated	1759	0.28	0.34	0.65
HCSC	Prime Therapeutics	Unintegrated	9639	0.28	0.34	0.63
Horizon	Prime Therapeutics	Unintegrated	1261	0.28	0.34	0.53

Notes: This table shows, for each pair of insurer and PBM, the integration status of the PBM, the number of patients with atrial fibrillation insured by the insurer, the base rebate captured by the PBM for each of the two anticoagulants, and the pass-through rate, the share of rebates we estimate are granted to the insurer. For integration status: "Self" indicates that the insurer engages in rebate negotiation on their own behalf, "Unintegrated" denotes that the PBM is not integrated with an insurer, "Integrated" denotes that the PBM is integrated with another insurer, and "Joint Entity" denotes that the insurer and PBM are vertically integrated.