Do Middlemen Raise Drug Costs?
Countervailing Market Power Meets Agency Frictions*

Catherine Che†

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Abstract

Many markets exhibit vertical layers with successive monopolists. One rationale for the existence of large middlemen is their ability to exercise countervailing market power to upstream monopolists. However, having market power may also inhibit middlemen's incentive to act in the interest of consumers. In this work, I study the trade-off between countervailing market power and agency frictions in the US prescription drug market. Pharmacy Benefit Managers (PBMs) are large middlemen who negotiate with drugmakers on behalf of insurers for rebates, which may in turn inflate list prices – sticker prices set by drugmakers – and make drugs less affordable. At the same time, high rebates may benefit consumers through lower insurance costs. To assess the role of PBMs, I estimate a vertical model of drug and insurance demand, rebate negotiation and list price setting for oral anticoagulants in Medicare Part D. I find that PBMs reduce dispersion in rebates, which helps smaller insurers. Moreover, policy solutions that remove agency frictions while preserving – or even enhancing – countervailing market power may improve consumer welfare by at least 6% of annual premiums.

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†Department of Economics, University of California, Berkeley. Email: cjche@berkeley.edu.

1 Introduction

List prices of prescription drugs in the United States have skyrocketed, increasing by as much as 100% from 2012 to 2019 for commonly used drugs.[1] Practitioners have speculated that Pharmacy Benefit Managers (PBMs) – middlemen who negotiate drug rebates on behalf of insurers – are responsible for this fact. For instance, in September 2024, the Federal Trade Commission filed an administrative complaint against the three largest PBMs, accusing them of "*engaging in anti-competitive and unfair rebating practices that have artificially inflated the list price of insulin drugs*."[2] This argument is based on an agency problem. PBMs negotiate rebates – and can have their compensation based on these rebates – which may cause drug manufacturers to increase list prices to offset these discounts. Insured consumers often pay a fixed share of the list price each time they consume a drug, meaning that higher list prices inflate out-of-pocket costs. Rising rebates and list prices have therefore placed a financial strain on American households, leading federal and state governments to consider regulations that limit the power of PBMs.

To provide a concrete example of how list price bloating matters for consumers, consider the case of Bristol Myers Squibb and Pfizer who jointly make the blockbuster drug Eliquis. Suppose the drugmakers set the list price of Eliquis at \$100, and that patients covered by United Health have a cost-share of 10% of *list price*. United Health uses Optum Rx as its PBM, who secures a 60% rebate on Eliquis from BMS and Pfizer. In this example, a patient pays \$10 in cost-share at the pharmacy counter. United Health pays the remainder of the list price (\$90) which is offset by \$60 in rebates, for a net payment of \$30. The drugmakers receive a net price of \$40. Note that if we view what the drugmakers receive as the "true" cost of the drug, then the patient's effective cost-share is \$10/\$40 = 25%, much higher than the stated 10% on her insurance coverage.

Now, suppose the list price *doubles* to \$200 while the net price stays *constant* at \$40, so the rebate rises to 80% (\$160).[3] As a result, the patient's out-of-pocket cost increases by 100%, from \$10 to \$20, while the insurer's cost falls from \$30 to \$20 and the drugmakers still earn the same amount.

The prevailing negative view of PBMs, however, fails to consider another salient feature of the prescription drug market. Drug manufacturers posses monopoly rights stemming from patents which is compounded by inelastic demand, giving them broad power to raise prices. Consumers and small insurers have little ability to counteract this fact. By aggregating demand through PBMs, downstream agents can generate countervailing market power to discipline drug prices. The overall

[1] Between 2012 and 2019, the list price – the sticker price set by the drugmaker – for rapid-acting insulin increased by around 125%, and the list price for oral anticoagulants increased by around 85%. Source: SSR Health.

[2] Source: https://www.ftc.gov/news-events/news/press-releases/2024/09/ftc-sues-prescription-drug-middlemen-artificially-inflating-insulin-drug-prices, retrieved June 1, 2025.

[3] These pricing patterns are consistent with what we have observed in the data for many widely used prescription drugs.

impact of PBMs on prescription drug prices therefore depend on the relative strength of agency problems and countervailing market power; in theory, curtailing the power of PBMs may raise net drug expenditures.

This paper develops and estimates a vertical model of the US prescription drug market to study the role of PBMs, agency problems, and countervailing market power in determining pharmaceutical list prices and rebates. Contrary to the prevailing view of the industry, the model reveals that PBMs likely make consumers better off by facilitating access to rebates for smaller insurers. Without PBMs, there may be further insurance consolidation as large insurers can negotiate rebates directly. On the whole, countervailing market power and agency frictions have offsetting effects in the status quo. Counterfactual simulations indicate that reforms that preserve countervailing market power while mitigating problems of misaligned incentives may yield meaningful benefits to consumers. This finding has broad importance as vertical market structures with upstream monopolists are widespread and the ways that incentive incompatibilities undermine countervailing market power is not well understood. For example, the markets for semiconductors, agrochemicals, shipping, and digital commodities exhibit similar features of powerful upstream producers with influential middlemen.

My paper first considers descriptive and reduced-form evidence which suggest that PBMs' role in rebate negotiation may in fact be responsible for rising pharmaceutical list prices. First, rebates increased by 30-50 percentage points of drug prices from 2012 to 2019 while the list prices of drugs roughly doubled.[4] Second, I examine the change in list prices over time, using peer countries without rebates as a placebo to account for cost or demand changes. List prices in the US increased by over 50% from 2015-2021 while prices were stable in peer countries. Furthermore, net prices in the US fell over this period, converging towards the price paid by peers.[5] Third, I use a novel linking of data sets to show a positive and statistically significant relationship between PBM size and rebates.

This evidence motivates an important role of PBMs in drug pricing, but there are several limitations of reduced-form approaches that have hindered research progress despite considerable policy interest. First, the rebates obtained by PBMs for individual drugs are trade secrets, so data availability for rigorous analysis is limited. Second, the pharmaceutical and insurance industries are complex and heterogeneous, creating challenges to isolating the role of any individual economic force. Third, drugmakers may face political constraints that bind their price setting ability given public focus on an industry that directly affects health. Finally, general equilibrium interactions

[4]These findings, which are specific to insulin and oral anticoagulants, are in line with other works that have examined the association between rebates, list prices, and consumer cost-share across drug classes (e.g. Yeung et al. (2021) and Sood et al. (2020)).

[5]Kakani et al. (2020) show that these pricing patterns are broadly representative of drug classes in the US: between 2012 and 2017, list prices grew substantially while net prices held fairly steady for 19 of the 20 top selling drug classes.

between agents at each level of the vertical chain may have consequential effects on welfare: for instance, insurers may raise healthcare premiums absent PBMs and rebates, and drugmakers may endogenously change prices in response to changes in downstream market power. I construct a structural model of the drug market to overcome these challenges.

The model is vertical with three stages. Upstream, drugmakers set list prices to maximize profits. Midstream, PBMs bargain on behalf of insurers with drug manufacturers for rebates. Downstream, consumers choose from a set of insurance plans and a set of drugs conditional on insurance coverage to maximize their utility.

I estimate the model using data for oral anticoagulants in Medicare Part D. Two branded drugs – Xarelto and Eliquis – dominate this drug class. Both entered the market relatively recently, and stayed on patent throughout my study period. Anticoagulants are also primarily used by the elderly, which makes modeling list price setting more tractable as I can focus on demand by Medicare beneficiaries. This drug class choice contrasts with other works in the literature, which have predominantly focused on statins (e.g. Lipitor and Crestor). For my study, statins are unsuitable for a number of reasons, the primary one being that they went off patent before PBMs and rebates became a driving force in drug pricing.[6]

Model estimation proceeds via backward induction, beginning with the consumer's problem. I estimate consumer demand for the two branded oral anticoagulants and a generic substitute, Warfarin, using a discrete choice logit demand system where the outside option is no drug. Given each insurance plan's coverage and formulary, which determines what drugs are covered at what level of cost sharing, I next construct the annual out of pocket cost, anticoagulant consumption, and surplus each consumer would receive from all insurance plans in the market. These are then used to estimate a discrete choice demand system for insurance plans by consumers.

Insurance plan and drug demand then enter into the PBM's problem in the next stage of the model. PBMs bargain over rebates, affecting both list and net prices, with drugmakers. They may also downgrade coverage of a drug, one of their chief negotiating tools, which affects insurance coverage. Each of these values affects the mass of consumers who demand a given insurance plan in a PBM's portfolio and a given drug within each plan. This in turn determines the PBM's payoff, which is a product of drug consumption and rebates. Importantly, the model captures that in the case a PBM and drugmaker fail to agree, the PBM may still earn a positive payoff associated with consumers switching to rival drugs where agreements were made. Similarly, the drug maker may still earn positive payoff from consumers switching into a rival PBM's plan where agreements were made. This "recapture" feature of the model, which is novel in the drug rebates setting, affects the

[6] Another reason why statins are unsuitable is their use is more common across demographic groups, which makes modeling list price setting more challenging. Based on claims count, over 75% of anticoagulant prescriptions come from Medicare Part D. By comparison, statins has a Medicare share of about 61%.

bargaining influence of middlemen and facilitates flexible simulations of counterfactuals that adjust countervailing market power.

Given these payoffs, PBMs engage in bilateral Nash-in-Nash bargaining with drugmakers upstream. The bargaining model embeds a parameter that determines the bargaining ability of PBMs as a function of their size. Setting this parameter to zero allows for a counterfactual simulation with PBMs removed. I overcome the fact that data on plan-drug specific rebates are not available by matching aggregate model predictions to average drug-by-year rebates from SSR Health.

In the final stage of the model, each drugmaker sets a list price that maximizes its objective function, given the negotiated net prices and quantities demanded by consumers. The drugmaker's objective consists of current period profits and a term that captures the risk of political or reputational costs if prices are set too high. These considerations, which I refer to as political constraints, are salient features of the market which lead drugmakers to price in the inelastic portion of demand.[7] I model political constraints by placing a weight on consumer surplus in the drugmaker's objective, reflecting the intuition that these constraints lead drugmakers to behave as though they internalize consumer welfare. Since this parameter is inferred from observed list prices, this stage of the model also nests the case where drugmakers only consider profits.

From the demand estimation, I find an aggregate insurance premium elasticity of -2, and a drug demand elasticity of -0.3. Both estimates are comparable to what others have found recently.[8] For the PBM-drugmaker bargaining model, I find that PBM bargaining weights range from 0.4 to 0.5. Finally, for the drugmaker's list price setting, I find that observed prices imply substantial political constraints. This result is driven by the fact that consumer drug demand is inelastic, and cost-share further dampens the effect of list price on demand. Without any constraints, list prices may be an order of magnitude higher.

For counterfactual analysis, I first consider a world where PBMs are removed from the market, but rebate negotiation is preserved, leading insurers to negotiate rebates directly. Contrary to the prevailing view that PBMs have harmed consumers, I find that such a change would yield little impact on welfare in the aggregate, as it has little effect on overall list prices or rebates. However, this masks considerable heterogeneity. Large insurers such as United Health, the largest American health insurance company, retain considerable market power and are therefore able to negotiate

[7]The political constraints in my model stem from the fact that when drug manufacturers set drug prices "too high" in the court of public opinion, they risk consumer backlash and government scrutiny. Two relatively recent example involving "binding" constraints are the pricing of Sovaldi, a curative drug for hepatitis C, and the pricing of insulin. Both resulted in congressional investigations. Sovaldi's price was brought down by competitor drugs and the Biden administration capped the out of pocket costs of insulin under the Inflation Reduction Act.

[8]The premium elasticity is on the more inelastic end relative to other estimates (e.g. Lucarelli et al. (2012), Decarolis et al. (2020), and Starc and Town (2020)), which may reflect the fact that consumers in my estimation sample are sicker. I restrict the estimation sample to consumers who have a diagnosis code that can require the use of an oral anticoagulant. The drug demand elasticity is almost identical to estimates in Einav et al. (2018), which leverages a different source of variation for identification.

similar rebates, while small insurers may face substantial cost increases from lower rebates. This will likely lead to more consolidation in the insurance market, to the detriment of consumer welfare. In other words, PBMs help small insurers compete, pooling market share to keep pace with large insurers. Furthermore, this counterfactual suggests that failure to pass rebates to consumers at the point-of-sale, and not PBMs per say, is the root cause of drugs becoming unaffordable. Eliminating PBMs without solving this agency problem only serves to lower countervailing market power.

A second counterfactual considers a case where insurers and PBMs are barred from negotiating for rebates. This both solves agency problems and eliminates countervailing market power, giving a net effect of these forces. I estimate that such a policy would reduce list prices by about 20%, to a level just above current net prices for the drugs. This would lower out-of-pocket pharmaceutical costs paid by consumers, leading to fewer distortions in the output market and a 5-7% increase in drug consumption. Improved efficiency in the output market implies an overall social welfare gain. Moreover, consumers may also be better off. This is because rebates in the current regime may or may not be ultimately passed on to consumers through reduced premiums. In fact, consumer surplus may rise by as much as $20 per person-year if rebates are currently not passed through to premiums.

Third, I examine a policy requiring health insurers to directly pass rebates through to consumers at the point-of-sale (e.g. pharmacy counter), reducing their out-of-pocket expenses by applying cost-share to net-of-rebate prices. This mitigates agency problems without reducing countervailing market power, making consumers unambiguously better off. I estimate that consumer prices would fall by about 25% on average, leading to an 8% increase in drug consumption. This translates into consumer surplus gains of $22-25 per person-year and social surplus improvements of $6 per person-year, driven by lower distortions in the output market.[9]

In the final counterfactual, I examine a case where Medicare negotiates prices directly and rebates are eliminated, a prominent policy proposal that was partially implemented after my sample period. Economically, this increases countervailing market power by pooling all consumer demand and resolves agency problems. Theory therefore predicts this should yield the largest gain in social surplus. Empirically, I find that social surplus increase by $7 per person-year, which is only marginally higher than what can be achieved under direct rebate pass-through. The degree to which consumers are better off depends on how much rebates are currently passed through to premiums, and can range from $3 per person-year (full pass-through) to $29 per person-year (zero pass-through).

This paper makes several contributions to literature. The first is on the welfare effects of inter-

[9]To put these numbers in perspective, the average insurance premium paid by consumers in this time period is $30 per person-month.

mediaries. To the best of my knowledge, it is the first empirical work to show how agency frictions undermine countervailing market power. Recent works have explored the consequences of misaligned incentives between intermediaries and their customers in a variety of settings, including financial products (e.g. Boehm (2024) in Chilean pensions, Hastings et al. (2017) in Mexican pensions and Robles-Garcia (2019) in UK mortgages) and health care markets (e.g. Gruber et al. (2020) in health insurance and Grennan et al. (2024) in pharmaceutical prescriptions). This strand of literature focuses on settings where consumers have difficulty making decisions about complex products, leading to the need for intermediaries. In my setting, intermediaries act as a counterweight to upstream monopolists, though their ability to improve consumer welfare is similarly hamstrung by agency frictions. My findings are in line with other works that find potential for countervailing market power in settings with upstream monopolists (Barrette et al. 2022).

Second, I contribute to a literature studying prescription drug pricing, which has recently focused on the role of PBMs (e.g. Brot et al. (2025), Feng and Maini (2024), and Conti et al. (2021)). I construct one of the first empirical models of the US drug market which captures its vertical structure, allowing me to separate the role played by PBMs vs drug manufacturers in drug pricing. The accompanying counterfactual analysis yields concrete findings for policy discussions. My work also relates to the literature on centralized vs decentralized procurement, which have generally found that centralized procurement lowers drug prices (e.g. Dubois et al. (2021), Cao et al. (2024), and Allende et al. (2025)).

Finally, I add to a literature that seeks to use tools from empirical industrial organization to more realistically model vertical contracting (Lee et al. (2021)). My rebate bargaining model is related to Ho and Lee (2024), which develops a theoretical model and empirical framework for studying middleman rebate negotiations. I build on their model by accounting for recaptures in the payoffs of the bargaining parties that naturally arise in a marketplace where consumers can switch insurance plans and drugs. This modeling technique is conceptually similar to those used in studies of hospital-insurer interactions (e.g. Ho and Lee (2017) and Gowrisankaran et al. (2015)), and allows me to endogenize the bargaining power of middlemen. The result is a tractable tool for studying countervailing market power in vertical markets. My model also relates to Olssen and Demirer (2023), which uses moment inequality conditions to set identify the rebates received by insurers and focuses on counterfactuals that change rebates and formulary placements.

The rest of the paper proceeds as follows. Section 2 contains background information on US prescription drug pricing, along with descriptive patterns that motivate the model. Section 3 describes the empirical setting. Section 4 presents the model. Section 5 lays out the estimation procedure and describes key estimation results. Section 6 covers counterfactual analysis. Section 7 concludes.

2 Background

The fact that prescription drug costs in the US are high is well-known, just how high and who pays and who receives what may be less so. According to the Health Care Cost Institute (HCCI), in 2019, a 30-day supply of Eliquis was $440 in the US, $96 in Germany, $102 in Spain, and $162 in Switzerland. One major caveat with these international comparisons is that in the US, the measure of price that is publicly available (and therefore quoted in these reports) is rarely the actual price that the drug manufacturer receives. For the example at hand, SSR Health data puts the total rebate for Eliquis in 2019 at almost 60%, so the actual price received by its drug manufacturer is in line with the Swiss price.[10]

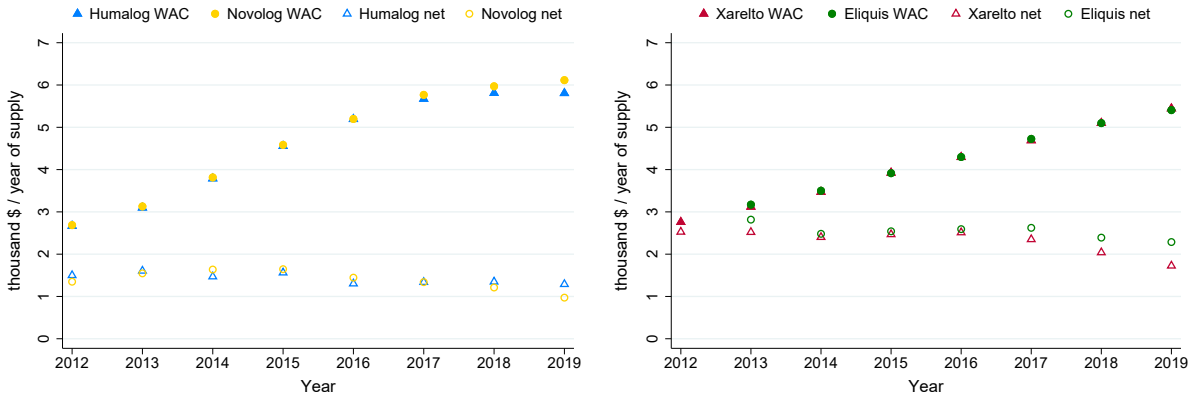
Given the magnitude of some drugs' rebates in the US, understanding who pays and who receives what is crucial to dissecting the incentives in the prescription drug market. The typical American receives health care coverage through an employer or the government (Medicaid for the poor and Medicare for the elderly), which either comes with prescription drug coverage or provides an option for a drug coverage add-on. When an insured individual needs a prescription drug, she goes to a pharmacy and gets the drug for an out-of-pocket cost, which is determined by the coverage level for the drug on her insurance plan's drug coverage formulary. A standard drug coverage structure may look like this: $5 co-pay for generics, 10% co-insurance for branded drugs on the preferred tier, and 20% co-insurance for branded drugs on the non-preferred tier. A co-pay is a flat price for the prescription, whereas a co-insurance rate indicates that the consumer pays for that percent of list price. The list price of a drug is set by its manufacturer for a broad geographical area (e.g. the US), and corresponds to the $440 number in the Eliquis example above. In other words, the list price doesn't include any rebate that the insurer, or a middleman who bargains on behalf of the insurer, may receive. Whether a branded drug is on the preferred (low cost-share) or the non-preferred (high cost-share) tier is typically determined through a negotiation process for rebates. All else being equal, a drug manufacturer is more likely to provide a larger rebate if its drug is placed on the preferred tier, as the manufacturer expects to have more sales when cost-share is low. Suppose our illustrative individual needs Eliquis which is on the preferred tier of her coverage. Then she pays 10% of $440, or $44 at the pharmacy counter. For this same transaction and at the time that the consumer picks up her drug, her insurer pays the remaining 90% of $440, or $396. What may not even be known to the consumer is that at some point after this transaction, her insurer, perhaps via the insurer's middleman, may receive a rebate related to her consumption of the drug. The size of that rebate may be on the order of magnitude of 60% of the list price, or $264. Hence, what her insurer pays for her drug is actually $396 minus $264, or $132. The manufacturer receives a net price of $132+44 = $176, which implies the consumer's effective cost-share is far

[10] Interestingly, prescription drugs carry rebates in Switzerland as well, which are not captured here.

higher than the stated 10% on her insurance; it is in fact $44 / 176 = 25%.

Often times, an insurer will outsource rebate negotiation to a middleman, who may or may not be owned by the same entity as the insurer. The focus of this paper is the role that these middlemen, who are called "Pharmacy Benefit Managers" or PBMs for short, play in the prescription drug market. As the above example illustrates, the insurer likes high rebate, because it effectively pushes the cost of drug to the consumer, and is therefore willing to pay the middleman a cut of the rebate in order to incentivize more effort in rebate negotiations with drug manufacturers. The drug manufacturer is in principle indifferent between high list price and high rebate, or low list price and low rebate, as long as a certain net margin is achieved. In reality, however, drug makers face tremendous backlash when they price their drugs too high or increase list prices by too much, not to mention the reduced demand induced by higher list prices, so there is some amount of constraint on how high list prices can go. Nonetheless, these incentive structures have led to wide gaps between list and net prices, which are observable in the data. In Figure 1, I show recent trends in list and net prices for two widely-used drug classes: rapid-acting insulin (left sub-figure) and oral anticoagulants (right sub-figure). Not only has the gap in list and net exploded since 2012, the net price has in fact been trending marginally *lower*. Another way to visualize the gap in list-to-net is by looking at rebates over time, which have been trending higher even in percentage terms (Figure A.1). Moreover, these patterns are generalizeable to other drug classes. In Figure 2, I show that the gap in the list-to-net price for the median drug (in the universe of drugs for which I have data) has also noticeably increased.

Figure 1: List to net bubble in drug pricing

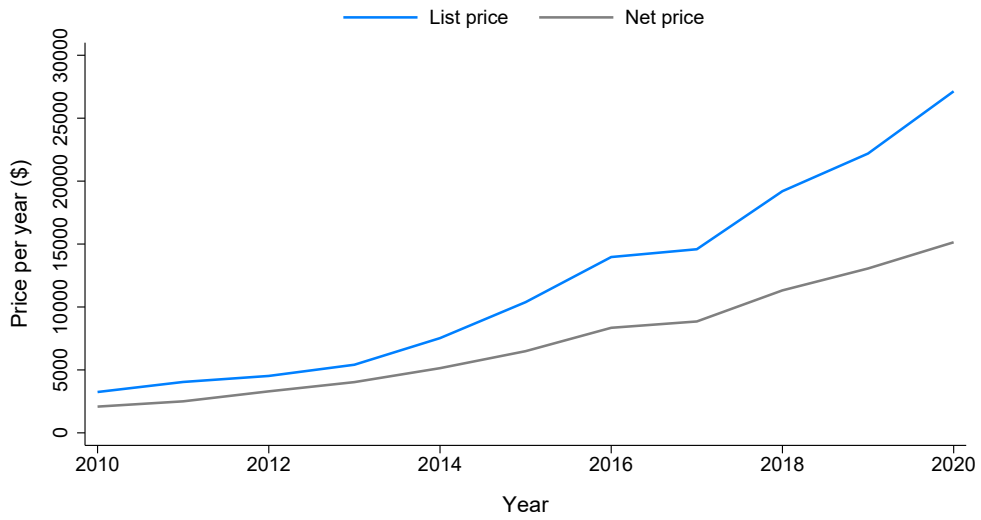


(a) Rapid-acting insulin

(b) Direct oral anticoagulants

Notes: These two figures show how list and net price have evolved in two drug classes: rapid-acting insulin (left) and oral anticoagulants (right). Humalog and Novolog are two popular insulin drugs. Xarelto and Eliquis are the two best-selling oral anticoagulants. WAC or weighted average cost, is a commonly-used measure of list price, and is the sticker price used for transactions between the drug manufacturer and wholesalers.

Figure 2: General trend in list and net price



Notes: This figure shows how the list and net price for the median drug in the SSR Health data set has evolved over time.

While some insurers negotiate directly with drug manufacturers for rebates, others will use a middleman. In theory, a middleman, by aggregating demand from many insurers, can generate more clout to counter the pricing power of drug manufacturers for on-patent drugs. In one PBM's own words:

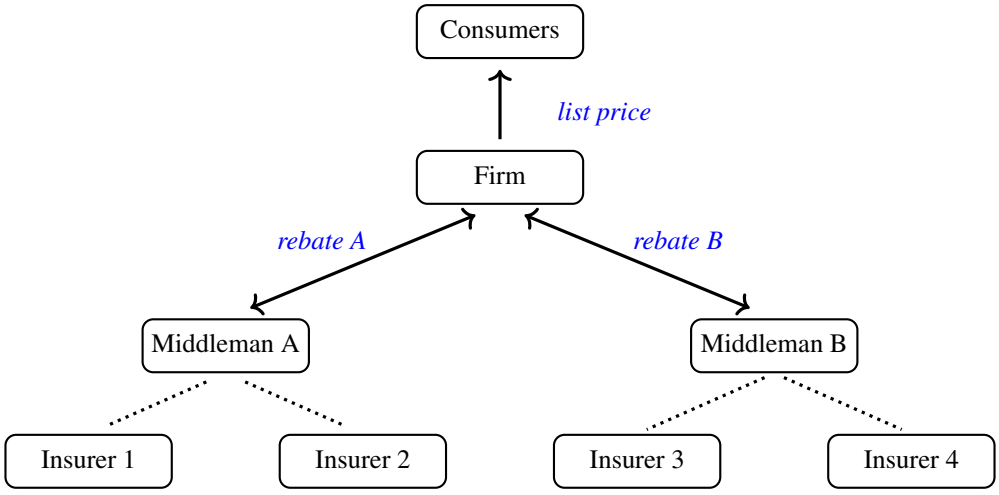
> "*Many plan sponsors lack the expertise or scale necessary to negotiate with drug manufacturers for discounts. In that case, plan sponsors can hire PBMs to provide pharmacy benefit management services. Optum Rx competes against other PBMs to use its scale – in the form of the population of its clients' members (i.e., "covered lives") – to negotiate with drug manufacturers for discounts off the list prices of the manufacturer's drugs.*"[11]

In practice, the existence of middlemen can also introduce welfare distortions. Because payments for their services are tied to the rebates that they negotiate, middlemen are incentivized to negotiate high rebates. Drug manufacturers, in turn, are large and strategic players, and have the ability to pass on higher rebates directly to end consumers through higher list prices. Hence, the middleman and the insurer's incentives are aligned in that both want high rebates, but their actions can indirectly harm consumers by raising out-of-pocket costs at the pharmacy counter. Figure 3 depicts a simple industry structure diagram that highlights the key players.

The potential for consumer harm due to inflated list prices is especially prominent in the Medicare setting – the empirical setting for this paper – where beneficiaries' drug coverage is tied to the

[11] Source: Optum Rx's response to the FTC complaint.

Figure 3: Current industry structure



Notes: This simplified diagram shows the main players in the supply chain who collectively determine prescription drug pricing in the US. The firm is a drug manufacturer who produces a drug, and typically negotiates bilaterally with a number of middlemen for rebates. Each middleman in turn represents a number of insurers, who in turn sell insurance plans to consumers. Some insurers do directly negotiate with firms, but those tend to be in the minority. Consumers are depicted at the top of the tree, instead of the bottom, to highlight the exposure they have to the list price set by the firm. A double-sided arrow denotes bilateral negotiation, while a single-sided arrow denotes unilateral price setting.

benefit phase that they are in. Because the government regulates Medicare benefits, plans design and price their benefits to be actuarially equivalent to a set of standard benefits which changes from year to year. As an example, in 2015, the standard benefits consist of the following. Consumers have a deductible of $320, so they pay fully out of pocket until they reach $320 in out of pocket costs. Between $320 and $2960, the consumer pays 25% co-insurance in what is known as the initial coverage period (ICL). Between $2960 and $4700, which is known as the coverage gap phase, the consumer pays 45% co-insurance. After hitting $4700, the consumer reaches the catastrophic phase of coverage, and pays 5% co-insurance for any additional drugs consumed for the rest of the year.[12] Plans can vary in their thresholds for reaching different coverage phases, as well as the co-insurance rate (or co-pay) in each phase. Most plans stick to most of the standard benefits, and the main parameters they differ on is whether there is a deductible phase and the cost-share structure in the initial coverage period. To provide a sense of where beneficiaries end up, in 2015, around 21% of beneficiaries ended the year in the coverage gap phase.[13]

2.1 Middleman size and rebate

A generally held hypothesis is that a larger middleman can secure a bigger rebate, relative to a smaller middleman. To the best of my knowledge, no empirical evidence has previously validated

[12] Beneficiaries progress through the phases based on their year-to-date accumulated out of pocket costs.
[13] Source: KFF

this hypothesis, as middleman-specific rebates are confidential. I shed light on the relationship between size and rebate by looking at the publicly available insurer-specific direct and indirect remuneration (DIR) data from Medicare Part D. DIR contains all price concessions, which include manufacturer rebates to middlemen as well as other forms of post point-of-sale price adjustments such as concessions paid by pharmacies. While we don't know what portion of DIR is manufacturer rebate, we do know that the rebate share of total DIR is significant.[14]

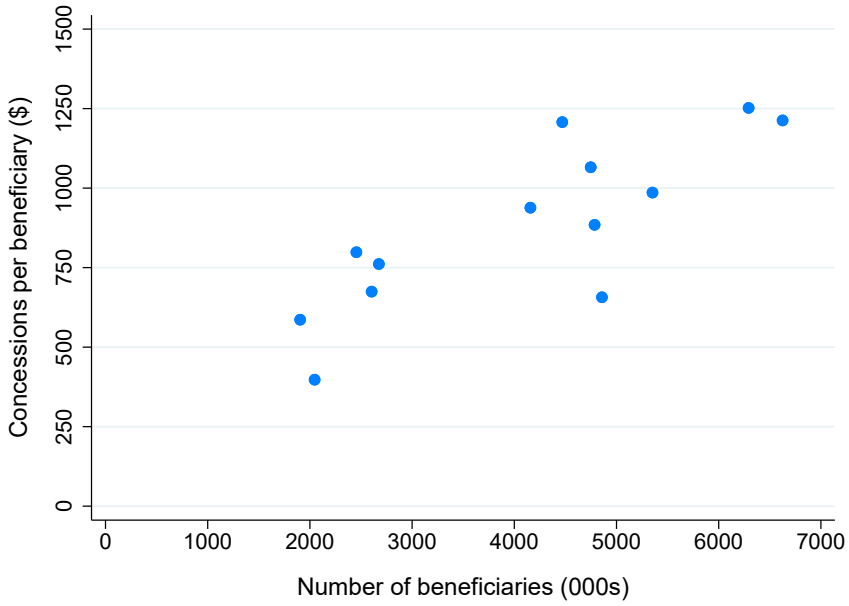
Insurer-specific DIR data is available for 2014 to 2017. Since the Medicare Part D insurance market is concentrated, I restrict to insurers with more than 500,000 beneficiaries; in aggregate, these insurers cover over 80% of total beneficiaries in each year. Next, I connect each insurer-year observation to the PBM associated with that insurer-year, using a proprietary data set that I describe in Section 3.1. For each PBM, I calculate the sum of beneficiaries covered by its insurers and the *maximum* of DIR per beneficiary among its insurers. This is motivated by the fact that we don't know the rebate split between the PBM and each of its insurers. The rebate that we are interested in inferring is the rebate that the PBM secures from the drugmaker, which is the sum of what it keeps and what it passes along to the insurer. Hence, the maximum of what insurers receive is the closest proxy to the metric of interest. Figure 4 shows the correlation between size (measured in total beneficiaries) and DIR per beneficiary. Each dot represents a PBM-year observation. We can see a clear positive relationship between size and total concessions, which is statistically significant. Table B.1 contains regressions of rebate on size. In the preferred specification (Model 4), which controls for year-fixed effect and removes an outlier observation, an additional 1000 beneficiaries is correlated with an additional $0.11 in total concessions per beneficiary.

2.2 Rebate and list price

Building on prior works that have pointed to a positive correlation between rebate and list price (e.g Sood et al. (2020)), I assume in my model that list price changes are primarily driven by rebates and demand conditions, and not by non-rebate marginal cost changes. In a standard economic framework, whenever we see price rising, we tend to look for either supply side factors (e.g. rising marginal costs) or demand side factors (e.g. consumers becoming less price sensitive). I provide descriptive evidence that the main supply side driver of list price is rebate by looking for cross-country comparisons. While countries outside the US will generally have some form of centralized procurement, cost shocks should still be reflected in price trends over time. Using data from the International Federation of Health Plans, Figure 5 compares US pricing for Xarelto to those in peer

[14] As Medicare notes in a factsheet, "manufacturer rebates comprise a significant share of all DIR reported to CMS" (source: https://www.cms.gov/newsroom/fact-sheets/medicare-part-d-direct-and-indirect-remuneration-dir, retrieved July 24, 2025).

Figure 4: Middleman size and rebate



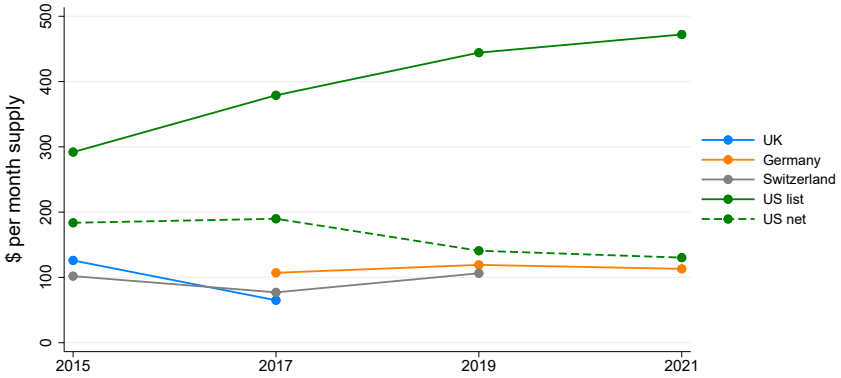
Notes: This figure shows the relationship between middleman size and rebate. Each dot represents a PBM-year observation. The x-axis is total number of beneficiaries covered by the PBM's insurer clients. The y-axis is total price concessions per beneficiary. While these concessions contain more than just PBM-negotiated rebates, a large share of concessions do come from rebates.

European countries: Switzerland, UK, and Germany.[15,16] Two patterns jump out. First, prices in peer countries were stable during the study period, at around $100 per month supply. Second, even as the US list price has skyrocketed, the US net price has been converging toward peer prices; even though the manufacturer still makes more profits in the US, its US margin is at least on the same order of magnitude as margins in other developed countries. I interpret the stability in pricing over time as supporting evidence that rising list prices in the US aren't due to cost shocks, and the fact that US net prices are in line with European prices as indicating that rebates are the main consideration in list price setting. Finally, the fact that US net price is not rising is suggestive that demand is not becoming more inelastic, though it is possible that the vertical supply chain prevents the drug manufacturer from capitalizing on changing demand conditions.

[15] An analysis based on cross-country comparisons, unfortunately, is constrained by data limitations. Xarelto, which is one of the drugs that I study, happens to be one of the very few drugs for which data from peer countries are publicly available.

[16] In the comparison countries, while some amount of rebating or concession off list price still exist, the gap between list and net is much smaller. Hence, the prices shown for these countries can be interpreted as the net price received by the drug manufacturer.

Figure 5: International price comparison for Xarelto



Notes: This figure provides a cross-country comparison of pricing for Xarelto. Prices in non-US countries are generally not subject to rebates, so the prices shown here are representative of actual prices. In the US, list and net price can be substantially different; net US price is shown as a dotted line.

3 Empirical setting

My empirical setting is the drug class known as novel oral anticoagulants (NOACs) in Medicare Part D. The first drug in this class – Pradaxa – was approved by the FDA in 2010. Since then, three more drugs have been approved: Xarelto (2011), Eliquis (2013), and Savaysa (2015). Colloquially known as blood thinners, these drugs are predominantly taken by the elderly to prevent strokes and pulmonary embolism. Their two main indications are atrial fibrillation (AFib) and deep vein thrombosis. AFib is the most common form of irregular heart rhythm, and is a chronic condition. Based on a recent UCSF study (Noubiap et al. (2024)), AFib affects up to 5% of Americans, which is almost the same order of magnitude as Type II diabetes at 10%.[17] Deep vein thrombosis occurs when a blood clot forms, usually in a deep vein of the leg. This is a common complication after knee surgery.

Before the introduction of novel oral anticoagulants, the primary drug option for AFib patients was the generic drug Warfarin, which had been around for many decades. Originally marketed as a rat poison, Warfarin is both less efficacious than the new drugs, and can lead to severe and serious side effects. Moreover, Warfarin users require frequent visits to the doctor's office in order to monitor their blood clot status and to ensure that they are getting the correct dosage. Hence, the introduction of novel oral anticoagulants fulfilled a large unmet need in terms of pharmacological options to mitigate stroke risk within AFib beneficiaries.

Anticoagulants in Medicare Part D is a good setting for this project for a number of reasons. First, these are widely-used drugs whose list and net prices have diverged significantly, as show in Figure 1. By around 2020, rebates for Xarelto and Eliquis were approaching 70% of their

[17] Source: https://www.cdc.gov/diabetes/about/about-type-2-diabetes.html, retrieved October 16, 2025.

list prices. Second, the setting is relatively "clean" from a modeling perspective as there was no generic equivalent to any of the novel drugs, anticoagulants treat well-defined conditions, and two drugs – Xarelto and Eliquis – have dominated the US market.

Medicare Part D consists of prescription drug benefits within Medicare, which is universal, government-subsidized health care coverage provided to those over 65 in the US. Medicare Part D is *the* market for anticoagulants, as these drugs are predominantly used for conditions that afflict the elderly. Based on claims count, over 75% of anticoagulant claims come from Medicare Part D. Another useful feature of the Medicare market is its universal nature implies that adverse selection is likely not a concern, at least not a first-order concern. This comes into play when I discuss how to quantity the welfare impacts of rebates in the model section (Section 4). Finally, Medicare Part D is a wonderful setting because of the availability of individual-level claims data for research purposes. In my data set, I observe each time that a consumer covered by Medicare uses their insurance, so I know each time they visited a doctor's office or a hospital, or filled a prescription.

3.1 Data

My main data sources are the 20% sample of Medicare Part D individual-level claims data, a Clarivate PBM data set that links insurers to PBMs, and aggregate drug-specific rebates from SSR Health. I supplement these with publicly available data from Medicare and the International Federation of Health Plans.

The Clarivate PBM data set is a proprietary data set that comes from surveying all insurers who offer commercial, Medicare Part D, or Medicaid insurance plans. It contains each insurer's self-reported relationship with PBMs who perform a set of functions, one of which is rebate negotiation. For each insurer-state-year, we observe at most one PBM used by that plan for rebate negotiation. The reason why there may not be a PBM is some insurers self-negotiate with drugmakers for rebates.

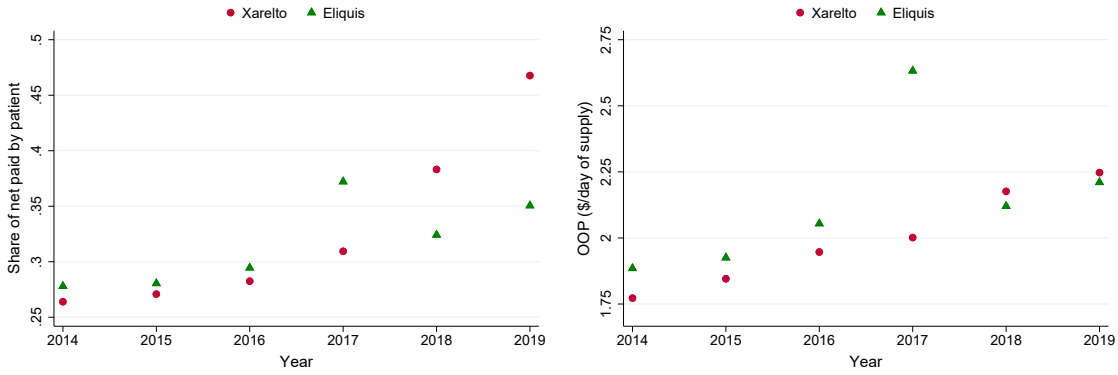
The SSR Health data set contains drug-year rebates for drugs manufactured or marketed by US-based firms. The data is constructed by looking at the financial reports of firms, which contain net profits from drugs, and merging in third-party data on drug sale volumes and list prices to infer rebates.

3.1.1 List price and consumer out-of-pocket cost

Since each consumer's out-of-pocket cost is a product of cost-share, which is specific to an insurance plan, and a drug-specific uniform list price, it is plausible that as list prices have increased, insurers may have competed away this increase through lower cost-shares. In Figure 6, I show the trends in consumer costs for Eliquis and Xarelto in the data. In the left sub-figure, I show the portion of the net price received by each drugmaker that comes from the consumer's out-of-pocket

costs (the remainder is paid by the insurer). In the right sub-figure, I show the out-of-pocket cost per day of drug supply. Both figures paint the same story: costs at the pharmacy counter – which is the relevant measure for consumption decisions – have consistently increased over time.

Figure 6: Consumer cost-sharing for drugs



(a) Share of net price

(b) Out of pocket costs

Notes: These figures highlight the cost for prescription drugs borne by consumers at the point-of-sale. The left figure shows the share of net price received by each drug's manufacturer that comes from consumers' out-of-pocket costs. The right figure shows how out-of-pocket costs have changed over time. A large middleman put Eliquis on the non-preferred tier in 2017, hence the discontinuous change in out of pocket costs. These numbers exclude prescription fills in the coverage gap phase of Medicare coverage, which was going through ACA-mandated changes in benefit design during this period.

One interpretation for these pattern is that competition isn't working. The Medicare Part D insurance market has indeed become more concentrated over time. A more likely explanation specific to Medicare is that insurers price their products to a standard set of Medicare benefits, which generally has the consumer's cost-share at 25%.[18] Moreover, there are works in the literature (e.g. Abaluck and Gruber (2011)) that show consumers are more sensitive to insurance premiums, relative to drug out-of-pocket costs, and so it is more profitable for insurers to compete on premiums.

3.2 Estimation sample

To estimate the demand model, I use Medicare claims data from 2015 to 2019. The estimation sample consists of beneficiaries in Medicare Part D standalone plans with a diagnosis code for atrial fibrillation, did not receive government subsidies, were on traditional Medicare for the full year, and over the age of 65.[19] The vast majority of beneficiaries used at most a single oral anticoagulant

[18] Each insurance plan can set its own benefits, which can also include a deductible phase. On average, a consumer can be expected to face roughly 25% of total healthcare costs.

[19] Except for the diagnosis code restriction, these sample restrictions are standard in the health literature that use Medicare claims data.

drug within a year, so the setting can be well modeled by a discrete choice demand model. For those who took more than a single drug within a year, most appear to be switching from Warfarin to one of the branded drugs; these people were assigned to the branded drug option. There is a small number of consumers who took Pradaxa and an even smaller number of consumers who took Savaysa. I drop these consumers from the sample because these drugs never took off in the US in the way that Xarelto and Eliquis did, and I also exclude them from the drug choice set.[20] Table 1 shows drug shares and sample size by year. The sample size increased from around 400,000 beneficiaries in 2015 to almost 500,000 in 2019.

Table 1: Drug share by year

	2015	2016	2017	2018	2019
Xarelto	7	8	9	9	10
Eliquis	6	10	13	18	22
Pradaxa	3	3	2	2	1
Warfarin	26	24	21	18	16
None	57	56	55	53	52
N	398,388	429,331	452,236	471,294	485,258

Notes: This table shows drug shares and sample size in the demand estimation sample.

Consumer out-of-pocket costs are observed in the data for the drug option that the consumer picked. For the other drug options, out-of-pocket costs are imputed by linking the drug-specific coverage tier to the cost-share information for that tier in the consumer's insurance plan. To calculate out-of-pocket costs for the year, I assume that the consumer picks up a 30-day supply in each month, which in combination with the other (non-anticoagulant) drugs used by the consumer, determine the Medicare benefit phase in which each 30-day supply occurred. Put differently, out-of-pocket costs are both a function of how generously the plan covers the drug and what other drugs the consumer is taking. The latter determines progression through the Medicare benefit phases, and different phases can have different cost-share rules.

To connect insurance plans to the middleman that they use for rebate negotiation, I use the Clarivate PBM data set, which provides this mapping at the insurer level for rebate negotiation.[21] Table B.2 shows out-of-pocket costs as a percentage of list price for each drug, averaged by year and by middleman, along with how many plans in the middleman's portfolio have a particular formulary placement for Xarelto and Eliquis. A standard cost-share for the preferred tier is around 20%, while for the non-preferred tier is 50%. It is also worth noting that most plans have both drugs on the preferred tier.

[20] One likely explanation for why Pradaxa and Savaysa couldn't compete with Xarelto and Eliquis in the US is they are produced by non-US firms.

[21] A PBM may perform a number of functions, such as rebate negotiation, benefit design, and claims administration. An insurer may use different PBMs for different functions.

Finally, SSR Health provides nationwide average rebates at the drug level, which are used to estimate the rebate model. This data for Xarelto and Eliquis is included in Figure A.1.

4 Model

The model is designed to study the economic distortion at the center of this paper, which is that PBM market power in the supply chain has pushed list prices higher than what they otherwise would be. As a result, real prices (i.e. out-of-pocket costs) at the pharmacy counter, which are often a fixed share of list prices, have increased as well, leaving too many consumers unable to afford their medications. While such a quantity distortion is commonplace in economics, quantifying it will require some additional context in the absence of a model for rebate to premium pass-through.[22]

4.1 Conceptual model

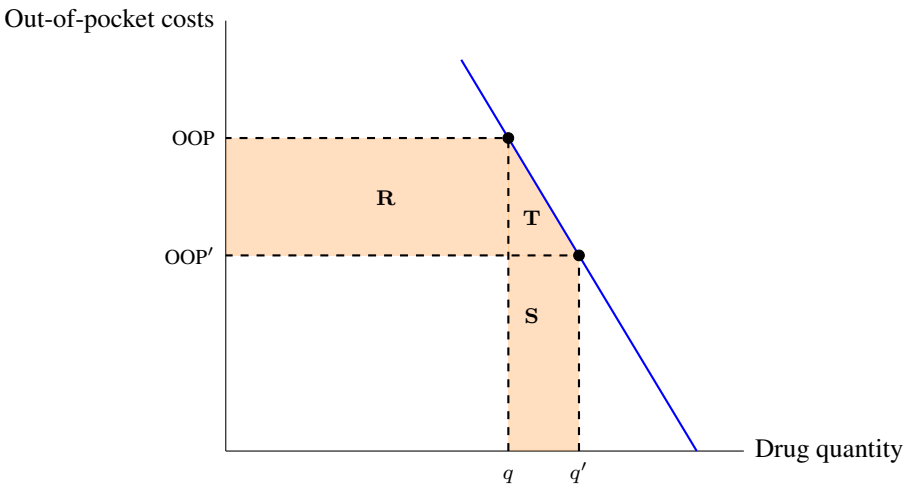
One way to conceptualize this setting and the accompanying potential for welfare distortion is depicted in Figure 7. The demand curve for a hypothetical drug is shown in blue. Suppose the point (q, OOP) is where we are currently at on the demand curve, which corresponds to a high rebate, high list, and high out-of-pocket cost environment. Under this status quo, middlemen exercise countervailing market power to secure a large rebate. Now, imagine a world with low rebate, low list, and low out-of-pocket cost, which corresponds to the point (q', OOP'). Without loss of generality, suppose there are no rebate under (q', OOP'). Hence, rebates reduce social surplus by $T + S$. Under an assumption of no adverse selection into the insurance market, which I discuss below, rebates reduce consumer surplus by $R+T$ minus the share of rebates that consumers receive via premium reduction in a high rebate environment. As a result, consumer surplus decline due to rebates can be bounded as $(R + T - \text{all rebates}, R + T)$.

An assumption of no adverse selection into the insurance market is needed to justify these bounds on consumer surplus changes. If there is adverse selection on the participation margin, then rebates that are passed back to consumers in the form of lower premiums may improve welfare by mitigating adverse selection. In that case, $R + T -$ all rebates will no longer be a lower bound on the decline in consumer surplus due to rebates.[23] In the Medicare Part D setting, it is reasonable to assume no adverse selection into the market because the government subsidizes about three-quarters of the cost of basic coverage for all, and provides additional subsidies for low-income beneficiaries. As a result, enrollment is quite high (e.g. in 2018, around 75% of Medicare beneficiaries were enrolled in Part D), and those who are not enrolled tend to have comparable pre-

[22] Such a model is outside my current framework as it would require modeling rebates for all drug classes, not just for a specific drug class.

[23] The true lower bound under adverse selection will be lower than $R + T -$ all rebates.

Figure 7: Welfare distortion



Notes: This diagram depicts the welfare distortion due to the agency problem between middlemen and consumers. Suppose (q', OOP') denotes quantity and out-of-pocket cost in a low rebate environment, which corresponds to lower list price and therefore lower out-of-pocket costs. Without loss of generality, suppose (q', OOP') corresponds to a world with no rebate. When middlemen exert countervailing market power, and successfully negotiate for a large rebate, the out-of-pocket cost correspondingly increases to OOP and drug consumption falls to q. Total welfare loss from consumers substituting away from the drug is $T + S$. Under an assumption of no adverse selection into the insurance market, rebates can be viewed as transfers and consumer surplus reduction from rebates is $R + T$ minus the share of rebates that consumers receive through premium reduction. Hence, consumer surplus loss from rebates can be bounded as ($T + S$−all rebates, $T + S$). Through the lens of insurance market competition, the lower bound maps to full competition and the upper bound to a single monopolist insurer.

scription drug coverage from other sources.[24] Moreover, those who fail to enroll in Part D when they first become eligible for Medicare and do not have comparable prescription drug coverage are subject to a late enrollment penalty, which further mitigates adverse selection.

In order to capture core economics in the current setting and contemplate alternative pricing and industry structures, we need a demand model, a model for how rebates are determined, and a model for list price setting. These correspond to the three stages of the modeling work presented below. In the first stage, each drug manufacturer sets a list price. In the second stage, each middleman-drug manufacturer pair negotiates for rebates. In the final stage, each consumer picks an insurance plan and a drug option. The timing assumption is as follows: at the end of each year, drug manufacturers and middlemen make decisions on rebates and list prices for the upcoming year. In the rebate stage, the parties have complete knowledge of how demand would change in case of agreement and in case of disagreement, i.e. they know about consumer demand for insurance plans and for drugs. Similarly, in the list price stage, each drug manufacturer understands how demand for its drug will change as it considers varying the list price.

[24] Source: https://www.medpac.gov/wp-content/uploads/import_data/scrape_files/docs/default-source/reports/mar19_medpac_ch14_sec.pdf, retrieved June 4, 2025.

It is worth noting that I do not model the division of surplus (i.e. rebate dollars) between middleman, insurer, and consumer.[25] While who gets what share of rebates clearly has payoff consequences, it doesn't impact the economic distortion highlighted above, as under an assumption of no adverse selection into the Medicare Part D market, the division of rebates can be viewed as transfers. Moreover, the largest middleman are (vertically) integrated with their largest insurer clients, and so can be thought of as the same entity.[26] However, not modeling rebate division does put restrictions on how I interpret my welfare results because the surplus kept by the middleman is rent while the surplus kept by the insurer may be passed on to consumers in the form of premium reduction. Since I do not take a stance on what portion of the insurer's share of rebates is passed on to consumers through premium reduction, I show the aforementioned bounds on consumer surplus change in my counterfactual analysis.

4.2 Demand

A market m is defined by a geographical region-year combination. A region roughly corresponds to a state and maps to the actual boundaries of a market within Medicare Part D. Within each market, there are J_m plan options. Each plan $j \in J_m$ can cover each of the anticoagulant drugs at varying levels of generosity, based on its formulary $\mathcal{F}_j$.

4.2.1 Drug demand

In market m, consumer i's utility from consuming drug $d \in \mathcal{D} = \{\text{Warfarin}, \text{Xarelto}, \text{Eliquis}\}$ on formulary $\mathcal{F}_j$ is given by

$$u_{ijdm} = \beta_g \text{OOP}_{gjdm} + \kappa_{gdm} + \xi_{ijm}\mathbb{I}\{d \neq 0\} + \lambda\epsilon_{ijdm} \tag{1}$$

The model allows for consumer heterogeneity at the demographic group level, where g denotes the group of consumer i. OOP_{gjdm} is the out-of-pocket cost for drug d on formulary $\mathcal{F}_j$ faced by members of group g in market m. κ_{gdm} is a group-drug-market fixed effect. The error structure $\xi_{ijm}\mathbb{I}\{d \neq 0\} + \lambda\epsilon_{ijdm}$ is assumed to follow that of a nested logit with nest parameter λ. The drug choice set $\mathcal{D}$ constitute a nest, and the outside option of taking no drug is in its own (degenerative) nest. The utility of taking no drug, u_{ij0m}, is normalized to zero.

This nesting structure was chosen because oral anticoagulants are suitable for consumers who have atrial fibrillation *and* meet certain criteria, such as a history of stroke. As a result, when

[25] In Brot et al. (2025), my co-authors and I look at how vertical integration between insurers and middlemen impact the division of surplus between the two.

[26] In counterfactual analysis, I simulate a scenario where insurers directly negotiate with drug manufacturers. For the currently integrated insurer-middleman entities, this amounts to bringing the middleman in-house and having that middleman only negotiate for its integrated insurer.

characteristics of a drug option change, we would expect different substitution patterns between two inside options relative to between an inside option and the outside option. In other words, there are consumers who choose no drug and they should continue to choose no drug when features of a drug option change; putting the no drug option in its own nest provides the model with an added degree of flexibility to accommodate these consumers.

A logit demand system is attractive for a number of reasons; here, it is especially appealing because of the closed-form solution for the expected utility from the drug choice problem:

$$CS_{ijm} = \log\left(1 + \left(\sum_{k\in\mathcal{D}} e^{V_{ijkm}/\lambda}\right)^{\lambda}\right) \tag{2}$$

where $V_{ijkm} \equiv \beta_g \text{OOP}_{gjkm} + \kappa_{gkm}$ is the deterministic portion of u_{ijkm}.

4.2.2 Insurance plan demand

Each consumer chooses from all available plans in a given market. Consumer i's utility from choosing plan j sponsored by insurer c in market m is:

$$u_{ijm} = \eta\phi_{jm} + \gamma CS_{ijm} + \alpha X_{jm} + \kappa_{gct} + \delta_{gm} + \Delta\delta_{gjm} + e_{ijm} \tag{3}$$

where g continues to denote the group that i belongs to, ϕ_{jm} denotes plan premium, CS_{ijm} is the consumer surplus from the plan's coverage of anticoagulants, and X_{jm} is a vector of plan attributes. κ_{gct} is a fixed effect at the group-insurer-year level which captures unobservable quality at the insurer level. δ_{gm} is a mean group-market fixed effect and $\Delta\delta_{gjm}$ is plan j's deviation from the group-market fixed effect. $\delta_{gm} + \Delta\delta_{gjm}$ capture the unobservable quality of plan j, after controlling for insurer-level unobservables. The error term e_{ijm} is assumed to come from a Type-I extreme value distribution.

4.3 Rebate negotiation

The goal of the rebate model is to allow us to infer plan-drug specific rebates. Put differently, the rebate model solves a missing data problem which is otherwise insurmountable as detailed rebate information are confidential trade secrets. The model is a simultaneous Nash-in-Nash bargaining model where each drug manufacturer-PBM pair negotiates plan-drug specific rebates. Given that the majority (over 75%) of plan formularies have both branded drugs on the preferred tier of coverage, for each bilateral bargaining problem, I assume that when the two parties agree, the drug is put on the observed (preferred) tier, and when they disagree, the drug is downgraded to the non-

preferred tier on all of the middleman's plans.[27] For the plans where the observed tier is not the preferred tier, I assume the rebate is zero and drop them from rebate calculations.

The bargaining set-up can be conceptualized as simultaneous bargaining in $J \times D$ rooms. For each plan j, the associated middleman $k(j)$ and manufacturer d bargain over the per-unit dollar rebate that the middleman receives on the quantity of drug sold to plan j's beneficiaries. In each room, agents have perfect information about demand, but do not know the results of other negotiations. They form beliefs over other rebates. While I'm in principle agnostic as to how beliefs are formed, I do impose the (strong) assumption that beliefs are correct in equilibrium. Such an assumption is defensible in a setting where agents represent sophisticated firms, and also repeatedly interact with each other.

For the purpose of exposition, fix a particular room jd. Let $\mathcal{K}$ denote all plans in middleman $k(j)$'s portfolio. Let $-\mathcal{K}$ denote all other plans. Let $\tilde{}$ denote the expectation operator, i.e. $\tilde{X} = \mathbb{E}_{jd}[X]$.

Middleman $k(j)$'s gain from trade with manufacturer d is

$$\text{GT}^{jk}(r) = \underbrace{rq_j^d}_{\text{profit if agree}} - \underbrace{\tilde{r}_j^{-d}\Delta_j^{-d}}_{\text{profit if disagree}} \tag{4}$$

where r is the per-unit rebate in dollars to be bargained over, and q_j^d is plan j demand for the drug in case of agreement. Should the two parties disagree, the middleman secures no rebate on drug d, but may receive more rebates on the rival drug $-d$, due to consumer substitution between the two drugs when the coverage level of drug d falls. Let Δ_j^{-d} denote this quantity substitution effect, which is sometimes referred to as "recapture" in the health care literature. Δ_j^{-d} is given by

$$\Delta_j^{-d} = \sum_{g\in\mathcal{G}}\sum_{m\in\mathcal{M}} \left(\overbrace{s_{-djmg}^{d \text{ non-pref}} * s_{jmg}^{d \text{ non-pref on } \mathcal{K}}}^{\text{disagreement quantity}} - \underbrace{s_{-djmg}^{d \text{ obs}} * s_{jmg}^{d \text{ obs}}}_{\text{agreement quantity}} \right) * N_{mg} \tag{5}$$

In words, the middleman's recapture consists of the increase in demand for the rival drug $-d$ in case of disagreement with manufacturer d (relative to agreement), summed across all markets and all demographic groups. Given the structure of the demand model, drug demand is expressed as the share of people on plan j who take a drug in a given market-group (e.g. s_{-djmg}), times the share of people who choose plan j in a given market-group (e.g. s_{jmg}), and multiplied by the

[27] An alternative disagreement point is exclusion, i.e. the drug is not covered at all and consumers pay the full list price out of pocket. In the data, we don't explicitly observe exclusion. Based on the claims cost of beneficiaries who are on a plan that appears to exclude a drug, it seems that true exclusion is very rare as even when the drug appears to be excluded, consumers do not pay full list price. This suggests that what we may observe as a drug being excluded is actually a missing formulary data problem.

total number of people in a given market-group, N_{mg}. The superscript denotes the contemplated bargaining status between middleman $k(j)$ and manufacturer d.

Manufacturer d's gain from trade with middleman $k(j)$ is

$$\text{GT}^{jd}(r) = \underbrace{(p^d - r)q_j^d}_{\text{profit if agree}} - \underbrace{\left\{ p^d q_j^{d,\text{dis}} + \sum_{l \in -\mathcal{K}} (p^d - \tilde{r}_l^d)\Delta_l^d \right\}}_{\text{profit if disagree}} \tag{6}$$

If the parties agree, the manufacturer receives a net price of $p^d - r$ dollars on each unit of drug sold, multiplied by the agreement quantity q_j^d. If they disagree, the manufacturer still anticipates some amount of demand from consumers who continue to purchase the drug under the degraded coverage, denoted by $q_j^{d,\text{dis}}$. For these units, the manufacturer receives the full list price. Moreover, some consumers may switch to rival middlemen's plans in order to gain better drug coverage. Let Δ_l^d denote manufacturer d's recapture through plan l due to this consumer plan switching channel if it disagrees with middleman k. Δ_l^d is given by

$$\Delta_l^d = \sum_{g \in \mathcal{G}} \sum_{m \in \mathcal{M}} s_{dlmg}^{d \text{ obs on } l} (s_{lmg}^{d \text{ non-pref on } \mathcal{K}} - s_{lmg}^{d \text{ obs on } j}) * N_{mg} \tag{7}$$

where

$$s_{lmg}^{d \text{ non-pref on } \mathcal{K}} - s_{lmg}^{d \text{ obs on } j}$$

denotes the increase in plan l's market share when coverage of d is degraded on all of middleman k's plans. Of the consumers who switch from plan j to plan l, we assume that the share that takes drug d is the same as for the existing customers in l under l's observed formulary, which is given by $s_{dlmg}^{d \text{ obs on } l}$.

Let b_j^d denote the bargaining weight of middleman $k(j)$ relative to manufacturer d. To capture the fact that larger middlemen are able to negotiate bigger rebates, the bargaining weight is parametrized as a function of the size of each middleman plus a mean-zero IID error:

$$b_j^d = \zeta \log(Q_k) + \epsilon_{jd} \tag{8}$$

The error term allows for plan-drug level heterogeneity in rebates within a middleman's portfolio. The rebate that results from bargaining is given by

$$r_j^d \equiv \arg\max_r \quad \left[\text{GT}^{jk}(r)\right]^{b_j^d} \times \left[\text{GT}^{jd}(r)\right]^{1-b_j^d}$$

From the first-order condition of the bargaining problem, each rebate r_j^d has a closed-form solution:

$$r_j^d = b_j^d \left(p^d - \frac{p^d q_l^{d,\text{dis}} + \sum_{l \in -\mathcal{K}} (p^d - \tilde{r}_l^d)\Delta_l^d + \tilde{r}_j^{-d}\Delta_j^{-d}}{q_j^d} \right) + \frac{\tilde{r}_j^{-d}\Delta_j^{-d}}{q_j^d} \tag{9}$$

Appendix D contains details on this derivation.

In this model, PBM size matters for rebates through two channels. The first is larger PBMs have more bargaining ability. The second is more subtle, and comes from the fact that as PBM size increases, the scope for drugmaker recapture falls. In the extreme case that a single middleman owns the whole market, then $-\mathcal{K}$ is the empty set and so the term

$$\sum_{l \in -\mathcal{K}} (p^d - \tilde{r}_l^d)\Delta_l^d$$

is trivially zero. Given how this term enters Eq. 9, rebate increases as the cardinality of set $-\mathcal{K}$ falls.

4.4 List price setting

Each drug manufacturer sets a single list price p to maximize its objective.[28] From each plan j, demand is a function of the out-of-pocket cost, which is cost-share multiplied by the list price: $\text{OOP}_j = cs_j \times p$. As is common in this literature, I assume that the marginal cost of producing drug is zero. The manufacturer's total net profits is given by

$$\pi(p) = \sum_j (p - r_j)\ q_j(\text{OOP}_j(p)) \tag{10}$$

where each rebate r_j can be interpreted as the firm's marginal cost of selling through that plan.[29] In a standard setting, the firm would set a p that maximizes this profit objective. However, in most health care settings in general, and this setting in particular, demand elasticities are below unity.[30] As a result, a standard price setting model won't be able to rationalize observed prices. In reality, there are a number of forces that constrain the list prices that drug manufacturers can charge. Arguably, the most binding constraints stem from the threat of consumer backlash, and the

[28] For notional brevity, I omit the superscript d, as everything in the list price model is specific to a drugmaker.

[29] At the list price stage, I assume that rebates have been negotiated and are constant when the firm thinks about list price setting. In Appendix F, I discuss an alternative price setting model, where the drug manufacturer internalizes that for each dollar increase in list price, some portion of it goes toward rebates, i.e. letting rebates vary with list prices. Under that model, the drug manufacturer is predicted to *decrease* list price as rebates increase, which is inconsistent with the list-to-net bubble that we observe in the data (e.g. Figure 1).

[30] As I show in Section 5, my demand estimates imply inelastic demand which is in line with other works in the literature.

threat of being scrutinized by regulatory authorities. Two relatively recent examples involving such constraints are the pricing of Sovaldi, a curative drug for hepatitis C, and the pricing of insulin.[31] A firm may also voluntarily set price lower due to dynamic considerations, such as wanting to increase consumer willingness to buy the firm's products in the future, or due to altruistic considerations such as wanting to alleviate illness and suffering. Another source of constraints may be due to the fact that the government is often a co-investor in R&D, especially in basic science that facilitates later stage drug development. In order to maintain a social consensus around continued government financial support, the firm may need to provide some price concessions.

To capture these constraints without imposing additional structural assumptions, I model list price setting as the firm trading-off aggregate consumer surplus vs its own profits. This modeling choice has precedents in the health economics literature: Gowrisankaran et al. (2015) includes a term for consumer welfare in the insurer's objective function and Ho and Lee (2024) includes a consumer welfare term in the objective of the middleman (who is integrated with a self-insured employer). In my setting, consumer surplus comes from the drug demand model, which I monetize into dollars by using estimates from the plan demand estimation.[32] The firm's objective is given by

$$\Pi(p) = \iota \left(\frac{\gamma}{\eta} \sum_{i,j,m} CS_{ijm}(p) \right) + (1 - \iota)\, \pi(p) \tag{11}$$

I refer to ι as the political constraints parameter which captures in a reduced-form way all the factors discussed above that may drive a wedge between what a pure profit maximizer would charge and what a pharmaceutical firm can charge. It is worth emphasizing that I don't necessarily view the firm as literally caring about consumer welfare; the totality of constraints forces it to behave as though it does. In a world without constraints, ι would be near zero and we would be back to the standard firm price setting. If the constraints are tightly binding, ι would be near 1 and the firm would appear as though it cares a great deal about consumer surplus.

The first-order condition with respect to list price setting is given by

$$0 = \frac{\partial \Pi}{\partial p} = \iota \left(\frac{\gamma}{\eta} \sum_{i,j,m} \frac{\partial CS_{ijm}}{\partial p} \right) + (1 - \iota) \frac{\partial \pi}{\partial p} \tag{12}$$

[31] Both of these examples resulted in congressional investigations and significant negative publicity for the drug makers. Sovaldi's price was brought down by competitor drugs and the Biden administration capped the out-of-pocket costs of insulin under the Inflation Reduction Act.

[32] The coefficient on consumer surplus, γ, informs us how many utils correspond to an unit of consumer surplus. The coefficient on premiums, η, tell us how many utils correspond to a dollar. The ratio γ/η is the dollar value of an unit of consumer surplus.

5 Estimation and Results

5.1 Estimation

I use Medicare claims data from 2015 to 2019 in the demand estimation, in order to leverage across-time variations in out-of-pocket costs in identifying demand. Consumers are bucketed into demographic groups based on risk status and gender. The construction of the risk variable follows Decarolis et al. (2020). Since the coefficient on drug out-of-pocket costs is identified from variation across plans, controlling for the risk status of a consumer is important. Otherwise, we run into the issue that sicker consumers are more likely to end up in plans with more generous coverage. I also allow the nest parameter λ to vary by year, which is motivated by the fact that Xarelto and Eliquis are new drugs during the sample period, and so it is possible that as physicians and consumers learn more about them, substitution patterns may change.

The nested logit drug demand model is estimated using Poisson regressions. This approach was chosen because it can efficiently handle high-dimensional fixed effects, and allows for zero market shares in the data. The insurance plan demand is estimated using 2SLS following Berry (1994). I also follow the literature (e.g. Starc and Town (2020) and Olssen and Demirer (2023)) in instrumenting for plan premium using the same insurer's comparable plans in other markets. Appendix C contains details on the demand estimation routine.

In the equilibrium of the rebate bargaining model, each bargaining room jd's expectations converge to their true values, and so Eq. 9 defines a system of $J \times D$ equations. Once demand is estimated, we have everything needed to derive the rebates up to the parameter ζ that governs bargaining weights. I recover ζ by moment-matching to the SSR average rebate, adjusted for middlemen's share of total manufacturer rebates. The SSR rebate includes all discounts provided by the manufacturer, so it contains not only rebates to middlemen but also discounts to wholesalers and statutory rebates under Medicare (e.g. discount in the coverage gap). Industry estimates put middlemen's share of total rebate at two-thirds, which is consistent with findings from Wouters et al. (2025).[33]

After both rebates and demand are estimated, price setting comes down to recovering the political constraints parameter ι, which comes from calibrating to observed list prices.

5.2 Results

The estimated demand parameters are given in Tables 2 (drug demand) and 4 (plan demand). Since coefficient estimates are hard to interpret in a discrete choice demand, Table 3 converts

[33] Source: https://www.drugchannels.net/2020/08/the-gross-to-net-bubble-hit-175-billion.html, retrieved June 4, 2025.

drug demand estimates into elasticities.[34] These elasticities are calculated holding insurance plan demand constant. For Eliquis and Xarelto, we find that own price elasticity is around -0.3, which is in line with literature (e.g. Einav et al. (2018)). While in theory, the demand model (through the group level heterogeneity) breaks IIA within a given nest, we see that this is not enough to produce different cross-price elasticities between the two branded drugs and between a branded drug and Warfarin. Though undesirable, it shouldn't have a first-order impact on rebates, list prices, and counterfactual analysis because none of the use cases for the demand model involves comparing substitution to a branded drug vs substitution to Warfarin.

With regard to the nest parameter λ, the estimates show that over time, substitution patterns are becoming more (standard) logit-like.[35] This can be rationalized by the fact that as people learn more about the new drugs, within-nest correlation between each of the new drugs and Warfarin breaks down.

Table 2: Drug demand 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 contains drug demand estimation results. I account for two dimensions of individual heterogeneity: a consumer's risk group and gender.

Table 3: Drug demand elasticities

	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 own and cross drug demand elasticities.

For insurance plan demand, I find an average demand elasticity of -2, which is on the more inelastic end of the range in the literature: -2 to -6 in Lucarelli et al. (2012), -5 to -13 in Decarolis et al. (2020), and -4 to -6 in Starc and Town (2020). This may reflect the fact that consumers in my estimation sample are sicker, as I restrict the estimation sample to consumers who have a diagnosis code that can require the use of an oral anticoagulant. Having a diagnosis for atrial fibrillation is also correlated with other ailments.

[34] I use 2015 data for estimating the rebate and list price models, so all of results presented from here on out are specific to 2015 unless otherwise noted. 2015 is chosen because this is the first year where both Eliquis and Xarelto have nontrivial demand. I focus on an earlier year in the sample, in order to minimize the effect of dynamics in driving rebates and list prices. These considerations are discussed in more detail in Section 6.5.

[35] In my notation, $\lambda = 1$ corresponds to a standard logit.

Table 4: Insurance plan demand 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 contains insurance plan demand estimation results.

Next, I calculate how own drug demand changes in response to changes in formulary placement (which maps to changes in out-of-pocket costs), the substitution pattern between the two branded drugs, and how willing consumers are to switch plans in order to keep taking their preferred drug. Table 5 shows for each middleman and each drug, how own demand changes in response to an own formulary downgrade, and how much of the own demand change is recaptured by the middleman and the drug manufacturer.[36] For example, for CVS, we find that if Eliquis' formulary placement is downgraded from preferred to non-preferred, then own demand will drop by 52%. 17% of the people who stop taking Eliquis will switch to Xarelto (and be "recaptured" by the middleman as the middleman collects rebates from the rival drug manufacturer), while 2% will switch plans in order to maintain access to Eliquis at preferred cost-shares. These results imply that consumers don't like to switch plans, which is consistent with findings in the literature of inertial consumers (e.g. Handel (2013)).

For the rebate model, I recover a preliminary estimate for ζ of 0.04. Model-implied rebates are given in column 5 of Tables 6 and 7, for Eliquis and Xarelto, respectively. Note that by construction, plans that put a branded drug on the non-preferred tier will have a zero rebate for that drug. The model-implied bargaining weights range from 0.44 to 0.52.

Finally, for the list price model, I calibrate to a value of 0.98 for the political constraints parameter ι. Ex-post, it shouldn't be surprising to find a large value of ι, which is directly driven by the fact that drug demand is inelastic, both in the literature and in my setting here. The fact that ι is so close to 1 is perhaps surprising. Another interpretation of this finding is that drug manufacturers do not engage in marginal-cost pricing since drug products are generally covered by insurance,

[36] Aetna is an outlier because some of its observed formularies already have Eliquis on the non-preferred tier. Therefore, a downgrade to non-preferred generates relatively little change in own demand.

Table 5: Substitution patterns

	Eliquis			Xarelto		
Rebate entity	Own change	Middleman recapture	Drugmaker recapture	Own Change	Middleman recapture	Drugmaker recapture
Aetna	0%	0%	0%	-52.7%	8.7%	2.7%
CVS/Caremark	-51.8%	17.2%	2.1%	-53.5%	15.9%	2.4%
Catamaran	-43.4%	8.3%	2.2%	-35.9%	12.3%	2.6%
Express Scripts	-48.1%	14.8%	2.1%	-49.8%	13.2%	2.3%
Humana	-46.2%	15.4%	1.7%	-47.8%	14.2%	2.0%
OptumRx	-50.2%	16.7%	1.9%	-52.2%	15.2%	2.1%
Prime Therapeutics	-44.6%	14.6%	1.5%	-54.6%	11.5%	1.9%

Notes: This table shows model predictions of how drug demand would change in the event of a formulary downgrade. For example, I find that if CVS downgrades coverage of Eliquis from preferred to non-preferred, then the demand for Eliquis would fall by around 52% among CVS plans; of this drop, 17% would be recaptured by CVS through consumer switching into Xarelto and 2% would be recaptured by the drugmaker through consumer switching into a non-CVS plan.

and ι denotes how far off we are from marginal-cost pricing. Put differently, if the drug manufacturer were to raise list prices more, the value of insurance to consumers would be further degraded. Drug manufacturers understand that there is only so much room they have to push list prices before triggering potentially catastrophic public backlash.

Table 6: Rebates for Eliquis

		Middleman			Insurer			Rebate change		
			Bargain			Bargain		Drugmaker	Bargain	
PBM	Insurer	Size	wgt	Rebate	Size	wgt	Rebate	recapture	wgt	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Aetna	Aetna	23133	0.44	0	23133	0.44	0	0	0	0
CVS/Caremark	BCBS (SC)	48090	0.47	0.16	701	0.29	0.10	-0.1	-5.7	-5.8
CVS/Caremark	CVS	48090	0.47	0.26	41398	0.47	0.25	0	-0.3	-0.3
CVS/Caremark	Capital Blue Cross	48090	0.47	0.24	192	0.23	0.13	-0.1	-11.5	-11.6
CVS/Caremark	Torchmark	48090	0.47	0.25	4708	0.37	0.20	-0.1	-5	-5
CVS/Caremark	USAble Mutual	48090	0.47	0.17	1091	0.31	0.11	0	-5.5	-5.6
Catamaran	BCBS (AZ)	33060	0.46	0.28	127	0.21	0.14	-0.1	-13.5	-13.6
Catamaran	CIGNA	33060	0.46	0.18	18386	0.43	0.17	0	-0.9	-0.9
Catamaran	WellCare	33060	0.46	0.23	14547	0.42	0.22	0	-1.8	-1.8
Express Scripts	Anthem	20923	0.44	0.24	10191	0.41	0.22	0	-1.5	-1.6
Express Scripts	Anthem & BCBS (MA, RI, VT)	20923	0.44	0.25	3194	0.36	0.21	0	-4.4	-4.4
Express Scripts	Express Scripts	20923	0.44	0.17	5043	0.38	0.15	0	-2.3	-2.3
Express Scripts	Highmark	20923	0.44	0.22	1701	0.33	0.17	0	-5.2	-5.2
Express Scripts	Wisconsin Physicians	20923	0.44	0.24	794	0.29	0.16	0	-7.5	-7.5
Humana	Humana	88740	0.50	0.24	88740	0.50	0.24	0	0	0
OptumRx	Granite Creek	135857	0.52	0.27	261	0.24	0.14	-0.1	-12.9	-13
OptumRx	UnitedHealth	135857	0.52	0.27	135596	0.52	0.27	0	0	0
Prime Therapeutics	BCBS (AL)	26720	0.45	0.19	1491	0.32	0.14	0	-4.9	-4.9
Prime Therapeutics	BCBS (KS)	26720	0.45	0.23	777	0.29	0.16	0	-7.4	-7.4
Prime Therapeutics	BCBS (MN, MT, NE, ND, WY) and Wellmark	26720	0.45	0.26	8911	0.40	0.24	0	-2.7	-2.7
Prime Therapeutics	BCBS (NC)	26720	0.45	0.20	1747	0.33	0.15	0	-4.7	-4.7
Prime Therapeutics	Guidewell Mutual	26720	0.45	0.17	2947	0.35	0.14	0	-3.3	-3.3
Prime Therapeutics	Health Care Service	26720	0.45	0.17	9588	0.40	0.16	0	-1.6	-1.6
Prime Therapeutics	Horizon	26720	0.45	0.19	1259	0.31	0.14	0	-5.2	-5.2

Notes: This table shows how rebate changes for each insurer, when the insurer uses a middleman and when it self negotiates for rebates. Column 3 – 5 show the size, bargaining weight, and rebate under middleman negotiation. Column 6 – 8 show the size, bargaining weight, and rebate under self negotiation. Column 9 – 11 decompose the change in rebate between middleman and self negotiation due to change in the drugmaker's recapture under the bargaining problem and change in the bargaining weight.

Table 7: Rebates for Xarelto

		Middleman			Insurer			Rebate change		
			Bargain			Bargain		Drugmaker	Bargain	
PBM	Insurer	Size	wgt	Rebate	Size	wgt	Rebate	recapture	wgt	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Aetna	Aetna	23133	0.44	0.23	23133	0.44	0.23	0	0	0
CVS/Caremark	BCBS (SC)	48090	0.47	0.26	701	0.29	0.16	-0.1	-9.2	-9.2
CVS/Caremark	CVS	48090	0.47	0.26	41398	0.47	0.26	0	-0.3	-0.3
CVS/Caremark	Capital Blue Cross	48090	0.47	0.26	192	0.23	0.13	-0.1	-12.2	-12.3
CVS/Caremark	Torchmark	48090	0.47	0.25	4708	0.37	0.20	-0.1	-5	-5.1
CVS/Caremark	USAble Mutual	48090	0.47	0.26	1091	0.31	0.17	-0.1	-8.5	-8.6
Catamaran	BCBS (AZ)	33060	0.46	0.28	127	0.21	0.14	0	-13.8	-13.8
Catamaran	CIGNA	33060	0.46	0.18	18386	0.43	0.17	0	-1	-1
Catamaran	WellCare	33060	0.46	0	14547	0.42	0	0	0	0
Express Scripts	Anthem	20923	0.44	0.24	10191	0.41	0.22	0	-1.6	-1.6
Express Scripts	Anthem & BCBS (MA, RI, VT)	20923	0.44	0.25	3194	0.36	0.20	0	-4.4	-4.4
Express Scripts	Express Scripts	20923	0.44	0.19	5043	0.38	0.16	0	-2.5	-2.5
Express Scripts	Highmark	20923	0.44	0.23	1701	0.33	0.17	0	-5.3	-5.3
Express Scripts	Wisconsin Physicians	20923	0.44	0.24	794	0.29	0.16	0	-7.7	-7.7
Humana	Humana	88740	0.50	0.24	88740	0.50	0.24	0	0	0
OptumRx	Granite Creek	135857	0.52	0.28	261	0.24	0.14	-0.1	-13.8	-13.9
OptumRx	UnitedHealth	135857	0.52	0.28	135596	0.52	0.28	0	0	0
Prime Therapeutics	BCBS (AL)	26720	0.45	0.25	1491	0.32	0.18	0	-6.5	-6.5
Prime Therapeutics	BCBS (KS)	26720	0.45	0.25	777	0.29	0.17	0	-8.1	-8.1
Prime Therapeutics	BCBS (MN, MT, NE, ND, WY) and Wellmark	26720	0.45	0.26	8911	0.40	0.24	0	-2.7	-2.7
Prime Therapeutics	BCBS (NC)	26720	0.45	0.26	1747	0.33	0.19	0	-6.3	-6.3
Prime Therapeutics	Guidewell Mutual	26720	0.45	0.24	2947	0.35	0.19	0	-4.8	-4.8
Prime Therapeutics	Health Care Service	26720	0.45	0.24	9588	0.40	0.22	0	-2.3	-2.3
Prime Therapeutics	Horizon	26720	0.45	0.24	1259	0.31	0.17	0	-6.7	-6.7

Notes: This table shows how rebate changes for each insurer, when the insurer uses a middleman and when it self negotiates for rebates. Column 3 – 5 show the size, bargaining weight, and rebate under middleman negotiation. Column 6 – 8 show the size, bargaining weight, and rebate under self negotiation. Column 9 – 11 decompose the change in rebate between middleman and self negotiation due to change in the drugmaker's recapture under the bargaining problem and change in the bargaining weight.

6 Counterfactual Analysis

Motivated by the forces of countervailing market power and agency frictions, I consider four counterfactuals, which are summarized in Table 8. Figure A.2 through A.5 show simplified diagrams for the industry structure under each counterfactual. The first counterfactual ("direct negotiation") dials down countervailing market power by stripping away the middleman layer in the vertical supply chain, and imposes that insurers directly negotiate with drug manufacturers for rebates. The second counterfactual ("firm pricing") gives all the bargaining power for rebates to drug manufacturers, in which case they will set a price and provide no rebates. Under this counterfactual, both agency frictions and countervailing market power are removed, leading to an evaluation of their net impact in the status quo. The third counterfactual ("rebate POS pass-through") removes agency frictions by compelling middlemen and insurers to share rebates with consumers at the point-of-sale (POS), which is usually a retail pharmacy. Under this counterfactual, instead of paying out-of-pocket costs based on the list price, consumers would pay costs based on the net-of-rebate price. Finally, I simulate what would happen if countervailing market power is held by a single entity who negotiates an uniform net price, which approximates Medicare centrally negotiating for all plans in Medicare Part D. In all counterfactual analysis, I hold constant cost-share, as a fraction of the list price, and insurance plan coverage generosity. This is reasonable in the Medicare setting because coverage generosity is largely determined by a set of standard benefits dictated by the government.

Table 8: Summary of counterfactuals

	Status quo	Direct negotiation	Firm pricing	Rebate POS pass-through	Medicare negotiation
		(1)	(2)	(3)	(4)
Agency problem	✓	✓	×	×	×
Countervailing market power	PBMs	Insurers	None	PBMs	Government

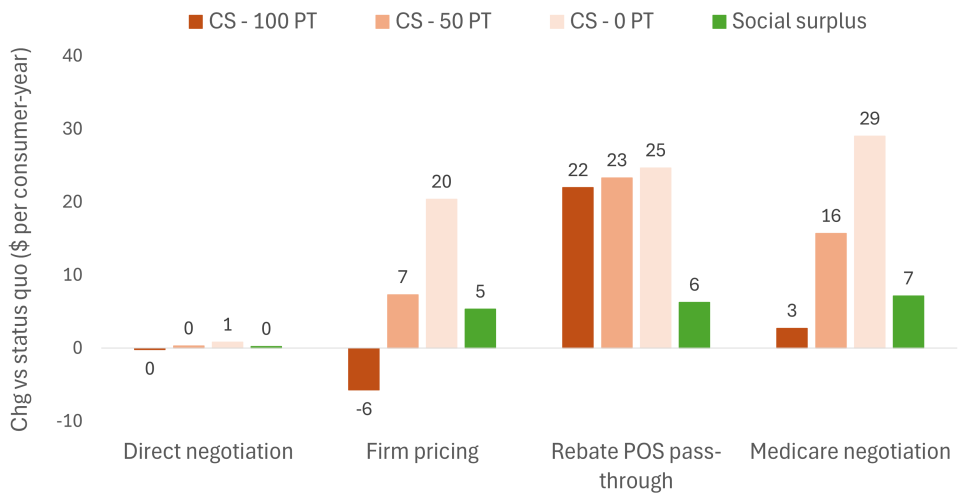
Notes: This table summarizes how each counterfactual differs from the status quo, based on how it adjusts agency frictions and/or countervailing market power.

All counterfactuals are evaluated relative to the status quo, which is the current system that we live under, where insurers hire PBMs to negotiate for rebates and consumers pay cost-share on list prices. The middleman's payoff is assumed to be 10% of rebates (net of any point-of-sale pass-through to consumers), which is based on industry reports.[37] The insurer's payoff is drug costs not paid by consumers at point-of-sale minus rebates kept. The consumer's payoff is out-of-pocket costs at point-of-sale, reduced by rebates received through premium reduction. Finally, the drug manufacturer's payoff is net price received on drug quantities sold. Figure A.6 contains a summary

[37] Industry reports estimate that middlemen pass on 91% of rebates to plan sponsors. Source: https://www.commonwealthfund.org/publications/explainer/2025/mar/what-pharmacy-benefit-managers-do-how-they-contribute-drug-spending, retrieved June 4, 2025.

of how each party's payoff changes under each counterfactual (relative to the status quo). For each party, the numbers are displayed such that a positive change benefits that party. Figure 8 compares surplus across the counterfactuals, once again relative to the status quo. The darkest orange bar shows consumer surplus change assuming that insurers pass 100% of rebates to premiums, while the lightest orange bar shows surplus change assuming that insurers pass 0% of rebates to premiums. As previously discussed under the conceptual model in Section 4.1, full and no rebate to premium pass-through in the status quo map to bounds on consumer surplus change due to drug prices being inflated by rebates. Note that in this setting, drug quantities demanded constitute a sufficient statistic for social welfare; under the maintained assumption that cost-share ratios are fixed, this implies that the list price is a sufficient statistic for social welfare. The remainder of this section discusses each counterfactual in more detail and ends with a discussion of external validity and potential caveats.

Figure 8: Surplus comparison across counterfactuals



Notes: This figure shows consumer and social welfare change vs the status quo under each counterfactual. A summary of what these counterfactuals represent relative to the status quo can be found in Table 8. An industry structure for the status quo is depicted in Figure 3 while an industry structure for each counterfactual can be found in Figure A.2 through Figure A.5. The orange bars show consumer surplus change based on how much rebates insurers pass through to consumers via premium reduction in the status quo. The darkest orange bar assumes 100% pass-through and the lightest assumes 0%; the former represents the lower bound on changes in consumer surplus and the latter the upper bound, as explained in Section 4.1. The green bar shows social surplus change, and corresponds conceptually to area $T + S$ in Figure 7.

6.1 Direct rebate negotiation

In this counterfactual, I simulate outcomes assuming that each insurer directly engages in bilateral rebate bargaining with each drug manufacturer. Tables 6 (Eliquis) and 7 (Xarelto) show for each drug and each insurer, how the rebate negotiated through a PBM differs from a directly negotiated

rebate. Two things change under this counterfactual. First, holding bargaining weight constant, any given insurer-drug manufacturer pair may have different disagreement payoffs relative to the corresponding middleman-drug manufacturer pair. For example, a middleman (which tends to be larger in size) can more effectively shut down the manufacturer's recapture, which comes from consumers switching into a different insurance plan. Second, since bargaining weight is modeled as a function of size, each insurer will have a lower bargaining weight relative to that insurer's PBM.

Column 9 of Tables 6 and 7 shows how the insurer-drug specific rebates would change from changes in the drugmaker's recapture only (and holding the bargaining weight constant, meaning that the insurer inherits the same bargaining weight as its middleman). Column 10 shows the additional contribution to the rebate change from adjusting the bargaining weight based on the insurer's size, as measured by the number of consumers enrolled in its plans. Column 11 shows the total change in rebate, from allowing both the recapture and the bargaining weight to adjust. Strikingly, the drugmaker's recapture is essentially zero across the board, which is a function of the fact that consumers do not like to switch plans. In addition, for certain markets, the insurer has the same size as the PBM. This is especially the case for Prime Therapeutics, which represents Blue Cross Blue Shield (BCBS) plans. For example, within North Carolina, Prime Therapeutics represents only BCBS NC. Not surprisingly, the largest insurers (e.g. UnitedHealth) achieve comparable rebates directly as they would through a middleman, while the smallest insurers may end up with rebates that are up to 14 percentage points lower. What's perhaps a bit more surprising is that in aggregate, rebates are only lower by 1 percentage point under direct negotiation, which implies that list prices would fall by under 1% vs the status quo. This is due to the fact that the insurance market is fairly concentrated.

Another interpretation of these findings is that the middlemen help the smaller insurers compete with the larger insurers. Without the middleman, the smaller insurers likely will not be able to offer insurance coverage that is competitive with the larger insurers' offerings. In return, the middleman presumably extracts a handsome profit. While modeling the division of surplus between the insurer and the middleman is outside the scope of this project, it stands to reason that both parties benefit from the relationship or else we would not observe it in practice.

6.2 Firm pricing

Under firm pricing, I simulate what price each drug manufacturer would set under no rebate by setting the marginal cost in the firm's profit term to zero (i.e. $r_j = 0$ in Eq. 10). I assume that insurers continue to cover the drug at the observed level of coverage in spite of receiving no rebate. Another way to think about this counterfactual is it corresponds to setting the bargaining weight of the middleman to zero in the rebate bargaining model. For 2015, I find that firm pricing for

Eliquis is $8.47 and for Xarelto is $9.02, corresponding to a 23% and 18% reduction from their shared list price of $11 in the status quo. For each drug, the firm price falls in between the list price and the net-of-rebate price in the status quo, but is much closer to the latter, which is consistent with descriptive evidence that drug manufacturers pass rebates through to list prices close to 1 to 1.[38] These declines in list price, and by association, in out-of-pocket costs, correspond to a 5-7% increase in drug sales. Clearly, drug manufacturers are unambiguously better off under firm pricing, as we would expect. Social welfare is also unambiguously higher, as the higher drug consumption moves us down the demand curve. Finally, consumer welfare may *increase* by as much as $20 per person-year if insurers pass no rebate to premium in the status quo. This finding is sensitive to what we assume about this pass-through parameter. In a world where insurers pass on all rebates, consumers would lose by $6 per person-year. To put these numbers in perspective, the average insurance premium in this time period is $30 per person-month.

6.3 Rebate point-of-sale pass-through to consumers

Suppose that rebates are passed on to consumers at the point-of-sale, meaning that their out-of-pocket costs are based on net-of-rebate prices. For 2015, the aggregate rebate is 23% for Eliquis and 25% for Xarelto. Under this counterfactual, consumers would see their out-of-pocket costs fall by the same percentages, leading to around 7% increase in drug utilization. This corresponds to at least $22 per person-year in consumer surplus gains, or 6% of average annual premiums. Social surplus increases by $6 per person-year.

This counterfactual produces the tightest bounds on consumer surplus gain, for two reasons. First, basing out-of-pocket costs on net prices means we are sharing rebates with the consumer at the point-of-sale in proportion to their existing cost-share, which is around 20% in general. This means that the remaining 80% of rebates continues to flow through the current system. If consumers currently benefit significantly from rebates reducing their premiums, then they will continue to benefit to a large extent. Second, the value to a potential anticoagulant user of a dollar reduction in the list price at the point-of-sale is larger than that dollar being used to reduce premiums, because the latter benefits *all* beneficiaries, including those who are healthy and do not need a drug.[39] For example, suppose a beneficiary with atrial fibrillation has a 20% cost-share in a plan with 100 subscribers. She will see her out-of-pocket costs fall by $0.20 for each dollar of rebate that is passed on at the point-of-sale. That same dollar of rebate will reduce her premium by only $0.01.

Relative to consumer surplus gain, social surplus gain is more modest at $6 per person-year.

[38] Using data on list and estimated net prices of U.S. branded pharmaceuticals, Sood et al. (2020) find that on average, a $1 increase in rebates is associated with a $1.17 increase in list prices.

[39] In this analysis, I do not take the welfare impact of non-atrial fibrillation beneficiaries into account.

This is driven by the (inelastic) quantity response to reduced out-of-pocket costs.

6.4 Medicare price negotiation

This counterfactual closely mimics the provision of the Inflation Reduction Act of 2022 that gave Medicare the authority to directly negotiate prices for drugs that meet certain criteria. The first set of negotiated prices was announced in 2024 and will enter into effect in 2026.[40] Under Medicare price negotiation, each drug manufacturer enters into discussion with the government for a single price for each drug in the firm's portfolio that is subject to negotiation. This single price would then be used throughout the supply chain, including for calculating out-of-pocket costs. Hence, the pricing mechanism induced by Medicare negotiation can be viewed as a single entity who aggregates all demand and engages in price negotiation with the drugmaker.

I find that under a single middleman, aggregate rebates would increase by 4 percentage points, which brings total reduction in out-of-pocket costs to around 28%. This implies a 8 percentage points increase in drug consumption. Consumer surplus gain is more dispersed, ranging from $3 per person-year to $29 per person-year. This is because rebates in the status quo are substantial. Unlike the rebate point-of-sale pass-through counterfactual, which maintains a large chunk of current rebates, Medicare negotiation removes all rebates. As a result, it magnifies the role that rebates currently play in premium reduction. If less (more) rebates currently make their way to consumers, then consumers will gain relatively more (less) from Medicare negotiation.

Since this counterfactual has the largest reduction in out-of-pocket costs, social surplus improves by the most out of all counterfactuals. The magnitude of improvement is still modest, at $7 per person-year.

6.5 Discussion

Given a prevailing understanding, perhaps from European experiences, that direct government involvement leads to lower drug prices, it is perhaps surprising that Medicare negotiation is only predicted to raise rebates by 4 percentage points. This stems from the structural assumption that bargaining ability increases *concavely* in middleman size (per Eq. 8). One way we can sanity check this vs reality is by looking to the outcome of actual Medicare price negotiation for Xarelto and Eliquis in 2024. Since my rebates data end in 2021, to be conservative, suppose that rebates stayed at 2021 levels (the actual data, as shown in Figure A.1 shows an upward trend). Then the actual Medicare-negotiated price of $231 for Eliquis and $197 for Xarelto represent an increase in rebates of 13 and 14 percentage points, respectively.[41] If, however, we assume that rebates between 2021

[40] Source: https://www.cms.gov/files/document/fact-sheet-negotiated-prices-initial-price-applicability-year-2026.pdf, retrieved Aug 12, 2025.

[41] Source: https://www.cms.gov/newsroom/fact-sheets/medicare-drug-price-negotiation-program-negotiated-prices-initial-price-applicability-year-2026, retrieved October 17, 2025.

and 2024 increased in line with the observed time trend, then Medicare's prices only represent a 6 and 9 percentage point increase in rebates. From this perspective, the model-based predictions are arguably qualitatively consistent with real-world experiences.

Another component of Medicare negotiation that is not widely understood is the fact that by removing rebates, consumers may experience higher premiums. The degree to which this will occur depends on how much of current rebates are used to reduce premiums, which is in turn a function of insurance market competition. There are signs, which are confirmed in the data, that the Medicare market has become quite concentrated. If that's indeed the case, then consumers should observe less increase in premiums, vs if the market is more competitive.

Since I have a static model, it is worthwhile discussing how dynamics may impact rebates and list prices over time. At least for some drugs, the patterns in the data (e.g. Figure 1) can potentially be rationalized by each drug manufacturer picking a launch list price, and then adjusting that by a fixed amount every year. Both the launch price and the annual adjustment can be engineered so that over the course of the expected patent duration of the drug, the manufacturer realizes a certain amount in net profit, after accounting for all the rebates it may need to provide. An even more extreme version of this would be the drug manufacturer sets the maximum launch price and increases it by as much as possible every year. Note that even if this is the model of decision-making by drug manufacturers, there are likely still constraints on pricing. At least for oral anticoagulants, there is evidence from medical journals (e.g. Harrington et al. (2013)) that even at their (relatively high) launch list prices, they still provide compelling value through the lens of cost-benefit analyses. Hence, without any pricing constraints, their launch prices would likely have been even higher.

Dynamic considerations are potentially significant as a confound mainly for the firm pricing counterfactual, because that is the only counterfactual that substantively relies on the model to assess how list prices would change in response to removing rebates. Arguably, as a drug matures on the market, how it has been priced in the past matters more for the present under a dynamic setting. When a drug is newly rolled out on the market, there may be more scope for the firm to make adjustments. This is why I focus on an earlier year – 2015 – in the estimation sample for the rebate and list price model estimation, and for the counterfactuals. All of this is not to say that dynamic considerations in drug pricing are unimportant; in fact, it is likely an underexplored area that merits more consideration in future work.

7 Conclusion

This paper sheds light on US prescription drug pricing by studying the role of the middleman in determining drug costs. In theory, a middleman, by aggregating demand through multiple insurers, can countervail the pricing power of drug manufacturers for on-patent drugs. At the same time, a middleman may exacerbate the gap between list and net price, and thereby make drugs less

affordable for consumers who depend on them. These trade-offs have featured in on-going policy discussions around drug pricing, which have pitted drug manufacturers against middlemen.

By bringing consumer drug and insurance plan demand, rebate negotiation, and list price setting together into a coherent and tractable modeling framework, I contribute new economic insight to this vital policy debate. By necessity, the model cannot capture all of the different moving parts in this complicated multi-layer industry. Arguably, it captures in a robust framework the core economic forces that are likely to be of first-order significance. First, demand estimates from both this paper and the broader literature indicate that consumer demand for prescription drugs is highly inelastic at observed out-of-pocket costs, which are in turn a fraction of list prices. These facts imply that a firm must be subject to some constraints in its price setting, or else we won't be observing pricing at the inelastic portion of demand. By modeling price setting as though a firm is trading off consumer surplus vs its own profits, I can parsimoniously capture these constraints without imposing more particular functional form assumptions. Second, while the rebate model and the list price model fit together coherently, they are also separable in the sense that the assumptions made for inferring rebates are self-contained and shouldn't have first-order spillover effects onto the list price model. One key assumption made is that the bargaining ability of the middleman is increasing in its size, which closely aligns with how industry insiders describe their business model and also appear supportable in data. Since the model-predicted rebates are matched to industry averages, even if the model specification for rebates is incorrect, conclusions about the overall size of rebates should continue to hold, and these are the key inputs to the upstream list price setting model.

My main findings shed new light on the role of the middleman, and what can be done to make drugs more affordable and thereby improve consumer welfare. At first glance, middlemen appear to do little: in aggregate, the countervailing market power they hold is not much greater than what the big insurers can wield. This means that with or without middleman, both rebates and list price may be high. However, this interpretation is not the full story – middlemen may potentially help smaller insurers, whose size puts them at a disadvantage in a hypothetical world where each insurer negotiates directly with each drug manufacturer. It is worth noting that there are concerns about other aspects of the middleman that I don't consider in this project, such as their ability to steer business to affiliated pharmacy networks and reimburse themselves at higher rates than independent pharmacies.

Another key finding is that while the agency problem induced by having consumers pay out-of-pocket costs based on list prices is unambiguously welfare-reducing, the magnitude of this distortion is modest due to inelastic demand. A beneficiary with atrial fibrillation will realize a surplus bump of around 6-7% of annual premiums if they can pay out-of-pocket costs based on

net-of-rebate prices.[42]

A final finding worth highlighting, which ties into recent political developments, is the value of government negotiation for lower drug prices. The government can be thought of as holding the ultimate countervailing market power viz-a-viz drug manufacturers, and correspondingly, can secure larger rebates, or lower net drug prices. On the other hand, how much this benefits consumers depends on how much they currently benefit from rebates through premium reduction. If rebates help reduce premiums meaningfully, then simultaneously removing rebates and agreeing to a lower net drug price will result in more modest gains for consumers. If rebates are predominantly pocketed by insurers and PBMs as rent, then consumers may gain substantially from Medicare negotiation.

On the whole, one direction for future research that emerges from this project is the potential for countervailing market power to reduce dispersion in downstream market outcomes. In my setting, it is likely that countervailing market power at the PBM or government level helps smaller insurers compete against larger insurers, by facilitating access to comparable rebates. To fully dissect the implication of this, however, would require a model of insurance plan competition and a model of how surplus is split within each PBM-insurer pair; these are outside the scope of this project. Nonetheless, the fact that we observe small insurers contracting with big middlemen implies that there are mutual gains from these relationships. That, in and of itself, is already indicative of a positive effect of countervailing market power on downstream competition.

[42]One potential concern with sharing rebates with consumers at the point-of-sale is that in doing so, these confidential rebates will be publicly revealed, which may reduce drug manufacturers' incentive to provide them. This doesn't appear to be an insurmountable obstacle, as United Health has implemented a rebate pass-through program (source: https://www.wsj.com/articles/unitedhealth-will-pass-drug-rebates-directly-to-some-consumers-1520337601, retrieved May 27, 2025). Moreover, there are precedents in other parts of healthcare, such as outpatient services, where cost sharing is applied after a negotiated discount.

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*, 1180–1210. 15

Allende, Claudia, Juan Pablo Atal, Rodrigo Carril, José Ignacio Cuesta, and Andrés González-Lira, "Centralizing Procurement: The Roles of Scale, Selection, and Variety," 2025. 6

Barrette, Eric, Gautam Gowrisankaran, and Robert Town, "Countervailing Market Power and Hospital Competition," *The Review of Economics and Statistics*, 2022, *104* (6), 1351–1360. 6

Berry, Steven, "Estimating Discrete-Choice Models of Product Differentiation," *RAND Journal of Economics*, 1994, *25* (2), 242–262. 25, 50

Boehm, Eduard, "Intermediation, Choice Frictions, and Adverse Selection: Evidence from the Chilean Pension Market," 2024. 6

Brot, Zarek, Catherine Che, and Benjamin Handel, "Pharmacy Benefit Managers and Vertical Relationships in Drug Supply," 2025. https://www.nber.org/papers/w29959. 6, 19

Cao, Shengmao, Lisa Xuejie Yi, and Chuan Yu, "Competitive Bidding in Drug Procurement: Evidence from China," *American Economic Journal: Economic Policy*, August 2024, *16* (3), 481–513. 6

Conti, Rena M, Brigham Frandsen, Michael L Powell, and James B Rebitzer, "Common Agent or Double Agent? Pharmacy Benefit Managers in the Prescription Drug Market," Working Paper 28866, National Bureau of Economic Research May 2021. 6

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. 4, 25, 26

Dubois, Pierre, Yassine Lefouili, and Stéphane Straub, "Pooled Procurement of Drugs in Low and Middle Income Countries," *European Economic Review*, 2021, *132*, 103655. 6

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), 122–153. 4, 26

Feng, Josh and Luca Maini, "Demand Inertia and the Hidden Impact of Pharmacy Benefit Managers," *Management Science*, 2024, *70* (12), 8940–8961. 6

Gowrisankaran, Gautam, Aviv Nevo, and Robert Town, "Mergers When Prices Are Negotiated: Evidence from the Hospital Industry," *American Economic Review*, 2015, *175*, 172–203. 6, 24

Grennan, Matthew, Kyle R Myers, Ashley Swanson, and Aaron Chatterji, "No Free Lunch? Welfare Analysis of Firms Selling Through Expert Intermediaries," *The Review of Economic Studies*, 9 2024, *92* (4), 2537–2577. 6

Gruber, Jonathan, Benjamin R. Handel, Samuel H. Kina, and Jonathan T. Kolstad, "Managing Intelligence: Skilled Experts and AI in Markets for Complex Products," Working Paper 27038, National Bureau of Economic Research April 2020. 6

Handel, Benjamin R., "Adverse Selection and Inertia in Health Insurance Markets: When Nudging Hurts," *American Economic Review*, 2013, *103* (7), 2643–2682. 27

Harrington, Amanda R., Edward P. Armstrong, Paul E. Nolan, and Daniel C. Malone, "Cost-Effectiveness of Apixaban, Dabigatran, Rivaroxaban, and Warfarin for Stroke Prevention in Atrial Fibrillation," *Stroke*, 2013, *44* (6), 1676–1681. 36

Hastings, Justine, Ali Hortaçsu, and Chad Syverson, "Sales Force and Competition in Financial Product Markets: The Case of Mexico's Social Security Privatization," *Econometrica*, 2017, *85* (6), 1723–1761. 6

Ho, Kate and Robin Lee, "Insurer competition in health care markets," *Econometrica*, 2017, *85* (2), 379–417. 6

_ **and Robin S. Lee**, "Contracting over Pharmaceutical Formularies and Rebates," 2024. 6, 24

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. 2

Lee, Robin S., Michael D. Whinston, and Ali Yurukoglu, "Structural Empirical Analysis of Contracting in Vertical Markets," in Kate Ho, Ali Hortaçsu, and Alessandro Lizzeri, eds., *Handbook of Industrial Organization*, Elsevier B.V., 2021, chapter 9, pp. 673–742. 6

Lucarelli, Claudio, Jeffrey Prince, and Kosali Simon, "The Welfare Impact of Reducing Choice in Medicare Part D: A Comparison of Two Regulation Strategies," *International Economic Review*, 2012, *53* (4), 1155–1177. 4, 26

Noubiap, Jean Jacques, Jessica J. Tang, John T. Teraoka, Thomas A. Dewland, and Gregory M. Marcus, "Minimum National Prevalence of Diagnosed Atrial Fibrillation Inferred From California Acute Care Facilities," *Journal of the American College of Cardiology*, 2024, *84* (16), 1501–1508. 13

Olssen, Alexander and Mert Demirer, "Drug Rebates and Formulary Design: Evidence from Statins in Medicare Part D," 2023. 6, 25

Robles-Garcia, Claudia, "Competition and Incentives in Mortgage Markets: The Role of Brokers," 2019. 6

Sood, Neeraj, Rocio Ribero, Martha Ryan, and Karen Van Nuys, "The Association Between Drug Rebates and List Prices," *Schaeffer Center White Paper Series*, 2020. 2, 11, 34

Starc, Amanda and Robert J. Town, "Externalities and Benefit Design in Health Insurance," *Review of Economic Studies*, 2020, *87*, 2827–2858. 4, 25, 26

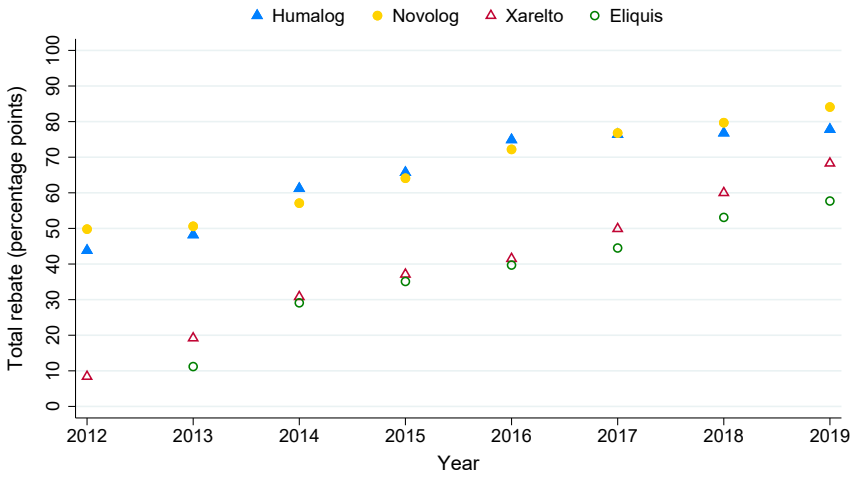
Wouters, Olivier J., Sean D. Sullivan, Emma M. Cousin, Nico Gabriel, Irene Papanicolas, and Inmaculada Hernandez, "Drug Prices Negotiated by Medicare vs US Net Prices and Prices in Other Countries," *JAMA*, 01 2025, *333* (1), 85–87. 25

Yeung, Kai, Stacie B. Dusetzina, and Anirban Basu, "Association of Branded Prescription Drug Rebate Size and Patient Out-of-Pocket Costs in a Nationally Representative Sample, 2007-2018," *JAMA Network Open*, 06 2021, *4* (6), e2113393–e2113393. 2

Appendices

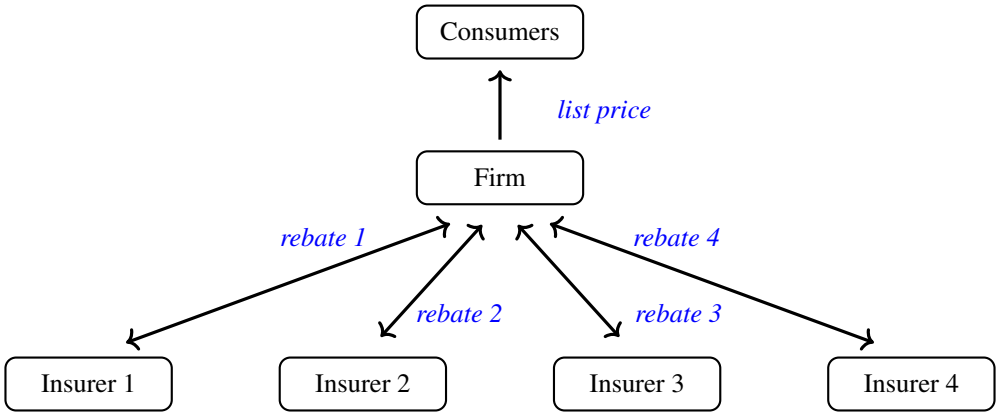
A Figures

Figure A.1: Rebate trends



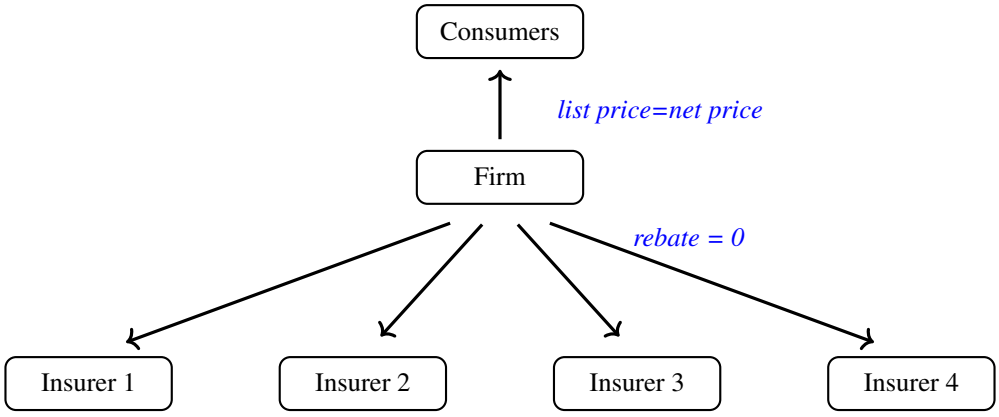
Notes: This figure shows how rebates, as a percent of list prices, for rapid-acting insulin products and oral anticoagulants have evolved over time.

Figure A.2: Industry structure for direct negotiation



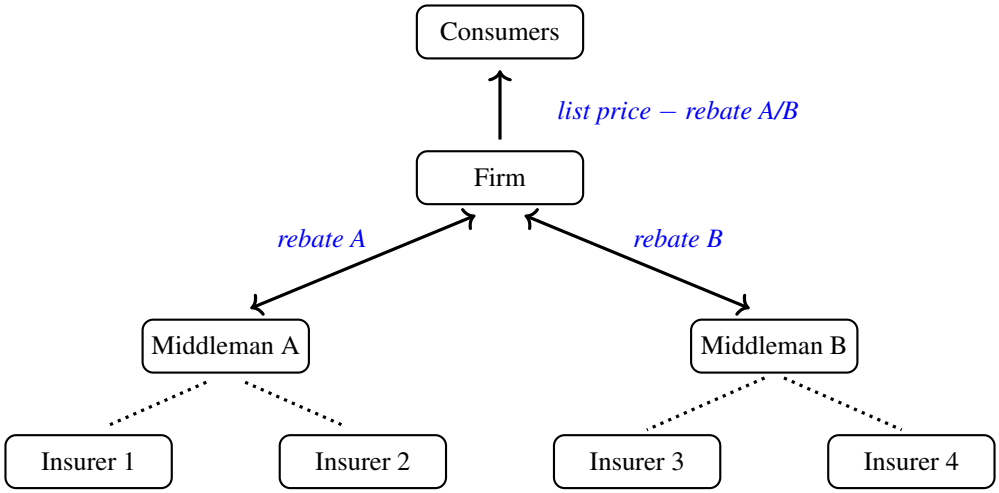
Notes: This simplified diagram shows how pricing would work in a counterfactual where insurers directly negotiate for rebates. A double-sided arrow denotes bilateral negotiation, while a single-sided arrow denotes unilateral price setting.

Figure A.3: Industry structure for firm price setting



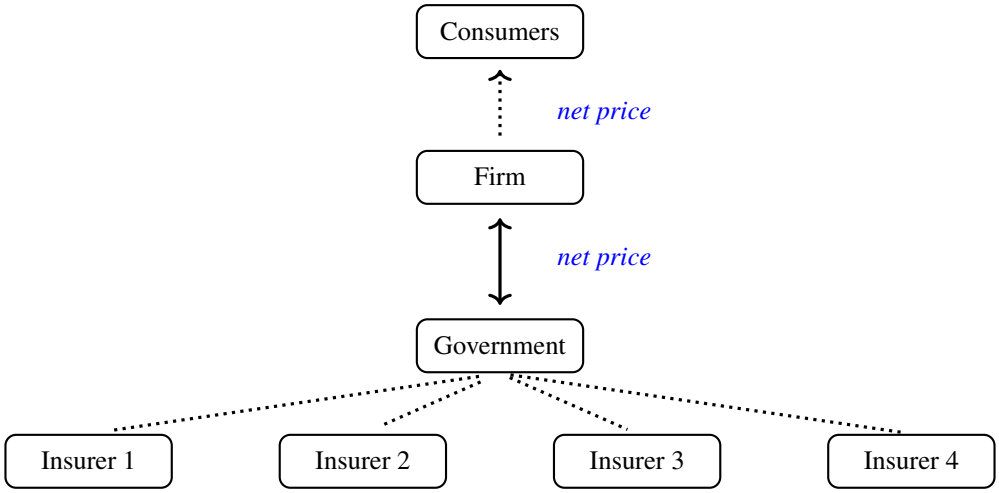
Notes: This simplified diagram shows how pricing would work in a counterfactual where the firm has full pricing power: it sets a price subject to political constraints, and doesn't provide any rebate. Put differently, the firm sets a single list price which coincides with the net price. List minus consumer out of pocket cost is what the insurer pays. A double-sided arrow denotes bilateral negotiation, while a single-sided arrow denotes unilateral price setting.

Figure A.4: Industry structure for rebate point-of-sale pass-through



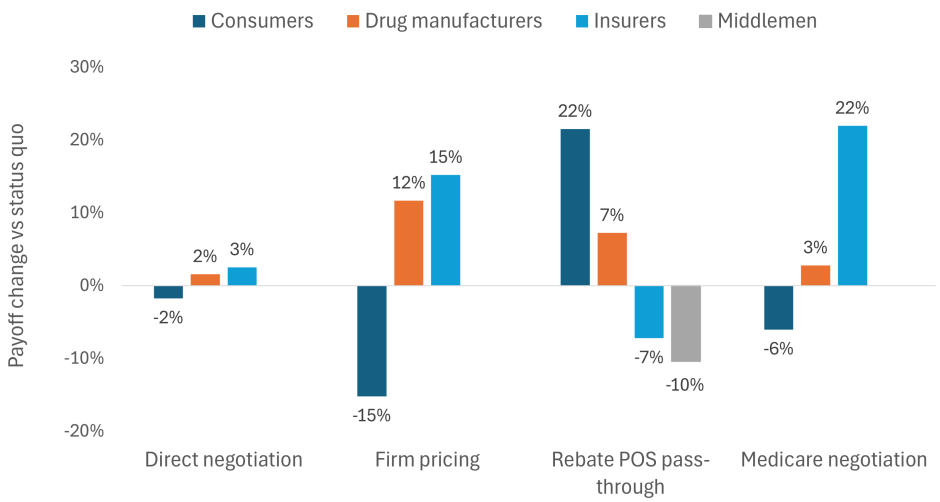
Notes: This simplified diagram shows how pricing would work in a counterfactual where middlemen pass through rebates to consumers at the point of sale, which is usually a pharmacy. Instead of facing out of pocket costs based on the list price, a consumer would pay out of pocket costs based on list minus the rebate negotiated for that consumer's insurance plan. In other words, a consumer covered by insurer 1 would pay based on list minus rebate A, and a consumer covered by insurer 3 would pay based on list minus rebate B. Note that this counterfactual is identical to each middleman-firm pair negotiating for a net price, which may be middleman-specific. A double-sided arrow denotes bilateral negotiation, while a single-sided arrow denotes unilateral price setting.

Figure A.5: Industry structure for Medicare negotiation

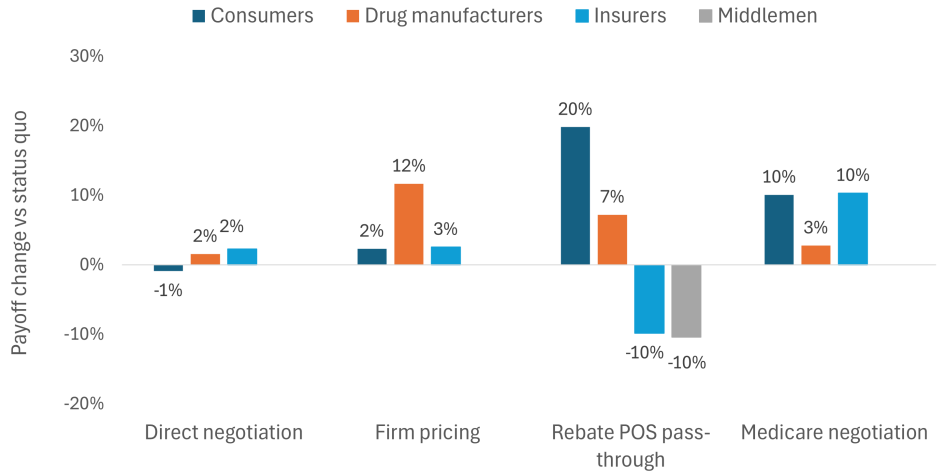


Notes: This simplified diagram shows how pricing would work in a counterfactual where the government aggregates all demand and negotiates with the drugmaker for a discounted price. This price would then be used throughout the supply chain, including for calculating consumer out-of-pocket costs.

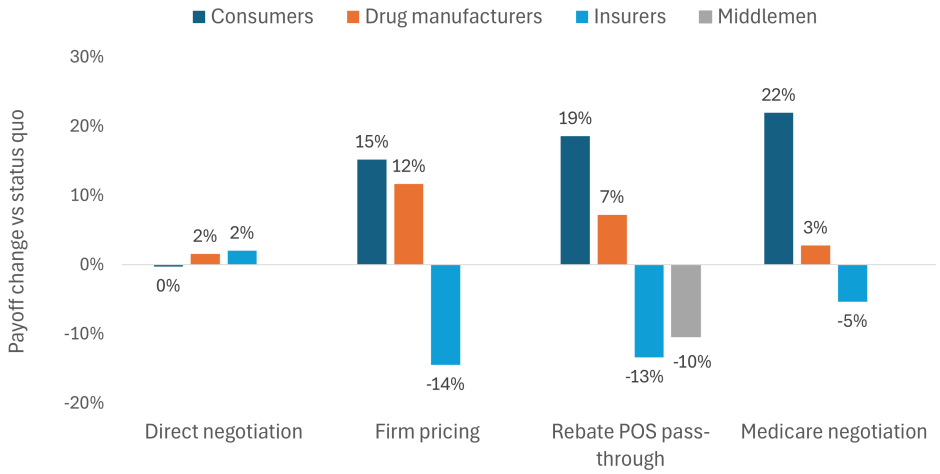
Figure A.6: Payoff comparison across counterfactuals



(a) Insurers pass 100% of rebates to consumers



(b) Insurers pass 50% of rebates to consumers



(c) Insurers pass no rebates to consumers

Notes: This figures shows payoff change vs the status quo for consumers, drug manufacturers, insurers and middlemen under 3 counterfactuals: direct negotiation, firm pricing, rebate POS pass-through, and Medicare negotiation. A summary of how these counterfactuals compare relative to the status quo can be found in Table 8. The industry structure for the status quo is depicted in Figure 3 while the industry structure for each counterfactual can be found in Figure A.2 through Figure A.5. Since the middleman doesn't exist under direct negotiation, firm pricing and Medicare negotiation, I have omitted the PBM's gray bar for these counterfactuals. The calculations for payoff change for consumers and insurers assume that insurers pass through 100% of rebates (sub-figure (a)), 50% of rebates (sub-figure (b)) or no rebates (sub-figure (c)) to consumers via premium reduction.

B Tables

Table B.1: Middleman size and concessions (DIR)

	(1)	(2)	(3)	(4)
	DIR	DIR	DIR	DIR
Size (000s)	0.10**	0.08**	-0.10***	-0.10***
	(0.05)	(0.04)	(0.03)	(0.03)
Size × Middleman (000s)			0.26***	0.21***
			(0.05)	(0.04)
Year FE	No	Yes	Yes	Yes
Outliers	Yes	Yes	Yes	No
Observations	23	23	23	22
R^2	0.20	0.45	0.76	0.84

Notes: Each observation is for a PBM-year. The main explanatory variable, size, is the number of enrollees that the insurer has. Model 3 and 4 include a dummy for if an insurer uses a middleman. Insurers who do not use middleman self-negotiate with drug manufacturers. Model 4 drops an outlier observation in the dependent variable. Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B.2: Cost-share and formulary placement

			Cost share		Formulary placement for Xarelto and Eliquis		
Year	Middleman	Member count	Xarelto	Eliquis	(pref, pref)	(pref, non-pref)	(non-pref, pref)
2015	Aetna	23133	0.11	0.48	0	81	0
2015	CVS/Caremark	48090	0.1	0.11	97	4	0
2015	Catamaran	33060	0.58	0.2	64	0	54
2015	Express Scripts	20923	0.15	0.15	69	0	0
2015	Humana	88740	0.19	0.2	96	0	0
2015	OptumRx	135857	0.13	0.13	67	0	0
2015	Prime Therapeutics	26720	0.1	0.21	6	18	0
2016	Aetna	35877	0.12	0.46	0	91	0
2016	CVS/Caremark	75016	0.12	0.12	142	0	0
2016	Express Scripts	22051	0.16	0.17	68	0	0
2016	Humana	97536	0.19	0.22	95	0	0
2016	OptumRx	150409	0.13	0.13	135	0	0
2016	Prime Therapeutics	26618	0.15	0.16	23	0	0
2017	Aetna	35881	0.11	0.45	0	88	0
2017	CIGNA	10789	0.1	1	0	57	0
2017	CVS/Caremark	82509	0.11	0.47	2	120	0
2017	Express Scripts	25118	0.14	0.18	73	2	0
2017	Humana	106694	0.21	0.23	95	0	0
2017	OptumRx	144629	0.11	0.15	88	29	0
2017	Prime Therapeutics	26730	0.17	0.22	21	3	0
2018	Aetna	38367	0.09	0.1	88	0	0
2018	CIGNA	10185	0.09	0.42	0	56	0
2018	CVS/Caremark	94443	0.1	0.1	124	0	0
2018	Express Scripts	27168	0.1	0.12	103	0	0
2018	Humana	109575	0.19	0.19	96	0	0
2018	OptumRx	142341	0.09	0.18	93	32	0
2018	Prime Therapeutics	28232	0.12	0.12	29	0	0
2019	CVS/Caremark	160363	0.09	0.09	246	0	0
2019	Express Scripts	37450	0.1	0.2	103	65	0
2019	Humana	100296	0.19	0.19	96	0	0
2019	OptumRx	138025	0.08	0.21	66	32	0
2019	Prime Therapeutics	27214	0.17	0.12	26	0	3

Notes: This table shows for each middleman-year, the number of patients covered by the middleman's insurers, average cost-share (as a percent of list price), and the distribution of health plans by formulary coverage. Patient count is restricted to those with atrial fibrillation.

C Demand estimation

C.1 Drug demand

Recall consumer i's utility from consuming drug $d \in \mathcal{D}$ on formulary $\mathcal{F}_j$ in market m (Eq. 1):

$$u_{ijdmt} = \underbrace{\beta_g \text{OOP}_{gjdmt} + \underbrace{\kappa_{gdmt}}_{\text{drug-market-group FE}}}_{=V_{ijdmt}} + \xi_{ijmt}\mathbb{I}\{d \neq 0\} + \lambda\epsilon_{ijdmt}$$

where $\xi_{ijmt}\mathbb{I}\{d \neq 0\} + \lambda\epsilon_{ijdmt}$ and ϵ_{ijdmt} each have a TIEV distribution. (The utility of taking no drug, u_{ij0mt}, is normalized to zero.)

The probability of choosing drug d can be written as

$$P_{ijdmt} = \underbrace{\frac{e^{V_{ijdmt}/\lambda}}{\sum_{k\in\mathcal{D}} e^{V_{ijkmt}/\lambda}}}_{=P_{ijdmt|d\neq 0}} \times \underbrace{\frac{\left(\sum_{k\in\mathcal{D}} e^{V_{ijkmt}/\lambda}\right)^{\lambda}}{1+\left(\sum_{k\in\mathcal{D}} e^{V_{ijkmt}/\lambda}\right)^{\lambda}}}_{=P_{ijdmt\neq 0}}$$

We can re-scale and relabel as follows:

$$\underbrace{\frac{u_{ijdmt}}{\lambda}}_{=\tilde{u}_{ijdmt}} = \underbrace{\frac{\beta_g}{\lambda}}_{\tilde{\beta}_g} \text{OOP}_{gjdmt} + \underbrace{\frac{\kappa_{gdmt}}{\lambda}}_{\tilde{\kappa}_{gdmt}} + \frac{\xi_{ijmt}\mathbb{I}\{d \neq 0\}}{\lambda} + \epsilon_{ijdmt}$$

Hence,

$$\tilde{u}_{ijdmt} = \tilde{\beta}_g \text{OOP}_{gjdmt} + \tilde{\kappa}_{gdmt} + \frac{\xi_{ijmt}\mathbb{I}\{d \neq 0\}}{\lambda} + \epsilon_{ijdmt}$$

To estimate the inside shares, we need to normalize by an inside good, call this drug 1.

$$\tilde{u}_{ijdmt} = \underbrace{\tilde{\beta}_g \text{OOP}_{gjdmt} + \underbrace{\tilde{\kappa}_{gdmt} - \tilde{\kappa}_{g1mt}}_{=\Delta\tilde{\kappa}_{gdmt}}}_{=\tilde{V}_{ijdmt}} + \tilde{\kappa}_{g1mt} + \frac{\xi_{ijmt}\mathbb{I}\{d \neq 0\}}{\lambda} + \epsilon_{ijdmt}$$

Given the TIEV distribution on ϵ_{ijdmt},

$$P_{ijdmt|d\neq 0} = \frac{\exp\left(\tilde{V}_{ijdmt} + \tilde{\kappa}_{g1mt} + \frac{\xi_{ijmt}\mathbb{I}\{d\neq 0\}}{\lambda}\right)}{\sum_{k\neq 0}\exp\left(\tilde{V}_{ijkmt} + \tilde{\kappa}_{g1mt} + \frac{\xi_{ijmt}\mathbb{I}\{k\neq 0\}}{\lambda}\right)} = \frac{\exp(\tilde{V}_{ijdmt})}{\sum_{k\neq 0}\exp(\tilde{V}_{ijkmt})}$$

Now we can take the log of both sides and apply a Poisson regression:

$$\log(\underbrace{\mathbb{E}[s_{ijdmt|d\neq 0}]}_{=P_{ijdmt|d\neq 0}}) = \tilde{V}_{ijdmt} + \kappa_i = \tilde{\beta}_g \text{OOP}_{gjdmt} + \Delta\tilde{\kappa}_{gdmt} + \kappa_i \tag{13}$$

Note that κ_i is a "decision-maker"-level fixed effect, and controls for the denominator in $P_{ijdmt|d\neq 0}$. In our context, since consumer heterogeneity is modeled at the group level, κ_i is equivalent to a plan-market-year-group fixed effect, where group is the demographic group $g(X_i)$ that i belongs to (i.e. $\kappa_i \equiv \kappa_{gjmt}$). From this regression, we can recover $\hat{\tilde{\beta}}_g$ and $\hat{\Delta\tilde{\kappa}}_{gdmt}$.

Now we move to the "second" or "outer" regression which recovers $\hat{\lambda}$ and $\hat{\kappa}_{g1mt}$. Note that by construction,

$$\frac{V_{ijdmt}}{\lambda} = \tilde{V}_{ijdmt} + \tilde{\kappa}_{g1mt}.$$

Hence, the probability of choosing the inside nest is

$$P_{ijdmt\neq 0} = \frac{\left(\sum_{k\neq 0} e^{V_{ijkmt}/\lambda}\right)^{\lambda}}{1 + \left(\sum_{k\neq 0} e^{V_{ijkmt}/\lambda}\right)^{\lambda}} = \frac{\left(\sum_{k\neq 0} \exp(\tilde{V}_{ijkmt} + \tilde{\kappa}_{g1mt})\right)^{\lambda}}{1 + \left(\sum_{k\neq 0} \exp(\tilde{V}_{ijkmt} + \tilde{\kappa}_{g1mt})\right)^{\lambda}}$$

which leads to our second estimating (Poisson) regression:

$$\begin{aligned}
\log(\underbrace{\mathbb{E}[s_{ijdmt\neq 0}]}_{=P_{ijdmt\neq 0}}) &= \lambda \log\left(\sum_{k\neq 0} \exp(\tilde{V}_{ijkmt} + \tilde{\kappa}_{g1mt})\right) + \kappa_{gjmt} \\
&= \lambda\tilde{\kappa}_{g1mt} + \lambda \log\left(\sum_{k\neq 0} \exp(\tilde{V}_{ijkmt})\right) + \kappa_{gjmt} \\
&= \kappa_{g1mt} + \lambda \log\left(\sum_{k\neq 0} \exp(\tilde{V}_{ijkmt})\right) + \kappa_{gjmt}
\end{aligned} \tag{14}$$

where κ_{gjmt} once again serves to control for the denominator in the probability.

The consumer surplus of a consumer from having access to drugs conditional on insurance choice is

$$\begin{aligned}
CS_{ijmt} &= \log\left(1 + \left(\sum_{k\neq 0} e^{V_{ijkmt}/\lambda}\right)^{\lambda}\right) \\
&= \log\left(1 + \exp\left(\kappa_{g1mt} + \lambda \log\left(\sum_{k\neq 0} \exp(\tilde{V}_{ijkmt})\right)\right)\right)
\end{aligned} \tag{15}$$

Note that consumer surplus is a function of plan formulary, e.g. $CS_{ijmt} \equiv CS_i(\mathcal{F}_{jmt})$, because out-of-pocket cost is a function of formulary.

C.2 Insurance plan demand

Given an insurance plan j, consumer surplus for the plan is given by plan j's formulary (denoted by $\mathcal{F}_j$), which we can estimate per Eq. 15. Consumers next choose from all available plans in a given market.

Recall consumer i's utility from choosing plan j in market m and year t sponsored by insurer c (Eq. 3):

$$u_{igjmt} = \eta\phi_{jmt} + \gamma CS_{gjmt} + \alpha X_{jmt} + \kappa_{gct} + \delta_{gmt} + \Delta\delta_{gjmt} + e_{igjmt}$$

where g denotes the group that i belongs to, η is premium-sensitivity, γ is the relative weight on realized consumer surplus from drug consumption relative to idiosyncratic features e, and X is a vector of plan attributes. κ_{gct} is a fixed effect at the group-insurer-year level. δ_{gmt} is a group-market fixed effect and $\Delta\delta_{gjmt}$ is plan j's deviation from the group-market fixed effect. We assume e has a TIEV distribution. Thus, patient demand for plan j is given by

$$s_{igjmt} \equiv s_{gjmt} = \frac{\exp\left(\eta\phi_{jmt} + \gamma CS_{gjmt} + \alpha X_{jmt} + \kappa_{gc(j)t} + \delta_{gmt} + \Delta\delta_{gjmt}\right)}{1 + \sum_{p\in\mathcal{J}_{mt}} \exp\left(\eta\phi_{pmt} + \gamma CS_{gpmt} + \alpha X_{pmt} + \kappa_{gc(p)t} + \delta_{gmt} + \Delta\delta_{gpmt}\right)}$$

Estimation follows Berry (1994).

$$\log(s_{gjmt}) - \log(s_{g0mt}) = \eta\phi_{jmt} + \gamma CS_{gjmt} + \alpha X_{jmt} + \kappa_{gc(j)t} + \delta_{gmt} + \Delta\delta_{gjmt} \tag{16}$$

Under the assumption that the plan's deviation from group-market utility, $\Delta\delta_{gjmt}$, is randomly distributed after controlling for group-insurer-year fixed effects, this can be estimated with OLS. I follow the literature in constructing a Hausman-style instrument for plan premium ϕ_{jmt} by using the premium for similar plans sponsored by the same insurer in other markets.

D Rebate derivation

The Nash solution for each plan-drug specific rebate r_j^d sets the ratio of gains from trade of the two parties equal to the ratio of their bargaining weight. The gains from trade are given in Eq. 4 (middleman) and Eq. 6 (drug manufacturer).

$$
\begin{aligned}
\frac{1-b_j^d}{b_j^d} &= \frac{(p^d - r_j^d)q_j^d - \left\{p^d q_j^{d,\text{dis}} + \sum_{l\in-\mathcal{K}}(p^d - \tilde{r}_l^d)\Delta_l^d\right\}}{r_j^d q_j^d - \tilde{r}_j^{-d}\Delta_j^{-d}} \\
(1-b_j^d)\left(r_j^d q_j^d - \tilde{r}_j^{-d}\Delta_j^{-d}\right) &= b_j^d\left((p^d - r_j^d)q_j^d - p^d q_j^{d,\text{dis}} - \sum_{l\in-\mathcal{K}}(p^d - \tilde{r}_l^d)\Delta_l^d\right) \\
r_j^d q_j^d - (1-b_j^d)\tilde{r}_j^{-d}\Delta_j^{-d} &= b_j^d\left(p^d q_j^d - p^d q_j^{d,\text{dis}} - \sum_{l\in-\mathcal{K}}(p^d - \tilde{r}_l^d)\Delta_l^d\right) \\
r_j^d &= \frac{b_j^d\left(p^d q_j^d - p^d q_j^{d,\text{dis}} - \sum_{l\in-\mathcal{K}}(p^d - \tilde{r}_l^d)\Delta_l^d\right) + (1-b_j^d)\tilde{r}_j^{-d}\Delta_j^{-d}}{q_j^d} \\
&= b_j^d\left(p^d - \frac{p^d q_j^{d,\text{dis}} + \sum_{l\in-\mathcal{K}}(p^d - \tilde{r}_l^d)\Delta_l^d}{q_j^d}\right) + \frac{(1-b_j^d)\tilde{r}_j^{-d}\Delta_j^{-d}}{q_j^d} \\
&= b_j^d\left(p^d - \frac{p^d q_j^{d,\text{dis}} + \sum_{l\in-\mathcal{K}}(p^d - \tilde{r}_l^d)\Delta_l^d + \tilde{r}_j^{-d}\Delta_j^{-d}}{q_j^d}\right) + \frac{\tilde{r}_j^{-d}\Delta_j^{-d}}{q_j^d}
\end{aligned}
$$

E List price derivation

Recall that consumer surplus from having anticoagulants covered on insurance is given by Eq. 2:

$$CS_{ijm} = \log\left(1 + \left(\sum_{k\in\mathcal{D}} e^{V_{ijkm}/\lambda}\right)^{\lambda}\right)$$

where $V_{ijkm} \equiv \beta_g \text{OOP}_{gjkm} + \kappa_{gkm}$ is the deterministic portion of u_{ijkm} and λ denotes the nest parameter.

This can be rewritten as

$$CS_{ijm} = \log\left(\exp\left(\kappa_{g1m} + \lambda \log\left(\sum_{k\neq 0} \exp(\tilde{V}_{ijkm})\right)\right) + 1\right).$$

with

$$\tilde{V}_{ijdm} = \tilde{\beta}_g \text{OOP}_{gjdm} + \underbrace{\tilde{\kappa}_{gdm} - \tilde{\kappa}_{g1m}}_{=\Delta\tilde{\kappa}_{gdm}}$$

where the tilde superscript denotes scaling by $1/\lambda$.

Recall the firm's FOC, per Eq. 12:

$$0 = \frac{\partial \Pi}{\partial p} = \iota\left(\frac{\gamma}{\eta}\sum_{i,j,m}\frac{\partial CS_{ijm}}{\partial p}\right) + (1-\iota)\frac{\partial \pi}{\partial p}$$

which implies that

$$\iota = \frac{-\partial\pi/\partial p}{\left(\frac{\gamma}{\eta}\sum_{i,j,m}\frac{\partial CS_{ijm}}{\partial p} - \partial\pi/\partial p\right)} \tag{17}$$

The derivatives are given by

$$\begin{aligned}\frac{\partial CS_{ijm}}{\partial p} &= \frac{\partial CS_{ijm}}{\partial \text{OOP}_{gjdm}} cs_{gjdm} \\ &= \left(\frac{\exp\left(\kappa_{g1m} + \lambda\log\left(\sum_{k\neq 0}\exp(\tilde{V}_{ijkm})\right)\right)}{\exp\left(\kappa_{g1m} + \lambda\log\left(\sum_{k\neq 0}\exp(\tilde{V}_{ijkm})\right)\right) + 1}\right)\ \frac{\lambda\exp(\tilde{V}_{ijdm})}{\sum_{k\neq 0}\exp(\tilde{V}_{ijkm})}\tilde{\beta}_g\ cs_{gjdm}\end{aligned}$$

and

$$\frac{\partial \pi}{\partial p} = \sum_j\left((p-c_j)\frac{\partial q_j}{\partial \text{OOP}_j}cs_j + q_j\right) = p\sum_j\frac{\partial q_j}{\partial \text{OOP}_j}cs_j - \sum_j\left(c_j\frac{\partial q_j}{\partial \text{OOP}_j}cs_j - q_j\right)$$

Once we recover ι, counterfactual prices can be calculated as

$$
\begin{aligned}
0 &= \iota \left(\frac{\gamma}{\eta} \sum_{i,j,m} \frac{\partial CS_{ijm}}{\partial p} \right) + (1-\iota) \frac{\partial \pi}{\partial p} \\
&= \iota \left(\frac{\gamma}{\eta} \sum_{i,j,m} \frac{\partial CS_{ijm}}{\partial p} \right) + (1-\iota) \left(p \sum_j \frac{\partial q_j}{\partial \text{OOP}_j} cs_j - \sum_j \left(c_j \frac{\partial q_j}{\partial \text{OOP}_j} cs_j - q_j \right) \right) \\
p &= \frac{-\iota \left(\frac{\gamma}{\eta} \sum_{i,j,m} \frac{\partial CS_{ijm}}{\partial p} \right) + (1-\iota) \sum_j \left(c_j \frac{\partial q_j}{\partial \text{OOP}_j} cs_j - q_j \right)}{(1-\iota) \sum_j \frac{\partial q_j}{\partial \text{OOP}_j} cs_j}
\end{aligned}
$$

Let p^0 denote price without rebates. Then the percentage change in price is given by

$$
\Delta p^0 \equiv \frac{p^0 - p}{p} = \frac{(1-\iota) \sum_j c_j \frac{\partial q_j}{\partial \text{OOP}_j} cs_j}{\iota \left(\frac{\gamma}{\eta} \sum_{i,j,m} \frac{\partial CS_{ijm}}{\partial p} \right) - (1-\iota) \sum_j \left(c_j \frac{\partial q_j}{\partial \text{OOP}_j} cs_j - q_j \right)}
$$

F Alternative model of list price setting

Instead of the firm's objective given in Eq. 10, suppose the drug manufacturer internalizes that a given change in the list price, some portion of it will go toward rebates. Without loss of generality, suppose rebate is now expressed in percentage terms, instead of in dollar values. The modified net profit objective is given by

$$\pi(p) = \sum_j (1 - r_j)\, p\, q_j(\text{OOP}_j(p))$$

where $\text{OOP}_j = cs_j \times p$. The corresponding derivative is

$$\frac{\partial \pi}{\partial p} = \sum_j (1 - r_j) \left(p \frac{\partial q_j}{\partial \text{OOP}_j} cs_j + q_j \right)$$

The political constraints parameter ι continues to be given by Eq. 17. Counterfactual prices are given by

$$0 = \iota \left(\frac{\gamma}{\eta} \sum_{i,j,m} \frac{\partial CS_{ijm}}{\partial p} \right) + (1 - \iota) \left(\sum_j (1 - r_j) \left(p \frac{\partial q_j}{\partial \text{OOP}_j} cs_j + q_j \right) \right)$$

$$p = \frac{-\iota \left(\frac{\gamma}{\eta} \sum_{i,j,m} \frac{\partial CS_{ijm}}{\partial p} \right) - (1 - \iota) \sum_j (1 - r_j) q_j}{(1 - \iota) \left(\sum_j (1 - r_j) \frac{\partial q_j}{\partial \text{OOP}_j} cs_j \right)}$$

As shown in Figure F.1 in the hollow scatter plot series, under this alternative list price model, price actually decreases with rebating. The intuition is when the firm contemplates raising price, it knows that demand responds to the full price increase, while it only benefits from a fraction (i.e. one minus the rebate fraction) of the price increase. As a result, it will actually lower price in response to higher percentage rebate. Since this pattern is clearly inconsistent with what we observe in data (e.g. Figure 1 and Figure A.1 show that as rebate rises in percentage term, so does the list price), the main specification uses the model that treats rebate as a (fixed) marginal cost in the firm's pricing decision, which are shown in the solid scatter plot series in Figure F.1.

Figure F.1: Rebate vs list price