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VERTICAL INTEGRATION IN THE PHARMACEUTICAL MARKET

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Disadvantaging Rivals: Vertical Integration in the Pharmaceutical Market

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ABSTRACT

The pharmaceutical market has experienced a massive wave of vertical integration between pharmacy benefit managers (PBMs) and health insurers in recent years. Using a unique dataset on insurer-PBM contracts, we document increasing vertical integration in Medicare Part D—vertically integrated insurers' market share increased from about 30% to 80% between 2010 and 2018. Next, we evaluate a large insurer-PBM merger in 2015 to assess the trade-offs of vertical integration—harms to competition due to input and customer foreclosure on the one hand and improved efficiency on the other. We find premium increases after the merger for insurers who bought PBM services from rivals, which is consistent with vertically integrated PBMs raising costs through input foreclosure.

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1. Introduction

Vertical integration –i.e., integration between an upstream supplier and a downstream buyer— has grown substantially in the healthcare sector over the last few decades. While antitrust regulators have historically focused attention on horizontal integration –i.e., integration between competing entities— there is growing interest in understanding the effects of vertical relationships on market competition and consumer welfare. In theory, vertical integration can eliminate double marginalization and better align incentives resulting in lower prices (Spengler 1950; Williamson 1985; Grossman and Hart 1986). On the other hand, vertically integrated firms can engage in input foreclosure, leading to higher prices for rival firms (Salop and Scheffman 1983; Ordover et al. 1990; Hart et al. 1990). The evidence on the effects of vertical integration in healthcare is quite limited and focuses largely on hospital and physician consolidation. In this study, we present some of the first empirical evidence of how vertical integration between pharmacy benefit managers (PBMs) and health insurers has impacted competition in the prescription drug insurance market of Medicare Part D.

PBMs are an important and controversial intermediary in the pharmaceutical supply chain. PBMs contract with insurers to manage the prescription drug benefits for health plans. A principal function of PBMs is negotiating with drug manufacturers and pharmacies on behalf of insurers to obtain discounts and rebates on prescription drugs. PBMs manage pharmaceutical benefits for almost 90% of insured Americans (Dowell 2022). PBMs are able to negotiate large rebates because they leverage enormous bargaining power from pooling together the enrollees of multiple insurers. However, PBMs have also drawn considerable criticism about the opacity of rebates and their potentially limited pass-through to insurers as well as perverse incentives that may encourage PBMs to give favorable formulary placement to drugs with higher list prices

(Socal et al. 2019; Sood et al. 2020; Van Nuys et al. 2021). These concerns have led to numerous policy proposals. In 2020, the Trump administration proposed the “rebate rule” that would require PBMs to pass through 100% of Medicare rebates at the point-of-sale.¹ Additionally, in 2021 alone, state legislatures put forth over one hundred pieces of legislation that were aimed at regulating PBMs (NASHP 2021).²

Underlying these concerns has been a trend towards increasing consolidation of PBMs. The initial wave of consolidation among PBMs was primarily horizontal, however, the last decade has brought vertical integration between PBMs and health insurers. In 2020, the three largest PBMs—who processed approximately four out of every five prescription drug claims—were each integrated with an insurer (Fein 2021). While this integration could have the benefit of aligning PBM incentives with the interests of the insurers that own them, it also raises anticompetitive concerns through input and customer foreclosure.

Input foreclosure occurs when a PBM owned by an insurer increases the costs or reduces the quality of its services provided to insurers who compete with its parent insurer. For example, the PBM could pass through a larger share of manufacturer rebates to its parent insurer than it passes through to rival insurers. The degree of input foreclosure depends on the level of competition in the PBM market. If PBM markets have many competitors, then input foreclosure is less likely as rival health plans experiencing input foreclosure can switch to one of many standalone PBMs. However, if PBM markets are highly concentrated then input foreclosure is more likely as rival plans have limited options to switch to another PBM. Customer foreclosure, by contrast, occurs when the downstream firm of a merged entity no longer purchases inputs

¹ Congress delayed implementation of the rule until 2032 with the Inflation Reduction Act (CRFB 2022).

² Many of these proposals aim to improve transparency of drug rebates and transaction prices, but previously enacted state laws have had limited success (Ryan and Sood 2019).

from its upstream competitors. For instance, when an insurer and PBM consolidate, the insurer's health plans will always use services from its own PBM, thus reducing the potential number of clients for standalone PBMs. The reduction in the potential customer base could ultimately lead standalone PBMs to exit the market which would further increase the concentration of PBMs.

In this study, we examine the consequences of vertical integration of PBMs and insurers in the Medicare Part D market. In particular, we ask whether vertical integration has harmed non-vertically integrated rival insurers through input foreclosure and how input foreclosure changes with changes in competition from standalone PBMs. This is the first study to link information on insurer-PBM contract relationships from a proprietary dataset to Centers for Medicare and Medicaid Services (CMS) data on Part D prescription drug insurance plans (PDPs). Using these unique data, we first highlight the potential for input and customer foreclosure by documenting increasing trends in market shares of vertically integrated Part D plans from 2010 through 2018. Next, we highlight potential input foreclosure by showing the association between increasing vertical integration in this market, declining competition from standalone PBMs, and premium increases for non-vertically integrated plans relative to vertically integrated plans. This descriptive analysis motivates our main empirical strategy. We conduct a difference-in-differences (DD) analysis leveraging a large insurer-PBM merger in 2015 (UnitedHealth-Catamaran) which eliminated the last significant standalone PBM and shifted more insurers into contracts with vertically integrated PBMs. This provides an opportunity to evaluate how premiums change when plans switch from a standalone PBM to a PBM that is vertically integrated with a rival insurer as well as how premiums change for all other non-vertically integrated plans when the main outside option for standalone PBM services is removed.

We focus on the Part D standalone PDP market for several reasons. First, insurer-PBM integration has been a long-standing feature of this market. Since the inception of Part D, some PBMs have simultaneously provided pharmacy benefit management services to insurers that offer PDPs while also underwriting their own competing prescription drug insurance plans (e.g., CVS Caremark operates as both an insurer and as a PBM). In this sense, many PBMs have operated as vertically integrated insurer-PBMs within Part D. This differs from the commercial market where vertical integration between insurers and PBMs is a more recent phenomenon; two of the largest vertical mergers, CVS-Aetna and Express Scripts-Cigna, were completed at the end of 2018. By studying the Part D PDP market, we have a longer time horizon in which to observe the impacts of insurer-PBM integration. Second, unlike most commercial health insurance plans and Medicare Advantage plans, PDPs offer only prescription drug coverage rather than bundled medical and drug benefits. This provides a clean setting for isolating the effects of insurer-PBM relationships on prescription drug premiums. Finally, studying the Part D market enables us to understand how insurer-PBM vertical integration affects consumer welfare through its impact on the cost of prescription drug coverage for the elderly, a medically vulnerable population with high prescription drug usage.

We find that the share of Part D beneficiaries enrolled in a plan that is vertically integrated with a PBM increased substantially from about 30% to 80% between 2010 and 2018. At the same time, premiums rose rapidly for non-vertically integrated insurers who obtained pharmacy benefit services from a PBM owned by a rival plan. We also find that the exit of the last significant standalone PBM in the Part D market—Catamaran—led to increases in premiums of former clients of the standalone PBM who had to switch to using a PBM owned by a rival insurer. Additionally, the loss of the last outside option for standalone PBM services resulted in

premium increases for other non-vertically integrated insurers that had already been using a PBM owned by a rival insurer. Overall, our difference-in-differences estimates show that non-vertically integrated insurers experienced premium increases of 36% when compared to vertically integrated insurers. These findings are consistent with vertically integrated PBMs engaging in input foreclosure. Specifically, a vertically integrated PBM had a larger incentive to raise costs for rivals when those rivals lost the ability to substitute to a standalone PBM.

This paper contributes to several lines of research. First, we contribute to the literature on vertical integration in healthcare. There has been considerable research in this area, but the vast majority of these studies have focused on vertical integration of hospitals and physicians. Much of this work has found that after hospitals acquire physician practices both hospital and physician prices increase, but there is no improvement in the quality of care provided to patients (Cuellar and Gertler 2006; Ciliberto and Dranove 2006; Baker et al. 2014; Koch et al. 2017; Capps et al. 2018; Richards et al. 2022). However, we are unaware of any empirical research that has studied the consequences of vertical integration between insurers and PBMs. This paper will be the first to consider this important understudied area.

Second, we contribute to the nascent research on PBMs, which has likely been limited due to a lack of data about PBM contracts and rebates. The existing literature has introduced theoretical models on the operations of PBMs (Conti et al. 2021; Brot-Goldberg et al. 2022; Feng and Maini 2023). Most relevant to our study, Brot-Goldberg, Che, and Handel (2022) show simulation results from a game-theoretic model of a PBM negotiating with drug manufacturers on behalf of two competing insurers. Their simulation results show that when the PBM integrates with one of the insurers, the PBM disadvantages the rival insurer by passing through a smaller proportion of the rebate, which leads to the rival having to raise its premium (i.e., input

foreclosure). The few empirical studies that exist on PBMs focus on how PBMs affect net drug spending through rebates from drug manufacturers (Olssen and Demirer 2021; Feng and Maini 2023) and subsequent R&D investments (Agha et al. 2022). While there has been substantial debate about the potential consequences of increasing vertical consolidation (e.g., Economist (2017); Madera (2018)), we are unaware of any empirical evidence on how insurer-PBM vertical integration affects consumer welfare. We aim to fill this knowledge gap by considering how this integration impacts premiums in Medicare Part D.

Finally, this paper also contributes to literature studying competition in the Part D market. Prior research studies the effects of horizontal insurer mergers on Part D premiums (Chorniy et al. 2020; Hill and Wagner 2021). We broaden our understanding of insurer competition in Part D by considering how vertical PBM-insurer mergers can have downstream effects on competition among insurers.

This paper proceeds as follows. In Section 2, we provide institutional background on Part D and PBMs. Section 3 describes our data sources and defines PBM-insurer relationships. Section 4 documents descriptive trends in vertical integration and premiums. Section 5 outlines our empirical strategy and Section 6 presents the results. Section 7 concludes.

2. Institutional Background

2.1 Medicare Part D

Medicare Part D is a voluntary benefit that has provided prescription drug insurance to Medicare beneficiaries since 2006. In 2021, about 80 percent of the 62 million Medicare beneficiaries were enrolled in a Part D plan (KFF 2021). These plans are designed and managed by private insurers who compete on an annual basis to enroll Medicare beneficiaries. Medicare beneficiaries choose prescription drug plans offered in 34 regional insurance exchanges. Plans

are offered as either standalone prescription drug plans (PDPs) or Medicare Advantage prescription drug plans (MA-PDs). We focus on PDPs, which account for about 48% of enrollees.³ MA-PDs provide prescription drug insurance bundled with medical coverage, which obscures the relationship between their premiums and prescription drug costs (Lucarelli et al. 2012; Trish 2019).

2.2 Pharmacy Benefit Managers

PBMs provide a multitude of services for insurers including processing of prescription drug claims, designing the drug formulary, contracting with pharmacies, and negotiating rebates with drug manufacturers. While Part D has regionally defined markets (PDP Regions), PBMs typically contract with insurers at a national level. For instance, an insurer that offers plans in multiple PDP regions will typically contract with the same PBM in all of those regions. The Managed Market Surveyor data described below confirms that the relationship between an insurer and PBM typically does not vary across PDP markets.⁴ Although PBM-insurer relationships are generally national, we will conduct our analysis at the plan-region-year level in order to account for competitive dynamics in regional insurance markets.

3. Data

3.1 Medicare Part D Data

We use publicly available datasets from CMS that contain information on Medicare Part D plan characteristics and enrollment from 2010 through 2018. We obtain plan characteristics from the CMS PDP Landscape files. The files include the insurer and plan names, Part D Region

³ In 2018, approximately 48% of Part D enrollees were enrolled in a standalone PDP while 36% were enrolled in a MA-PD plan. The remaining 16% were enrolled in employer sponsored Retiree plans (KFF 2021).

⁴ While the primary services provided by the PBM are the same across plans for a given insurer, there could be differences in formularies, pharmacy networks, and fees across plans.

of the plan, monthly premium paid by the beneficiary⁵, annual deductible, and whether the plan offers “enhanced” benefits, i.e., benefits that are actuarially greater than the standard benefit. We also obtained each plan’s annual enrollment from the CMS Part D Contract and Enrollment Data files. We restrict the plans in our sample to standalone PDPs. Our full sample consists of 9,416 plan-region-year observations.

3.2 PBM Data

Our second data source comes from historical snapshots of the Decision Resources Group (DRG) Managed Market Surveyor (MMS) from 2010 through 2018.⁶ The MMS is a proprietary dataset created by surveying all insurers offering commercial, Medicare Part D, or Medicaid plans to determine which PBM each plan utilizes for several categories of services: formulary management, rebate negotiations, claims adjudication, mail-order pharmacy, and benefit design. We match these PBM service variables from the MMS data to our sample of Medicare standalone PDPs to identify the PBM services used by each plan.

Most plans in our sample (about 66% of plan-region-year observations) utilize only one PBM per year. The remainder either do not use a PBM (14%) or use two or more PBMs for different services (e.g., one PBM for rebate negotiations/formulary design and another PBM for mail-order pharmacy) (20%). When there are multiple PBMs recorded, we assign the PBM that is responsible for rebate negotiations and formulary management which is most relevant for our analysis. For about 6% of plan-region-year observations, a plan uses a different PBM for rebate negotiations and formulary management. In these cases, we research the insurer and PBMs by

⁵ Part D premiums are subsidized by the federal government. However, the CMS Landscape data report the portion of the premium paid by Medicare beneficiaries.

⁶ DRG was acquired by Clarivate in 2020.

reading 10Ks, annual reports, and other publications to determine the primary PBM serving each plan (see Appendix A for details on the assignment algorithm).

The MMS data have been used elsewhere by researchers to measure market shares of insurers by geographic region (e.g., Cooper et al. 2019). However, this is the first research study that we are aware of which has utilized the PBM information contained in the MMS data.

3.3 Defining Insurer-PBM Relationships

Our analysis will study trends in insurer-PBM relationships in the Part D PDP market. We categorize insurer-PBM relationships into four distinct groups: (a) insurers that are vertically integrated with a PBM (e.g., CVS Caremark plans using CVS Caremark as their PBM); (b) insurers without PBM capabilities that use a PBM which is vertically integrated with a rival insurer (e.g., Wellcare using CVS Caremark as its PBM); (c) insurers without PBM capabilities that use standalone PBMs—that is, PBMs that sell their services to Part D insurers, but do not offer prescription drug plans themselves (e.g., Wellcare using Catamaran as its PBM); (d) insurers who possess PBM capabilities that they use for their own plans, but do not sell those PBM services to rival insurers (e.g., Humana).⁷ In this paper, we focus on the first three insurer-PBM relationships, which account for three-fifths of the PDP market and exclude group (d) from our main analysis because those PBMs do not directly compete with other PBMs. For example, a non-Humana insurer cannot purchase PBM services from Humana’s PBM. In robustness tests, we include group (d) plans and find no meaningful changes to our results.

4. Trends in Insurer-PBM Vertical Integration and Premiums in Medicare Part D, 2010-2018

⁷ See Appendix Table B.3 for frequency of insurers in each category.

Using these definitions, we first compute market shares for the three insurer-PBM types above by summing enrollment for each insurer-PBM type and dividing by total enrollment across the three types: (a) through (c). Figure 1 documents trends in the market shares of each type from 2010-2018. In 2010, about 30% of Medicare Part D PDP enrollees in our sample were enrolled in an insurance plan vertically integrated with a PBM (type (a) above). By 2018, more than 80% were enrolled in a vertically integrated plan. Over the same time period, the market shares of non-vertically integrated plans using a rival insurer's PBM or a standalone PBM plummeted. The market share of plans using a rival's PBM was only 17% by 2018. The market share of plans utilizing standalone PBMs never exceeded 20%. However, their collective market share fell close to zero after Catamaran, the last significant standalone PBM, was acquired in 2015.⁸ Rising market share of the vertically integrated plans over this time period indicates rising customer foreclosure in the PBM market as members of these plans are locked out from the PBM market and are unlikely to use the services of standalone PBMs. This could have been a precipitating factor in the collapse of the standalone PBM market in Part D. Furthermore, this trend could indicate the potential for input foreclosure since plans will be less able to threaten a switch to a standalone PBM as vertical integration increases.

Next, we show trends in mean monthly Part D premiums paid by Medicare beneficiaries in Figure 2. If input foreclosure is increasing in this market, then we would expect that premiums would rise faster for non-vertically integrated plans using PBMs owned by rival insurers (type (b)), who would face higher input costs for PBM services due to input foreclosure, relative to

⁸ Two small standalone PBMs, DST Pharmacy Solutions and MedImpact, remained after Catamaran's exit with a combined market share of 0.37% in 2016. DST exited the PDP market in 2017 and MedImpact retained only one client that operated in one Part D region.

vertically integrated plans (type (a)). These differences would be more pronounced as competition from standalone PBMs weakens.

Part D premiums were initially similar across plan types, but began to diverge as the market share of vertically integrated plans increased such that by 2018, the average premiums of non-vertically integrated insurers using a rival's PBM were almost 65% higher than premiums of vertically integrated plans.⁹ Overall, premiums grew by 78% from 2010 to 2018 for non-vertically integrated plans using a rival's PBM compared to a slight reduction of approximately 5% for vertically integrated plans. These trend lines are raw means that do not account for differences in plan or geographic characteristics. However, these trends are consistent with the possibility that there was increasing input foreclosure since the risk of input foreclosure increases as the outside options for hiring a standalone PBM diminishes. The trend of decreasing premiums for vertically integrated insurers is consistent with possible efficiency gains from vertical integration, however, these gains do not appear to be transferred to rival plans contracting with vertically integrated PBMs since their premiums increase.

5. Empirical Strategy: Leveraging the Exit of the Last Standalone PBM

To further assess whether input foreclosure can explain the increase in premiums observed in the previous descriptive analysis, we conduct a difference-in-differences and event study analysis to study the exit of the last major standalone PBM, Catamaran, which occurred when UnitedHealth/OptumRx acquired it in July 2015.¹⁰ When Catamaran became part of the vertically integrated UnitedHealth/OptumRx, insurers previously using this standalone PBM transitioned largely to contracts with vertically integrated PBMs. This merger provides an

⁹ We exclude from Figure 2 plans using standalone PBMs (type (c)) since there were very few enrollees in these plans in the later years of our study period, so the premium data are noisy. Appendix Table B.2 shows premium trends for these plans.

¹⁰ UnitedHealth is the insurance arm while OptumRx is the PBM arm of the same company.

opportunity to test two hypotheses. First, we predict that insurers switching from a standalone PBM to a rival's vertically integrated PBM could experience input foreclosure which could raise their costs and lead them to increase their premiums relative to vertically integrated insurers. Second, the exit of Catamaran could also affect other non-vertically integrated insurers which had already been utilizing a PBM owned by a rival insurer prior to Catamaran's exit. These insurers could also be exposed to an increased risk of input foreclosure as they no longer have the outside option of switching to a standalone PBM. To test this, we compare premiums before and after the UnitedHealth-Catamaran merger for non-vertically integrated insurers who were exposed to an increased risk of input foreclosure relative to a control group of vertically-integrated insurers that do not face increased input costs as a result of the merger. This isolates the effects of input foreclosure, which should only affect non-vertically integrated insurers.

It should be noted that there could be horizontal effects of the merger in addition to the vertical effects noted above. However, we cannot identify the pure horizontal effects (i.e., enhanced market power of PBMs due to OptumRx's integration with Catamaran) because it affects all insurers in the market. Thus, these effects will be differenced out in our difference-in-differences regression framework.¹¹ Our strategy thus focuses on and is well suited for identifying the vertical aspects of the merger (i.e., input foreclosure) which are predicted to have *differential* effects by insurer status.

¹¹ We assume that in the absence of any vertical effects (e.g., input foreclosure) from the UnitedHealth-Catamaran merger, the horizontal effect of increased concentration in the PBM market caused by the merger would affect all insurers similarly. Thus, our time fixed effects account for these changes to market concentration. To the extent that non-vertically integrated insurers raise their premiums less (more) than vertically integrated insurers in response to greater horizontal market power of PBMs, we may understate (overstate) our estimates of vertical input foreclosure. However, we find no evidence of increasing premiums among vertically integrated insurers after 2015 (see Figure 2) suggesting limited horizontal effects of the merger. Prior studies of horizontal insurer mergers use variation in exposure to the merger across geographic markets (e.g., Dafny et al. 2012), however, this is not an effective strategy for studying horizontal PBM mergers because PBMs operate in a national market (i.e., there is no market that is unaffected by Catamaran's acquisition). Thus, an alternative strategy is needed to estimate these horizontal effects.

To conduct our difference-in-differences analysis, we estimate the following regression:

$$Premium_{ijrt} = \gamma_j + \tau_t + \alpha_r + \mathbf{X}'_{ijrt}\boldsymbol{\beta} + \delta \left(1(Treated_j) \times 1(Year_t \geq 2015) \right) + \varepsilon_{ijrt} \quad (1)$$

Where $Premium_{ijrt}$ is the monthly premium of plan i offered by insurer j in Part D region r in year t .¹² $1(Treated_j)$ is an indicator equal to one if the insurer is not vertically integrated with a PBM and thus must purchase PBM services from a rival firm. These insurers are most affected by the input foreclosure effects of the merger. The control group are insurers who are vertically integrated with a PBM and thus face no risk of input foreclosure before and after the exit of Catamaran. We define both groups based on the insurer's status just prior to the merger. $1(Year_t \geq 2015)$ is an indicator equal to 1 in all years on or after 2015, when Catamaran exited the standalone PBM market. We include insurer fixed effects γ_j to account for fixed, unobservable characteristics of the insurers that may influence their premiums, year fixed effects τ_t to account for national trends in premiums, and Part D region fixed effects α_r to control for regional characteristics that are constant over time. We also control for a full set of plan characteristics: annual deductible, an indicator for enhanced benefits, an indicator for gap coverage, and an indicator for whether the plan is eligible to enroll low-income beneficiaries. Standard errors are clustered at the insurer level. We also estimate an analogous event-study version of Equation (1) where we interact $1(Treated_j)$ with year fixed effects to evaluate the parallel trends assumption and show how the merger effects evolve over time.

We assess heterogeneity in the effects of Catamaran's exit across two groups of non-vertically integrated plans compared to vertically integrated plans. First, we examine plans that had been using Catamaran as its PBM in the quarter prior to its acquisition and were forced to

¹² We do not adjust Part D premiums for inflation since we include year fixed effects in our analyses which will account for national inflationary effects on premiums.

switch to a rival's vertically integrated PBM after Catamaran's exit. Two insurers met this criterion: BlueCross BlueShield (BCBS) of Arizona and Wellcare.¹³ Second, we examine plans that had already been using a vertically integrated PBM owned by a rival insurer in 2015. These plans lost their remaining outside option of a standalone PBM when Catamaran exited. Fourteen insurers met this criterion.¹⁴

Finally, we assess heterogeneity in the merger's effects for UnitedHealth's own plans compared to other vertically integrated insurers. For example, UnitedHealth plans may realize efficiency gains from the enhanced bargaining power of adding additional lives to its PBM.¹⁵

6. Results

6.1. Effects of UnitedHealth-Catamaran Merger on Premiums

As shown previously in Figure 1, the merger of UnitedHealth and Catamaran led to a large increase in the market share of vertically integrated plans in the Part D market and reduced the market share of insurers using standalone PBMs to close to zero. In this section, we study the effects of this merger on premiums of non-vertically integrated plans including plans that used Catamaran as their PBM prior to the merger. We begin by estimating an event study of premium changes in Figure 3. Prior to the merger, between 2010 and 2014, the premium trends for non-vertically integrated plans were not statistically distinguishable from vertically integrated plans. However, following Catamaran's exit in 2015, we observe a statistically significant divergence in these trends. Non-vertically integrated plans' premiums begin to grow relative to vertically

¹³ Cigna also used Catamaran's PBM services in 2015. However, Cigna's financial reports indicate that it transitioned its core PBM functions (i.e., rebate negotiation and formulary management) internally following Catamaran's exit. All other insurers using Catamaran in 2015 did not have those internal capabilities and lacked the ability to substitute their PBM services away from a rival insurer's PBM. (Fein 2018). We also observe exits of a few small insurers who used Catamaran's services in 2015.

¹⁴ The insurers are Anthem, BCBS AR, BCBS CT, BCBS MA, BCBS MI, BCBS RI, BCBS SC, BCBS TN, BCBS VT, Capital BlueCross, Educators, Healthnow NY, Highmark, and WI Physicians.

¹⁵ Additionally, we perform robustness tests where we exclude from the analysis UnitedHealth's own plans and rival plans using UnitedHealth's PBM.

integrated plans. Using our difference-in-differences model in equation (1), Figure 4 shows that non-vertically integrated plans experienced premium growth of approximately \$19 per month after Catamaran's exit relative to the control group of vertically integrated plans (Column (1)); this represents an approximately 36% increase from the mean monthly premium of \$54. We test the sensitivity of these results to expanding the control group to include insurers of type (d)—i.e., those with PBM capabilities that are not sold to rival insurers. We find a similar effect. The premiums of non-vertically integrated plans increased by \$23 per month (Column (5) of Appendix Table B.1).

6.2. Heterogeneity by Insurer Type: Direct and Indirect Effects of Merger

Next, we decompose this effect separately for two groups of non-vertically integrated insurers who were directly and indirectly affected by the merger, respectively: (1) plans using Catamaran in the quarter before its exit who switched to a rival's vertically integrated PBM, and (2) plans that were already using a rival's vertically integrated PBM before the exit (Columns (2) and (3) of Figure 4). The insurers that shifted to a rival's vertically integrated PBM after using Catamaran experienced a premium increase of approximately \$12 relative to the control group of vertically integrated plans (22% increase). For insurers already using a rival's vertically integrated PBM in 2015, the relative premium increase was approximately \$29 (53% increase). One possible explanation for the smaller effect for the first group is that insurers who switched from a standalone PBM to a vertically integrated PBM could have experienced some cost savings from using a rival's vertically integrated PBM, even if the net effect on premiums was still positive because of the vertically integrated PBM's incentives for input foreclosure. For example, because of its larger size, this vertically integrated PBM may be better able to achieve economies of scale, which could reduce costs for rival insurers that utilize its services. However,

the fact that we find an increase in premiums overall, suggests that this potential benefit may have been offset by the vertically integrated PBM's incentives for input foreclosure.

We investigate two additional possible explanations for this somewhat counterintuitive result that the plans most directly affected by Catamaran's exit had a smaller premium increase than plans indirectly affected because they lost their outside option for standalone PBM services. First, we explore the extent to which an insurer's size predicts the magnitude of the premium effect. We hypothesize that smaller insurers are more likely to experience input foreclosure from their vertically integrated competitors because they cannot credibly threaten to manage their own pharmacy benefit if they obtain unfavorable PBM contracts. Since plans that previously used Catamaran tended to be larger insurers, the premium effects of the merger for these plans could be lower than the premium effect of the merger for smaller insurers. To test this explanation, we estimate the premium effect separately for insurers who had been using a rival's PBM in 2015 based on quartiles of their size. We characterize each insurer's size as the average of its national enrollment in the two years immediately preceding Catamaran's exit. Indeed, the largest increase in premiums occurs for the smallest insurers (quartile 1). For the remaining quartiles there is no relationship between insurer size and the premium increase (Appendix Figure B.1). Thus, this may explain some, but not likely all, of the differences in effects between the two groups of plans.

The second explanation we consider is inertia or inattention among insurers. Insurers who had Catamaran as their PBM were forced to switch to a new PBM. PBMs might offer better deal terms to new clients and then gradually increase input foreclosure over time as insurers become more inattentive (i.e., "invest-then-harvest" strategy (Ericson 2014)). To investigate this hypothesis, we re-estimate our main regression, but split the plans already using a rival's PBM in

2015 into two subgroups: (1) those that stayed with the same PBM for all years after Catamaran's exit and (2) those that switched to a different PBM at any point after Catamaran's exit.¹⁶ Indeed, we find that insurers that switch to a new PBM increase their premiums by approximately \$16 (Column (4) of Figure 4). In contrast, the inertial insurers that did not change PBMs increased premiums by nearly \$30 (Column (5)). These results are consistent with PBMs raising input costs more for inattentive insurers.

6.3. Heterogeneity by Insurer Type: Effects of Merger on UnitedHealth's Own Plans

While the increase in premiums for non-vertically integrated insurers relative to vertically integrated ones after 2015 is consistent with input foreclosure, an alternative possibility is that this differential in premiums is due to vertically integrated insurers becoming more efficient than their non-vertically integrated rivals. For example, acquiring Catamaran could have improved the operations of UnitedHealth's PBM, which enabled UnitedHealth to reduce its premiums. Additionally, the integration of Catamaran and OptumRx could enhance the PBM's bargaining power in negotiations with drug manufacturers resulting in greater cost savings. To test this, we compare how the premiums of UnitedHealth's plans change relative to the premiums of the other vertically integrated insurers before and after the merger. We estimate an event study similar to Figure 3, but we restrict our sample to vertically integrated plans and compare UnitedHealth's plans to all others as controls. The point estimates from this event study are near zero and not statistically significant suggesting that UnitedHealth did not experience meaningful efficiency gains to lower its premiums relative to the other vertically integrated competitors (see Appendix Figure B.2).¹⁷

¹⁶ Five out of the fourteen insurers switched to a new PBM and the remaining nine stayed with the same PBM.

¹⁷ As an additional robustness check, we also re-estimate our primary regression excluding UnitedHealth's vertically integrated plans and the non-vertically integrated rivals using OptumRx. Our results are effectively unchanged (columns (6) through (8) of Appendix Table B.1).

7. Conclusion & Discussion

We document that the market share of vertically integrated Part D prescription drug plans grew significantly from approximately 30% to 80% between 2010 and 2018. As integrated insurer-PBM enrollment expanded, the potential market size for standalone PBMs shrunk (i.e., customer foreclosure). This is one force that may have contributed to Catamaran's exit and the end of the standalone PBM market in Medicare Part D.

As the market share of vertically integrated insurers grew, premiums increased rapidly for non-vertically integrated plans using a rival insurer's PBM while premiums decreased slightly for vertically integrated plans. This premium increase was particularly pronounced following Catamaran's exit, the last significant standalone PBM; the premiums of non-vertically integrated plans increased by almost 36% relative to their vertically integrated counterparts. We find a large increase in premiums for plans that previously used Catamaran and switched to a vertically-integrated PBM and other non-vertically integrated plans using a rival's PBM that were indirectly affected by Catamaran's exit. The faster growth in premiums of non-vertically integrated plans is consistent with input foreclosure. That is, when non-vertically integrated insurers lost a viable outside option for standalone PBM services, vertically integrated PBMs had a greater incentive to raise costs for its rivals which led to premium increases.

Our study focuses on the consequences of vertical integration for non-vertically integrated rival insurers, finding evidence consistent with input foreclosure. We do not rule out the possibility that insurers vertically integrated with a PBM experience efficiency gains that enable them to lower their own premiums. However, we find suggestive evidence that there are little or no efficiency gains in this case because premium changes were similar for United Health

plans whose PBM became larger after the acquisition of Catamaran relative to other vertically integrated insurers.¹⁸

The results of our study should be viewed in light of its limitations. First, we do not include Medicare Advantage (MA) prescription drug plans in our analysis. Thus, our results may not generalize to MA plans or to other commercial plans that combine drug and medical benefits. Second, although the MMS data classifies the services provided by each PBM to each insurer, we do not have detailed information on the specific contract terms. PBM contracts are likely to be heterogeneous across insurers leading to different incentives for PBM behaviors. Finally, although we show that the exit of Catamaran is associated with changes in insurers' premiums, these changes may not be solely attributable to this event. We control for observable plan characteristics, but there may be unobservable factors that could also influence plan premiums. For instance, to the extent that vertically integrated PBMs improve *unobserved* dimensions of plan quality, this will not be captured in our study.

That said, our results have important implications for policymakers and antitrust regulators. First, regulators should carefully weigh the potential benefits of vertical integration with the potential for foreclosure. Proponents of vertical mergers often emphasize that vertical mergers eliminate the "double marginalization" effect. A vertical merger can also reduce costs by improving the operational efficiency of the joint firm. However, regulators should also consider how increasing vertical integration caused by rising concentration of these firms, or even the removal of a non-integrated competitor, could increase the incentive for foreclosure which may offset potential efficiencies gained from the merger. Our empirical analysis suggests

¹⁸ To test for this possibility more generally, however, one would need to study what happens to premiums after a non-vertically integrated insurer acquires a standalone PBM. This type of merger does not exist during our study period and thus we leave it as an important area for future research.

that both customer foreclosure and input foreclosure can occur and are potentially linked.

Customer foreclosure could explain the demise of the standalone PBM market in Part D.

Additionally, the exit of the last major standalone PBM may have played a role in exacerbating input foreclosure.

Second, regulators should consider the extent to which a vertical merger could potentially concentrate market power in both the upstream and downstream markets. A downstream insurer market concentrated by vertically integrated firms could increase the incentive for input foreclosure. Coupled with a concentrated upstream PBM market, potential entrants are likely to face greater difficulties since successful entry may require simultaneous entry into both the PBM and insurer markets. As a result, there has been limited entry into the PBM market (Minemyer 2021).

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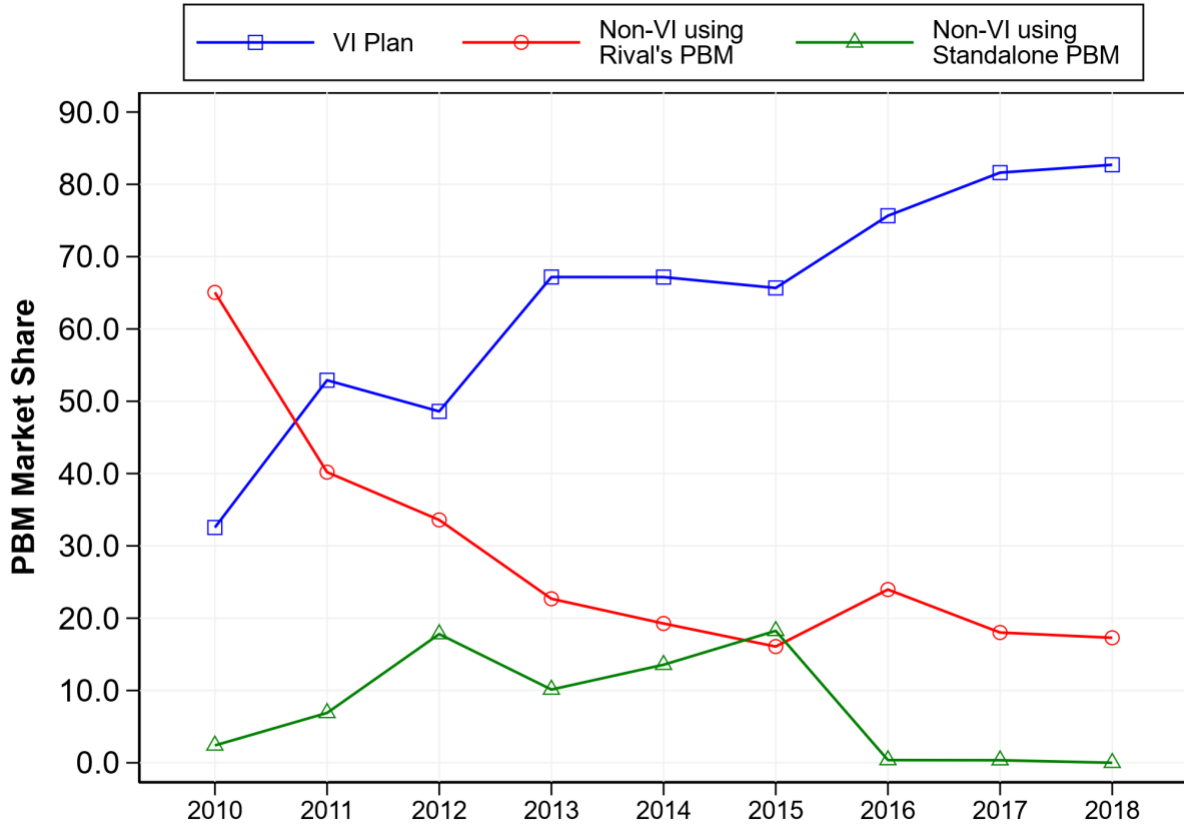
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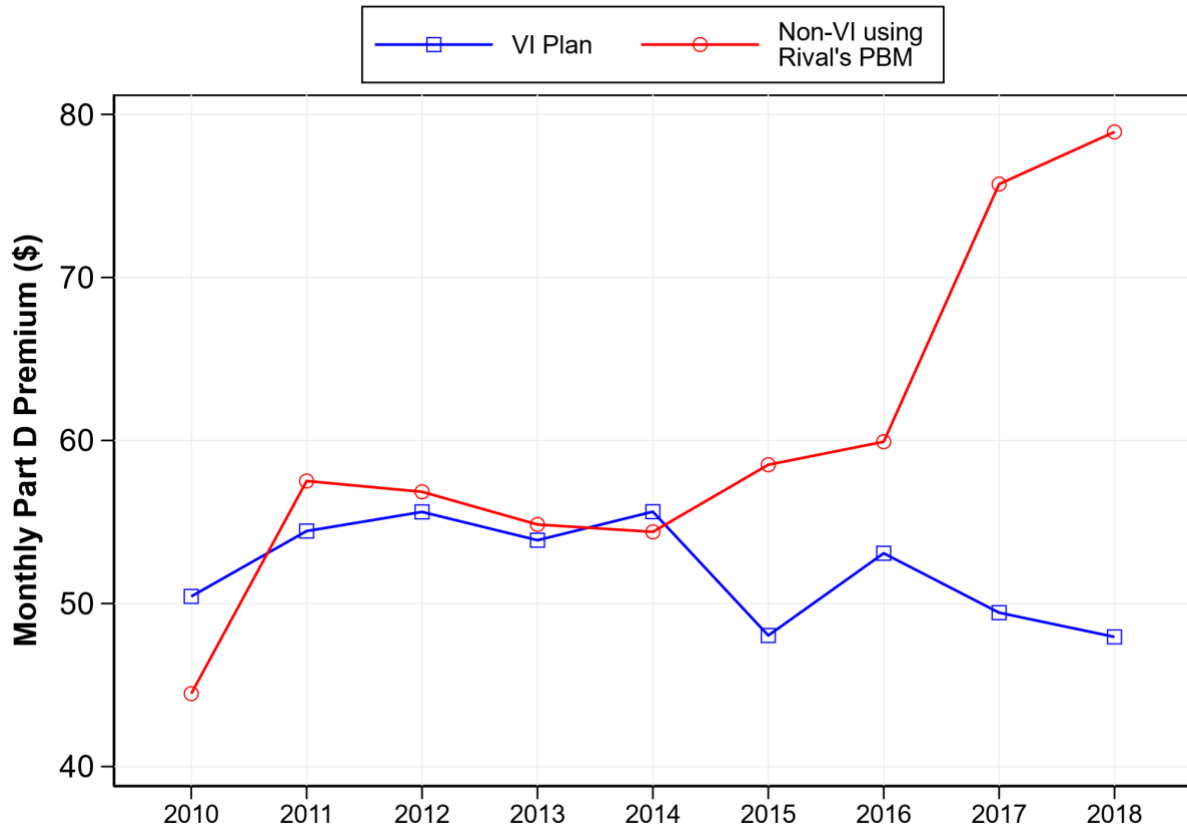
Figures

FIGURE 1: Trends in Part D Plan Market Shares by Insurer-PBM Relationship Type



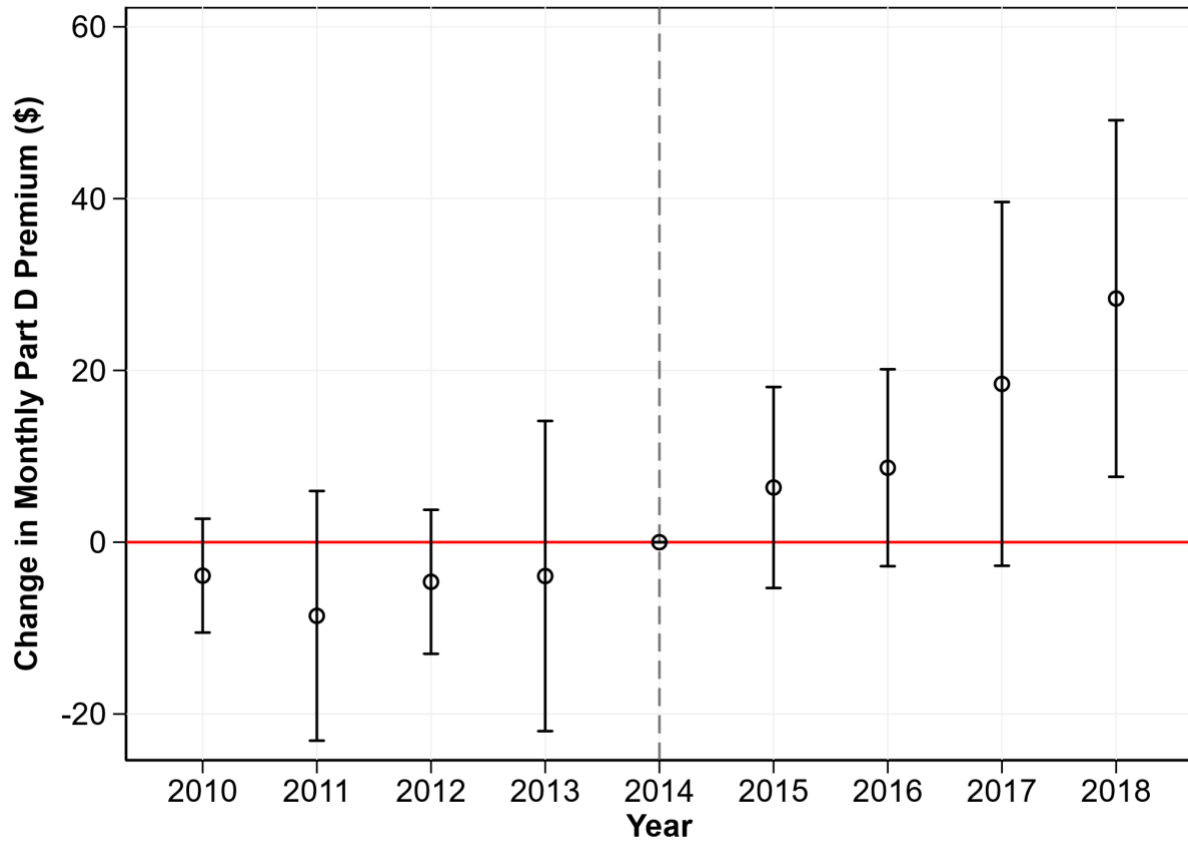
NOTES: The graph displays trends in national market shares of Part D enrollment for the three categories of insurer-PBM relationships. The blue line displays the market share of plans which are operated by an insurer that is vertically integrated (VI) with a PBM. The red line displays the market share of non-vertically integrated (Non-VI) insurers that utilize a PBM that is vertically integrated with a rival insurer. The green line displays the market share of non-vertically integrated plans that utilize a standalone PBM. Note that these market shares are calculated only for prescription drug plan (PDP) enrollment (i.e., no Medicare Advantage drug plans). We also do not include enrollment for insurers who possess PBM capabilities that they use for their own plans, but do not sell those PBM services to rival insurers (e.g., Humana).

FIGURE 2: Trends in Average Monthly Part D Premiums by Plan Type



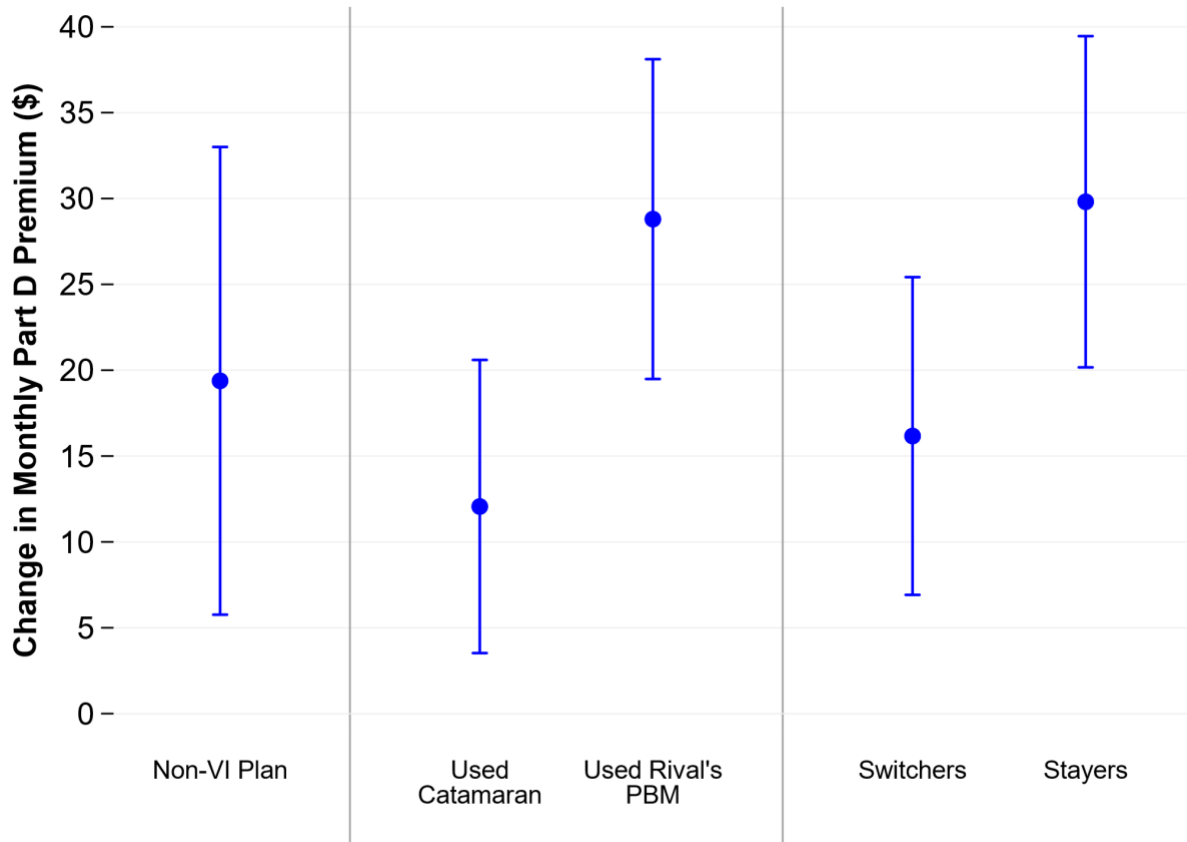
NOTES: The graph displays trends in average monthly Part D premiums. The blue line displays the average premium of plans which are operated by an insurer that is vertically integrated with a PBM. The red line displays the average premium of non-vertically integrated insurers that utilize a PBM that is vertically integrated with a rival insurer.

FIGURE 3: Event Study Estimates of Premium Changes for Non-Vertically Integrated Plans After UnitedHealth-Catamaran Merger



NOTES: This graph displays the treatment effect point estimates (and their 95% confidence intervals) from our event study analysis. The treatment group includes non-vertically integrated plans and the control group is vertically integrated plans. Standard errors are clustered at the insurer level. We include a full set of plan characteristics as controls (annual deductible, indicators for LIS eligibility, gap coverage, and plans with enhanced benefits), year fixed effects, region fixed effects, and insurer fixed effects.

FIGURE 4: Difference-in-Differences Estimates of Premium Changes for Non-Vertically Integrated Plans After UnitedHealth-Catamaran Merger, by Plan Subgroup



NOTES: The treatment group in Column (1) is all non-vertically integrated plans: either plans that used Catamaran as their PBM in 2015 or used a rival insurer’s PBM in 2015. Columns (2) and (3) separate out these two groups to allow for group specific estimates. Columns (4) and (5) split the insurers who used a rival’s PBM (Column (3)) into two groups: those that switched PBMs in any year after Catamaran’s exit and those that stayed with the same PBM for all years after Catamaran’s exit. In all columns, the control group is vertically integrated plans. Standard errors are clustered at the insurer level. The error bars indicate 95% confidence intervals. We include a full set of plan characteristics as controls (annual deductible, indicators for LIS eligibility, gap coverage, and plans with enhanced benefits), year fixed effects, region fixed effects, and insurer fixed effects.

FOR ONLINE PUBLICATION

Appendix A: Insurer Name Match and PBM Assignment Algorithm

Insurer Name Match Between CMS and MMS Data

The Managed Market Surveyor (MMS) data describe which PBMs each Medicare Part D plan uses each year. The MMS data also contain a variable that describes the parent insurer underwriting the Part D plan. In the CMS Part D PDP Landscape data from 2010 to 2018, there were 79 unique parent insurer names. To start, we perform a string match to find matches for the 79 PDP parent insurers within the MMS data. We use the user-written Stata command ‘reclink’ which uses a measure of string distance to determine the closest match. This allows us to match strings like “UnitedHealth” to “UnitedHealth Group, Inc.” We review these matches on a case-by-case basis to ensure that they are accurate.

Next, we identify in the MMS data if the parent insurer offers more than one Part D plan. For those insurers offering only one plan, we match that plan to CMS PDP data. For insurers offering more than one plan in the MMS data, we perform a string match of plan names between PDP plans and MMS plans. Again, we review these matches on a case-by-case basis to ensure accuracy.

PBM Assignment Algorithm

As described in the text, approximately 66% of our plan-region-year observations utilize only one PBM in a given year. For an additional 14% of observations, a plan may use multiple PBMs, but it uses only 1 PBM for either rebate negotiations or formulary design. In those instances, we assign the rebate or formulary PBM as the primary PBM. For another 14% of observations, the plan does not utilize a PBM at all.¹ For the remaining 6% of observations, a plan may use one

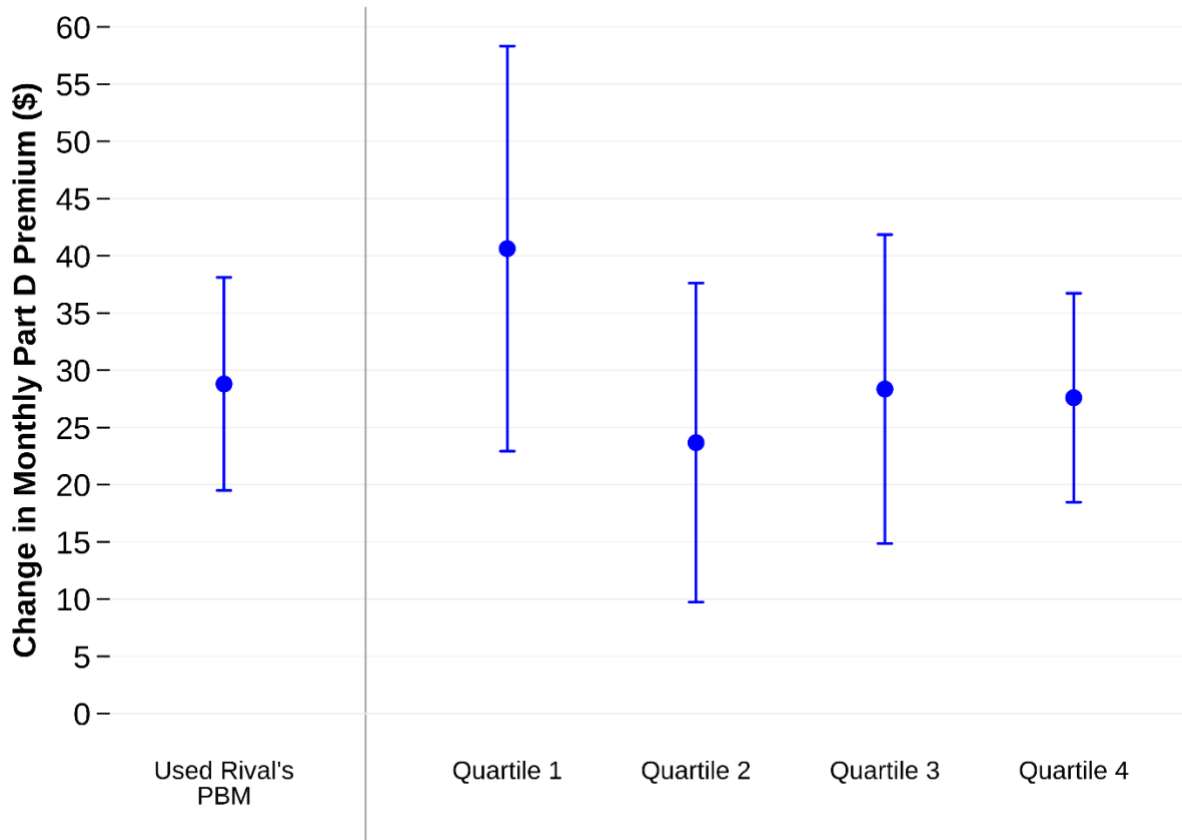
¹ For a small subset (about 3%) of these observations, which are predominantly in the earliest years of the sample, we are unable to distinguish between plans that do not utilize a PBM and those where no PBM was recorded. We

PBM for rebate negotiations or another for formulary design. In these cases, we perform external research to determine which PBM we believe is the primary PBM providing these services. We consulted industry experts, company filings, media reports, etc. to assign the PBM in these cases.

categorize these plans as not using a PBM (i.e., type (d)). Since we exclude type (d) plans from our main analysis this assignment rule not affect our results.

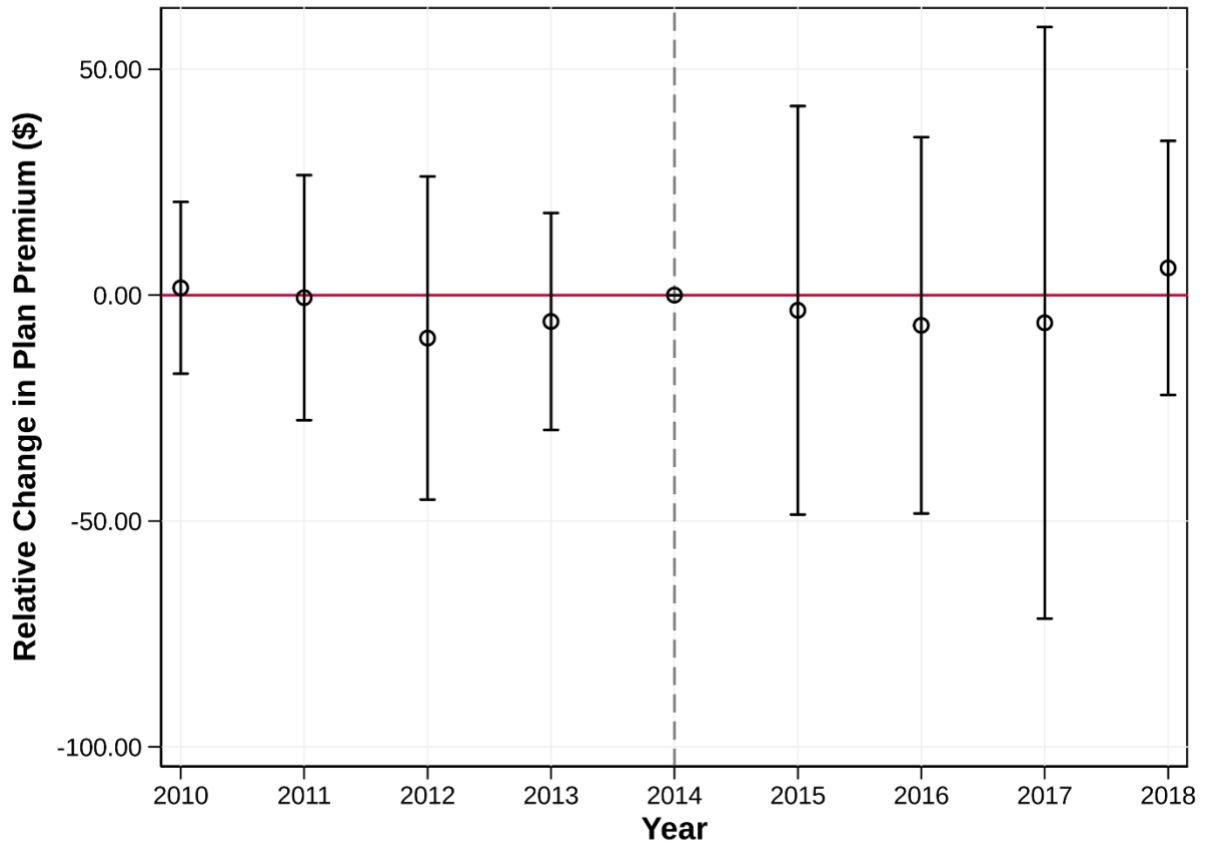
Appendix B: Supplementary Figures and Tables

Appendix Figure B.1: Heterogeneity of Treatment Effect By Insurer Size



Notes: Column (1) is a reproduction of Column (3) from Figure 4. It displays the estimated treatment effect for insurers that used a rival insurer’s PBM in 2015. Columns (2) through (5) show the estimated treatment effects when we split the insurers that use a rival’s PBM into quartiles based on the insurer’s “size”—i.e., average enrollment in 2013 and 2014. For instance, quartile 1 contains the smallest insurers who used a rival insurer’s PBM in 2015. Standard errors are clustered at the insurer level. The error bars indicate 95% confidence intervals. We include a vector of plan-specific controls (annual deductible, indicators for LIS eligibility and gap coverage), year fixed effects, region fixed effects, and insurer fixed effects.

Appendix Figure B.2: UnitedHealth’s Relative Premium Changes vs. Other Vertically Integrated Insurers’ Premiums Changes



Notes: This graph displays the treatment effect point estimates (and their 95% confidence intervals) from an event study analysis similar to that presented in Figure 3. However, in this figure, the “treatment” group is all plans offered by UnitedHealth and the control group consists of all other vertically integrated insurers’ plans (CVS and Express Scripts). Standard errors are clustered at the insurer level. We include a full set of plan characteristics as controls (annual deductible, indicators for LIS eligibility and gap coverage), year fixed effects, region fixed effects, and insurer fixed effects.

Appendix Table B.1: Difference-in-Difference Regression – Tabular Form

Dependent Variable = Monthly Part D Premium (\$)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1(Treated)*1(Year > 2015)	19.383*** (6.482)	--	--	--	23.104*** (5.530)	18.132** (7.227)	19.360*** (6.484)	18.106** (7.227)
1(Year ≥ 2015)*1(Used Catamaran in 2015)	--	12.064*** (4.063)	12.064*** (4.060)	12.064*** (4.073)	--	--	--	--
1(Year ≥ 2015)*1(Used VI PBM in 2015)	--	28.801*** (4.433)	--	--	--	--	--	--
1(Year ≥ 2015)*1(Used VI PBM in 2015)*1(Stayed with PBM)	--	--	29.812*** (4.591)	--	--	--	--	--
1(Year ≥ 2015)*1(Used VI PBM in 2015)*1(Switched PBMs)	--	--	16.170*** (4.404)	--	--	--	--	--
1(Year ≥ 2015)*1(Used VI PBM in 2015)*1(Size Quartile 1)	--	--	--	40.624*** (8.427)	--	--	--	--
1(Year ≥ 2015)*1(Used VI PBM in 2015)*1(Size Quartile 2)	--	--	--	23.673*** (6.633)	--	--	--	--
1(Year ≥ 2015)*1(Used VI PBM in 2015)*1(Size Quartile 3)	--	--	--	28.359*** (6.423)	--	--	--	--
1(Year ≥ 2015)*1(Used VI PBM in 2015)*1(Size Quartile 4)	--	--	--	27.601*** (4.345)	--	--	--	--
Average Premium	54.073				52.319	55.591	54.059	55.575
Number of Observations	4,104	4,104	4,104	4,104	6,851	3,196	4,098	3,190
R ²	0.710	0.716	0.717	0.717	0.650	0.693	0.710	0.693

Notes: The treatment group in Column (1) is all non-vertically integrated plans: either plans that used Catamaran as their PBM in 2015 or used a rival insurer’s PBM in 2015. Column (2) separates out these two groups to allow for group specific coefficients. Column (3) splits the insurers who used a rival’s PBM into two groups: those that stayed with the same PBM post Catamaran’s exit and those that switched PBMs post Catamaran’s exit. Column (4) splits the insurers who used a rival’s PBM into quartiles based on the insurer’s “size”—i.e., average enrollment in 2013 and 2014. For instance, quartile 1 contains the smallest insurers who used a rival insurer’s PBM in 2015. In columns (1) through (4), the control group is vertically integrated plans. The control group in column (5) include vertically integrated plans and plans offered by insurers with PBM capabilities that they do not offer to rival insurers (i.e., type (d)). The control group in column (6) is vertically integrated plans but excludes UnitedHealth/OptumRx. The treatment group in column (7) excludes insurers who used UnitedHealth/OptumRx as their PBM. Column (8) excludes both UnitedHealth from the control group and excludes insurers who used UnitedHealth/OptumRx as their PBM from the treatment group. Standard errors are clustered at the insurer level. We include a full set of plan characteristics as controls (annual deductible, indicators for LIS eligibility and gap coverage), year fixed effects, region fixed effects, and insurer fixed effects.

Appendix Table B.2: Trends in Average Monthly Part D Premiums – Tabular Form

Year	VI Plan	Non-VI using Rival's PBM	Non-VI using Standalone PBM
2010	50.43	44.47	63.96
2011	54.45	57.51	43.42
2012	55.62	56.85	45.77
2013	53.88	54.84	42.55
2014	55.63	54.39	39.35
2015	48.04	58.51	55.83
2016	53.08	59.92	112.37
2017	49.44	75.73	95.43
2018	47.95	78.93	100.80

Notes: Each column displays the average premium for the three types of plans in our sample. Column (1) is for insurers vertically integrated with a PBM, Column (2) is for non-vertically integrated insurers using a rival's PBM, and Column (3) is for non-vertically integrated insurers using a standalone PBM. Note that the number of plans using a standalone PBM drops precipitously in 2016 after the exit of Catamaran. In 2015, 188 different plans used a standalone PBM. That number decreased to 34 in 2016, 3 in 2017, and 1 in 2018.

Appendix Table B.3: Insurer-PBM Relationships from 2010-2018

Insurer-PBM Type	Number of Insurers	Number of Plan-Region-Year Observations
(a) VI Plan	3	2,763
(b) Non-VI Plan using Rival's PBM	42	2,534
(c) Non-VI Plan using Standalone PBM	19	658
(d) Plan using Own Exclusive PBM	25	3,461

Notes: Insurers in group (a) are vertically integrated with a PBM that sells its services to rival insurers in Part D (the three vertically integrated insurers in Part D are CVS/Caremark, Express Scripts/Medco, UnitedHealth^a). Insurers in group (b) do not have PBM capabilities but use a PBM which is vertically integrated with a rival insurer (e.g., Wellcare using CVS Caremark as its PBM). Insurers in group (c) do not have PBM capabilities but use standalone PBMs (e.g., Wellcare using Catamaran as its PBM). Insurers in group (d) have their own PBM that they utilize for PBM services, but they do not sell those PBM services to competing insurers during our time period (e.g., Humana). For our primary analyses, we exclude group (d). In robustness checks, we include group (d) insurers and find very little change to our results. In our analyses, we allow insurers to change classifications over time as they switch from one Insurer-PBM type to another. Thus, some insurers appear in more than one group across the sample period.

^aNote that prior to 2013, UnitedHealth operated a smaller PBM, called Prescription Solutions. In 2013, it renamed its PBM OptumRx and began selling PBM services to rival insurers in Part D. Thus, for our average premium and market share calculations, we follow the categorization of the MMS data and treat UnitedHealth as a group (d) insurer from 2010 to 2012 and then a group (a) insurer from 2013 onwards. Medco operated as vertically integrated insurer-PBM from 2010 to 2011 while Express Scripts operated as a standalone PBM during that time. In 2012, the two merged and kept the Express Scripts name.