Stocking Under the Influence: Spillovers from Commercial Drug Coverage to Medicare Utilization*

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Abstract

We document a novel channel through which commercial drug coverage affects utilization in Medicare Part B. Using biosimilars as a setting and exploiting plausibly exogenous differences in their state-level commercial coverage, we show that increasing biosimilar exclusion rates in commercial formularies by 10pp leads to 3pp lower utilization among Part B beneficiaries. By analyzing the prescribing behavior of physicians operating across multiple facilities, we provide evidence that facilities drive variation in biosimilar utilization, likely through preferred stocking of brands with better commercial coverage. Our results stress the need to account the influence of the commercial market when designing Medicare policy.

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In the United States, government-regulated insurance markets like Medicaid and Medicare coexist alongside a large and mostly unregulated commercial market. While health plans across these two markets rarely serve the same patients, the economic literature has highlighted several instances when outcomes in one market affect the other through regulation (Scott Morton, 1997; Duggan and Scott Morton, 2006, 2010; Feng et al., 2023), the introduction of new payment models (Baker, 2003; Baicker et al., 2013; Richards and Tello-Trillo, 2019), or capacity constraints (Garthwaite, 2012). This literature has almost entirely focused on the spillover effects of government-regulated insurance on outcomes in commercial insurance markets.[1] However, the sheer size and profitability of the commercial market leave open the possibility of reverse spillover effects.

In this paper, we provide causal evidence that equilibrium outcomes in the commercial health insurance market can affect the care beneficiaries of government-funded insurance receive. In particular, we show that prescription drug coverage in the commercial insurance market affects drug utilization of Medicare Part B patients. Our analysis focuses on the adoption of biosimilar drugs—bioequivalent copies of complex biologic drugs such as monoclonal antibodies (Food and Drug Administration, 2015). We find that a 10 percentage point increase in biosimilar coverage by commercial plans leads to a 3 percentage point increase in biosimilar utilization among Part B beneficiaries.

The spillover channel we identify arises from general features of US healthcare markets, and operates at the facility level rather than the physician level. It arises because i) patients covered by public and private insurance alike receive care from common facilities, and ii) facilities tend to standardize elements of care. These features are not specific to our setting, so the mechanism is likely relevant in markets for other healthcare services. A recent but growing literature has documented spillover effects of this nature that arise from reform-induced changes in physician behavior (see, e.g., Glied and Zivin, 2002; Barnett et al., 2022). Conversely, we show that the main mechanism driving our spillover effect is not physician behavior, but rather the stocking decisions of healthcare facilities, which tend to prioritize drug brands with broad coverage among commercial health insurance plans. Our results highlight the

[1]We note two exceptions: Richards and Tello-Trillo (2019) show that the introduction of Managed Care in Florida by Blue Cross Blue Shield led to higher utilization in Medicare and Medicaid, while Glied and Hong (2018) show that a expansion in commercial dental coverage led to a contraction in public provision of the same kind of care. Both papers test a theory of capacity constraints that is conceptually distinct from the channel we analyze and predicts opposite effects to the ones we find.

role facility logistics and operations play in steering physician behavior and, thereby, healthcare utilization and spending. With increasing consolidation and private equity involvement in healthcare facilities (see, e.g., Cooper et al., 2019; Bruch et al., 2021; Cerullo et al., 2021; Gupta et al., 2021; La Forgia, 2023), understanding the role facility management plays in physician behavior is increasingly important.

Our paper focuses on the use of drug formularies to manage outpatient utilization of physician-administered drugs. Formularies are the main tool that health plans and facilities use to determine what drugs are available to patients. There are two types of formularies that are relevant for our study. *Prescription drug formularies* are tiered menus of drugs that determine what is covered by a health plan and at what cost to the patient. *Facility formularies* are lists that determine what drugs are stocked and available to physicians at a healthcare facility.

Commercial insurance health plans often employ prescription drug formularies that exclude certain drugs or impose additional restrictions on physicians, such as requiring prior authorization from the insurer before dispensing a given medication (see, e.g., Brot-Goldberg et al., 2023). Conversely, Traditional Medicare (TM) beneficiaries receive coverage for physician-administered drugs under Medicare Part B, which covers virtually all drugs approved by the Food and Drug Administration. While not restricted by prescription drug formularies, TM beneficiaries may still face limited access because facility formularies may impose restrictions on which drugs are stocked for two reasons. First, limiting the number of drugs simplifies logistics such as inventory management and storage space (Dean et al., 2023). Second, favoring a specific drug over its therapeutic substitutes can unlock higher discounts from the manufacturer. When deciding which products to include on the formulary, the facility has an incentive to favor drugs broadly covered by commercial insurance formularies to maximize the chance that patients will be able to receive the drug. This incentive creates a spillover effect from commercial formularies to facility formularies. In turn, because facility formularies determine what is administered to patients with commercial and government health insurance, it introduces a channel through which equilibrium outcomes in the commercial market can influence patients covered by publicly sponsored insurance plans.

To empirically test the relevance of this channel, we study the adoption of biosimilar drugs—highly similar alternatives to complex biologic drugs that enter the market after a reference biologic loses patent protection. Biologics and biosimilars are close therapeutic substitutes, making it appealing for a facility to favor a single brand over

others. Biosimilars also have highly varying adoption and coverage rates across the U.S., providing the necessary variation to identify our channel of interest (Socal et al., 2020; Stern et al., 2021). In particular, the low uptake of biosimilars in Medicare Part B has prompted substantial debate and several policy proposals to increase utilization (Medicare Payment Advisory Commission, 2022).

To establish a link between Part B drug utilization and commercial formulary exclusion rates, we employ a research design based on variation across states in exposure to national formularies. Most commercial plans contract with intermediaries known as Pharmacy Benefit Managers (PBMs) to design their formulary and negotiate rebates. Many plans use off-the-shelf formularies offered by the PBM, known as national formularies, whereas others may design their own.[2] We use data from MMIT Network Solutions tracking coverage of reference biologic and biosimilar drugs across all commercial insurance plans to calculate variation in state-level exposure to national formularies and translate it into state-level changes in exclusion rates.

Our instrumental strategy relies on two assumptions. First, exclusions in national formularies cannot be motivated by patient or physician preferences at the state level. This assumption likely holds because PBMs offer the same national formularies to payers across all states. Second, a large enough fraction of payers must keep the same national formulary year after year, even if that formulary undergoes small changes (such as the inclusion or exclusion of a biosimilar or reference biologic drug). We validate this assumption by looking at yearly turnover rates at the health plan level in the MMIT data. Intuitively, our empirical approach identifies the effect of commercial exclusions by comparing changes in utilization among Part B beneficiaries in states where national formularies that include (or exclude) a given reference biologic or biosimilar brand have higher penetration rates.[3]

Our results show that a 10pp higher exclusion rate from commercial formularies for a given brand results in a 3pp lower utilization rate among Part B beneficiaries. Beyond documenting a causal link between commercial formularies and Part B utilization that likely extends beyond reference biologics and biosimilars, this spillover effect has economically meaningful implications on government spending and biosimilar adoption. Biosimilars are significantly cheaper than originator biologics but are often not covered in commercial formularies. Using a simple back-of-the-envelope calculation, we estimate that full nationwide biosimilar coverage could result in annual savings of ap-

[2] 33% of individuals covered by commercial insurance are on a plan that uses a national formulary.

[3] We use the term brand to refer to a version of the same molecule manufactured by a specific company—either the reference biologic or one of the biosimilars.

proximately $61 million for TM beneficiaries and the government.[4] However, we stress that any government intervention aiming to achieve this lower level of spending would likely require formulary coverage mandates, which would likely lead to significantly higher prices for affected drugs (Hwang et al., 2019).

Having documented a spillover effect between commercial formularies and Medicare Part B utilization, we provide further evidence that facility stocking decisions (rather than physician behavior) are the primary transmission mechanism. First, we show that prescribing choices are strongly correlated within a facility, with an overwhelming majority of facilities concentrating over 80 percent of prescriptions for a given molecule on a single brand. Moreover, we document many instances when a facility's preferred brand switches from one year to the next. Because physician practice style is likely to evolve slowly over time, these abrupt shifts provide an initial indication that facility-level factors drive prescription patterns. To confirm this intuition, we study variation in the prescription patterns of physicians who operate in different facilities. Using the same design as in Finkelstein et al. (2021), we decompose changes in prescribing behavior between physicians and facilities to estimate that 80% of the variation in biosimilar adoption is explained by facility-level factors, thus confirming facility formularies as the most likely driver of the spillovers.

Our findings have important implications for government spending and healthcare policy. First, the spillover effect we identify implies that commercial coverage decisions affect government spending. This effect is not unambiguously good or bad but depends on how well commercial markets function. However, given evidence that PBMs occasionally prefer more expensive drugs if they carry higher rebates, there is a real possibility that this effect can have a detrimental effect on spending (see, e.g., Dusetzina et al., 2021). Even in a well-functioning market, PBMs would not consider the externality of their decisions on government programs, which would generally lead to an inefficient equilibrium and may provide grounds for government intervention. Second, the finding that facilities play an essential role in steering physician behavior matters for policy. Physicians are not isolated in their practice; rather, they are influenced by the environment where they work. Our research suggests that changes in physician prescribing behavior could sometimes be more appropriately attributed to facility-level decisions. Recognizing this distinction is crucial because policies aimed at altering physician behavior may prove ineffective when they ignore the restrictions

[4]TM patients face a 20% coinsurance rate for Part B services, though many beneficiaries also use Medigap to cover part of their out-of-pocket costs.

imposed by facilities.

Our paper makes three contributions to the economic literature. First, we contribute additional evidence on the complex interplay between the various segments of the U.S. healthcare market by highlighting the effect that equilibrium outcomes in commercial markets can have on care for patients enrolled in government-sponsored plans. Whereas a large body of work has focused on the effect of government programs on the private market (see, e.g., Scott Morton, 1997; Glied and Zivin, 2002; Duggan and Scott Morton, 2006, 2010; Baicker et al., 2013; Clemens and Gottlieb, 2017; Einav et al., 2020; Wilcock et al., 2020; Barnett et al., 2022; Feng et al., 2023), relatively little attention has been paid to the impact of commercial market outcomes on government insurance. The existing work on the topic generally focuses on the rival nature of these two markets by highlighting how expansions (or contractions) in commercial coverage affect publicly insured patients through capacity constraints (Glied and Hong, 2018; Richards and Tello-Trillo, 2019).[5] Conversely, our paper identifies a channel that is fundamentally different and depends on the standardization of care at the provider level.[6]

Second, we add to the current understanding of manufacturer-PBM negotiations and insurance coverage incentives in drug markets. This topic has received increased attention recently, with researchers identifying several factors that affect negotiations, such as demand inertia (Feng and Maini, 2023) and the presence of most-favored-nation clauses (Conti et al., 2021; Feng et al., 2023). A parallel line of work has studied the incentives facing insurance plans when choosing which drugs to cover, which include rebates (Olssen and Demirer, 2023), screening (Geruso et al., 2019), and spillovers to medical spending (Lavetti and Simon, 2018; Starc and Town, 2020). Our work uncovers a mechanism that would encourage manufacturers of drugs administered in an outpatient setting to attain better formulary coverage when negotiating with PBMs.

Third, we uncover another potential barrier that could slow down the diffusion of biosimilar brands. Past work on biosimilar uptake has highlighted the aggressive response of incumbent biologics (Maini et al., 2021), the role of patent uncertainty (Van de Wiele et al., 2021; Hemphill and Sampat, 2022), the relative safety and efficacy of biosimilar drugs (Cohen et al., 2017; Zhai et al., 2019), and the financial incentives faced by physicians and facilities (Scott Morton, 2021; Bond et al., 2023). In this paper,

[5] Garthwaite (2012) is another relevant work on the effect of capacity constraints on the healthcare system.

[6] A conceptually related, but distinct paper is Grabowski et al. (2008), which shows how patients receive the same type of care at nursing homes regardless of their insurance provider.

we show that the stocking behavior of outpatient facilities is another critical barrier to adoption and that most of the variation in US physician-administered biosimilar adoption is due to facility effects rather than physician effects.

1 Institutional Background and Data

1.1 Commercial Insurance and Facility Drug Formularies

When prescribing medication, physicians consider clinical concerns such as efficacy, safety, side effects, and drug interactions. In the case of drugs administered in an outpatient setting (e.g., hospital outpatient departments and physician offices) in the US, physicians also need to account for restrictions created by two types of formularies: the prescription drug formulary of the patient's health plan and the formulary of the facility where the doctor is prescribing.[7]

1. *Prescription drug formularies* are tiered menus listing all drugs covered by the health plan. Tiers determine the out-of-pocket cost to the patient and whether the plan imposes any non-monetary restrictions on the drug's utilization, such as step therapy or requiring prior authorization before administering the drug.

   Drugs are assigned to tiers based on negotiations between drug manufacturers and intermediaries called Pharmacy Benefit Managers (PBMs). The role of PBMs is to negotiate higher rebates in exchange for better tier placement. Often, rebates are also contingent on the tier of direct competitors, with manufacturers granting additional concessions when direct competitors are placed in less generous tiers or excluded altogether (Senate Finance Committee, 2021). As a result, it is common for drug formularies to exclude drugs that have close substitutes.

   After negotiations, PBMs offer formularies to payers such as insurance companies and self-insured employers. Payers can create a custom formulary from the grids of contingent rebates negotiated by the PBM. Alternatively, most PBMs also offer some ready-made "national formularies." Because they require less expertise and effort, national formularies are usually preferred by self-insured employers. As a result, they have a dominant position in the commercial insurance segment, which we exploit for our identification strategy.

[7] Due to differences in reimbursement structure, hospitals may have separate inpatient and outpatient formularies. Our analysis focuses on drugs prescribed primarily in outpatient settings and therefore on hospital outpatient formularies.

2. *Facility formularies* determine what drugs facilities stock and make available to physicians. There are at least two reasons a facility would restrict its formulary. First, limiting the number of drugs in stock has logistical advantages, such as easier inventory management and reduced storage space (Dean et al., 2023). Second, facilities can unlock additional discounts from manufacturers through volume or percentage-based guarantees, which often imply that competing products must either be excluded or their use strongly discouraged.

   Exclusive contracts for facility formularies are particularly prominent in cases where close therapeutic substitutes are available, such as biologic drugs with biosimilar competitors. According to interviews we conducted with hospital pharmacy representatives, exclusions are frequent. They are not costless, however, because they restrict the available options for patients and physicians, which can be problematic for patients whose insurance company also uses a restricted prescription drug formulary. In the most extreme scenario, a patient whose insurance does not cover any of the drugs in stock at a facility may be responsible for the entire list price of the treatment received. To avoid such scenarios and ensure reimbursement, facilities strive to include broadly covered drugs in their formularies.

Figure 1 summarizes the key agents involved in physician-administered drugs and their incentives, with blue arrows highlighting the channels that directly influence Medicare Part B utilization and green arrows highlighting the channels that directly influence commercial utilization. Commercial insurance formularies are separate from the blue part of the system but may affect Medicare Part B utilization through the hypothesized spillover channel, represented by the red arrow.

1.2 Biosimilars

Biologic drugs ("biologics") are complex molecules derived from organic material, such as insulin or monoclonal antibodies. Due to their complexity, biologics cannot be exactly reproduced like traditional, small-molecule drugs. Instead, potential competitors can create "biosimilars": highly similar versions of an existing reference biologic without clinically meaningful differences in safety and efficacy (Food and Drug Administration, 2021).

Biosimilars present a useful setting for studying potential spillovers of commercial formularies on facility formularies and drug utilization in Medicare Part B for

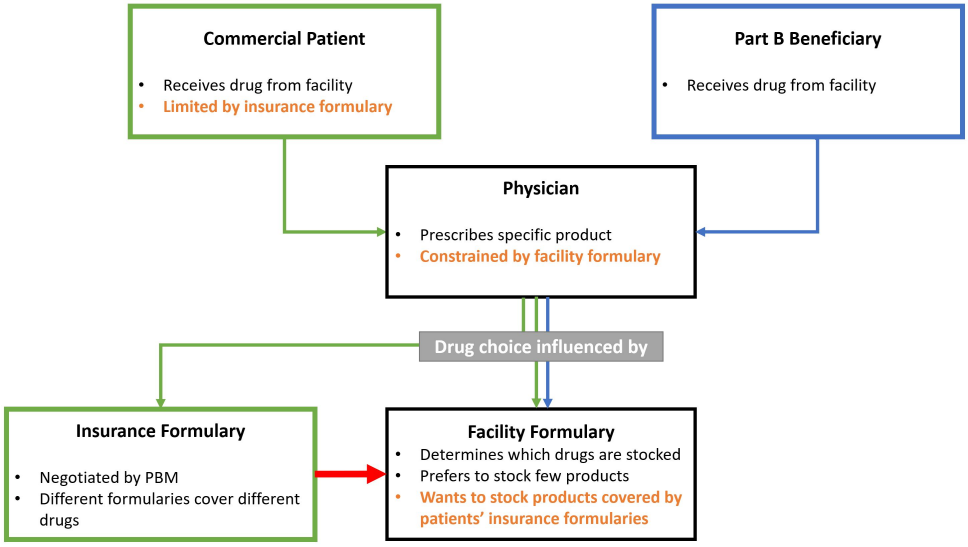


Figure 1: Diagram for impact of hospital formularies

several reasons. First, they are often physician-administered infusions, meaning they are covered by Medicare Part B. Second, the FDA standard for biosimilar approval requires that there are no clinically meaningful differences between biosimilar medications and their reference brand, meaning that—while not identical—these products are close substitutes: patients can switch between them without suffering negative consequences (Barbier et al., 2020). This makes them ideal candidates for exclusive contracts. Third, partly because biosimilars are relatively new, there is significant variation in their commercial coverage, both across plans and over time. Moreover, evidence shows that the adoption of biosimilars has been slowed by issues such as physician awareness (Cohen et al., 2017), skewed financial incentives (Bond et al., 2023), and the aggressive use of manufacturer rebates (Maini et al., 2021; Frank et al., 2022). Finally, even though only a limited number of biosimilars have been approved, biologic drugs represent almost half of pharmaceutical spending, and many policymakers and researchers see adoption of biosimilars as a crucial step towards moderating drug spending.[8]

Our empirical analysis focuses on a set of four physician-administered biologic molecules with biosimilar competitors that launched before 2019: filgrastim (a bone-marrow stimulant, brand name Neupogen), infliximab (an immunosuppressant, brand name Remicade), pegfilgrastim (a bone marrow stimulant, brand name Neulasta), and

[8]See for example, Marta Wosińska's interview on Tradeoff on January 26, 2023 (https://tradeoffs.org/2023/01/26/humira-biosimilar-drug-prices/, retrieved June 8, 2023).

epoetin alpha (a treatment for anemia, brand name Procrit).[9] Appendix Table 2 shows the number and launch dates of the biosimilar competitors for each of these drugs.

1.3 Data Sources and Summary Statistics

We use three data sources for our study. First, to measure physician behavior and brand-level utilization in Medicare Part B, we use a 20 percent random sample of all Medicare Part B fee-for-service claims data from 2015 to 2019 (Centers for Medicare and Medicaid Services, 2019). For our regression analyses, we aggregate this data to the state-brand-year level.

Figure 2 provides an overview of biosimilar uptake in Medicare Part B, calculated as the annual state-level penetration rate of biosimilar brands for each of our four molecules of interest. We find that uptake is highly heterogeneous across states—ranging from 41% to 99% for filgrastim, 5% to 32% for infliximab, 0% to 66% for epoetin alfa, and 7% to 47% for pegfilgrastim in 2019. Moreover, there is no apparent spatial correlation in uptake across neighboring states and we don't find significant pairwise correlations in state-level uptake between any molecules in our sample (see Appendix Table 4). The lack of a reliable pattern is particularly striking in the case of filgrastim and pegfilgrastim, which are both prescribed and administered primarily by hematology-oncologists and oncologists.

Second, to measure commercial insurance coverage, we use plan-level insurance coverage information from MMIT Network solutions (Managed Markets Insight and Technology, 2020). The data contain plan-year-brand level coverage information for reference biologic and biosimilar brands, including whether a brand is covered by the plan (our main variable of interest) and whether its use is restricted by prior authorization requirements (which we use in robustness checks). In addition, MMIT tracks enrollment numbers for each plan (which we use as weights in calculating state-level coverage statistics) and whether the plan adopted a specific national formulary or used a custom formulary. Table 3 in Appendix B reports additional summary statistics on commercial formulary coverage, broken down by brand.

Third, we collect data on detailing payments to physicians from OpenPayments data, which we use as a control in one of our regressions.

[9] We chose 2019 as a cutoff because our Medicare data ends in 2019. Epoetin alfa is also marketed under the name Epogen for the treatment of end-stage renal disease (ESRD). As usage for ESRD is limited and sample size is insufficient, we focus only on non-ESRD usage and the reference brand Procrit.

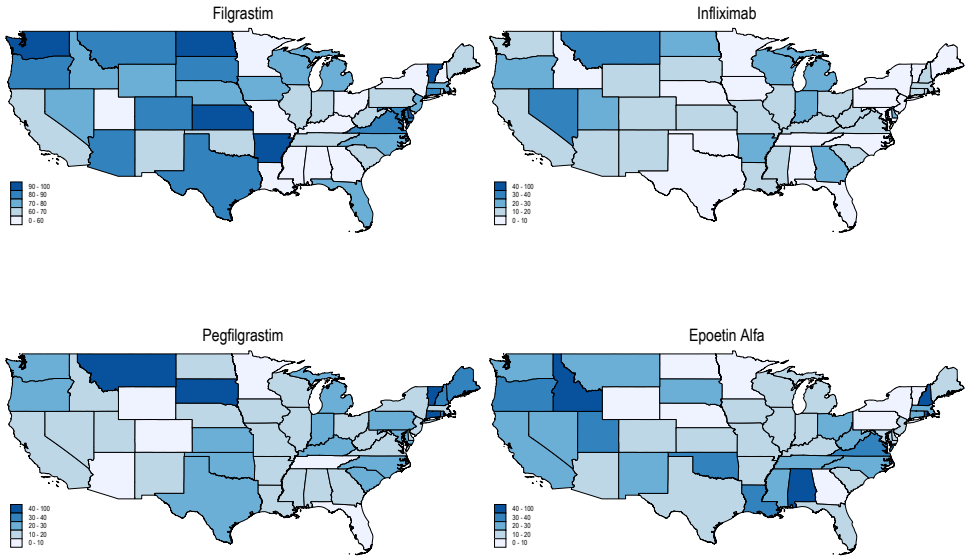


Figure 2: Uptake of biosimilar Filgrastim, Infliximab, Epoetin Alfa, and Pegfilgrastim across US states in 2019

Notes: Data comes from the Medicare Part B 20% claims sample. Biosimilar uptake is measured as the sum of market shares across all biosimilar brands. Data for epoetin alfa includes only non-ESRD usage.

2 Impact of Insurance Formulary Coverage on Biosimilar Uptake in Part B

This section shows that formulary coverage in commercial and Medicare Advantage plans causally affects biosimilar uptake among Medicare Part B patients.

Our strategy compares the within-molecule market share of a given biologic or biosimilar brand among Medicare Part B patients to the fraction of commercial and MA patient lives for whom the formulary does not cover the brand. Our analysis is at the state-year level.[10] We estimate the following regression equation:

$$\text{Brand Market Share}_{jkt} = \lambda_t + \gamma_{jk} + \beta \text{ Fraction of uncovered lives}_{jkt} + \varepsilon_{jt} \quad (1)$$

where j denotes brand, k denotes state, and t denotes year. As controls, we include

[10] A better way to conduct this analysis would be at the level of a hospital referral region (HRR). However, this would require exact data on the geographic location of patients (matched to formulary data), which is hard to come by at the scale required for this project.

fixed effects for biosimilar age to account for national biosimilar uptake curves, λ_t, and the interaction of brand and state, γ_{jk}. Our coefficient of interest, β, represents the association of the fraction of uncovered lives amongst commercially insured patients with the brand market share amongst Medicare Part B patients. In this specification, our variation comes from changes in commercial insurance coverage over time within a given state.

A primary challenge in estimating Equation 1 is that a correlation between commercial coverage and Part B utilization could reflect the unobserved evolution of state-level preferences over time. Evolving preferences may cause changes in physician prescribing patterns and commercial formularies, many of which are designed by the health plan to match enrollee preferences.

To address this issue, we propose an instrumental variable approach based on *national* formularies, stock products designed by PBMs, and available to all US payers. Not everyone uses national formularies—payers can also design *custom* formularies based on the rebates negotiated by PBMs but potentially more tailored to the preferences of local enrollees. However, national formularies are particularly popular among self-insured employers—who make up a significant fraction of the commercial insurance market—because designing a custom formulary can be challenging. Changes in drug coverage on national formularies should be independent of state-level preferences for a given brand because PBMs design them for the entire US market. Of course, differential adoption of these formularies partly reflects differences in state preferences. To ensure that our instrument is uncorrelated with these preferences, we use penetration of national formularies at the state level in the previous year to create a projected level of coverage for a given year. This strategy works because (i) national formularies often maintain the same identity for many years (e.g., Express Scripts has been offering their "National Preferred Formulary" for the last ten years), and (ii) payers rarely switch formularies.[11] Therefore, any change in a national PBM formulary will mechanically affect exclusion rates at the state level in a way that is plausibly unrelated to changes in state-level preferences.

Formally, our instrument is the sum across all national formularies of the fraction of commercially insured lives in state k covered by national formulary f in year $t-1$, multiplied by an indicator $\mathbb{I}^{\text{excluded}}{}_{jft}$ for whether brand j is excluded from coverage by

[11] See Express Scripts' formulary page where they describe their National Preferred Formulary: https://www.express-scripts.com/corporate/about/formularies, retrieved July 27, 2023. Appendix Table 5 reports annual turnover rates of commercial plans using national formularies, showing, for instance, a 79.3% retention rate in national formularies between 2017 and 2018..

formulary f in year t:

$$Z_{jkt} = \sum_{f=1}^{N} \left(\frac{lives_{kft-1}}{lives_{kt-1}} \times \mathbb{I}^{excluded}{}_{jft} \right)$$

Variation in our instrument Z_{jkt} arises from two sources. The first source of variation is the time-varying market share of specific national formularies across states. Appendix Figure 5 plots the distribution of state-level market shares in 2019 for the four most popular national formularies in the US commercial insurance segment. It shows market shares for the four largest national formularies vary across states, ranging from 0.4% to 20.2%. The second source of variation is changes in the exclusion of reference biologic and biosimilar brands across national formularies.[12] Overall, we identify 29 exclusion events and 146 new coverage events (see Appendix Table 6 for details).

We report our results in Table 1. Our first stage results in Panel C show a strong association between our instrument and coverage rates, confirming that our instrument has sufficient power. The reduced-form regression suggests that a 10pp increase in the exclusion rate of a given brand is associated with a 3.1pp decline in utilization among Medicare Part B beneficiaries (Column 1). When we instead rely solely on variation generated by national formularies through our IV approach, we find a similar effect (2.9pp). Additional specifications that control for marketing payments to physicians (Column 2) and weight results by state population (Column 3) return almost identical coefficients. Across all these regressions, the effect is consistent and ranges between 2.9 and 3.0pp. In Appendix E, we conduct three sets of robustness checks, all of which confirm our results. First, we follow Papke and Wooldridge (2008) in calculating average partial effects using pooled quasi-maximum likelihood estimation (QMLE) to account for our fractional response variable and endogenous regressor. Second, we measure coverage using the fraction of commercial lives with unrestricted access to a given brand (e.g., coverage with no prior authorization or other restrictions). Third, we exclude the four largest states and re-run our analysis to account for the possibility that PBMs cater to patients in these states.

Our results suggest that the spillover effect of commercial formularies is economically significant. The reference biologic generally has broad coverage in commercial

[12] These coverage decisions are linked to the PBMs associated with the commercial insurers operating within a state. For instance, Connecticut's commercial insurance market is dominated by two large national PBMs, each of which covers between 30–40% of the commercial market in our timeframe. Between 2018 and 2019, commercial coverage for the pegfilgrastim biosimilar brand Udenyca in Connecticut increased from 41% to 91%, when both PBMs added it to their formularies.

Table 1: IV Regression of Impact of Private Insurance Formulary Coverage on Biosimilar Uptake

	(1)	(2)	(3)
PANEL A. REDUCED-FORM ESTIMATES			
Fraction Excluded	-0.309	-0.306	-0.309
	(0.036)	(0.036)	(0.058)
Specification	OLS	OLS	OLS
PANEL B. IV RESULTS			
Fraction Excluded	-0.290	-0.288	-0.297
	(0.046)	(0.046)	(0.094)
Specification	2SLS	2SLS	2SLS
First-Stage *F*-stat.	941.0	823.3	941.6
PANEL C. IV FIRST STAGE			
Uncovered on National Formulary	0.522	0.522	0.511
	(0.010)	(0.010)	(0.009)
Specification	OLS	OLS	OLS
R^2	0.921	0.921	0.928
Observations	1,836	1,836	1,836
Open Payments Control	No	Yes	Yes
Population Weights	No	No	Yes

Notes: Estimates of Equation 1, using OLS and IV approaches. The data is at the state-year-brand level and include data from 2015 to 2019. The dependent variable is the brand-level market share for each brand in a given state-year. Standard errors are clustered at the state-brand level. Molecules are only included after their first biosimilar launch.

formularies, translating to higher market share among TM beneficiaries. As reference brands are more expensive than biosimilar competitors, this likely increases Medicare spending.

While calculating the exact impact of the spillover effect would require more detailed data and several additional assumptions, we can obtain an approximate value of the money at stake using a simple back of the envelope calculation.

To perform the calculation we take the difference in the average cost of a claim between each reference biologic and biosimilar brand. Then, for each biosimilar brand j, we assume that commercial formularies cover all available biosimilar brands. Using the estimated coefficient from our preferred specification in Column (2) of Table 1, we estimate the change in utilization as $\Delta Q_{jk} = \hat{\beta} \times \Delta Coverage_{jk} \times Q_{jk}$, where Q_{jk} is the number of Part B claims for biosimilar j in state k. We also assume that the additional claims for biosimilar j come from the other brands proportionally to their observed market share.[13]

Using this method, we find potential excess Medicare Part B spending of up to $61 million in 2019—approximately 10 percent of the total potential savings from switching all patients to the cheapest available biosimilar.

3 Mechanisms

Having established a link between commercial formularies and Part B utilization, we now investigate the mechanisms behind this link. We start by presenting some summary statistics on facility-level prescribing patterns in Part B, then decompose variation into doctor-level and facility-level effects.

3.1 Facility Prescribing Patterns

From qualitative interviews, we know that facilities set internal formularies and earn financial considerations from manufacturers if they prefer one brand within a given molecule. We provide descriptive evidence consistent with this behavior by looking at facility-level prescribing patterns using the 20% random sample of fee-for-service Medicare beneficiaries.

Facilities overwhelmingly prescribe a single brand over all possible alternatives. In 2019, about 80 percent of facilities had a dominant brand (either a biosimilar or the

[13] See Appendix F for more details.

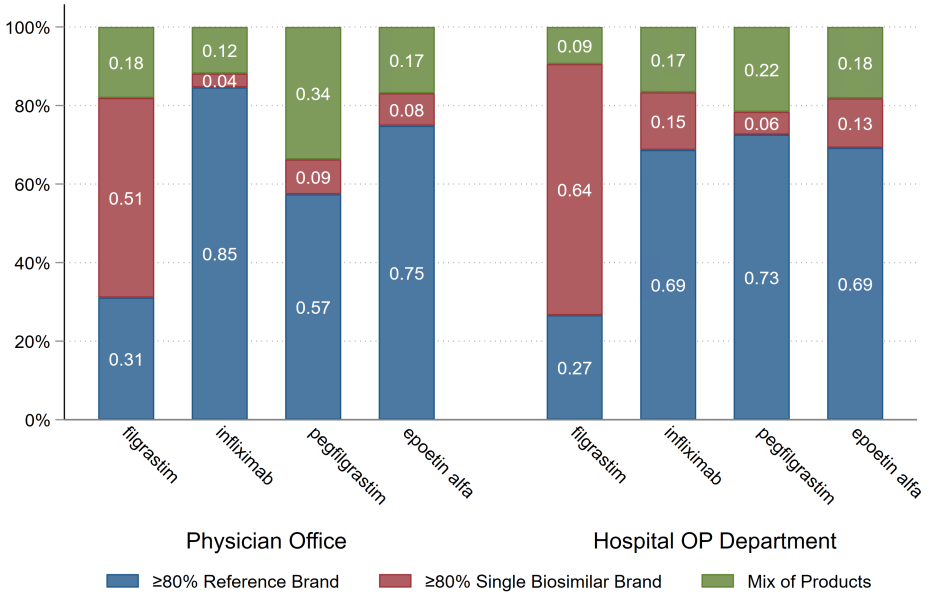


Figure 3: Fraction of Facilities with over 80% Utilization of a Single Brand, by Molecule and Facility Type

Notes: Figure is calculated using the 20% Medicare Part B data from 2019. Facilities with less than 5 administrations of a given molecule are excluded.

reference biologic) with at least an 80 percent prescription share within a molecule.[14] As Figure 3 shows, the result holds broadly: across all molecules, at least two-thirds of physician offices and hospital outpatient facilities have a dominant brand.

This result strongly suggests that prescribing choices are highly correlated within facilities. This correlation could arise either because of facility-imposed restrictions or because of physicians' preferences in that facility. Something that provides suggestive support for facility restrictions is that 6 percent of facilities with a dominant brand in 2018 and 2019 switch to a different one in the following year. These abrupt switches are unlikely to be generated by changes in physician preferences or beliefs, which—while correlated with organizations and networks—are more persistent over time (Epstein and Nicholson, 2009). We provide more rigorous evidence in support of facility restrictions in the next section.

[14] We use 80 percent as a threshold for dominance because discussions with hospital pharmacists and administrators responsible for facility purchasing indicated this threshold as a common requirement for percentage-of-sales contracts. We exclude facilities with fewer than 5 claims.

3.2 Physicians versus Facilities

While existing research documents that physician practice style can generate spillovers across insurance markets (Glied and Zivin, 2002; Barnett et al., 2022), studies of biosimilar uptake have provided descriptive evidence that doctor characteristics do not explain much of the variation in utilization (Dean et al., 2021; Socal et al., 2020). Therefore, we conjecture that the primary mechanism behind the link between commercial formularies and Part B utilization is the effect of commercial formularies on facility formularies.

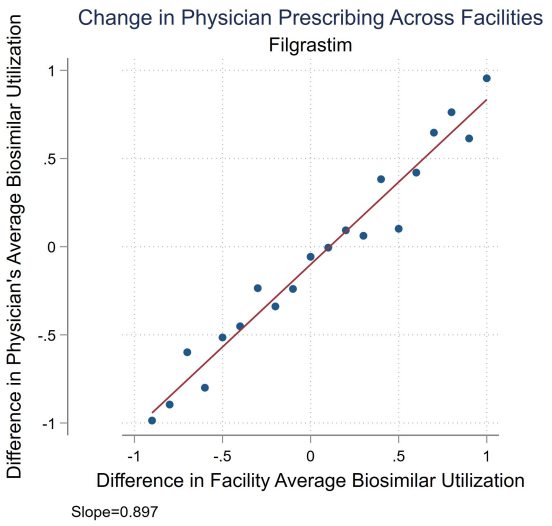
To test this hypothesis, we follow the methodology from Finkelstein et al. (2021). We construct aggregate utilization rates at the physician-facility-brand level using the 20% Medicare Part B sample. For each physician i and facility f, we calculate the physician's average biosimilar utilization within the facility Y_{if} and the biosimilar market share amongst all other physicians prescribing within the facility (γ_f).[15] γ_f is an indicator of facility-level prescribing that is not directly influenced by physician i. Then, limiting our sample to physicians who prescribe in two facilities f_1 and f_2, we plot $Y_{if_1} - Y_{if_2}$ against $\gamma_{f_1} - \gamma_{f_2}$. Intuitively, this plots the change in facility-level biosimilar utilization from one facility to another on the x-axis against the change in a physician's prescribing when moving across those two facilities on the y-axis. If variation in biosimilar prescribing were entirely due to physician choices, the slope of this line would be zero. However, if the facility influences the decision, the slope will be positive. A slope of one would imply that physicians conform completely to the prescribing habits of each facility where they operate.[16]

Figure 4 plots our results separately by molecule. Across all brands, the facility appears to dominate the decision of whether to use a biosimilar or a reference brand, with line slopes of 0.897 (95% confidence interval: 0.844–0.951) for filgrastim, 0.788 (95% confidence interval: 0.737–0.843) for infliximab, 0.779 (95% confidence interval: 0.721–0.838) for pegfilgrastim, and 0.788 (95% confidence interval: 0.739–0.837) for epoetin alpha. Hence, across all molecules, physicians adapt their prescription patterns to adhere very closely to the choices of other physicians at the same facility.[17]

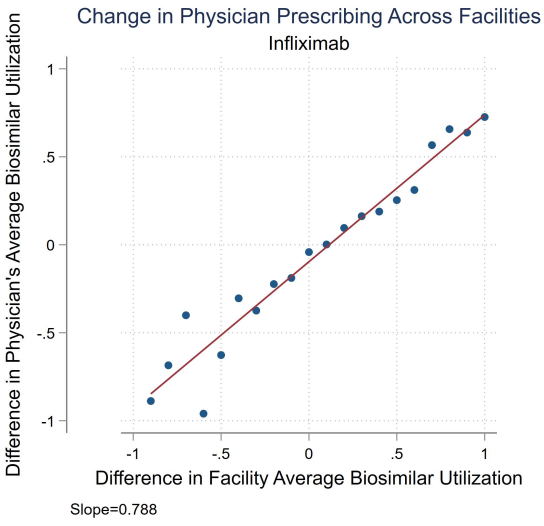
[15] We aggregate across biosimilar brands because specific biosimilar brands often have very low market shares at the facility level.

[16] Notice that this is an indirect test because we cannot measure physician and facility responses to a change in formulary coverage using our data. With more granular data, we could measure doctor-facility level responses to insurance coverage changes and decompose variation in that quantity. Instead, we decompose variation in the observational data.

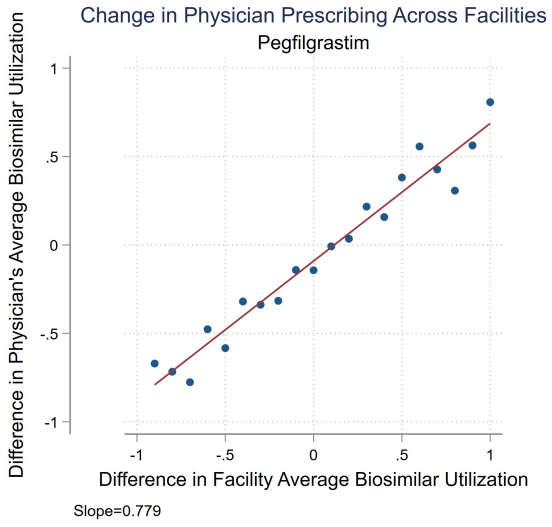
[17] Ideally, we would run a similar analysis for patients switching between two facilities. However, this switch is often associated with a corresponding change in prescribing physician, thus any change in



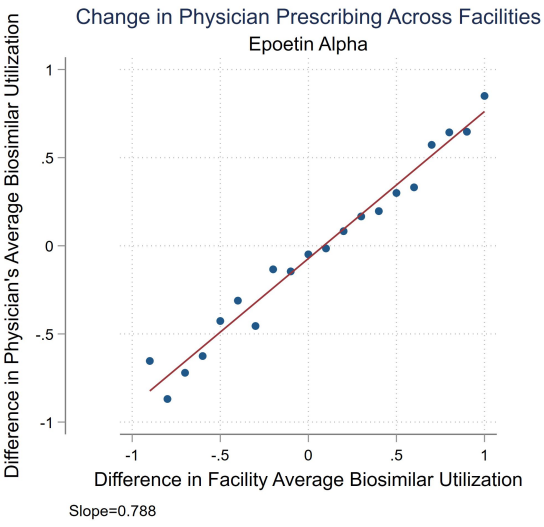
(a) filgrastim



(b) infliximab



(c) pegfilgrastim



(d) epoetin alfa

Figure 4: Change in Physician Biosimilar Prescribing Across Facilities

Notes: Figure reports estimates based on the Finkelstein et al. (2021) design. The sample includes all physicians prescribing a given drug in two facilities, using data from the 20% Medicare Part B data between 2015 and 2019.

The results help refine our understanding of our estimates in the previous section. The evidence suggests that doctors generally defer to the facility when choosing which brand to prescribe within a set of similar drugs. Therefore, facilities are more likely to drive the responses to commercial insurance changes.

4 Conclusion

This article provides causal evidence of a quantitatively significant spillover from commercial insurance coverage restrictions to utilization in Medicare Part B, a program that does not limit drug coverage. We provide further evidence that facility stocking decisions likely drive this effect.

We demonstrate the existence of this channel by analyzing coverage of reference biologics and their biosimilar competitors. In doing so, we also uncover a potential obstacle to biosimilar adoption, which in turn has the potential to affect Medicare spending. A back-of-the-envelope calculations suggests that this spillover effect may generate as much as $61 million in excess spending in Medicare Part B. We note, however, that this effect would be difficult to eliminate through regulation. For example, requiring facilities to stock more brands or commercial formularies to exclude fewer would almost certainly result in higher costs for facilities and health plans.

More importantly, the channel we identify is unlikely to be limited to our empirical setting, which calls for additional research around this phenomenon. This spillover channel unlocks a strategic opportunity for manufacturers of outpatient-administered drugs with close therapeutic substitutes. Manufacturers that achieve broad commercial coverage for their brands enhance their ability to secure preferred status on facility formularies and, in turn, affect the drug utilization of patients receiving care at those facilities. This includes Medicare Part B beneficiaries but also beneficiaries of other government programs that do not impose formulary restrictions, such as state Medicaid programs. Our findings may also generalize to any setting where different agents make insurance coverage and distribution decisions. For example, this channel could affect how pharmacies choose which generic brand to stock when insurance plans favor certain generics over near-identical counterparts.

Finally, our results raise two crucial policy questions. First, because the spillover

prescribing behavior could not be directly attributed to the switch in facility. Previous literature shows that few patient characteristics are correlated with biosimilar utilization (Socal et al., 2020; Dean et al., 2021).

effect we identify implies that equilibrium outcomes in commercial markets affect government spending, our results raise the possibility that the government may be justified in introducing limited regulation in private markets to protect public insurance programs from these spillover effects. Second, because it allows linking two otherwise separate markets, this channel can—in theory—allow firms to exploit a dominant position in one market to gain a competitive advantage in a separate market, a behavior that has traditionally been considered anticompetitive. Future research should investigate whether drug manufacturers engage in this type of behavior.

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Appendix to "Stocking Under the Influence: Spillovers from Commercial Drug Coverage to Medicare Utilization"

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July 2023

A Molecules and Brands Included in Analysis

Table 2: Reference biologic and biosimilar brand names and US launch dates

Generic Name	Brand Name	Biosimilar Brand Names & Launch Dates
filgrastim	Neupogen	Granix - 11/2013 Zarxio - 09/2015 Nivestym - 10/2018
infliximab	Remicade	Inflectra - 11/2016 Renflexis - 07/2017
pegfilgrastim	Neulasta	Fulphila - 06/2018 Udenyca - 11/2018
epoetin alfa	Procrit	Retacrit - 11/2018

Notes: Information on doctor-administered biosimilars that launched before 2019 (our analysis sample). Granix's manufacturer submitted its regulatory application to the FDA prior to the availability of the Biologics Price Competition and Innovation Act, thus is approved under the traditional biologic pathway. Inflectra launched in November 2016, but was not given a Medicare billing code until January 2017, thus our analysis considers it to have launched in 2017. Two additional biosimilar launches – Avsola (infliximab) – 12/2019 and Ziextenzo (pegfilgrastim) – 11/2019 are not included in our sample as they launched at the end of our sample timeframe.

B Summary Statistics

Table 3: Summary Statistics of MMIT Commercial Insurance Coverage Data

Brand	All commercial plans (level: state-year)		National Formularies (level: formulary-year)	
	Fraction covered Mean, [IQR]	Fraction Unrestricted Mean, [IQR]	Covered Mean, [IQR]	Unrestricted Mean, [IQR]
Neupogen	0.872	0.449	0.897	0.384
	[0.765, 0.988]	[0.269, 0.613]	[1,1]	[0,1]
Granix	0.954	0.504	0.813	0.432
	[0.946, 0.982]	[0.386, 0.617]	[1,1]	[0,1]
Nivestym	0.811	0.368	0.459	0.233
	[0.746, 0.912]	[0.276, 0.451]	[0,1]	[0,0]
Zarxio	0.953	0.560	0.720	0.441
	[0.943, 0.984]	[0.426, 0.711]	[0,1]	[0,1]
Remicade	0.945	0.165	0.856	0.182
	[0.929, 0.976]	[0.109, 0.188]	[1,1]	[0,0]
Inflectra	0.767	0.328	0.503	0.187
	[0.732, 0.828]	[0.233, 0.411]	[0,1]	[0,0]
Renflexis	0.742	0.250	0.505	0.153
	[0.620, 0.881]	[0.177, 0.309]	[0,1]	[0,0]
Neulasta	0.984	0.308	0.888	0.407
	[0.986, 0.997]	[0.182, 0.406]	[1,1]	[0,1]
Fulphila	0.742	0.357	0.488	0.255
	[0.571, 0.929]	[0.260, 0.446]	[0,1]	[0,1]
Udenyca	0.651	0.337	0.427	0.240
	[0.368, 0.934]	[0.174, 0.489]	[0,1]	[0,0]
Procrit	0.964	0.330	0.964	0.272
	[0.951, 0.994]	[0.246, 0.379]	[1,1]	[0,1]
Retacrit	0.871	0.367	0.593	0.215
	[0.785, 0.977]	[0.283, 0.437]	[0,1]	[0,0]

Notes: Summary statistics on the coverage levels of different brands. Statistics shown are means and the interquartile range for each brand. The "All commercial plans" columns compute summary statistics at the state-year level using coverage data from 2015 to 2019. The "National Formularies" columns use data at the formulary-year level for national formularies (and the outcomes are binary variables for each formulary). Statistics are not weighted by enrollment.

C Within-State Correlation of Biosimilar Uptake Across Molecules

Table 4: Correlation Matrix of State-Level Biosimilar Uptake Across Molecules in 2019

	filgrastim	**infliximab**	**pegfilgrastim**	**epoetin alfa**
filgrastim	1			
infliximab	0.166	1		
	(0.244)			
pegfilgrastim	0.231	0.076	1	
	(0.103)	(0.598)		
epoetin	-0.164	0.011	0.183	1
alfa	(0.250)	(0.937)	(0.198)	

Notes: Correlations across brands in terms of biosimilar uptake at the state level, focusing on 2019. Biosimilar uptake is measured as the combined market share of all launched biosimilar brands. Epoetin alfa only includes non-ESRD usage.

D Breakdown of Variation in Instrumental Variable

D.1 Inertia in Commercial Insurance Partnerships with PBMs and National Formularies

Table 5: Percentage of Commercial Insurers that Contract with the Same PBM and National Formulary as the Previous Year

Year Transition	Plan Remains	Same PBM	Same National Formulary
2015 to 2016	66.47%	65.04%	34.87%
2016 to 2017	90.96%	84.87%	89.09%
2017 to 2018	88.14%	87.70%	79.33%
2018 to 2019	94.91%	93.85%	72.36%
2019 to 2020	89.70%	88.39%	86.54%

Notes: For a given year, we keep all plans that use a national formulary. We then calculate the probability that the same plan remains in the MMIT data for the next year ("Plan Remains"). We then calculate the probability that the plan remains AND uses the same PBM in the next year ("Same PBM"). Finally, we calculate the probability that the plan remains AND uses the same formulary ("Same National Formulary"). All probabilities are weighted by plan enrollment. The 2015 rate is affected by the Optum-Catamaran merger, which consolidated two large PBMs and shuffled the identity of several large national formularies.

D.2 Variation in Market Share of National Formularies Across States

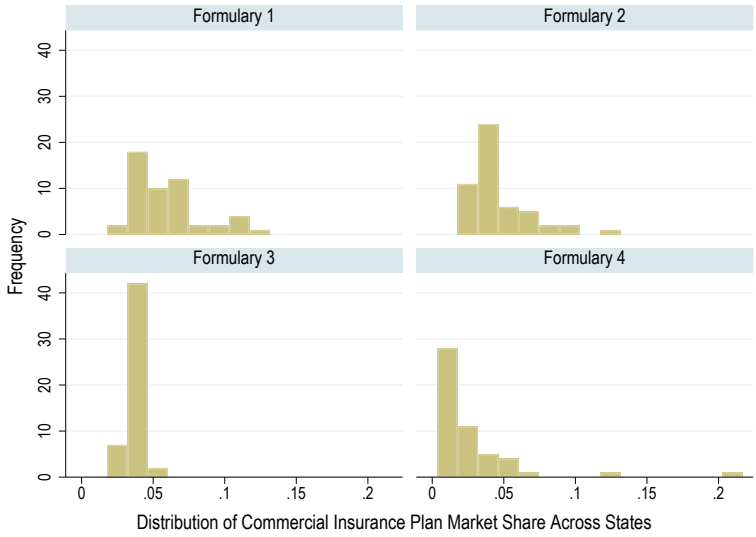

Figure 5: Distribution of Market Share of Four Largest National Formularies Across States in 2019

Notes: Distribution of market shares of national formularies across all fifty states. Market share is defined as the fraction of patients covered by a given national formulary in the given state.

D.3 Variation from Changes in the Exclusion of Reference Biologic and Biosimilars from National Formularies

Table 6: Coverage and Exclusion Events for Molecules of Interest

	Coverage Events	Exclusion Events
Filgrastim Brands		
Neupogen	2	9
Granix	4	0
Zarxio	8	2
Nivestym	16	0
Infliximab Brands		
Remicade	4	6
Inflectra	7	5
Renflexis	21	4
Pegfilgrastim Brands		
Neulasta	0	3
Fulphila	30	0
Udenyca	39	0
Epoetin alfa Brands		
Procrit	0	0
Retacrit	15	0
Total Reference Brand	6	18
Total Biosimilar	140	11
Total Events	146	29

Notes: Coverage events denote a change in a national formulary where a previously excluded brand is included in coverage. Exclusion events denote a change in a national formulary where a previously covered brand is excluded from coverage.

E Robustness Tests

E.1 Pooled Quasi-Maximum Likelihood Estimation

Table 7: IV Regression of Impact of Private Insurance Formulary Coverage on Biosimilar Uptake

	(1)
PANEL A. REDUCED-FORM ESTIMATES	
Fraction Excluded	-0.898
	(0.060)
Specification	APEs using Pooled QMLE
PANEL B. IV RESULTS	
Fraction Excluded	-0.483
	(0.100)
Specification	APEs using Pooled QMLE with endogenous regressor
First-Stage *F*-stat.	823.3
PANEL C. IV FIRST-STAGE	
Coverage on National Formulary	0.522
	(0.010)
Specification	OLS
R^2	0.921
Observations	1,836
Open Payments Control	Yes
Population Weights	No

Notes: Robustness check related to Table 1 of the main text. We use the same sample (state-year-brand level aggregate data from 2015 to 2019). The dependent variable in all regressions is the brand-level market share for each state-year. Molecules are only included for years after their first biosimilar launch. Results shown are average partial effects calculated using a pooled quasi-maximum likelihood estimator, with bootstrapped robust standard errors.

E.2 Link between Preferred Coverage in Commercial Formularies and Part B Utilization

Table 8: Association of Private Insurance Formulary Unrestricted Coverage with Biosimilar Uptake

	(1)	(2)	(3)
PANEL A. REDUCED-FORM ESTIMATES			
Fraction Unrestricted	0.364 (0.030)	0.365 (0.029)	0.364 (0.060)
Specification	OLS	OLS	OLS
PANEL B. IV RESULTS			
Fraction Unrestricted	0.544 (0.045)	0.532 (0.044)	0.534 (0.114)
Specification First-Stage *F*-stat.	2SLS 250.8	2SLS 222.8	2SLS 234.8
PANEL C. IV FIRST-STAGE			
Unrestricted Coverage on National Formulary	0.413 (0.013)	0.417 (0.013)	0.415 (0.12)
Specification R^2	OLS 0.844	OLS 0.846	OLS 0.843
Observations	1,836	1,836	1,836
Open Payments Control	No	Yes	Yes
Population Weights	No	No	Yes

Notes: Robustness check related to Table 1 of the main text, using a fraction of lives with unrestricted coverage as the independent variable. We use the same sample (state-year-brand level aggregate data from 2015 to 2019). The dependent variable in all regressions is the brand-level market share for each state-year. Standard errors are clustered at the state-brand level. Molecules are only included for years after their first biosimilar launch.

E.3 Removing Large States

Table 9: IV Regression of Impact of Private Insurance Formulary Coverage on Biosimilar Uptake Excluding Large States

	(1)	(2)	(3)
PANEL A. REDUCED-FORM ESTIMATES			
Fraction Excluded	-0.304	-0.302	-0.298
	(0.039)	(0.038)	(0.051)
Specification	OLS	OLS	OLS
PANEL B. IV RESULTS			
Fraction Excluded	-0.286	-0.284	-0.278
	(0.049)	(0.049)	(0.080)
Specification	2SLS	2SLS	2SLS
First-Stage *F*-stat.	845.4	739.3	839.0
PANEL C. IV FIRST-STAGE			
Coverage on National Formulary	0.522	0.522	0.514
	(0.010)	(0.010)	(0.010)
Specification	OLS	OLS	OLS
R^2	0.919	0.920	0.928
Observations	1,692	1,692	1,692
Open Payments Control	No	Yes	Yes
Population Weights	No	No	Yes

Notes: Robustness check related to Table 1 of the main text. We use the same sample (state-year-brand level aggregate data from 2015 to 2019) but exclude the four largest states by population (California, Texas, Florida, and New York). The dependent variable in all regressions is the brand-level market share for each state-year. Standard errors are clustered at the state-brand level. Molecules are only included for years after their first biosimilar launch.

F Calculation of savings from unrestricted formularies

In the main paper, we estimate potential Medicare Part B savings if all commercial formularies covered all biosimilar brands. We perform this calculation in three steps.

1. First, we use the estimated coefficient in our preferred specification, $\hat{\beta} = 0.301$ (Table 1, column 3) and calculate the predicted change in utilization rate (e.g. market share) for each biosimilar brand j and state k as $\hat{\beta} \times \text{Frac. Uncovered}_{jk}$ (note that all data refers to the year 2019)

2. Because all biosimilar brands increase in market share, we need to also adjust the number from step 1 downward to account for the fact that some of the increased utilization of a given biosimilar brand j may come from other biosimilar brands. To make this adjustment, we assume that substitution patterns are proportional to observed market shares (this is what would happen with logit demand). The Table below illustrates the adjustment with a numerical example

	Reference Biologic	Biosimilar 1	Biosimilar 2
Initial market share	70%	20%	10%
Fraction uncovered in commercial formularies	0%	40%	30%
Raw change in market share	0%	12%	9%
Adjustment	−17.5%	−2%	−1.5%
New adjusted market share	52.5%	30%	17.5%

In the example, Biosimilar 1 would experience a potential increase in market share of about 12% ($0.301 \times 40\%$), while Biosimilar 2 would experience a potential increase by 9%. Most of those increases would come at the expense of the reference biologic, but some of it would be from patients who were already using the other biosimilar brand. To calculate that proportion we use the leave-one-out market shares: Biosimilar 1 absorbs 2% of the potential market share increase of Biosimilar 2 because its market share relative to the reference biologic is $2/9$; Biosimilar 2 absorbs 1.5% of the potential market share increase of Biosimilar 1 because its market share relative to the reference biologic is $1/8$. The reference biologic absorbs what remains.

1. Finally, we multiply the difference between the initial and new adjusted market share by the total number of claims for a given molecule (inclusive of both

biosimilars and biologics) and by the difference in average spending between claims for the reference biologic and for each biosimilar.[18]

Note that this procedure does not take into account two potential effects:

1. Changes in demand, which could arise because patient cost-sharing for biosimilars is lower than for reference biologics; and
2. Changes in equilibrium price for biosimilars (or reference biologics), which could arise if commercial insurers were forced to include all biosimilars on their formulary

[18] An alternative way to compute this number would have been to use the publicly available Average Sales Price (ASP) series. However, ASP for some biologics and biosimilars refer to a different number of administered units, which would have required additional adjustments.