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Branded response to generic entry: Detailing beyond the patent cliff

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ABSTRACT

The literature on pharmaceutical marketing devotes little attention to the promotion of branded drugs after generic competitors enter the market. This paper addresses this gap in the literature and explores how the sales of branded drugs respond to specific promotional strategies following generic entry. We focus on physician detailing, and specifically, firms' post-generic-entry decisions regarding overall detailing spending and physician-level allocation (i.e., which physicians to visit). We utilize a novel, custom-built dataset containing information on aggregate-level sales, prescriptions, and promotional budget for 72 brands and their competitors; our dataset further includes detailed physician-level data on detailing visits and prescription behavior for 25 of these brands. We first describe the detailing strategies that brands use in practice, and then analyze the outcomes associated with changes in detailing spending and allocation. Our analyses reveal that, on average, brands' detailing spending decreases after generic entry, yet the ROI on such spending increases compared to before generic entry. Refocusing of detailing efforts after generic entry such that physicians with higher brand preference are targeted is more likely to lead to an increase in detailing ROI than other allocation strategies post entry. However, in practice, many brands do not undertake such reallocation and do not enhance their ROIs. Our findings are of clear practical relevance to manufacturers of branded drugs, as well as to policy makers who wish to curb detailing efforts for branded drugs when generic alternatives are available, so as to lower healthcare costs.

1. Introduction

Much of the literature on pharmaceutical marketing focuses on branded drugs prior to patent expiration and subsequent generic entry. However, branded drugs that near patent expiration face a formidable demand problem for which no straightforward solution seems to exist. Specifically, these drugs are subject to a 'patent cliff' in which, after the expiry of a branded drug's patent protection, sales of the branded drug drop precipitously as generic competitors begin to enter the market. Indeed, a 2020 report suggested that branded drug manufacturers (which we also refer to as 'branded firms') were likely to lose $252 billion in sales between 2020 and 2026, due to patent expiries and subsequent generic entries (Evaluate Pharma, 2020).

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The patent cliff associated with generic entry is distinct from the challenges imposed by other forms of competition, as generic drugs are close substitutes for their branded counterparts—containing the same active ingredients—yet their prices are much lower. Moreover, in many countries, regulations require (or permit) pharmacies to dispense generic options even when branded drugs are prescribed, unless explicitly instructed to do otherwise (Song and Barthold, 2018). Notably, however, despite these challenges, mature drugs continue to make up a substantial portion of branded firms' sales, providing incoming cash flow that is crucial both to firms' bottom line and to their investments in R&D (Evaluate Pharma, 2020).

This situation suggests a need for an in-depth examination of marketing strategies for mature drugs around the point of generic entry, towards identifying means of mitigating the damage associated with the patent cliff. The current paper addresses this need. Specifically, we focus on the interrelated dynamics of the sales of mature branded drugs and firms' decisions regarding physician detailing—a practice in which sales representatives of pharmaceutical companies market drugs to individual physicians, in an effort to convince them to prescribe those drugs. Detailing is one of the main marketing tools in pharmaceutical companies' arsenal, alongside direct-to-consumer advertising (DTCA) and other approaches such as dispensing of drug samples to physicians and advertising in medical journals (see, e.g., Kremer et al., 2008).

Planning a detailing strategy for a branded drug involves two basic elements: (i) determining the overall budget that will be dedicated to the drug's detailing; and (ii) allocating that budget across physicians (Fezza,Glazier and Reynolds, 2016). When faced with generic entry, different branded firms may respond differently in terms of how they approach each element. In some cases, branded firms may retain the detailing approaches they used before generic entry—sustaining or even increasing their overall detailing budgets and targeting similar sets of physicians. For example, for about six months after generic entry, Pfizer continued to aggressively promote its cholesterol drug, Lipitor, in the hope of lowering the impact of generic competition on the drug's annual sales, which previously stood at about $10 billion (Rockoff, 2012). In other cases, a branded firm may seek to cut costs by significantly reducing both the overall detailing budget for the drug and the set of physicians targeted. For example, Eli Lilly downsized its sales force prior to the patent cliff of its blockbuster drug Cymbalta (Staton and Palmer, 2013). Still other firms might retain overall spending levels but reallocate the budget across physicians. For instance, in a 2010 interview, AstraZeneca's then-CEO stated that, once the firm's blockbuster drugs Nexium and Seroquel started facing competition from generics, AstraZeneca would reallocate the drugs' marketing and sales resources to other geographical regions where there might still be potential for growth (Hirschler, 2010).

The examples above suggest that firms do not adhere to any one universal set of guidelines in reconfiguring their detailing efforts after generic entry. And it seems that marketers perceive that such guidelines are lacking. For example, in a survey by Accenture (2013), nearly half of the 200 respondents—sales and marketing executives at large pharmaceutical companies—indicated that there is significant room for improvement of their sales and marketing models after the patent cliff, and 87 % of them indicated that they would increase the use of analytics to target detailing spending and improve ROI.

Accordingly, the current research aims to provide a comprehensive understanding of post-generic-entry detailing decisions by firms marketing branded drugs. We approach this aim in two steps. First, we provide an empirical description of detailing spending decisions that firms take in practice when faced with generic entry. That is, we ask: How do firms change their detailing spending and the allocation of this spending across physicians after generic entry compared with before generic entry? Second, we analyze the outcomes of these strategies in practice. Specifically, we ask: How do specific measures of detailing effectiveness change after generic entry compared with those before generic entry, across brands? These questions are of clear practical relevance to pharmaceutical firms, yet to our knowledge, they have yet to be addressed in the marketing literature. Notably, these questions are also of societal importance: Their answers might contribute to the development of policies that limit prescriptions of mature branded drugs when generic alternatives are available; such policies could reduce costs for healthcare payers. We elaborate further on this aspect in the Discussion section.

To address our research questions, we built a unique, custom-made dataset in close collaboration with IQVIA, the leading data intermediary for the pharmaceutical industry. We combined the IQVIA data with DTCA information from Nielsen. Our final dataset contains aggregate national-level data on sales, prices, and spending on detailing, DTCA, journal advertising, and sampling from the US on 72 brands that faced generic entry between 2006 and 2017, as well as on all competing brands in the respective categories to which our focal brands belong. The dataset also contains disaggregate, physician-level data from IQVIA on 25 of these 72 brands—specifically, those that had the highest detailing spend prior to generic entry—as well as on all competing brands in the respective categories to which these 25 focal brands belong. To the best of our knowledge, this paper has, by far, the richest data set ever deployed in the academic literature on pharmaceutical marketing.

We provide detailed descriptive statistics on the changes that brands initiate in detailing spending and allocation of detailing after generic entry. First, we find that firms generally tend to reduce overall detailing spending for branded drugs: on average, a brand's detailing spending after generic entry is 57 % of that before generic entry. At the same time, one in six brands increases its detailing spending after generic entry compared with before generic entry. Second, we find that brands tend to substantially modify the allocation of their detailing visits: on average, only 24 % of physicians who were detailed before generic entry are detailed after generic entry. Third, focusing on the 25 brands for which we have physician-level data, we map each brand along two dimensions: (i) the extent to which the brand decreased (vs. sustained/increased) its detailing spending after generic entry; and (ii) the extent to which the brand reallocated detailing visits across physicians. We find that most brands in our sample either substantially decrease detailing spending combined with major reallocation of detailing visits, or less drastically decrease (or even increase) spending combined with more minor reallocation of detailing visits across physicians.

Next, we econometrically estimate the effect of detailing on demand for branded drugs before and after generic entry, and we evaluate how changes in a brand's detailing spending and allocation affect the market's responsiveness to its detailing investments. This step comprises two studies. In Study 1, we use our aggregate-level dataset to estimate a hierarchical Bayesian model and assess the market-level sensitivity of sales to detailing spending before and after generic entry, while controlling for DTCA spending, other marketing spending, price, and competitive actions. In Study 2, we leverage our physician-level data to take a closer look at how brands reallocate their detailing efforts across physicians after generic entry, and to measure the relationship between this reallocation and physicians' prescription behavior. Specifically, we estimate correlated count models for the number of prescriptions that each physician writes and the number of detailing visits that he or she receives, and assess how firms reallocate their detailing visits according to specific physician characteristics: the physician's brand preference, detailing sensitivity, and exposure to competitive detailing.

Our analyses provide revealing insights regarding the dynamics of detailing and demand for branded drugs around generic entry. We obtain the following main findings. First, a brand's detailing sensitivity is higher, on average, after generic entry than before generic entry. Second, we find that branded firms, on average, reduce the number of detailing visits after generic entry but allocate a larger proportion of visits to physicians with a higher brand preference, compared with before generic entry. Third, we find that both the short-term and long-term ROIs of detailing increase on average after generic entry; specifically, current-period ROI levels increase from $1.2 (per dollar invested) before generic entry to $3.2 after generic entry, and multiperiod ROI levels (calculated over 12 months) increase from $4.3 before generic entry to $14.5 after generic entry. While the detailing ROIs that we obtain before generic entry are similar to those reported in prior literature (e.g., Narayanan,Desiraju and Chintagunta, 2004; Neslin, 2001), we are the first, in the academic literature, to report detailing ROIs after generic entry.

In calculating these aggregate-level ROIs, we observe substantial heterogeneity across brands in terms of the post generic-entry change in market-level detailing sensitivity. We integrate the data from Study 1 and Study 2 to examine whether this heterogeneity can be explained by firms' changes in detailing allocation (i.e., overall change in the total number detailing visits and reallocation with respect to physicians' brand preference, detailing sensitivity, and competitive detailing activity). We find that the overall change in the total number of detailing visits following generic entry does not explain the change in detailing sensitivity. However, the specific nature of the change in detailing allocation is significantly associated with the change in sensitivity. Specifically, following generic entry, firms that reallocate their detailing visits to focus more on physicians with higher brand preference experience a larger increase in market-level detailing sensitivity compared with firms that do not.

Finally, we assess the effectiveness of different detailing responses across brands in our sample. We find that when firms reduce the proportion of physicians that are detailed after generic entry compared to before entry, they have a higher likelihood of obtaining increases in detailing ROI—particularly long-term ROI—after generic entry.

Taken together, these results indicate that, regardless of firms' decisions regarding the size of their overall detailing budgets, firms that react to generic entry by drastically reallocating their detailing visits to physicians with a higher preference for their branded drugs gain most in terms of returns on their detailing investments.

2. Overview of related works

This study contributes to three main streams of marketing literature, discussed in what follows: (a) detailing spending and sales response to detailing, (b) detailing allocation across physicians, and (c) the effects of generic entry on sales of branded drugs.

2.1. Detailing spending and sales response to detailing

Several studies have analyzed the effectiveness of detailing as a marketing tool, focusing on the period before generic entry (e.g., Neslin, 2001; Wittink, 2002). Some of these studies compared the effectiveness of detailing with that of other pharmaceutical marketing approaches, such as DTCA and advertising in medical journals (e.g., Fischer and Albers, 2010; Stremersch Landsman and Venkataraman, 2013; Narayanan et al., 2004). These studies highlight the critical role of detailing for pharmaceutical firms, showing, for example, that detailing is more effective than DTCA in driving demand for branded drugs (Fischer and Albers, 2010), and that it has a higher ROI (Narayanan et al., 2004). Likewise, in a *meta*-analysis, Kremer et al. (2008) showed that branded drug manufacturers spend more on detailing than on DTCA or journal advertising, and that sales response to detailing is higher than that of DTCA and journal advertising.

Other studies have delved into strategic planning of detailing spending at different stages in a drug's life cycle—albeit still prior to generic entry. In one *meta*-analysis, Sridhar, Mantrala and Albers (2014) found that detailing elasticities are lower in later (pre-generic entry) stages of the drug's life cycle than in earlier stages. Using this finding and the Dorfman-Steiner theorem (Dorfman and Steiner, 1954), which shows that the optimal detailing spending is proportional to detailing elasticity, the authors suggest that a brand's detailing spending should be lower in later stages of the product life cycle than in earlier stages.

A few studies in this stream (Narayanan,Manchanda and Chintagunta, 2005; Ching and Ishihara, 2012; Ching et al., 2016) have tried to disentangle the process through which detailing affects sales. Specifically, they examined the 'informative'

versus 'persuasive' roles of detailing (Leffler, 1981). Narayanan et al. (2005) imposed structural assumptions and found that the mechanism through which detailing affects demand changes over the drug's life cycle, namely, that detailing primarily plays an informative role for about 6–14 months after the introduction of the brand, after which detailing primarily plays a persuasive role.[1]

Together, these studies suggest that appropriate detailing spending is of critical strategic importance and that its effectiveness may change over the life cycle of the drug. No studies thus far have examined the effectiveness of detailing spending during the post-generic-entry stage of the drug's life cycle.

2.2. Detailing allocation across physicians

As noted in the introduction, a pharmaceutical firm's detailing strategy comprises not only decisions regarding overall detailing spending but also decisions regarding how to allocate that spending across physicians. Several studies have focused on such allocation. Montoya, Netzer and Jedidi (2010) proposed a model for dynamically targeting physicians and allocating resources to detailing these physicians at different stages of a drug's life cycle (prior to generic entry). Manchanda, Rossi and Chintagunta (2004) developed a model for detailing allocation to physicians on the basis of physicians' specific brand preferences and detailing sensitivity. The authors concluded that pharmaceutical firms do not allocate detailing visits to physicians optimally—specifically, allocation of detailing visits tends to be based on physicians' brand preference rather than on their responsiveness to detailing efforts. Kappe, Venkataraman and Stremersch (2017) extended Manchanda et al.'s (2004) framework and showed that, after controlling for competitive detailing, firms' detailing allocation is related to both brand preference and detailing sensitivity. Yet, none of these studies focused on how detailing is allocated across physicians after generic entry.

2.3. Effects of generic entry on demand for branded drugs

Several studies in the economics literature (e.g., Frank and Salkever, 1997; Grabowski and Vernon, 1992) have examined the relationships between generic entry, drug sales and pharmaceutical companies' price responses. Yet, the economics and marketing literatures have largely ignored the impact of drug promotion following generic entry. One exception is a study by Bhattacharya and Vogt (2003), who proposed a model in which it is effective for pharmaceutical companies to increase prices and decrease promotional activities over the course of a drug's life cycle, including after patent expiry. The logic is that high levels of advertising early in the life cycle help brands to build public knowledge about their drugs, and this knowledge can enable the brands to effectively compete with generic competitors late in the drug's life cycle. Additional exceptions include the work of Berndt, Kyle and Ling (2003) that, focusing on the US market for antiulcer and heartburn drugs, examined the interplay between generic entry and transitions of branded drugs from prescription-only availability to over-the-counter availability. The authors found that detailing spending decreased for brands facing generic entry, but they did not measure the returns on detailing investments before and after generic entry. In another study, Ellison and Ellison (2011) theoretically proposed that, prior to generic entry, firms may use detailing to strategically discourage such entry, yet they did not find empirical evidence for such strategic use of detailing.

Other studies, in the marketing domain, have examined the effects of generic entry on physicians' prescription behavior (Gonzalez et al., 2008; Kappe and Stremersch, 2016). Gonzalez et al. (2008) studied one therapeutic category and found that generic entry was followed by a decrease in prescriptions for the entire molecule—including both branded and generic drugs—a paradox identified previously in several pharmaceutical categories (e.g., Caves et al., 1991, Vandoros and Kanavos, 2013). The authors attributed the decline in preference for the molecule to detailing-sensitive physicians switching from the brand facing generic entry to other branded alternatives in the therapeutic category. Kappe and Stremersch (2016), also studying one therapeutic category, examined how generic entry for two branded drugs affected the number of prescriptions for the branded drugs as well as the physician-level detailing sensitivity for competing branded drugs. Notably, the authors did not measure the change in detailing sensitivity for the brands facing generic entry, since the brands they studied essentially stopped detailing after generic entry. In this paper, we show that many brands do not stop detailing after generic entry, and we study the effectiveness of different detailing response strategies across firms. Table 1 summarizes the papers on the effects of generic entry on the sales of branded drugs, the marketing response strategies of branded firms to generic entry, and post-entry changes in demand elasticities.

2.4. Summary

Summing up the above, prior studies in healthcare marketing have examined (1) the effects of detailing on sales *prior* to generic entry; (2) optimal detailing allocation prior to generic entry; and (3) the effects of generic entry on the sales of branded drugs and on sensitivity to competitors' detailing, *without* accounting for (changes in) brands' own detailing spending and allocation. To our knowledge, the current study is the first to evaluate the effectiveness of a brand's detailing spending and allocation strategies following the market entry of generic competitors to that brand.

[1] Using data on comarketing agreements, Ching and Ishihara (2012) showed that the informative role of detailing is mainly responsible for molecule demand, whereas the persuasive role of detailing is mainly responsible for brand-level demand.

Table 1
Summary of papers on the effects of generic entry on the sales of branded drugs, marketing response strategies to entry, and post-entry changes in demand elasticities.

Paper	Examined variables										Data	Main relevant findings
	Branded drug response to generic entry					Post-Entry Decisions Outcomes (demand sensitivity)						
	Price	Detailing spending	Detailing allocation	DTCA spending	Other prom.*	Price	Detailing spending	Detailing allocation	DTCA	Other prom.		
Frank and Salkever (1997)	√										A sample of 32 drugs that lost patent protection during the early to mid-1980 s	Brand-name prices increase after generic entry and are accompanied by large decreases in the price of generic drugs.
Grabowski and Vernon (1992)	√										A sample of 18 drugs that lost patent protection 1984–1988	Also after the 1984 Act, firms typically continued to increase drug prices at the same rate as before generic entry.
Bhattacharya and Vogt (2003)	√				√ (journal ads count)	√					All β-blockers (11 molecules) between 1987 and 1993	Prices increase throughout the drugs' lifecycle. The number of ads declines more quickly after patent expiry than before.
Berndt, Kyle and Ling (2003)	√	√		√	√ (journal ads)	√					Antiulcer and heartburn drugs (4 molecules) 1988–1999	Following patent expiration, prices of branded drugs are maintained or slightly increased, and marketing spending decreases.
Gonzalez et al. (2008)	√	√									One molecule with patent expiration. The analysis covers 4 other molecules in the category between 1998 and 2000.	After generic entry, there is a decrease in prescriptions for the focal molecule. Detailing sensitive physicians switch to other branded alternatives in the therapeutic category.
Ellison and Ellison (2011)	√	√			√ (journal ads)						A sample of 63 distinct chemical compounds with exclusivity expiration between 1986 and 1992	Detailing advertising change patterns before patent expiration cannot provide significant evidence of strategic entry deterrence, likely due to too few observations of real changes.
Kappe and Stremersch (2016)		√									Two molecules with patent expiration. The analysis covers 6 other molecules in the category between 2002 and 2008	Competitors of drugs facing generic entry can positively differentiate themselves from generics by mentioning contraindications and indications during detailing visits after the entry.
Current study	√	√	√	√	√	√	√	√	√	√	Aggregate-level data on 72 brands facing generic entry and their full category, and Physician-level data on 25 of these brands (and category), between 2003 and 2020	Brands' detailing spending decreases after generic entry, yet detailing ROI increases. Detailing reallocation after generic entry to physicians with higher brand preference is more likely to lead to a rise in detailing ROI than other reallocation strategies.

* Other promotion types include journal advertising and drug samples.

3. Empirical investigation

To address our research questions and explore the dynamics of detailing spending, detailing allocation, and the outcomes associated with various post-generic-entry promotional decisions, we proceed to our empirical investigation using unique secondary datasets covering the pharmaceutical industry. Our empirical analysis comprises two studies, each utilizing a different dataset (one at the aggregate level and the other at the disaggregate level); the two studies complement each other and enhance our understanding of the investigated phenomenon. Study 1 uses an aggregate-level dataset to estimate a hierarchical Bayesian model and assess the market-level sensitivity of sales to detailing spending before and after generic entry, while controlling for DTCA spending, other marketing spending, price, and competitive actions. Study 2 uses physician-level panel data to take a closer look at how brands reallocate their detailing efforts across physicians after generic entry, and to measure the relationship between this reallocation and physicians' prescription behavior.

In what follows, we present the two studies, each in turn, their corresponding conceptual frameworks, the data used in each study, the specification of the econometric model, and the estimation results we obtained.

3.1. Study 1: Aggregate-Level Analysis: Detailing spending and Market-Level detailing sensitivity before and after generic entry

In Study 1 we used our aggregate-level dataset—corresponding to 72 drugs in 62 Anatomical Therapeutic Chemical (ATC) level-4 categories (see Section 3.1.2 below)—to examine how brands changed their detailing spending after generic entry (vs. before entry) and to evaluate the effects of detailing on sales in the periods before versus after generic entry.

3.1.1. Conceptual framework

To isolate how changes in detailing spending following generic entry affect aggregate sales of a branded drug, it is necessary to account for the different routes through which generic entry might influence these sales (given that we rely on aggregate-level data).[2] We identify three such routes, depicted in Fig. 1. The first route is direct competition (Path (a) in Fig. 1), in which generic drugs, which contain the same active ingredients as the branded drug yet at lower prices, draw sales away from the branded drug. The second route (Path (b) in Fig. 1) is the effect of generic entry on the brand's detailing spending, which is the focus of this analysis. The third route (Path (c) in Fig. 1) depicts the effect of generic entry on the market-level detailing sensitivity. This effect is likely to incorporate, on the one hand, shifts in individual physicians' sensitivity to detailing efforts; for example, the availability of generic options may make some physicians become less responsive to detailing efforts. On the other hand, as discussed in previous sections, branded firms may address this possibility by reallocating their detailing efforts to focus on physicians with certain characteristics, who may be more responsive to detailing visits. Such targeted allocation may increase the sales response to detailing spending after generic entry compared with before generic entry. We elaborate on these ideas in greater detail in Study 2 (Section 3.2 below).

We control for the effect of generic entry on the branded drug's DTCA spending, other marketing spending, price, and competitor's sales (Path (d) in Fig. 1), and the change in the effects of these variables on sales after generic entry compared to before generic entry (Path (e) in Fig. 1). We also control for the effect of competitive detailing spending on the focal brand's detailing spending.

3.1.2. Data – Aggregate-Level dataset

We obtained a novel dataset from IQVIA on dollar and unit sales and promotional spending amounts—for detailing, DTCA, medical journal advertising, and drug samples—for several dozen drug brands across various therapeutic categories in the US between 2003 and 2020. This dataset did not include data on DTCA spending between 2015 and 2020; we obtained these data from Nielsen.

To compare changes in detailing spending, detailing allocation, and the effect of detailing on demand (aggregate-level sales and physician-level prescriptions) due to generic entry across brands, we focus on three years before and three years after generic entry (72 months) for each brand.[3] The sample for our aggregate analysis consists of all brands[4] in our dataset that faced generic entry between 2006 and 2017, and for which we had information for at least three years before and three years after generic entry. We eliminated brands for which sales or detailing activity did not cover the entire three years before

[2] Pharmaceutical firms anticipate the entry of generic drugs as it follows the expiry of the branded drug patent, yet they typically are unaware of the exact entry date. That date depends on the FDA approval process by generic firms and may, in some cases, even be challenged by branded firms through legal and other procedures leading to further entry delays (Vokinger et al., 2017). Thus, while we model the entry date based on retrospective information regarding the first appearance of a generic entrant, this date is not fully known a priori by firms.

[3] While firms make detailing investment decisions throughout the lifecycle of branded drugs knowing that there will be an eventual entry of generic substitutes to the market (Bhattacharya and Vogt, 2003), we describe detailing patterns taking a window of 3 years before and 3 years after generic entry to define our pre- and post-entry periods. Note also that generic entry may deviate from the time of patent expiry. Among the brands for which we were able to obtain information on patent expiry, we found that generic entry could occur both before or after patent expiry. We, therefore, do not see firm adjustments of detailing activities in anticipation of the timing of generic entry as a major issue to empirical identification. Moreover, our key findings are robust if we include two years before and two years after generic entry instead of three years. See Section 3.1.8 (Robustness Checks).

[4] Our sample only consists of drugs that are prescribed by physicians outside hospitals. We sample only single-molecule drugs and not combination drugs to avoid the modeling complexity combination drugs would cause. Pricing and promotion decisions and patent expiry would have to be defined both at the level of the combination and for each of the single-molecule drugs, creating complex interdependencies beyond the focus of our study (Liu,Liu and Chintagunta, 2017).

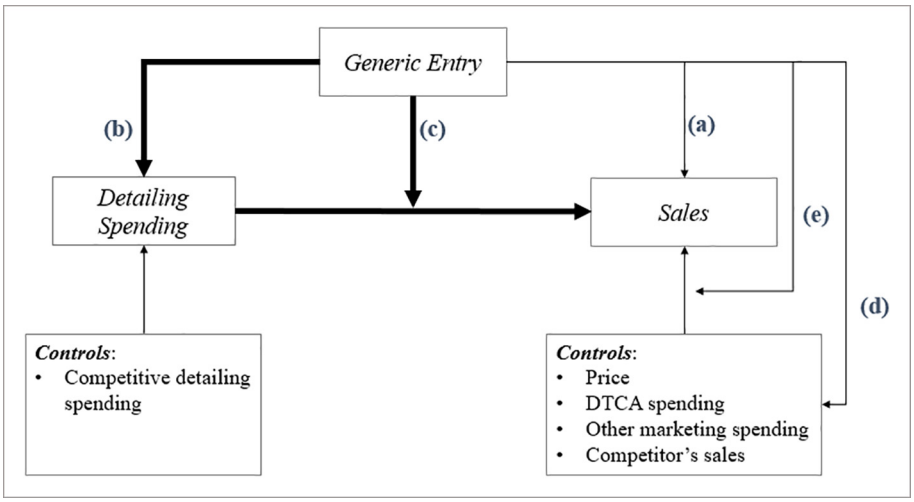


Fig. 1. Conceptual framework capturing the effects of generic entry on aggregate-level brand sales.

generic entry. This process resulted in 72 brands, which belonged to 62 level-4 categories, as defined in the World Health Organization's ATC classification system.[5] The brands in our sample had, on average, $800 million in annual revenues before generic entry and $200 million in annual revenues after generic entry.

The largest brand in our sample was Pfizer's cholesterol drug Lipitor (ATC level-4 category: C10AA HMG CoA reductase inhibitors) with $8 billion in annual revenues prior to generic entry in December 2011. The second-largest was AstraZeneca's antipsychotic drug Seroquel (ATC level-4 category: N05AH Diazepines, oxazepines, thiazepines and oxepines), with $5.2 billion in annual revenues prior to generic entry in March 2012. The third-largest was Merck's anti-inflammatory drug Singulair (in ATC level 4 category: R03DC Leukotriene receptor antagonists), with $4.7 billion in annual revenues prior to generic entry in August 2012.[6] Web Appendix A lists the brands in our sample, their molecule names, ATC level-4 categories, and annual revenues before and after generic entry.

3.1.3. Model-Free Descriptives: Change in detailing spending

Fig. 2 shows the distribution of brands in our aggregate-level sample across different percentage changes in detailing spending after generic entry compared to before generic entry. On average, detailing spending after generic entry dropped by 43 % compared with before generic entry, indicating that a brand's detailing spending after generic entry is, on average, 57 % of that before generic entry. We note that for 20 of the 72 brands, detailing spending after generic entry decreased by 90 %–100 % compared with before generic entry; among these 20 brands, 4 stopped detailing altogether after generic entry. In contrast, 12 of the 72 brands increased their detailing spending after generic entry, compared with before generic entry.

Fig. 3 depicts the annual detailing spending in the years before and after generic entry for three of the 72 brands: Numorphan/Opana (a narcotic painkiller), Cordran (a topical steroid), and Cedax (an antibiotic). These brands represent three different detailing spending patterns. For Numorphan/Opana, annual detailing spending increased from about $5 million during the year before generic entry to about $7 million in the second and third years after generic entry (leftmost chart in Fig. 3). For Cordran, annual detailing spending increased from less than $6 million prior to generic entry to about $11 million during the year after generic entry (middle chart in Fig. 3). For Cedax, annual detailing spending decreased by about 50 % every year after generic entry compared to the previous year (rightmost chart in Fig. 3).

3.1.4. Measures – Aggregate-level model

Our key dependent variable is the unit sales ($sales_{jt}$) of brand j in a particular month t.[7] Our key independent variable is detailing spending (det_{jt}) for brand j in month t, measured in USD per month. Price (pr_{jt}) is the monthly price per unit of brand j in month t, DTCA spending ($dtca_{jt}$) is the monthly spending on DTCA, and other marketing spending (om_{jt}) is the monthly spending on journal advertising and sampling for brand j in month t. We measure competitive sales ($compsales_{jt}$) as the unit sales of all other products (brands and generics included) in the ATC level-4 category of brand j in month t. We measure competitive detailing ($compdet_{jt}$) and competitive DTCA ($compdtca_{jt}$) as the spending of all other brands in the ATC level-4 category on detailing

[5] The molecules for seven brands in our sample (Imiquimod, Aztreonam, Risedronate, Oxymorphone, Zolmitriptan, Olopatadine, and Sevelamer) are sold under more than one brand name by the same or another manufacturer with marketing agreements. We consider multiple brands for a molecule as a single brand and combine their sales and marketing spending.

[6] The revenues are calculated as the average across the three years before generic entry.

[7] Our key findings are robust if we use prescriptions instead of unit sales. See Section 3.1.8 (Robustness Checks).

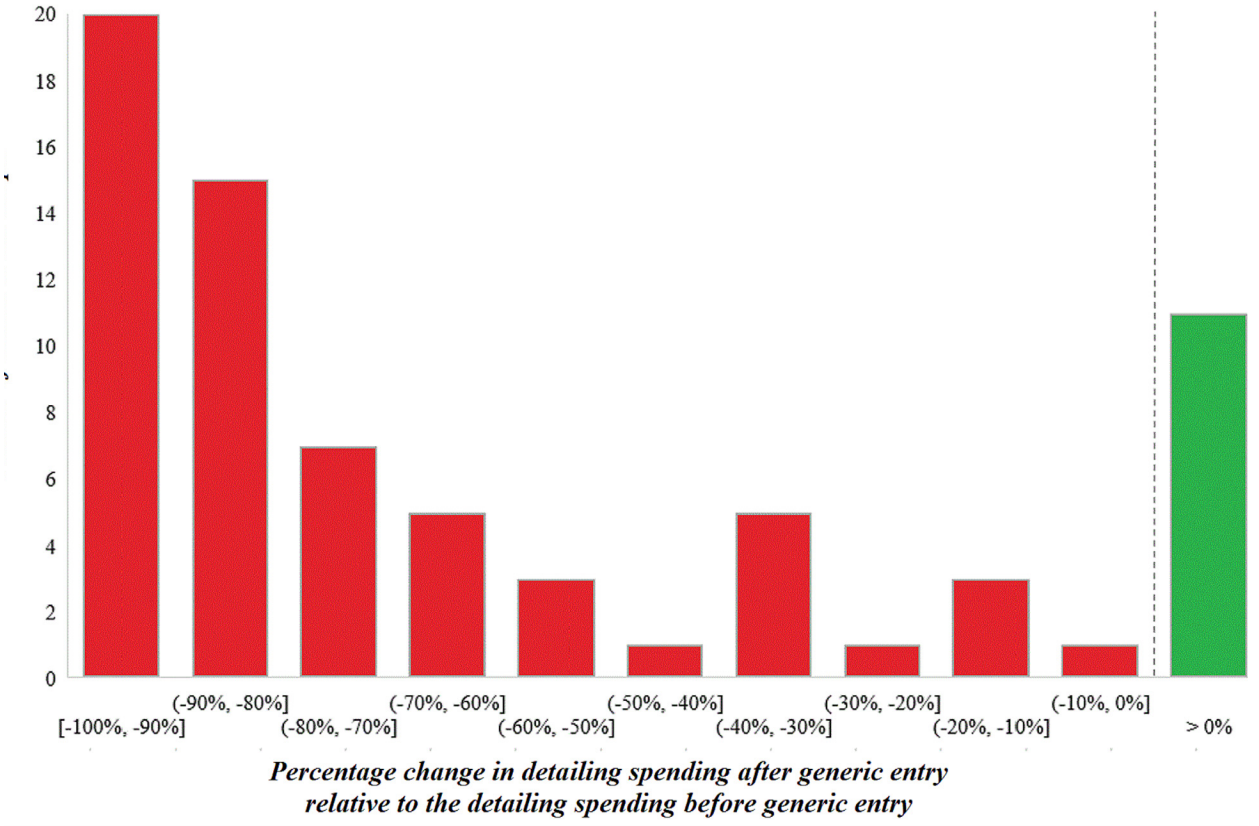


Fig. 2. Change in detailing spending after generic entry. Note: percentage change is calculated as the difference between post- and pre- entry spending divided by pre-entry spending. Red bars represent decreases in detailing spending. Green bars represent increases in detailing spending. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

and on DTCA, respectively. We represent generic entry (ge_{jt}) as a dummy variable that is equal to 0 during the period before generic entry and equal to 1 during the period after generic entry.

Table 2 summarizes the variables used in our analysis. Column 2 in Table 2 contains the means and standard deviations of the variables in the three-year period before generic entry, and Column 3 in Table 2 contains the means and standard deviations of the variables in the three-year period after generic entry. Columns 4–9 provide the correlations between the variables for all brands over 72 months (3 years before and 3 years after generic entry).

3.1.5. Econometric model

In line with prior studies (e.g., Chintagunta and Desiraju, 2005; Narayanan et al., 2004), we use a log-linear model for sales. Moreover, instead of estimating the effects of raw promotional spending amounts (e.g., detailing spending and other forms of promotional spending), we translate each promotional spending variable into a 'promotional goodwill' variable that captures the carryover effect of promotional spending (i.e., spending in a given month is likely to continue to have an effect on sales in later months). Specifically, we model the log of unit sales for brand j in month t, $\ln(sales_{jt})$, as follows:

$$\begin{aligned} ln(sales_{jt}) = {} & \alpha_j^1 + \beta_{1j}^1 ln(\bar{pr}_{jt}) + \beta_{2j}^1 \bar{detgw}_{jt} + \beta_{3j}^1 \bar{dtcagw}_{jt} + \beta_{4j}^1 \bar{omgw}_{jt} + \beta_{5j}^1 ln(\bar{compsales}_{jt}) + \beta_{6j}^1 ge_{jt} \\ & + \beta_{7j}^1 \left(ge_{jt} \times ln(\bar{pr}_{jt}) \right) + \beta_{8j}^1 \left(ge_{jt} \times \bar{detgw}_{jt} \right) + \beta_{9j}^1 \left(ge_{jt} \times \bar{dtcagw}_{jt} \right) + \beta_{10j}^1 \left(ge_{jt} \times \bar{omgw}_{jt} \right) \\ & + \beta_{11j}^1 \left(ge_{jt} \times ln(\bar{compsales}_{jt}) \right) + \varepsilon_{jt}^1 \end{aligned} \quad (1)$$

The variables $detgw_{jt}$, $dtcagw_{jt}$, $omgw_{jt}$ represent the promotional goodwill associated with spending on detailing, DTCA, and other marketing, respectively; we elaborate below on how these variables are specified. All other variables are defined above. α_j^1 is the brand-specific fixed-effect, or baseline sales, which captures time-invariant factors that affect the brand's sales. Since we mean-center the independent variables, β_{1-5j}^1 capture the effects of the independent variables before generic entry,

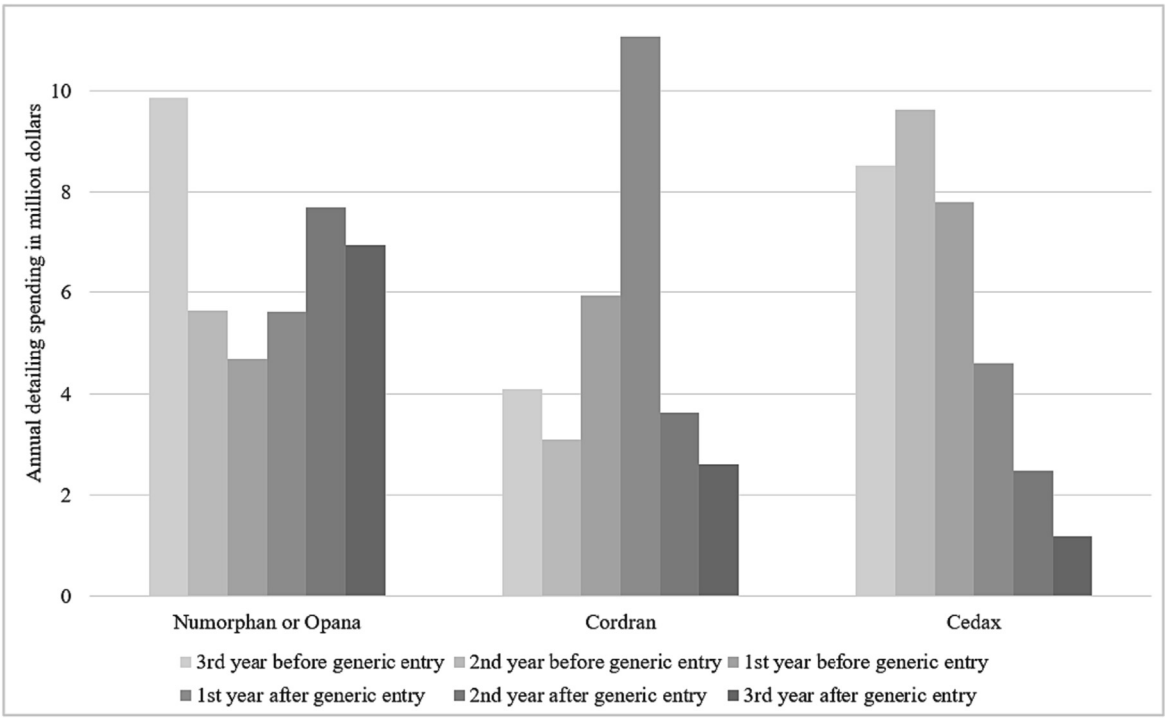


Fig. 3. Detailing patterns of selected brands before and after generic entry.

Table 2
Descriptive statistics of key variables in the aggregate analysis.

Variable	*Mean (S.D.)*		*Correlations*					
	Before generic entry	*After generic entry*	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
(1) Sales(in millions)	0.248 (0.469)	0.039 (0.067)	1					
(2) Detailing spending (in million dollars)	0.967 (1.800)	0.219 (0.452)	0.683	1				
(3) DTCA spending (in million dollars)	0.908 (3.077)	0.111(0.483)	0.555	0.634	1			
(4) Other marketing spending (in million dollars)	2.917 (5.788)	0.521 (1.176)	0.763	0.819	0.536	1		
(5) Price (per unit in USD)	459.5 (614.1)	572.7 (789.1)	−0.138	−0.096	−0.050	−0.093	1	
(6) Competitive sales	1.586 (2.094)	1.707 (2.049)	0.025	0.031	0.061	0.045	−0.152	1

β^1_{6j} captures the change in baseline sales after generic entry compared to before generic entry, and β^1_{7-11j} capture the change in the effects of the independent variables after generic entry compared to before generic entry. Specifically, our focal interest is in β^1_{2j} and β^1_{8j}, which capture the detailing elasticity of a branded drug j before entry and the change in detailing elasticity for brand j after generic entry, respectively. We assume that β^1_j are jointly distributed according to $N\left(\bar{\beta}^1, V^1_\beta\right)$.

We model promotional goodwill similarly to Narayanan et al. (2004), as follows:

$$detgw_{jt} = \varphi_{det} detgw_{jt-1} + \sqrt{det_{jt}} \tag{2}$$

$$dtcagw_{jt} = \varphi_{dtca} dtcagw_{jt-1} + \sqrt{dtca_{jt}} \tag{3}$$

and

$$omgw_{jt} = \varphi_{om} omgw_{jt-1} + \sqrt{om_{jt}} \tag{4}$$

where det_{jt}, $dtca_{jt}$, and om_{jt} are the brand's spending on detailing, DTCA and other marketing activities, respectively, and φ_{det}, φ_{dtca}, and φ_{om} are the corresponding carryover parameters. We estimated the values of these carryover parameters using a grid search algorithm in which we set different values for each carryover parameter and picked the one with the highest R^2. The best fit was obtained for a model in which the values of these carryover parameters were 95 %, 55 % and 55 %, respectively.[8]

In Equation (1), detailing spending, DTCA spending, and price might be endogenous, since unobserved factors could drive both the error term, ε^1_{jt}, and the marketing variables. We account for this potential endogeneity concern in several ways. First, we use instruments that may affect the potentially endogenous variables yet not sales, in line with prior studies (Chintagunta and Desiraju, 2005; Narayanan et al., 2004). Second, we model our focal dependent variable and the potentially endogenous variables as a system of equations and allow for correlations between the error terms of the four equations. For instrumental variables, our instrument for detailing is the wage index of all employees in sales and office jobs obtained from the Bureau of Labor Statistics ($wageidx_t$). Wages in sales jobs are expected to affect pharmaceutical firms' detailing spending, but not brand sales. For DTCA spending, we use the producer price index for advertising agencies obtained from the Federal Reserve ($adppi_t$), which we expect to affect the brand's DTCA spending, but not brand sales. For price, we use the monthly producer price index for pharmaceutical manufacturers, obtained from the Federal Reserve ($pmppi_t$), which we expect to affect brand price, but not brand sales. We use lagged instruments of up to 12 months and allow the instruments to differentially influence the marketing variables of the various brands by interacting them with the brand intercepts in the estimation. We test for the strength of the instrumental variables used to account for the potential endogeneity by measuring the extent to which the R^2 of the first-stage regression changes due to the inclusion of the instruments, as suggested by Papies, Ebbes and Van Heerde (2017). Our first-stage regressions have the marketing variables (price, detailing and DTCA) as dependent variables. As independent variables, we include the instrumental variable, other marketing variables of the focal brand, and the competitors' corresponding marketing variables. We assess the difference in R^2 between the model with the instrumental variables and a model without the instrumental variables using a likelihood ratio (LR) test (Papies,Ebbes and Van Heerde, 2017). For detailing, the R^2 of the model excluding the instrumental variables is 0.72, and the R^2 of the model including the instrumental variables is 0.78 (LR = 991.99, $p < 0.01$). For DTCA, the R^2 of the model excluding the instrumental variables is 0.52, and the R^2 of the model including the instrumental variables is 0.66 (LR = 1345.4, $p < 0.01$). For price, the R^2 of the model excluding the instrumental variables is 0.88, and the R^2 of the model including the instrumental variables is 0.96 (LR = 4782.8, $p < 0.01$). These fit statistics indicate that the instruments we use to tackle the endogeneity of detailing, DTCA and price are reasonably strong.

In our Bayesian estimation, we model the endogenous variables and let the error terms from those equations be correlated with the error term of Equation (1). In doing so, we incorporate other marketing variables included in Equation (1) as explanatory variables, and we include competitive detailing spending ($compdet_{jt}$) and competitive DTCA spending ($compdtca_{jt}$) as additional explanatory variables in the detailing and DTCA equations, respectively. We therefore model detailing spending, DTCA spending, and price as follows:

$$\ln(det_{jt}+1) = \alpha^2_j + \beta^2_{1j}\ln(\mathrm{pr}_{jt}) + \beta^2_{2j}\ln(\mathrm{dtca}_{jt}+1) + \beta^2_{3j}\ln(\mathrm{om}_{jt}+1) + \beta^2_{4j}\ln(compdet_{jt}+1) + \beta^2_{5j}\mathrm{ge}_{jt} + \sum\nolimits_{\tau=t-12}^{t-1}\phi^2_{(t-\tau)j}wageidx_\tau + \varepsilon^2_{jt} \quad (5)$$

$$\ln(dtca_{jt}+1) = \alpha^3_j + \beta^3_{1j}\ln(pr_{jt}) + \beta^3_{2j}\ln(det_{jt}+1) + \beta^3_{3j}\ln(\mathrm{om}_{jt}+1) + \beta^3_{4j}\ln(compdtca_{jt}+1) + \beta^3_{5j}\mathrm{ge}_{jt} + \sum\nolimits_{\tau=t-12}^{t-1}\phi^3_{(t-\tau)j}adppi_\tau + \varepsilon^3_{jt} \quad (6)$$

and

$$\ln(\mathrm{pr}_{jt}) = \alpha^4_j + \beta^4_{1j}\ln(det_{jt}+1) + \beta^4_{2j}\ln(\mathrm{dtca}_{jt}+1) + \beta^4_{3j}\ln(\mathrm{om}_{jt}+1) + \beta^4_{4j}\mathrm{ge}_{jt} + \sum\nolimits_{\tau=t-12}^{t-1}\phi^4_{(t-\tau)j}pmppi_\tau + \varepsilon^4_{jt} \quad (7)$$

where α^2_j, α^3_j, and α^4_j are brand-specific fixed effects for detailing spending, DTCA spending, and price, respectively, to capture the time-invariant levels of these variables per brand. We assume that $\beta^m_j \forall m = 2, 3, 4$ is distributed as $N\left(\bar{\beta}^m, V^m_\beta\right)$, and that the error terms from Equations (1), (5), (6) and (7), ε^{1-4}_{jt}, are jointly distributed as $N(0, \Sigma_j)$, where Σ_j is the variance–covariance matrix for brand j. Since 32 of the 72 brands in our sample did not spend on DTCA during our sample period, for these brands we exclude the DTCA equation, as well as the parameters capturing the effects of DTCA on sales, detailing, and price.

We estimated our aggregate-level model using the Gibbs sampler algorithm. We let the sampler run for 50,000 iterations, and discarded the first 40,000. We used the last 10,000 iterations for posterior inference. We graphically plotted the estimates to check for convergence.

[8] Our key findings are robust if we set the carryover parameters to zero. See Section 3.1.8 (Robustness Checks) below.

3.1.6. Estimation results for Study 1

Table 3 summarizes the parameter estimates obtained in our aggregate analysis.

Sales equation estimates (Equation (1)). We find that detailing goodwill has a positive main effect ($\bar{\beta}_2^{-1}$ = 0.040) on sales and a positive interaction effect with generic entry ($\bar{\beta}_8^{-1}$ = 0.482). These findings indicate that detailing is effective both before and after generic entry, and that market-level sensitivity to detailing is higher after generic entry than before generic entry. We find that generic entry has a negative effect on sales ($\bar{\beta}_6^{-1}$ = –0.912), indicating that brand sales are lower after generic entry than before generic entry at mean levels of the explanatory variables. DTCA goodwill does not have a significant effect either before or after generic entry. This result is consistent with findings of prior studies that have reported lower effectiveness of DTCA compared with detailing (Fischer and Albers, 2010). Price has a negative main effect ($\bar{\beta}_1^{-1}$ = -0.664) and a positive interaction effect with generic entry ($\bar{\beta}_1^{-1}$ = 0.489). These findings indicate that, consistent with prior findings on pharmaceutical drugs (e.g., Ching 2010a), price elasticity for the drugs in our sample is lower than one. Furthermore, the price sensitivity for the branded drug is lower (less negative) after generic entry than before generic entry. This finding may reflect a situation in which price-sensitive healthcare payers switch patients to cheaper generics after generic entry, such that the demand for the branded drug after generic entry comes from less price-sensitive payers. The effect of the promotional goodwill associated with other marketing spending is insignificant before generic entry; the effect is significantly stronger after generic entry than before generic entry ($\bar{\beta}_{10}^{-1}$ = 0.199).

Detailing equation estimates (Equation (5)). Price has a negative effect on detailing spending ($\bar{\beta}_1^{-2}$ = -2.014), and DTCA spending has a positive effect ($\bar{\beta}_2^{-2}$ = 1.080). Together, these two findings suggest that branded firms align their DTCA spending, detailing spending, and price. We do not find a significant effect of generic entry on detailing spending. This result may be because the impact of generic entry on detailing spending is captured in this equation through the effect of drug prices that increase following generic entry.

DTCA equation estimates (Equation (6)). We find positive effects of price and detailing spending on DTCA spending ($\bar{\beta}_1^{-3}$ = 3.955; $\bar{\beta}_2^{-3}$ = 0.807). These findings again suggest that branded firms align their DTCA spending, detailing spending, and price. We find that DTCA spending is significantly lower after generic entry than before generic entry ($\bar{\beta}_5^{-3}$ = -2.394).

Price equation estimates (Equation (7)). We find that DTCA spending has a positive effect on price ($\bar{\beta}_2^{-4}$ = 0.127). This finding suggests that, in line with our findings from the DTCA equation (6), it is common for firms to coordinate a price increase with increased DTCA spending. We find that generic entry positively affects the brand's price ($\bar{\beta}_4^{-4}$ = 0.303), indicating that firms may compensate lower sales volume with higher average prices to sustain cash flows after generic entry.

3.1.7. ROI calculations

Our next step was to use the findings from our aggregate analysis (Study 1) to calculate how an additional dollar spent on detailing affects aggregate-level sales, before and after generic entry, in both the short term and the long term. To this end, conditional on the model specification and the posterior estimates in Study 1, we use the procedure outlined in Narayanan et al. (2004) to generate estimates of the ROI on detailing. Web Appendix B describes the steps that we take to calculate the short-term (current-period) ROI, corresponding to one month; and the long-term (multiperiod) ROI, corresponding to a 12-month period.

We find that before generic entry, the current-period ROI was $1.2, and the multiperiod ROI was $4.3. These ROI estimates for the period before generic entry are comparable to those obtained in prior literature. Neslin (2001), for example, reported a long-run ROI of $1.72 for a $1 increase in detailing expenditure for a median brand using data from 391 branded drugs from various chemical subgroups. Wittink (2002), who focused on sales during the years 1998–2000, obtained an ROI of $2.1 for brands with annual revenues of $100-$500 million and an ROI of $11.6 for brands with annual revenues of more than $500 million. Narayanan et al. (2004), who focused on large brands, obtain a current-period ROI of $1.10-$3.73 and a multiperiod ROI of $7.65-$17.63.

ROI estimates after generic entry, which we are the first to report in the academic literature, are higher than those obtained before generic entry. Specifically, for time periods after generic entry, we obtain a median current-period ROI of $3.2 and a multiperiod ROI of $14.5. These ROI estimates, generalized across a large set of brands, could broaden pharmaceutical managers' perspectives and add insights beyond the specific categories they have operated in. Our findings suggest that, taking into account firms' decisions with regard to detailing spending and allocation, on average, demand for branded drugs is more sensitive to detailing efforts after generic entry than before generic entry.

3.1.8. Robustness Checks

For robustness, we repeated our analyses with several modifications. First, we reduced our sample period to two years before and two years after generic entry to see if our findings would be affected. Second, we used the number of prescriptions instead of unit sales of the branded drugs as the dependent variable. Third, we set the goodwill parameters in Equations (2),

Table 3
Parameter estimates of the aggregate level model.

Equation	*Variable*	*Path in Fig. 1*	*Parameter*	*Estimate*
Sales (Equation (1))	Price		β_1^{-1}	**−0.664**
	Detailing goodwill		β_2^{-1}	**0.040**
	DTCA goodwill		β_3^{-1}	0.004
	Other promotional goodwill		β_4^{-1}	−0.025
	Competitive sales		β_5^{-1}	**0.758**
	Generic entry	(a)	β_6^{-1}	**−0.912**
	Generic entry × Price	(e)	β_7^{-1}	**0.489**
	Generic entry × Detailing goodwill	(c)	β_8^{-1}	**0.482**
	Generic entry × DTCA goodwill	(e)	β_9^{-1}	0.980
	Generic entry × Other promotional goodwill	(e)	β_{10}^{-1}	**0.199**
	Generic entry × Competitive sales	(e)	β_{11}^{-1}	−0.060
Detailing spending (Equation (5))	Price		β_1^{-2}	**−2.014**
	DTCA spending		β_2^{-2}	**1.080**
	Other marketing spending		β_3^{-2}	0.004
	Competitive detailing spending		β_4^{-2}	−0.005
	Generic entry	(b)	β_5^{-2}	0.298
DTCA spending (Equation (6))	Price		β_1^{-3}	**3.955**
	Detailing spending		β_2^{-3}	**0.807**
	Other marketing spending		β_3^{-3}	−0.002
	Competitive DTCA spending		β_4^{-3}	0.000
	Generic entry	(d)	β_5^{-3}	**−2.394**
Price (Equation (7))	Detailing spending		β_1^{-4}	−0.031
	DTCA spending		β_2^{-4}	**0.127**
	Other marketing spending		β_3^{-4}	0.000
	Generic entry	(d)	β_4^{-4}	**0.303**

Note: Bolded estimates indicate that 95% of posterior intervals do not include zero.

(3), and (4) to zero (i.e., incorporating the raw spending instead of the carryover effects). Web Appendix C contains the results of these analyses. Our main finding that detailing is more effective after generic entry than before generic entry is robust to alternative model specifications.

3.2. Study 2: Comparing Firms' detailing allocation after versus before generic entry

In Study 2 we examine how brands reallocate their detailing efforts across physicians after generic entry compared to before generic entry, and to evaluate how such reallocation affects demand for branded drugs, in terms of individual physicians' prescription behavior. In this study, we rely on our disaggregate-level data, corresponding to 25 branded drugs in 20 ATC level-4 categories (see Section 3.2.2 below).

3.2.1. Conceptual framework

In line with our approach in Study 1, before specifying our model, we first identify routes through which generic entry might influence physicians' individual-level (i.e., disaggregate-level) prescription behavior. Fig. 4 presents three such routes. First, after generic entry, a particular physician may tend to write fewer prescriptions for the branded drug (compared with pre-entry), because of the competition introduced by generic substitutes (Path (h) in Fig. 4).

Second, a physician may alter his or her prescription behavior—becoming either more or less likely to prescribe the branded drug—because of changes in the extent to which the firm allocates detailing efforts to that physician, following generic entry (Path (f) in Fig. 4). As discussed in previous sections, we assume that such changes in allocation can be driven by several factors. First, the branded firm may increase or reduce the overall number of detailing visits across all physicians, and this change affects the number of individual-level detailing visits that a focal physician receives. Moreover, the firm may reallocate detailing visits across individual physicians to focus on physicians with specific characteristics. In line with prior

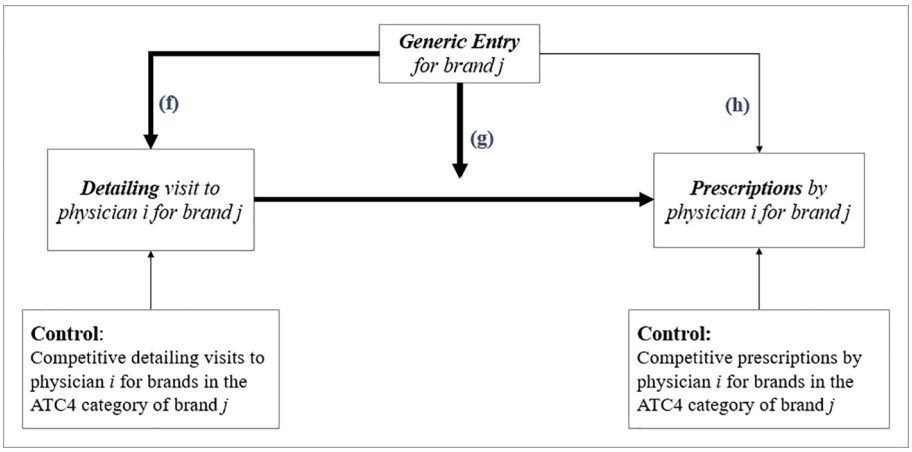


Fig. 4. Conceptual framework capturing the effects of generic entry on disaggregate-level prescriptions.

literature (Manchanda et al., 2004; Kappe et al., 2017), we consider three physician characteristics that may influence firms' allocation of detailing visits. The first is the physician's brand preference; it is possible, for example, that after generic entry a branded firm may prefer to allocate visits to physicians with higher (vs. lower) preference for the brand, as these physicians represent a greater loss in sales if they decide to switch over to prescribing generics. The second factor is the physician's responsiveness to detailing visits of the brand facing generic entry; indeed, branded firms may decide to allocate a higher proportion of detailing visits to physicians who are more likely to respond positively to such visits, so as to generate a bigger 'bang for their buck.' The third factor is the extent of competitive detailing the physician receives; a brand may allocate higher proportion of detailing visits to physicians who are particularly likely to receive competitive detailing visits, so as to mitigate these physicians' likelihood of switching to other branded drugs in the same therapeutic category (Gonzalez et al., 2008).

The third path by which generic entry may affect prescriptions is through its effect on physicians' sensitivity to detailing (Path (g) in Fig. 4).

In specifying our model, we control for the effect of the number of competitors' prescriptions on the number of prescriptions of the focal brand. We also control for the effect of the number of competitive detailing visits on the focal brand's number of detailing visits.

3.2.2. Data – Disaggregate-level panel data

For our physician-level analysis, we built on a large set of physician panel data, constructed by IQVIA, capturing individual physicians' prescription behavior and detailing visits during our period of interest. IQVIA's complete physician-level dataset included all prescriptions and detailing visits for all panel members, covering all ATC level-4 categories except oncology drugs. For feasibility of analysis, we selected a subset of the brands on which to focus our disaggregate-level analysis and extracted data for these brands according to the following process. First, we identified the 50 brands in our aggregate-level dataset with the highest detailing spending during the three years before and three years after generic entry, excluding oncology drugs, for which IQVIA did not have disaggregate-level data. Among the 50 selected brands, we identified brands for which there were at least 50 physicians in IQVIA's panel who met all three of the following criteria: (a) the physician either prescribed or was detailed at least once in the focal brand's ATC level-4 category during the three years after generic entry; (b) the physician prescribed the focal brand at least once during the three years before generic entry; and (c) the physician received detailing for the focal brand at least once during the three years before generic entry. These constraints resulted in 25 brands from 20 ATC level-4 categories.

After this selection process, we obtained a custom-made dataset from IQVIA containing individual physician-level information for a panel of 3,668 physicians across the 20 ATC level-4 categories corresponding to the 25 selected brands. This dataset covers three years before and three years after generic entry for each investigated brand and includes information on the monthly number of prescriptions and the monthly number of detailing visits for all brands in the respective categories. Web Appendix D contains the list of brands, the categories they belong to, and the number of physicians in our sample. In total, we analyzed 17,415 physician-brand combinations over six years of monthly data for all brands.[9] Our comprehensive dataset allows us to provide empirical generalizations on a scope surpassing that of prior scholarly studies in pharmaceutical marketing.

[9] Since physicians may have entered or left the panel during our sample period, we exclude months in which a physician neither prescribed nor received a detailing visit in any of our sample's 20 ATC level 4 categories.

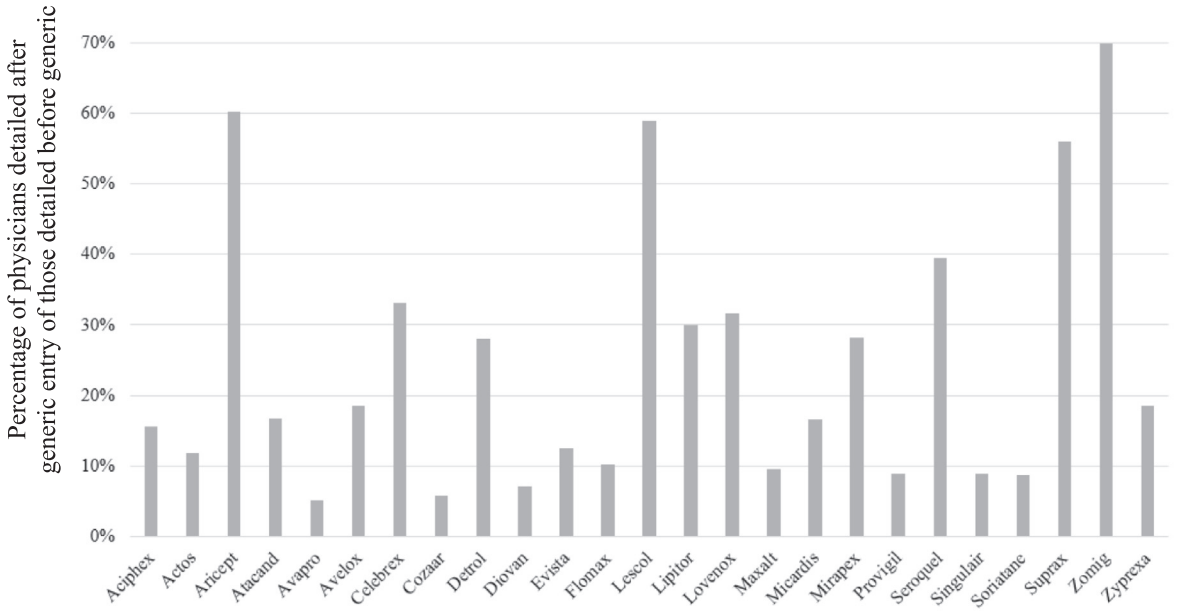


Fig. 5. Percentage of physicians detailed after generic entry among those detailed before generic entry.

3.2.3. Model-Free Descriptives: Change in detailing allocation

We use the disaggregate-level data to calculate changes in detailing allocation across physicians. For each brand, we calculate the percentage of physicians who were detailed after generic entry among those who had been detailed prior to generic entry. Fig. 5 plots this percentage across the brands in our sample. On average, 24.4 % of physicians detailed before generic entry continued to be detailed after generic entry. We observe that some brands—including Zomig, used to treat migraines, and Aricept, used to treat Alzheimer's disease—preserved a substantial portion of their detailing activity, such that more than 60 % of physicians who were detailed before generic entry continued to be detailed after entry. Other brands—such as the antihypertensive drugs Avapro and Cozaar—reallocated or reduced their detailing activity to a much greater extent, such that only about 5 % of the physicians who were detailed before generic entry continued to be detailed after entry.

Next, we characterize each brand by considering both components of its detailing strategy simultaneously: overall spending combined with physician-level detailing allocation. To this end, for the set of 25 brands for which we had derived disaggregate-level data, we calculate the values of (i) the percentage change in detailing spending after generic entry compared with before generic entry (this information was obtained from the aggregate-level data), and (ii) the percentage of physicians that the brand detailed after generic entry, among those who had been detailed before generic entry.

We observe that several brands are mapped in the bottom left area of Fig. 6 (e.g., Avapro, Cozaar); these brands faced a strong reduction in detailing spending and in the share of detailed physicians receiving detailing visits after generic entry.

Other brands in our individual physician-level sample are mapped in the upper right area (e.g., Lescol, Zomig). These brands faced lower relative reduction—and in one case, even an increase—in detailing spending, as well as relatively lower reductions in the proportion of physicians who continued to receive detailing visits after generic entry.

3.2.4. Measures – Disaggregate-level model

The key variables in our disaggregate analysis are the number of prescriptions (rx_{ijt}) that physician i writes and the number of detailing visits ($detvisits_{ijt}$) that physician i receives for brand j in month t. Regarding the number of prescriptions, it is important to clarify what constitutes a prescription for the branded drug in the periods before versus after generic entry. In general, physicians may prescribe a drug either by its brand name or by the molecule name. In the period before generic entry, a branded drug is the only one on the market using the molecule; accordingly, a prescription carrying either the brand name or the molecule name can only be fulfilled with the branded drug and thus constitutes a prescription for that drug.[10] After generic entry, however, when given a prescription for either a molecule or a specific brand, it is the pharmacist's prerogative to dispense either the branded drug or a generic equivalent. In fact, according to regulations in most states, if a generic version of a prescribed drug or molecule is available, the pharmacist may (or must, depending on the state) dispense the generic drug—unless the physician prescribes a brand and explicitly writes 'dispense as written' in the prescription, in which case the pharmacist must dispense the branded drug (Song and Barthold, 2018; Vivian, 2008). Therefore, for the period before generic

[10] Pharmacists rarely substitute the prescription for one branded drug with another drug (Vanderholm,Klepser and Adams, 2018).

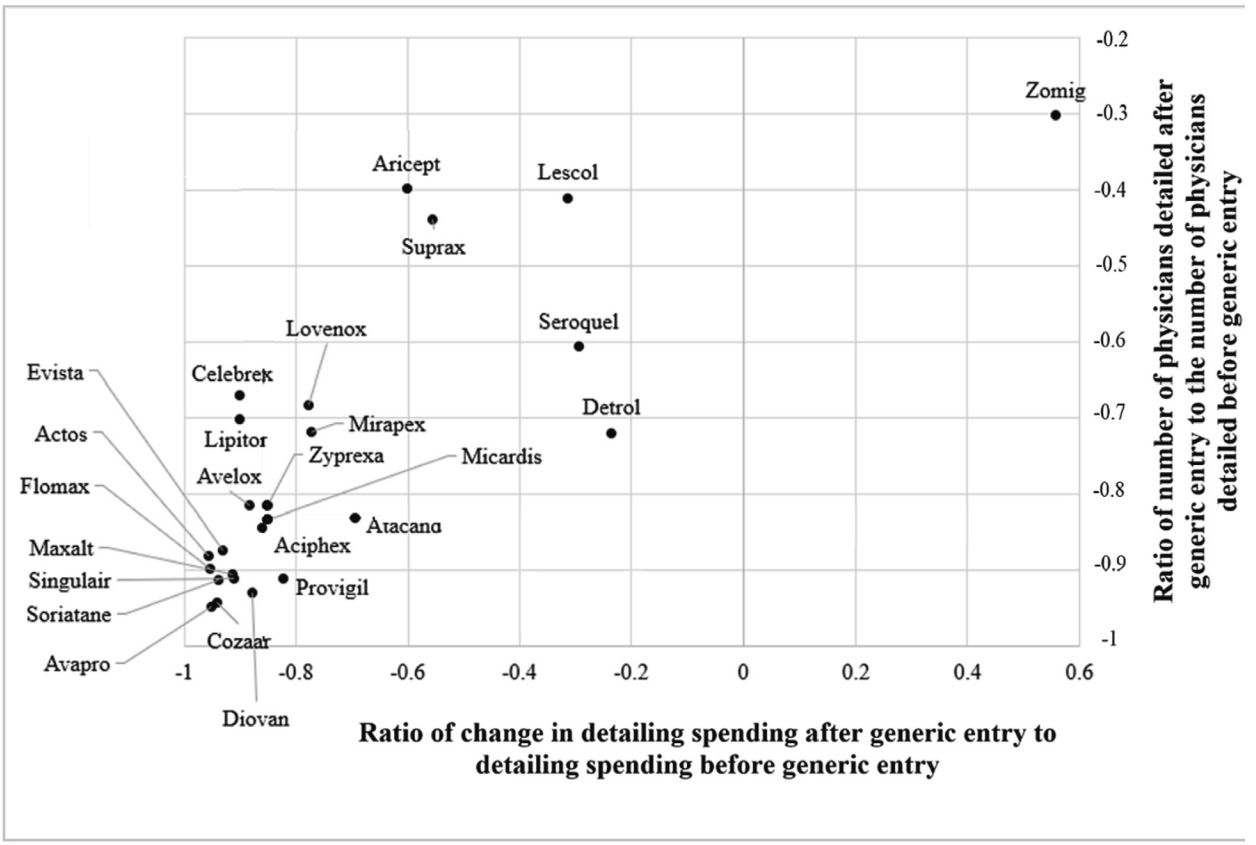


Fig. 6. Mapping brands based on changes in detailing spending and allocation after generic entry compared with before generic entry.

entry, we measure the number of prescriptions as those for either the brand or the molecule, and for the period after generic entry, we measure the number of prescriptions for the brand with the 'dispense as written' indication.

We control for competitive effects by including competitive prescriptions ($comprx_{ijt}$) and competitive detailing ($compdetvisits_{ijt}$). We measure competitive prescriptions as the number of prescriptions a physician writes for all drugs (branded or generic) in the ATC level-4 category, excluding those for the focal brand. We operationalize competitive detailing as the number of detailing visits that the physician receives for all other brands in the same ATC level-4 category. As in the aggregate level analysis, we measure generic entry (ge_{jt}) as a dummy variable that is equal to 0 during the periods before generic entry and equal to 1 during the periods after generic entry.

Table 4 summarizes our key variables. Column 2 contains the means and standard deviations of the variables in the three-year period before generic entry, and Column 3 contains the means and standard deviations of the variables in the three-year period after generic entry. Columns 4–7 contain the bivariate correlations of the variables across all months in which the physician was active (i.e., prescribed or received detailing visits for any of the drugs in the 20 ATC level-4 categories in our sample). Web Appendix D contains the number of prescriptions and detailing visits before and after generic entry for the brands we examine in Study 2.

3.2.5. Econometric model

We jointly model the number of prescriptions and the number of detailing visits as joint Poisson regression models with correlated errors, which allow for over-dispersion (Chib and Winkelmann, 2001; Kappe et al., 2017). Specifically, we model the number of prescriptions written by physician i for brand j in month t (rx_{ijt}) as follows:

$$Pr(rx_{ijt} = m) = \frac{\delta_{ijt}^{m} exp(-\delta_{ijt})}{m!} \tag{8}$$

and

$$ln(\delta_{ijt}) = \theta_{0ij} + \theta_{1ij} ln(detvisits_{ijt} + 1) + \theta_{2ij} ln(comprx_{ijt} + 1) + \theta_{3ij} ln(rx_{ijt-1} + 1) + \theta_{4ij} ge_{jt} + \theta_{5ij} [ln(detvisits_{ijt} + 1) \times ge_{jt}] + \zeta_{ijt}^{1} \tag{9}$$

All variables were defined above. The fixed effect for each physician-brand combination, θ_{0ij}, captures time-invariant factors influencing the number of prescriptions by physician i for brand j, and reflects the physician's intrinsic brand preference

Table 4
Descriptive statistics of key variables in the disaggregate-level analysis.

Variable	*Mean (S.D.)*		*Correlations*			
	Before generic entry	*After generic entry*	*(1)*	*(2)*	*(3)*	*(4)*
(1) Prescriptions	1.029 (2.481)	0.044 (0.514)	1			
(2) Detailing visits	0.326 (0.708)	0.044 (0.287)	0.234	1		
(3) Competitive prescriptions	2.314 (5.673)	3.594(7.564)	0.226	0.070	1	
(4) Competitive detailing	0.594 (1.417)	0.381 (1.104)	0.137	0.168	0.386	1

before generic entry. θ_{2ij} captures the physician's sensitivity to detailing visits before generic entry for brand j, θ_{3ij} captures the carryover effect, θ_{4ij} denotes the change in the physician's brand preference after generic entry compared to before generic entry (Path (h) in Fig. 4), and θ_{5ij} captures the change in physician i's sensitivity to detailing visits of drug j after generic entry compared to before generic entry (Path (g) in Fig. 4).

We specify a brand-specific hyper-mean for the θ s with $\theta_{ij}\ N\left(\mu_j, \Sigma_\theta\right)$, and in turn a common mean across brands $\mu_j\ N\left(\bar{\mu}, \Sigma_\mu\right)$. We do not estimate the change in physician-level detailing sensitivity (θ_{5ij}) for physicians who did not receive any detailing visits for the brand after generic entry. ζ^1_{ijt} is the error term of the prescription equation, which we model to be correlated with that of the detailing visits equation (Equation (11)) below.

Since we are interested in the change in the overall number of detailing visits and the allocation of detailing visits after generic entry compared to before generic entry (see Path (f) in Fig. 4), we model the number of detailing visits that the branded firm allocates to physician i for brand j in month t as follows:

$$\Pr(\text{detvisits}_{ijt} = k) = \frac{\eta_{ijt}^k exp\left(-\eta_{ijt}\right)}{k!} \tag{10}$$

and

$$\ln\left(\eta_{ijt}\right) = \begin{cases} \lambda_{0j} + \lambda_{1j}\left(\frac{\theta_{0ij}}{1-\theta_{3ij}}\right) + \lambda_{2j}\left(\frac{\theta_{1ij}}{1-\theta_{3ij}}\right) + \lambda_{3j} ln\left(compdet\,visits_{ijt-1} + 1\right) + \zeta^2_{ijt}, ifge_{jt} = 0 \\ \lambda_{4j} + \lambda_{5j}\left(\frac{\theta_{0ij}+\theta_{4ij}}{1-\theta_{3ij}}\right) + \lambda_{6j}\left(\frac{\theta_{1ij}+\theta_{5ij}}{1-\theta_{3ij}}\right) + \lambda_{7j} ln\left(compdet\,visits_{ijt-1} + 1\right) + \zeta^2_{ijt}, ifge_{jt} = 1 \end{cases} \tag{11}$$

In Equation (11), the first row contains the equation for the number of detailing visits before generic entry, and the second row contains the equation for the number of detailing visits after generic entry. Within each row, we include (a) an intercept, to capture the baseline number of detailing visits, and the effects of (b) the physician's long-term brand preference, denoted as $\left(\frac{\theta_{0ij}}{1-\theta_{3ij}}\right)$ before generic entry and as $\left(\frac{\theta_{0ij}+\theta_{4ij}}{1-\theta_{3ij}}\right)$ after generic entry, (c) the physician's long-term physician-level detailing sensitivity, denoted as $\left(\frac{\theta_{1ij}}{1-\theta_{3ij}}\right)$ before generic entry and as $\left(\frac{\theta_{1ij}+\theta_{5ij}}{1-\theta_{3ij}}\right)$ after generic entry, and (d) the lagged number of competitive detailing visits that the physician receives.

λ_{0j} captures the baseline number of detailing visits before generic entry, and $(\lambda_{4j} - \lambda_{0j})$ captures the change in the baseline number of detailing visits after generic entry compared to before generic entry for brand j. λ_{1j} captures the effect of the physician's brand preference on the number of detailing visits before generic entry, and $(\lambda_{5j} - \lambda_{1j})$ captures the change in the effect of the physician's brand preference on the number of detailing visits after generic entry compared to before generic entry for brand j. Similarly, λ_{2j} and λ_{3j} capture the effects of physician-level detailing sensitivity and the number of competitive detailing visits on the number of detailing visits before generic entry, respectively, and $(\lambda_{6j} - \lambda_{2j})$ and $(\lambda_{7j} - \lambda_{3j})$ capture the changes in these effects after generic entry compared to before generic entry for brand j. We estimate λ_j for each brand in our sample and then pool the estimates with a hyper-mean $\lambda_j\ N\left(\bar{\lambda}, \Sigma_\lambda\right)$.

We jointly model Equations (8)-(11) and let the error terms be jointly distributed for each brand, i.e., $\left(\zeta^1_{ijt}, \zeta^2_{ijt}\right)\ N(0, Z_j)$, to account for unobservable factors that may affect both the number of prescriptions written by a physician as well as the number of detailing visits that the physician receives.

To estimate the disaggregate model, we used a combination of Gibbs and Metropolis–Hastings steps. We refer to Kappe et al. (2017) for the sampling steps. We ran the sampling algorithm for 50,000 iterations, of which we discarded the first 40,000. We used the last 10,000 iterations for posterior inference. We graphically plotted the estimates to check for convergence.

3.2.6. Estimation results for Study 2

Table 5 provides the estimates of the disaggregate-level analysis. The estimation results for the prescription equation (Equation (9)) (top part of Table 5) show that the number of detailing visits a physician receives for a focal branded drug

Table 5
Parameter estimates of the disaggregate level model.

Equation		*Variable*	*Path in Fig. 4*	*Parameter*	*Estimate*
Prescriptions (Equation (9))		Intercept		$\bar{\mu}_0$	**−1.771**
		Detailing visits		$\bar{\mu}_1$	**0.109**
		Competitive prescriptions		$\bar{\mu}_2$	**0.286**
		Lag prescriptions		$\bar{\mu}_3$	**0.360**
		Generic entry	(h)	$\bar{\mu}_4$	**−6.429**
		Detailing visits × Generic entry	(g)	$\bar{\mu}_5$	−0.165
Detailing visits (Equation (11))	*Before generic entry*	Intercept		$\bar{\lambda}_0$	**−1.293**
		Brand preference		$\bar{\lambda}_1$	**0.160**
		Detailing sensitivity		$\bar{\lambda}_2$	−0.928
		Competitive detailing visits		$\bar{\lambda}_3$	**0.273**
	Change after generic entry	Intercept	(f)	$\left(\bar{\lambda}_4 - \bar{\lambda}_0\right)$	**−3.499**
		Brand preference		$\left(\bar{\lambda}_5 - \bar{\lambda}_1\right)$	**0.119**
		Detailing sensitivity		$\left(\bar{\lambda}_6 - \bar{\lambda}_2\right)$	0.715
		Competitive detailing visits		$\left(\bar{\lambda}_7 - \bar{\lambda}_3\right)$	−0.026

Note: Bolded estimates indicate that 95% of the posterior density excludes zero.

has a positive main effect on the physician's tendency to prescribe that drug ($\bar{\mu}_1$ = 0.109) and an insignificant interaction effect with generic entry. These findings indicate that physicians are, on average, sensitive to the detailing visits, and an additional detailing visit increases the number of prescriptions, in the periods both before and after generic entry.

We further observe that the number of competitive prescriptions has a positive effect on the number of prescriptions of the brand facing generic entry ($\bar{\mu}_2$ = 0.286). This finding may suggest that a brand facing generic entry benefits from category growth, as observed in prior literature (e.g., Venkataraman and Stremersch, 2007). We find a significant positive effect of lagged prescriptions ($\bar{\mu}_3$ = 0.360), capturing physician-level carryovers or habit persistence in branded prescribing. Finally, we find that generic entry has a significant negative effect on the number of branded drug prescriptions ($\bar{\mu}_4$ = -6.429), indicating that physicians are less likely to prescribe the branded drug after generic entry. This finding provides evidence for Path (h) in Fig. 4 (i.e., direct competition).

For the results of the detailing equation (Equation (11); second part of Table 5), we report the hyper-means of the intercept ($\bar{\lambda}_0$) and the effects of brand preference ($\bar{\lambda}_1$), detailing sensitivity ($\bar{\lambda}_2$), and competitive detailing ($\bar{\lambda}_3$) before generic entry; and the changes in the intercept ($\bar{\lambda}_4 - \bar{\lambda}_0$), and the effects of brand preference ($\bar{\lambda}_5 - \bar{\lambda}_1$), detailing sensitivity ($\bar{\lambda}_6 - \bar{\lambda}_2$), and competitive detailing ($\bar{\lambda}_7 - \bar{\lambda}_3$) after generic entry compared to before generic entry.

We find that the brand's overall number of detailing visits is lower after generic entry than before generic entry ($\bar{\lambda}_4 - \bar{\lambda}_0$ = -3.499). We find a positive effect of brand preference on the number of detailing visits before generic entry ($\bar{\lambda}_1$ = 0.160), and an increase in this effect after generic entry ($\bar{\lambda}_5 - \bar{\lambda}_1$ = 0.119). These findings indicate that physicians who have higher brand preference not only receive more detailing visits before generic entry compared to other physicians, but they also receive a higher proportion of detailing visits after generic entry than before generic entry.

We also find a positive effect of competitive detailing on the number of detailing visits for the focal brand ($\bar{\lambda}_3$ = 0.273) before generic entry. This finding indicates that, before generic entry, branded firms allocate detailing visits to physicians who are more likely to receive detailing visits from competitors. We do not find any significant effect of detailing sensitivity on the number of detailing visits before generic entry or a significant change in the effects of detailing sensitivity and competitive detailing on the number of detailing visits after generic entry compared to before generic entry. Thus, while firms reallocate their detailing visits after generic entry to physicians with higher brand preference, we do not find evidence that they reallocate based on physicians' detailing sensitivity or the number of competitive detailing visits they receive.

3.3. An integrated view of Study 1 and Study 2: Relationship between allocation of detailing visits and Market-Level detailing sensitivity

In this section, we focus on the subset of 25 brands for which we have both aggregate- and disaggregate-level data to obtain broader insights regarding the effectiveness of post-generic-entry detailing strategies. First, in a cross-sectional analysis of this subset of brands, we integrate the models used in Study 1 (aggregate-level sales) and in Study 2 (individual-level prescription behavior) to examine whether the post-generic-entry changes in brands' market-level detailing sensitivity (estimated in Study 1) can be explained by brands' detailing reallocation after generic entry (estimated

Table 6
Effects of detailing reallocation on change in market-level detailing sensitivity after generic entry compared to before generic entry.

Variable	*Parameter*	*Estimate*
Intercept	κ_0	0.120
Change in number of detailing visits	κ_1	−0.001
Reallocation of detailing visits based on		
... brand preference	κ_2	0.348**
... detailing sensitivity	κ_3	−0.017
... competitive detailing	κ_4	−0.132
R^2 = 0.332		

Note: ** = $p < 0.05$.

in Study 2). Next, we evaluate the efficacy of the post-entry detailing responses used by the 25 brands, as reflected in the change in ROI following generic entry (as compared with pre-entry).

3.3.1. Cross-Sectional analysis of aggregate- and Disaggregate-Level data

The dependent variable in our cross-sectional analysis is the change in market-level detailing sensitivity after generic entry compared to before generic entry, which we estimated in Study 1 (specifically, β_{8j}^1 in Equation (1)). As independent variables, we include the estimates from Equation (11) corresponding to the change in the baseline number of detailing visits ($\Delta\text{DetVisits}_j = \lambda_{4j} - \lambda_{0j}$), and the changes in detailing allocation associated with physicians' brand preference ($\Delta\text{AllocBrandPref}_j = \lambda_{5j} - \lambda_{1j}$), detailing sensitivity ($\Delta\text{AllocDetSens}_j = \lambda_{6j} - \lambda_{2j}$), and competitive detailing ($\Delta\text{AllocCompDet}_j = \lambda_{7j} - \lambda_{3j}$) after generic entry compared to before generic entry. Specifically, we estimate the following OLS model:

$$\beta_{8j}^1 = \kappa_0 + \kappa_1 \Delta\text{DetVisits}_j + \kappa_2 \Delta\text{AllocBrandPref}_j + \kappa_3 \Delta\text{AllocDetSens}_j + \kappa_4 \Delta\text{AllocCompDet}_j + e_j \quad (13)$$

where κ_0 is the intercept; κ_1 is the effect of change in the baseline detailing visits on the change in market-level detailing sensitivity after generic entry compared to before generic entry; and κ_2, κ_3, and κ_4 are the effects of allocating a higher proportion of detailing visits to physicians with higher brand preference, higher detailing sensitivity, and higher competitive detailing visits, respectively, on the change in market-level detailing sensitivity after generic entry compared to before generic entry. e_j is the error term, which is distributed as $N(0, \sigma^2)$.

Table 6 presents the estimation results of Equation (12). We find that the explanatory variables explain 33.2 % of the variance in the change in market-level detailing sensitivity after generic entry compared to before generic entry across brands.

κ_1 is not significant, suggesting that an overall change in the number of detailing visits does not, in and of itself, affect individual physicians' prescription behavior. However, we find κ_2 to be positive and significant (κ_2 = 0.348; $p < 0.05$), indicating that firms that increase the proportion of detailing visits to physicians with higher brand preference after generic entry experience a larger increase in market-level detailing sensitivity after generic entry compared with firms that do not do so.

3.3.2. Effectiveness of detailing responses following generic entry

To obtain insights regarding the effectiveness of detailing decisions post generic entry, we assessed the change in ROI (post-generic-entry ROI as compared with pre-entry ROI) for each of the 25 branded drugs in our subset. Fig. 7 presents a mapping of the brands according to their degree of change in detailing spending and detailing reallocation (the same mapping shown in Fig. 6), color-coded according to the changes in brands' short-term ROI (Panel A) and long-term ROI (Panel B). Brands that are colored green underwent an increase in detailing ROI in the three years following generic entry (compared to the three years before entry), whereas brands that are colored red underwent a decrease in the corresponding detailing ROI.

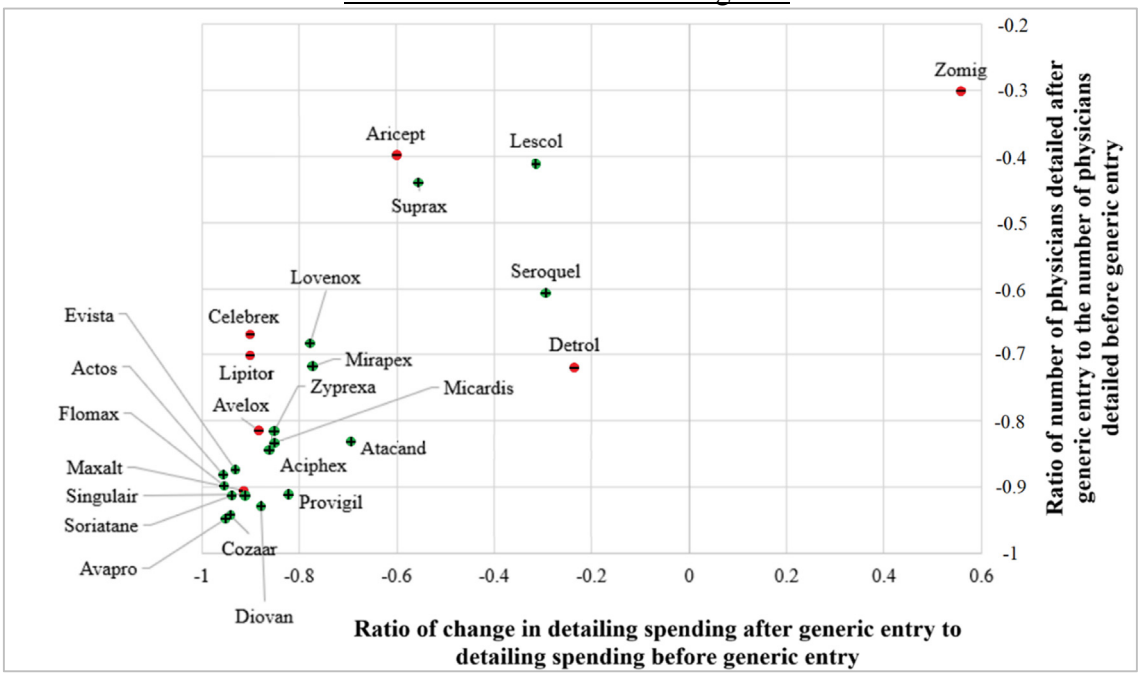
Fig. 7 shows that the majority of brands in the bottom right area experienced increases in detailing ROI following generic entry both in the short and in the long term. In contrast, brands with relatively higher proportions of physicians that are detailed both before and after generic entry are more likely to experience drops in detailing ROI, especially in the long term.

To summarize, our findings are compatible with the idea, suggested in the analysis above, that brands that substantially reallocate detailing visits across physicians—and specifically, refocus their efforts on physicians with stronger brand preference—stand to gain the most in terms of detailing ROI following generic entry.

4. General Discussion

This paper is the first to study branded drugs' detailing spending, detailing allocation, and sales response to detailing after generic entry compared to before generic entry. We used a customized dataset obtained from IQVIA and Nielsen on aggregate-level sales, detailing, DTCA, and other marketing spending for 72 drugs, together with disaggregate-level data on prescriptions and detailing visits for 25 of these 72 drugs. We provided an overview of the various responses branded

Panel A – Short-Term Detailing ROI



Panel B – Long-Term Detailing ROI

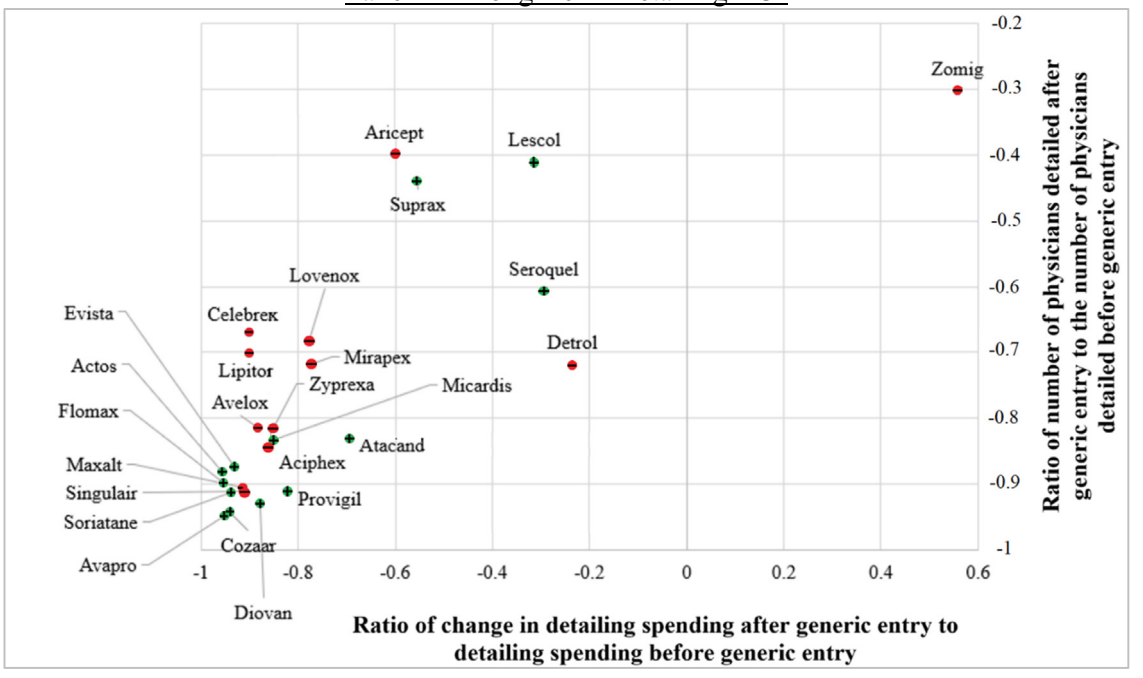


Fig. 7. ROI changes associated with different detailing responses Note: Green dots with a cross mark represent drugs that underwent an increase in detailing ROI in the three years following generic entry (compared to the three years before entry). Red dots with a minus sign represent drugs that underwent a decrease in the corresponding detailing ROI. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

firms adopt in practice following generic entry, and specifically (i) the extent to which they modify detailing spending post-entry; and (ii) the extent to which they reallocate detailing visits across physicians. Most brands in our sample either substantially decreased detailing spending combined with major reallocation of detailing visits or opted to less drastically decrease detailing (or even to increase spending) combined with more minor reallocation of detailing visits.

Next, in two studies, we sought to shed light on the effectiveness of different strategies by econometrically estimating the dynamics in brands' detailing spending and allocation around generic entry, and the demand response to detailing for branded drugs. The studies provide several insights that are new to the literature. First, the median detailing ROI after generic entry—calculated over both the short term and the long term—is about three times higher than that before generic entry, but the ROI changes are highly heterogeneous across brands. Second, firms that reallocate their detailing visits after generic entry to physicians with higher brand preference experience a larger increase in market-level detailing sensitivity after generic entry than firms that do not do so, leading to higher ROI on detailing following generic entry. A possible explanation for this outcome relates to market segmentation or heterogeneity (Frank and Salkever, 1997; Gonzalez et al., 2008; Grabowski and Vernon, 1992; Ching 2010a; Ching 2010b). Prior studies found that increased price patterns for branded drugs going off patent could be explained by a large enough segment of physicians with strong brand preference and low price sensitivity. The existence of such a segment could also explain the increase in detailing ROI for firms that concentrate their detailing efforts on this segment of physicians.

4.1. Implications for managers

Our findings have clear implications for branded firms that are faced with the need to evaluate their detailing budgets and allocations after generic entry. Specifically, our findings suggest that, after generic entry—and regardless of the overall budget set for post-entry detailing—firms can accomplish increases in detailing ROI by reallocating their detailing efforts to target physicians with a higher brand preference. Notably, it seems that this insight may not be obvious to pharmaceutical marketers, given the large number of firms in our (disaggregate-level) sample that implemented only minor reallocation of detailing visits across physicians and did not generally improve detailing ROI. We recommend that, when deciding how to allocate their firm-wide detailing efforts between drugs facing generic competition and drugs that are still under patent, firms bear in mind that, if targeted appropriately, detailing has the potential to contribute significantly to branded drug sales after generic entry.

4.2. Implications for public policy

In general, the entry of generic drugs has substantial societal consequences, as it helps lower healthcare costs: Healthcare payers in the US have saved nearly $2.4 trillion in the last 10 years through increased penetration of generic drugs (AAM, 2021). Thus, in effect, post-entry detailing efforts aimed at ensuring that physicians continue to prescribe branded drugs create unnecessary costs to healthcare payers. For example, Socal, Bai and Anderson (2021) have shown that Medicare could save about $1 billion annually if physicians were to stop prescribing branded drugs after generic entry. These costs may ultimately be detrimental to consumer welfare (Königbauer, 2007). Accordingly, our findings might serve public policy makers who are interested in curtailing such detailing efforts and stimulating generic substitution. For example, healthcare regulators and payers might explore the possibility of capping the number of detailing visits or banning physician detailing for molecules with generic competition.

Notably, our data enable us to provide a basic idea of the effects such policies might have. Using the estimates from our study, we simulate the extent to which brands' sales may be lower if they are not allowed to detail after generic entry. Specifically, we set detailing spending to zero after generic entry and simulate brand sales in the corresponding period. Assuming that these sales are replaced by generics, we calculate the savings to healthcare payers as the unit sales multiplied by the difference between the brand price and generic price. We find that healthcare payers save an average of $12 million annually per brand that is not allowed to detail after generic entry. (We note that this calculation does not consider cases in which physicians switch to other branded drugs still under patent protection.).

Our findings regarding the substantial ROIs attributable to reallocation of detailing to physicians with a higher brand preference suggest that policy makers might benefit from regulating heavy prescribers of a branded drug after generic entry. Such initiatives would complement recent efforts in the US to promote generic drugs by banning pharmaceutical manufacturers from paying generic counterparts to delay entry (Goldstein, 2021).

4.3. Future research

This paper is a first step towards understanding the dynamics of pharmaceutical promotion after generic entry, and comparing promotional effectiveness to that before generic entry. Thus, several important questions remain for further research to explore. First, though the dataset we used is among the most comprehensive in the academic literature on pharmaceutical marketing, we studied only the US market. Future studies should extend our work to examine pharmaceutical promotion after generic entry in other geographic markets with different regulatory regimes. Also, our individual-level panel, while comprehensive and rare, covers a sample of drugs that was not randomly selected (i.e., it covers 25 of the 72 brands that had the highest detailing spend prior to generic entry). Future research could examine whether the results of Study 2 replicate to branded drugs with lower detailing support prior to generic entry.

Second, our models incorporated measures to account for brand heterogeneity: Specifically, we included brand-specific fixed effects, which should capture the overall strategy of a brand; we also modeled brand-specific responses to changes in detailing after generic entry compared to before generic entry, which should capture the heterogeneity in the effect of

changes in detailing spending. Though these measures enabled us to avoid potential endogeneity concerns stemming from brand heterogeneity, we do not have information on the causes of heterogeneity across brands, which limits our ability to interpret the estimated heterogeneity. Future studies may want to explore drug-specific features (e.g., chronic, life-threatening diseases) as potential factors relating to the change in detailing strategy and the effectiveness of such strategies (Venkataraman and Stremersch, 2007). Similarly, future research could examine whether post-generic-entry dynamics in physicians' responses to detailing are affected by the length of the estimated pre- and post-entry periods.

Third, while drug promotion is a key strategic tool that branded pharmaceuticals can use after generic entry, firms can use other strategies such as price discounts (e.g., in the form of savings cards that drug manufacturers offer to patients to offset copay costs), enriching patent portfolios, or partnering with generic firms to extend their patent life cycle. On the other hand, generic firms can challenge patent protection to enter the market earlier. It would be interesting to see if patent extensions or patent challenges (Hemphill and Sampat, 2012) affect firms' detailing budget and allocation and the effectiveness of detailing after generic entry. Similarly, it would be valuable to investigate whether, beyond mere generic presence, the number of generic firms active in the market affects these dynamics.

Fourth, it would be interesting to explore if marketing mix interactions that prior research has identified in early stages of a brand's life cycle (e.g., Narayanan et al., 2004) also exist after generic entry, and, if so, how such marketing mix interactions change after generic entry.

Finally, our empirical analysis was primarily descriptive rather than prescriptive. A prescriptive approach would be of high value to branded firms as a complementary source of information to support their detailing allocation decisions. We consider such normative inquiries on how branded pharmaceuticals should allocate their marketing budgets after generic entry as the next, albeit challenging, step for the academic literature.

Data availability

The data that has been used is confidential.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijresmar.2023.12.004.

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