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Measuring the Informative and Persuasive Roles of Detailing on Prescribing Decisions

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In the pharmaceutical industry, measuring the importance of informative and persuasive roles of detailing is crucial for both drug manufacturers and policy makers. However, little progress has been made in disentangling these two roles of detailing in empirical research. In this paper, we provide a new identification strategy to address this problem. Our key identification assumptions are that the informative component of detailing is chemical specific and the persuasive component is brand specific. Our strategy is to focus on markets where some drug manufacturers engage in a comarketing agreement, under which two or more companies market the same chemical using their own brand names. With our identification assumptions, the variation in the relative market shares of these two brands, together with their brand specific detailing efforts, would allow us to measure the persuasive component of detailing. The variation in the market shares of chemicals, and the detailing efforts summed across brands made of the same chemical, would allow us to measure the informative component of detailing. Using the data for angiotensin-converting enzyme inhibitor with diuretic in Canada, we find evidence that our identification strategy can help disentangle these two effects. Although both effects are statistically significant, we find that the persuasive function of detailing plays a very minor role in determining the demand at the chemical level—the informative role of detailing is mainly responsible for the diffusion patterns of chemicals. In contrast, the persuasive role of detailing plays a crucial role in determining the demand for brands that comarket the same chemical.

Key words: detailing; informative role; persuasive role; prescription drugs; decisions under uncertainty; diffusion
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1. Introduction

In the pharmaceutical industry, measuring the importance of informative and persuasive roles of detailing is crucial for both drug manufacturers and policy makers. Understanding the relative importance of these two roles can help drug manufacturers allocate resources to detailing more efficiently. If the persuasive role is important, firms can create artificial product differentiation by increasing their detailing efforts. On the contrary, if detailing is mainly informative and its persuasive role is weak, the effectiveness of detailing will highly depend on the actual quality of drugs (i.e., side effects and efficacy profiles). Among policy debates, many people believe that detailing is mainly persuasive and consumers will be better off if the industry reduces their detailing budget. Consequently, there are frequent calls for the industry to restrict detailing activities. However, if detailing is mainly informative in nature, putting restrictions on it might slow down the adoption rate of new innovative drugs. This in turn would hurt manufacturers' profits and their incentives to innovate, and lower consumer welfare.

Despite its importance, little progress has been made in disentangling the informative and persuasive roles of detailing. The main difficulty is that both effects would likely have positive impacts on the demand for prescription drugs. If one only observes sales and detailing efforts over time, it is hard to disentangle these two roles. In this paper, we provide a new identification strategy to address this problem. Our key identification assumptions are that the informative component of detailing is chemical specific and the persuasive component is mainly brand specific. Our strategy is to focus on a market where some drug manufacturers engage in a comarketing agreement. Under such an agreement, two companies market the same chemical using two different brand names. With our identification assumptions, the variation in the relative market share of these

two brands, together with their brand-specific detailing efforts, would allow us to measure the persuasive component of detailing. After controlling for the persuasive effect, the variation in the market share of chemicals, and the corresponding chemical-specific detailing efforts summed across brands made of the same chemical, would allow us to measure the informative component of detailing. For instance, if detailing does not have any persuasive effect at all, our assumptions would imply that the market shares for two brand-name drugs made of the same chemical should be roughly the same over time even if the detailing efforts are very different across these two brands (assuming the values of other marketing-mix variables are about the same across brands).

More specifically, to model persuasive detailing, we follow the previous literature (e.g., Nerlove and Arrow 1962) and allow a brand-specific persuasive detailing goodwill stock to enter physicians' utility functions. To model informative detailing, we follow Ching and Ishihara (2010), which models informative detailing as a means to build and maintain the measure of physicians who know the most updated information about drugs.

Our identification strategy applies to both product level data and individual level data. As an application, we apply it to the product level data from the market of angiotensin-converting enzyme (ACE) inhibitor with diuretic (which is a subclass of hypertension drugs) in Canada. This market has three brand-name drugs: Vaseretic, Zestoretic, and Prinzide. Zestoretic and Prinzide are made of the same chemicals, but are comarketed by two different companies. To investigate the validity of our identification assumptions, we estimate two versions of the model: (i) *two-chemical version* that captures the comarketing environment and assumes that Zestoretic and Prinzide share one information set; (ii) *three-chemical version* that assumes that Zestoretic and Prinzide could be made of different chemicals, and hence each brand has its own information set, and both informative and persuasive effects of detailing are brand specific. We find that the estimation results are counterintuitive in the three-chemical version—the persuasive effect of detailing is negative and insignificant. On the contrary, the estimation results from the two-chemical version are much more sensible—the persuasive effect is positive and significant. This provides support for our identification assumptions.

Based on the parameter estimates from the two-chemical version of the model, we find that the persuasive function of detailing plays a very minor role in determining the demand at the chemical level—the informative function of detailing is mainly responsible for the diffusion patterns of chemicals. In contrast, the persuasive function of detailing plays a crucial role in determining the demand for brands that comarket the same chemical.

The rest of this paper is organized as follows. Section 2 reviews the literature and discusses the background of the comarketing agreement. Section 3 presents the demand model. Section 4 describes the data. Section 5 discusses the results. Section 6 provides the conclusion.

2. Literature Review and Comarketing Agreement

2.1. Previous Literature on Persuasive Detailing

Leffler (1981) argues that detailing plays both informative and persuasive roles. He finds that new drugs tend to receive more detailing than older drugs, and interprets this as evidence that supports informative detailing. He argues that physicians are relatively unfamiliar with new drugs and hence if detailing provides information about drug's benefits and side effects, drug manufacturers would spend more detailing efforts for newer drugs. However, he also finds that drug companies continue to spend significant amount of detailing efforts on old drugs and target older physicians. He interprets this as evidence for its persuasive role, assuming that older physicians have already known the older drugs' efficacy and side-effect profiles.

Hurwitz and Caves (1988) find that pre-patent expiration cumulative detailing efforts slow down the decline in post-patent expiry market shares of brand-name drugs. They interpret this as evidence for its persuasive role. Rizzo (1999) also finds evidence that detailing lowers the price elasticity of demand and argues that it supports persuasive detailing. However, it should be pointed out that the results from Hurwitz and Caves (1988) and Rizzo (1999) are also consistent with informative detailing. As argued by Leffler (1981), informative detailing reduces the uncertainty about drug qualities, and hence could also achieve similar empirical implications.

Narayanan et al. (2005) is the first paper that structurally estimates informative and persuasive roles of detailing in the pharmaceutical market by extending the framework of Erdem and Keane (1996). Their identification argument builds on Leffler (1981). More specifically, they assume that drug companies know the true quality of their drugs when launching them, and informative detailing provides physicians with noisy signals about the true quality. With this assumption, physicians will eventually learn the true quality and hence detailing will not play any informative role in the long run. As a result, the long-run correlation between sales and cumulative detailing efforts will identify the persuasive role of detailing. The product diffusion paths then identify the informative role.

It should be emphasized that in their framework, to separately identify the informative and persuasive roles of detailing, it is crucial that (i) one assumes detailing does not play any informative role in the long run, and (ii) the data set needs to be long enough so that it captures part of the product life cycle after learning is complete.[1] In contrast, these features are not necessary for our identification strategy.

Finally, Ackerberg (2001) argues that one can empirically distinguish informative and persuasive effects of advertising by examining consumers' purchase behavior conditional on whether they have tried the product before. His insight is that advertisements that give consumers product information should primarily affect consumers who have never tried the brand, whereas persuasive advertisements should affect both inexperienced and experienced consumers. His identification argument requires one to observe individual level panel data, whereas our identification strategy applies even if one only observes product level panel data.

Compared with the previous studies, the main limitation of our identification strategy is that comarketing agreement only happens in a relatively small subset of product categories. Therefore, one should be cautious about how to generalize our results.

2.2. Comarketing Agreement

Comarketing in the pharmaceutical industry is a marketing practice where a company, in addition to its own, uses another company's sales force to promote the same chemical and allow the partner company to use a different brand name.[2] According to CurrentPartnering (2009), the total number of comarketing deals announced in the United States between 2000 and 2008 is 208, and the yearly number has remained at fairly steady levels. One reason why an originator of the drug is willing to partner with another company could be because it requires high fixed costs to build a sales force. The sales force in the pharmaceutical industry requires extensive training as they need to know the clinical trials results of the drug being promoted and their rivals' drugs. Instead of paying such a high fixed cost, a company that is short in their sales force of promoting a certain category of drugs might find it worthwhile to sign a comarketing agreement with another company, and charge its partner a royalty fee.

[1] Byzalov and Shachar (2004), Mehta et al. (2008), and Narayanan and Manchanda (2009) rely on similar identification arguments to estimate informative and persuasive advertising or detailing using individual level data.

[2] This definition of comarketing agreement is given by CurrentPartnering (2009). There is another type of closely related marketing practice where two or more firms market the same chemical under *one* brand name. CurrentPartnering calls this type of arrangement *copromotion* agreement.

Comarketing agreements have also appeared in the automobile industry (Sullivan 1998, Lado et al. 2003). Furthermore, for industrial products, it is common that different firms market identical products using their own brand names (Saunders and Watt 1979, Bernitz 1981). In some countries such as Australia and Japan, firms also market generic drugs with brand names (Birkett 2003, Iizuka 2011). Under these environments, we expect that our identification arguments could also be applied.[3]

3. Model

We modify the model proposed by Ching and Ishihara (2010) to implement our new identification strategy. They model informative detailing as a means to build and maintain the measure of physicians who know the most updated information about drugs, but ignore persuasive detailing. Here, we model persuasive detailing by including a detailing goodwill stock in the utility function for physicians.

The basic setup of the model is as follows. We consider a set of brand-name drugs, which treat the same illness using similar chemical mechanisms. Let $j = 1, \ldots, J$ indexes brands, $j = 0$ denotes an outside alternative, which represents other close substitutes. Some of the brands may be marketed under a comarketing agreement and are made of the same chemical. Let $k = 1, \ldots, K$ indexes for chemicals, where $K \leq J$. We assume that each brand is made of one chemical. Let A_k be the set of brands that are made of chemical k. The characteristics of brand $j \in A_k$ are given by p_j and q_k, where p_j is the price of brand j, and q_k is the mean quality level of chemical k. Physicians are imperfectly informed about the chemical's mean quality level q_k. Let $I(t) = (I_1(t), \ldots, I_K(t))$ be a vector of public information sets that describe the most updated belief about $q = (q_1, \ldots, q_K)$ at time t. Ching and Ishihara (2010) assume that $I(t)$ is updated by a representative opinion leader based on past patients' experiences. Let $\underline{I}_k$ be the initial prior that physicians have when a drug made of chemical k is first introduced. For each chemical k, a physician either knows $I_k(t)$ or $\underline{I}_k$ at time t. For simplicity, we assume that physicians and the representative opinion leader share the same initial prior belief. Let M_{kt} be the measure of physicians who know $I_k(t)$; M_{kt} is modeled as a function of the cumulative detailing efforts at time t.

Our key identification assumptions are that (1) informative detailing is chemical specific and (2) persuasive

[3] However, the applicability of our identification strategy for industries other than pharmaceutical may depend on the existence of nonproduct factors that differentiate products under a comarketing agreement (e.g., after-sales services in automobile). If consumers care about such nonproduct factors and advertising help consumers learn about them over time, our identification strategy would not be applicable unless researchers can control for them.

detailing is brand specific. The first assumption implies that (a) $I_k(t)$ is updated based on past patients' experiences for all drugs made of chemical k and (b) M_{kt} depends on the sum of the cumulative detailing efforts for all drugs made of chemical k. The second assumption implies that the persuasive detailing goodwill stock for brand j only relies on the detailing efforts for brand j.

3.1. Updating of the Information Set

A drug is an experienced good. Consumption of a drug provides information about its quality. Each patient i's experience with the quality of a drug made of chemical k at time t ($\tilde{q}_{ikt}$) may differ from its mean quality level q_k. As argued in Ching (2010a, b), the difference between $\tilde{q}_{ikt}$ and q_k could be due to the idiosyncratic differences of human bodies in reacting to drugs. An experience signal may be expressed as

$$\tilde{q}_{ikt} = q_k + \delta_{ikt}, \tag{1}$$

where δ_{ikt} is the signal noise. We assume that δ_{ikt} is independent and identically distributed (i.i.d.). We further assume that δ_{ikt} is normally distributed with zero mean, and the representative opinion leader's initial prior on $q_k(\underline{I}_k)$ is also normally distributed:

$$\delta_{ikt} \sim N(0, \sigma_\delta^2) \quad \text{and} \quad q_k \mid \underline{I}_k \sim N(\underline{q}_k, \underline{\sigma}_k^2). \tag{2}$$

The representative opinion leader updates the public information set at the end of each period using the experience signals that are revealed to the public. The updating is done in a Bayesian fashion. In each period, we assume that the experience signals revealed to the public is a random subsample of the entire set of experience signals.

According to the Bayesian rule (DeGroot 1970), the expected quality is updated as follows:

$$E[q_k \mid I(t+1)] = E[q_k \mid I(t)] + \iota_k(t)(\bar{q}_{kt} - E[q_k \mid I(t)]), \tag{3}$$

where $\bar{q}_{kt}$ is the sample mean of all the experience signals that are revealed in period t; $\iota_k(t)$ is a Kalman gain coefficient, which assigns the updating weight to $\bar{q}_{kt}$. Note that both $\iota_k(t)$ and the perception variance, $\sigma_k^2(t+1)$, are functions of the variance of the signal noise (σ_δ^2), perceived variance ($\sigma_k^2(t)$), the quantities sold together with free samples at time t for all drugs made of chemical k (n_t^k), and the proportion of experience signals revealed to the public (κ). They can be expressed as

$$\iota_k(t) = \frac{\sigma_k^2(t)}{\sigma_k^2(t) + (\sigma_\delta^2/(\kappa n_t^k))} \quad \text{and}$$

$$\sigma_k^2(t+1) = \frac{1}{(1/\sigma_k^2(t)) + ((\kappa n_t^k)/\sigma_\delta^2)}. \tag{4}$$

3.2. Detailing and Measure of Well-Informed Physicians

There is a continuum of physicians with measure one. They are heterogeneous in their information sets. A physician is either well informed or uninformed about chemical k. A well-informed physician knows the current information set maintained by the representative opinion leader ($I_k(t)$). An uninformed physician only knows the initial prior ($\underline{I}_k$). The number of physician types is then 2^K.

The measure of well-informed physicians for chemical k at time t, M_{kt}, is a function of M_{kt-1} and $D_t = (D_{1t}, \ldots, D_{Jt})$, where D_{jt} is the detailing efforts for brand j at time t. For simplicity, we assume that this function only depends on M_{kt-1} and $D_t^k = \sum_{j \in A_k} D_{jt}$, i.e., $M_{kt} = f(M_{kt-1}, D_t^k)$. We capture the relationship between M_{kt} and (M_{kt-1}, D_t^k) by introducing an informative detailing goodwill stock, G_{kt}^I, which accumulates as follows:

$$G_{kt}^I = (1 - \phi_I) G_{kt-1}^I + D_t^k, \tag{5}$$

where $\phi_I \in [0, 1]$ is the depreciation rate. We specify the relationship between M_{kt} and G_{kt}^I as

$$M_{kt} = \frac{\exp(\beta_0 + \beta_1 G_{kt}^I)}{1 + \exp(\beta_0 + \beta_1 G_{kt}^I)}. \tag{6}$$

3.3. Prescribing Decisions

Each physician's objective is to choose a drug so as to maximize the current period expected utility for his or her patients conditional on his or her information set and other marketing variables such as persuasive detailing and free samples. The demand system is obtained by aggregating this discrete choice model of an individual physician's behavior.

The utility of patient i who consumes drug j made of chemical k at time t is given by

$$u_{ijt} = \alpha_j - \exp(-r\tilde{q}_{ikt}) - \pi_p p_{jt} + \varsigma_{i1t} + \zeta_{ikt} + e_{ijt}, \tag{7}$$

where α_j is a brand-specific intercept; r is the coefficient of absolute risk aversion; π_p is the utility weight for price; $(\varsigma_{i1t} + \zeta_{ikt} + e_{ijt})$, which represents the distribution of patient heterogeneity, is unobserved to the econometrician but observed to the physicians when they make their prescribing decisions; and ς_{ilt} corresponds to the shock associated with the outside alternative ($l = 0$) or inside alternatives ($l = 1$). This setup is equivalent to modeling physicians' choice as a three-stage nested process, where they choose between the inside goods and the outside good in the first stage (when ς_{ilt} is realized), then choose one of the chemicals in the second stage (when ζ_{ikt} is realized), and then choose a brand in the third stage (when e_{ijt} is realized) if the chemical is comarketed by two or more firms. We assume that ς_{ilt}, ζ_{ikt}, and e_{ijt} are i.i.d. extreme value distributed.

Note that $\tilde{q}_{ikt}$ is observed by physicians and patients only after patients have consumed the drug (but remains unobserved by the econometrician). Thus, physicians make their prescribing decisions based on the expected utility of their patients. Let $I^h(t)$ denote physician h's information set at time t. Suppose that drug j is made of chemical k. If physician h is well informed about chemical k at time t, then $I_j^h(t) = I_k(t)$ and his or her expected utility will be

$$\begin{aligned} E[u_{ijt} \mid I^h(t)] &= E[u_{ijt} \mid I_k(t)] + \gamma_P G_{jt}^P + \gamma_S FS_{jt} \\ &= \alpha_j - \exp\left(-rE[q_k \mid I(t)] + \tfrac{1}{2}r^2(\sigma_k^2(t) + \sigma_\delta^2)\right) - \pi_p p_{jt} \\ &\quad + \gamma_P G_{jt}^P + \gamma_S FS_{jt} + \varsigma_{i1t} + \zeta_{ikt} + e_{ijt}, \end{aligned} \tag{8}$$

where G_{jt}^P is a persuasive detailing goodwill stock for drug j at time t with the depreciation rate ϕ_P, and γ_P captures the effect of persuasive detailing; FS_{jt} is the amount of free samples given for drug j at time t, and γ_S captures the effect of free samples. If physician h is uninformed about chemical k at time t, his or her expected utility follows the same functional form as in Equation (8) except that $I_j^h(t) = \underline{I}_k$. We emphasize that (a) G_{jt}^P is drug j specific rather than chemical k specific, and (b) the depreciation rates for G_{kt}^I and G_{jt}^P are allowed to be different.

In each period, physicians may also choose an outside alternative (i.e., other nonbioequivalent drugs). We assume the expected utility associated with the outside alternative takes the following functional form:

$$E[u_{i0t} \mid I^h(t)] = \alpha_0 + \pi_t t + \varsigma_{i0t} + \zeta_{i0t} + e_{i0t}. \tag{9}$$

The time trend of the outside alternative allows the model to explain why the total demand for inside goods may increase or decrease over time. With the above setup, we can construct the market shares in a standard way. The quantity demanded for drug j (n_{jt}) can then be expressed as

$$\begin{aligned} n_{jt} &= Size_t \cdot S\left(j \mid D_t, (E[q_k \mid I(t)], \sigma_k(t), M_{kt-1})_{k=1}^K; \theta_d\right) \\ &\quad + \epsilon_{jt}, \end{aligned} \tag{10}$$

where $Size_t$ is the size of the market at time t, $S(j \mid \cdot)$ is the market share of drug j, ϵ_{jt} represents a measurement error, and θ_d is a set of demand side parameters.

3.4. Identification

It should be highlighted that if $K = J$ (i.e., each brand corresponds to a distinct chemical), the parameters of the informative and persuasive effects will mainly be identified based on the functional form restrictions. This is because the measure of well-informed physicians (which is the main driver for the informative effect), similar to the persuasive effect, is also governed by a detailing goodwill stock. As a result, some empirical patterns (e.g., increasing sales trend) could be explained by either informative or persuasive detailing. If the functional form assumptions specified here precisely capture the true nonlinear nature of these two effects, we can still separately identify them and obtain consistent estimates in principles. Under this situation, however, the main source of data variation for identification is only the diffusion patterns of each brand.

If one has data from a market where some drugs use a comarketing agreement (i.e., $K < J$), one will be able to use an additional source of data variation to help identify the persuasive effect: When two or more companies use their own brand names to market the same chemical, our identification assumptions imply that the variation of their relative market shares and their relative detailing efforts would be mainly responsible for identifying the persuasive effect of detailing. For instance, if the persuasive effect is close to zero, we expect to see that the relative market shares should remain roughly the same across brands that are made of the same chemical even if their relative detailing efforts vary significantly over time. On the contrary, if the data shows that their relative market shares are highly positively correlated with their relative detailing efforts, this tells us that the persuasive effect is strong and positive. With this additional source of data variation, we can control for the persuasive effect and use the diffusion paths of each drug to identify the informative effect (i.e., the parameters of learning process and initial prior beliefs).

We should reemphasize that the traditional identification argument also relies on two sources of data variation to disentangle informative and persuasive effects. It requires one (i) to have a sufficient number of observations of sales and detailing efforts in the long run in order to identify the persuasive effect, and (ii) to use the diffusion patterns of brands to identify the informative effect after controlling for the persuasive effect. Nevertheless, such a long panel may not be readily available. Under this situation, having data from markets with comarketing arrangement will be particularly helpful in identifying these two effects.

We should note that like all structural estimation research, our results still need to rely on functional form assumptions (Keane 2010). But with the extra source of data variation provided by the comarketing environment, we should be able to identify informative and persuasive effects more accurately compared with the traditional approach. It is also important to recognize that our specification ignores one possible function of detailing—it might increase physicians' awareness of some brands sharing the same chemicals. If this function is important, our estimates would suffer misspecification bias. In particular, the

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