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Structural Models of the Prescription Drug Market

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ABSTRACT

We survey the literature on structural models for the prescription drug market, which has attracted significant attention from researchers in marketing and economics, and related fields. The literature has evolved from adopting standard structural models developed for other markets to models that are specifically designed to capture the institutional details of the prescription drug market. Along the way, these empirical frameworks have not only greatly improved in terms of explaining stylized facts, but also in terms of producing better counterfactual predictions. Topics covered by this survey include the application of learning models to explain slow diffusion, post-patent expiry competition, pre-patent expiry competition, R&D and new drug introduction, managerial and public policy analysis, and the economics of the Medicare Part-D program. We conclude by discussing future research directions.

1

Introduction

In the past 20 years, the structural econometric modeling approach has received a lot of attention in marketing and economics. Its ability to conduct counterfactual experiments has made this approach particularly valuable to policy makers that need to find ways to improve consumer welfare, and to firms that need to figure out how to improve their profits. One prominent example of such markets is the prescription drug market. In the US, prescription drug expenditure has increased from \$265 billion to \$325 billion from 2013 to 2015.¹ Beyond its sheer size, this market is important because prescription drug choice has crucial implications for the health of consumers, which in turn affect both consumer welfare and the economy's aggregate productivity levels. These and other reasons have fueled a large body of academic literature in economics and business. Scott Morton and Kyle (2012) review papers in this literature that mainly adopt a reduced form approach. This survey complements that of Scott Morton and Kyle (2012) by focusing on research that employs the structural modeling approach. It also provides a more updated and

¹<https://www.pewtrusts.org/en/research-and-analysis/fact-sheets/2018/02/a-look-at-drug-spending-in-the-us>

extensive review of the structural modeling literature for the prescription drug market compared to that of Manchanda *et al.* (2005).

Much of the appeal of structural models lies on their ability to generate counterfactual predictions, that is, predictions for how changes in the ground rules of behavior would impact outcomes of interest. For this reason, one of the most challenging tasks that structural modellers face is how to sensibly incorporate key institutional features of the problem at hand without imposing too much computational burden. Structural models are also developed with the main goals of augmenting information that is not directly observed from the data, and correcting for econometric endogeneity problems, such as selection. In every case, the quality of inference directly hinges not only on how sensible the assumed structure is, but also on how informative available data is for identifying this structure.

The richness and complexity of the prescription drug market is perhaps the most important challenge faced by researchers in the area. Although a new drug is a product of intensive R&D and can enjoy patent protection, it is usually not the only drug available to treat a given condition. Due to the influence of switching costs and the uncertainty about the drug's quality compared to others, new drugs often face challenging hurdles to gain acceptance by doctors and patients. In order to penetrate the market, patients and doctors need to become convinced that the new drug has some superior features over available alternatives. Furthermore, drug prescription choices often result from the joint deliberation of a patient and her doctor, which makes the market unique in that end-users (patients) are not the sole (or even primary) decision maker. As a result, firms use both direct-to-consumer advertising (mass media) and direct-to-physician advertising (individual targeting) to inform all potential decision makers about a new drug's therapeutic benefits. Individual targeting is particularly important for the latter type of advertising, as physicians are heterogeneous in terms of receptiveness to detailing messages and their own influence on others (opinion leaders). For direct-to-consumer advertising, the design of the advertising message (informative or persuasive) may play a more important role. Moreover, advertising strategies are shaped by another unique feature of the industry – outcomes of clinical trials. In order to

expand a drug's efficacy profile and develop competitive edge over other close substitutes, firms often conduct additional clinical trials during the product's life-cycle. Additional modeling challenges arise in this context, as a drug's known efficacy/side-effect profile may change over time.

Because of the high cost of entry (R&D investments required for regulatory approval), the number of drugs marketed within each therapeutic class is usually small. Together with the long-lasting effect of marketing efforts, this industry feature suggests that market dynamics can be characterized by dynamic oligopolistic competition models. As such, structural dynamic oligopoly models have been applied to study branded-generic competition. In this case, because of the free-rider problem, firms typically curtail advertising expenditures after generic entry. As a consequence, prices acquire a heightened importance within the marketing mix. At the same time, the slow diffusion of generic drugs suggests that consumers may be uncertain about their quality. Modelling the competition between branded and generic drugs while accounting for dynamic pricing, heterogeneous segments, and consumer learning has emerged as a new horizon in the literature. Dynamic oligopoly structural models have also been used to study the competition among brand-name drugs within the same category, specifically, with a focus on modeling a dynamic game in detailing. More recently, single-agent dynamic models have been applied to study issues related to drug development such as inter-firm technology transfer (drug candidate licensing), as well as the behavior of patients that participate in clinical trials.

Lastly, fueled by the increased availability of data from the Medicare Part-D prescription drug coverage program, the topic of drug plan choice has also received a significant amount of attention. In this case, the large number of insurance plans and their complexity beg for the development of frameworks that adapt the baseline rational choice assumption so as to account for the use of heuristics or bounded rationality in individual choice.

Our goal in this survey is to provide a critical review of the structural econometric research that focuses on the aforementioned issues, and to discuss future research directions. Because a large number of papers rely on Bayesian learning framework, Section 2 sets the stage by introducing

the basic learning model that will be useful in later sections. Section 3 discusses the literature that makes use of individual level data. Section 4 discusses the literature that studies the product lifecycle, which primarily uses product level data. This is a broad set of articles, which includes studies focusing on persuasive vs. informative effects, clinical outcomes, publicity, etc., as well as models related to pre-market behavior (e.g., R&D decisions, clinical trial outcomes). Section 5 addresses other related applications of structural models in this area, and Section 6 summarizes the key takeaways and discusses future research directions.

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