Pharmaceutical Targeting: Dynamics of Doctor's Innovative Tendency and The Degree of Doctor-Patient Relationship

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The pharmaceutical firm's detailing effort of a new drug plays an important role but the pharmaceutical salespeople often find hard time achieving what they initially planned to deliver. Hence, they will need to target their messages to the right group of physicians to perform an efficient detailing. Controlling for other factors, physician's latent innovative tendency in drug prescription and the unobserved degree of doctor-patient relationship would be important considerations. An econometric model is set up to make inference about the doctor's innovative tendency and the degree of doctor-patient relationship. Using a national survey about the physicians' profile, their past treatments and the prescription intentions of a new drug, such model is estimated. The study further discusses managerial implications about how the firm can use the estimated values of doctor's latent innovative tendency and the unobserved degree of doctor-patient relationship for their detailing effort.

Keywords: physician targeting, pharmaceutical detailing, prescription intention, doctor's latent innovative tendency, degree of doctor-patient relationship

INTRODUCTION

The pharmaceutical industry has faced an unprecedented number of challenges in recent years, with many branded drugs going off patent and not enough blockbuster drugs in the pipeline to replace them (PricewaterhouseCoopers 2008). Moreover, the industry has received a great deal of negative press from the government and consumers alike, who see its aggressive marketing strategy and spending as excessive and unnecessary, as well as connecting them to rising healthcare costs (Gagnon and Lexchin 2008).

Sales force operation is the most expensive marketing investment that pharmaceutical companies make; with detailing costing a firm $150 to $200 per detail, or approximately $61,000 per physician per year (Gagnon & Lexchin 2008). In addition, a detailing visit typically lasts two to five minutes and the salespeople find hard time achieving what they initially planned to deliver (Chin 2006). However, the pharmaceutical firm's detailing effort of a new drug still plays an important role. Studies find that detailing and free samples have positive and statistically significant effects on the number of new prescriptions issued by a physician (Mizik and Jacobson 2004; Gonul et al. 2001). Clearly, improving resource utilization and subsequently reducing unnecessary operational and promotional spending by determining the right set of

physicians for the sales reps to target from the beginning of the launch may lead to much-needed cost reduction that can be shared by both industry and consumers.

For efficient physician targeting, the pharmaceutical companies would study the doctors' prescription intention of the new drug and the factors that are associated with it. Controlling for other factors, physician's latent innovative tendency in drug prescription and the unobserved degree of doctor-patient relationship would be important considerations. Doctor's latent innovative tendency is an important predictor of their future drug prescription behavior since innovativeness represents the degree to which an individual is relatively early in adopting a new product or idea (Midgley and Dowling 1978). Doctors who are innovative should show higher likelihood to prescribe a new drug. Understanding the unobserved degree of doctor-patient relationship is also important since the scientific aspects of care are always delivered in the context of the doctor-patient relationship and such relationship is fundamental to the art and science of medicine as are drugs and technologic advances (Friedenberg 2003).

However, physician's innovative tendency and the degree of doctor-patient relationship are not observed by the pharmaceutical firms. So the objective of the study is to model the latent innovative tendency of the physicians and the unobserved degree of doctor-patient relationship and test the hypotheses about the relative influence of these constructs and the interaction of the two on the physician's prescription intention. The paper first discusses the hypotheses about the relative influence of physician's innovative tendency and the degree of doctor-patient relationship, and the interaction of the two. Then it describes the physicians' survey data and details the models for testing the hypotheses and discuss the empirical results and hypothesis testing results. It concludes with a discussion of managerial implications and the future research opportunities.

LITERATURE REVIEW

There has been a large amount of research in the area of pharmaceutical demand in marketing and economics as well as medical sciences. Early studies in the marketing literature (Parsons and Abeele 1981; Lilien et al. 1981) studied the effect of sales force effort on sales using aggregate data. Other studies investigated the influence of pharmaceutical advertising on prescription. Friedman and Gould (2007) discussed the consumer attitude toward direct-to-consumer advertising using a survey data from 321 US residents and noted some negativity towards such advertising approach for prescription drug, but 59% of the respondents agreed that the advertisement was better than not having one. On the other hand, only 19% of physicians thought their patients made better health decisions. Hall et al. (2011) analyzed the similarities and differences between the direct-to-consumer advertisement and disease awareness advertising, and its respective impact on both the physicians and patients. They found that both advertising methods heightened awareness of treatment options and improved discussions with physicians, but many patients were left confused due to the unbalanced nature of information and they often made inappropriate requests for treatment to their physicians. More research (Gonul et al. 2001; Kamakura et al. 2004; Manchanda and Chintagunta 2004) used panel data to investigate the effect of detailing on the pharmaceutical demand. There has also been research that has specifically investigated informative and persuasive effects of pharmaceutical promotion (Leffler 1981; Hurwitz and Caves 1988; Rizzo 1999).

The broad consensus in the literature is that detailing is effective in that it affects prescribing behavior by physicians. However, to the best of our knowledge, no studies have been done about improving the detailing effort by targeting the right groups of physicians using specifically the latent innovative tendency of the physicians and unobserved degree of doctor-patient relationship.

HYPOTHESES DEVELOPMENT

Hypotheses are set up to evaluate the latent innovative tendency of the physicians and the degree of doctor-patient relationship.

Assael (1998) defines innovativeness as the actual adoption of a new product. The study of the adoption of new products and the innovativeness of individual consumers is well established in the literature. When

physicians have innovative tendency in prescribing a medicine, they will be more likely to try new drug. Therefore, we hypothesize the following:

H1: *Controlling for other factors, when the doctor has tendency to be innovative, it is more likely for the doctor to prescribe new drug.*

Doctor-patient relationship has been described as agency relationship where informed agents make decisions for uninformed clients. However, the decision to prescribe and the decision to accept the prescription by the patient are more complex in nature and involve many variables such as the need for the prescription and the disease state. Controlling for these other factors, communication between the physician and patient is found to be important for prescribing practice (Steinke et al. 1999). By more communication with the patient, the doctor can use the same practice style in the consultation and cope with the pressures to prescribe in the same manner (Bradley 1992). Therefore, we hypothesize the following:

H2: *Controlling for other factors, when the doctor has a longer-term relationship with individual patient, it is less likely for them to prescribe new drug.*

To the best of our knowledge, there is no literature that supports the interaction effect between the physician's innovative tendency and the doctor-patient relationship. We make a conjecture that in the longer-term relationship between the doctor and the patient, the physician with innovative tendency might continue the same practice style and prescribe the same manner. Therefore, we hypothesize the following:

H3: *Controlling for other factors, when the doctor has tendency to be innovative but has a longer-term relationship with individual patient, it is less likely to prescribe new drug.*

PHYSICIAN'S PRESCRIPTION SURVEY DATA

A national survey of physicians is conducted in January-February 2005 to obtain their profile, past treatments before the new drug, and the prescription intention of the new drug. The respondents are cardiologists, hematologists, internists, and nephrologists (See Table 1). The name of the new drug and the specifics about the disease it treats are kept confidential per our agreement with the respondents.

TABLE 1
SELECTED SURVEY QUESTIONS

1. What is your specialty?
2. In the last month, what is the total number of different patients you have seen across all conditions?
3. In the last month how many different patients have you seen, for kidney-related disease?
4. How many years have you been in practice, since completing residency?
5. What is this patient's gender?
6. What is this patient's age?
7. When did you first see the patient for his/her kidney-related disease?
8. When was this patient diagnosed with the disease?
9. To the best of your knowledge, what caused this patient's disease?
10. How many visits did this patient have for the disease during the last 12 months?
11. What was this patient's first line prescription drug therapy for the disease?
12. Based on the scenario above and thinking of the last three kidney-related disease patients that you saw, please indicate how you would treat each of these patients if the new drug were available and had been found to perform as specified.

The new drug introduced to the respondents is a prescription drug with better efficacy and safety profile compared to the leading drug in treatment of a specific kidney-related disease. A total of 211 completed questionnaires are collected by telephone in-depth interviews and an online survey. Each respondent is asked about interactions relating to their last three patients suffering from the disease.

The physician profile includes the area of specialty, total number of all patients seen in last month, total number of patients with a kidney-related disease seen in last month, total number of patients with a specific kidney-related disease seen in last month, and the number of years in practice. The past treatments before the new drug include the patient's gender and age, the first time to see the patient, the time that the patient was diagnosed with a kidney-related disease, the cause of the patient's disease, the number of visits for the last 12 months, and the prescription drug therapy chosen (single therapy or combo-therapy). Finally, the new drug is described, and their prescription intention is asked about the new drug.

MODEL OF PHYSICIAN'S PRESCRIPTION INTENTION

Model of Innovative Tendency

$$\text{Tendency}_h = \delta_0 + \delta_1 \#TreatCombo_h + \varepsilon_{T_h}, \text{ where } \varepsilon_{T_h} \sim N(0,1) \quad (1)$$

where $\#\text{TreatCombo}_h$ = the number of patients treated with a combination of drugs for physician h. The physician's innovative tendency is latent and it should be estimated as a distribution using revealed information. The physician who prescribes a combination of drugs as opposed to a single drug can be considered more innovative in prescription behavior. Any other variables that might be related to the innovative tendency are in the error term.

Model of the Degree of Doctor-Patient Relationship

$$\text{Relationship}_{h,p} = \gamma_0 + \gamma_1 \#Visit_{h,p} + \gamma_2 \#Lines_{h,p} + \varepsilon_{R_{h,p}}, \text{ where } \varepsilon_{R_{h,p}} \sim N(0,1) \quad (2)$$

where $\#\text{Visit}_{h,p}$ = total number of visits with physician h by patient p, and $\#\text{Lines}_{h,p}$ = the number of lines (treatments) for the disease by physician h for patient p. The degree of doctor-patient relationship is not observed by the pharmaceutical firms and so it should be estimated as a distribution using the revealed information. The number of total doctor visits can imply the degree of doctor-patient relationship. The number of lines (treatments) for an individual patient for the disease can also imply the degree of doctor-patient relationship. Any other variables that might be related to the degree of doctor-patient relationship are in the error term.

Model of the Relative Influence of Innovative Tendency and the Degree of Doctor-Patient Relationship

$$\text{Tendency}_h \times \text{Relationship}_{h,p} \quad (3)$$

It is an interaction variable between the innovative tendency and the degree of doctor-patient relationship.

Model of Prescription Intention

We assume that the physician's intention to prescribe the new drug depends on the attractiveness of the new drug and define the attractive of the new drug to the physician h for patient p as $U_{h,p}$. We assume that the physician's intention to prescribe the new drug, $Y_{h,p} = 1$ if $U_{h,p} > 0$, 0 otherwise. The attractiveness of the new drug to the physician h for patient p is defined as:

$$U_{h,p} = \alpha_0 + \alpha_1 Tendency_h + \alpha_2 Relationship_{h,p} + \alpha_3 Tendency_h * Relationship_{h,p} + \alpha_4 Hepa_h + \alpha_5 Gast_h + \alpha_6 \#Pat_h + \alpha_7 \#PatD_h + \alpha_8 \#Yr_h + \alpha_9 \#NewPatD_h + \alpha_{10} \#Alco_h + \alpha_{11} \#HepB_h + \alpha_{12} \#HepC_h + \alpha_{13} \#Viral_h + \alpha_{14} \#NonAlco_h + \alpha_{15} \#TP_h + \alpha_{16} \#RF_h + \alpha_{17} \#Trans_h + \alpha_{18} Disease1_{h,p} + \alpha_{19} Disease2_{h,p} + \alpha_{20} Sex_{h,p} + \alpha_{21} Age_{h,p} + \alpha_{22} Alco_{h,p} + \alpha_{23} HepB_{h,p} + \alpha_{24} HepC_{h,p} + \alpha_{25} Viral_{h,p} + \alpha_{26} NonAlco_{h,p} + \alpha_{27} Start_{h,p} + \alpha_{28} ComboDrug_{h,p} + \varepsilon_{h,p} \quad \varepsilon_{h,p} \sim N(0,1) \tag{4}$$

where we assume that the attractiveness of the new drug is related to the physician's innovative tendency (Tendency$_h$), the degree of relationship of the physician h with patient p (Relationship$_{h,p}$), interaction between the two (Tendency$_h$ × Relationship$_{h,p}$), and the control variables such as physician profile, treatment record and individual patient's characteristics. Physician profile includes Hepatology or not (Hepa$_h$), Gastroenterology or not (Gast$_h$), total number of different patients (Pat$_h$), total number of different patients with disease (PatD$_h$), number of years in practice post residency (#Yr$_h$), and number of new patients with disease (#NewPatD$_h$). Treatment record includes number of patients with alcohol abuse (#Alco$_h$), number of patients with Hepatitis B (#HepB$_h$), number of patients with Hepatitis C (#HepC$_h$), number of patients with viral infection (#Viral$_h$), number of patients with non-alcoholic disease (#NonAlco$_h$), number of patients required therapeutic paracentesis (#TP$_h$), number of patients refractory (#RF$_h$), and number of patients recommended for transplant (#Trans$_h$). Physician h's individual patient's characteristics include number of months diagnosed with disease 1(Disease1$_{h,p}$), number of months diagnosed with disease 2 (Disease2$_{h,p}$), patient's sex (Sex$_{h,p}$), patient's age (Age$_{h,p}$), patient with alcohol abuse or not (Alco$_{h,p}$), patient with Hepatitis B or not (HepB$_{h,p}$), patient with Hepatitis C or not (HepC$_{h,p}$), patient with viral infection or not (Viral$_{h,p}$), patient with non-alcoholic disease or not (NonAlco$_{h,p}$), number of months since the first therapy with patient (Start$_{h,p}$), and new treatment of combination of drugs for the patient or not (Combo$_{h,p}$). The variance of the error term is set to 1 for model identification, thus this constitutes a Probit specification.

RESULTS

Starting from the Model of Innovative Tendency, the number of patients with a combination of drugs shows significant and positive relationship with the latent innovative tendency of the physician as expected. As for the Model of the Degree of Doctor-Patient Relationship, the total number of visits by patient shows significant and positive relationship with the doctor-patient relationship as expected. However, the number of lines (treatments) for the disease for an individual patient shows significant but negative relationship with the doctor-patient relationship. This result is not as expected but making more lines (treatments) for a patient for the same disease might imply that the treatment has not been effective, which shows shorter-term relationship with the doctor (See Table 2).

Results of the Model of Physician's prescription Intention tell an interesting story about the physician's latent innovative tendency, the unobserved degree of doctor-patient relationship, and the relative influence of the two in control of other variables.

The physician's latent innovative tendency shows significant and positive relationship with the prescription intention and hence supports H1: Controlling for other factors, when the doctor has tendency to be innovative, it is more likely for the doctor to prescribe new drug.

The unobserved doctor-patient relationship shows significant and negative relationship with the prescription intention and hence supports H2: Controlling for other factors, when the doctor has a longer-term relationship with individual patient, it is less likely for them to prescribe new drug.

The interaction between the physician's latent innovation tendency and the unobserved doctor-patient relationship shows significant and negative relationship with the prescription intention and hence supports H3: Controlling for other factors, when the doctor has tendency to be innovative but has a longer-term relationship with individual patient, it is less likely to prescribe new drug.

Physician profile variables are used for control variables but the total number of different patients with disease shows significant and negative relationship with the prescription intention. Physician's treatment

record variables are also used for control variables but the number of patients with alcohol abuse, the number of patients with Hepatitis C, and the number of patients with viral infection show significant and positive relationship with the prescription intention. Finally, Individual Patient Characteristics are used for control variables and none of the variables show significant relationship with the prescription intention.

TABLE 2
ESTIMATION RESULT

	Model of Innovative Tendency	
	Estimate	Std Error
Intercept	-0.4705*	0.1280
Combination Treatment	0.0174*	0.0031
	Model of the Degree of Doctor-Patient Relationship	
Intercept	-4.4520*	1.0910
Number of Patient Visits	0.6718*	0.1110
Number of Lines (Treatments)	-2.8720*	0.6737
	Model of Prescription Intention	
Intercept	0.0555	2.1320
Innovative Tendency	2.2600*	0.9060
Doctor-Patient Relationship	-1.6740*	0.3790
Innovative Tendency * Doctor-Patient Relationship	-2.8450*	0.7315
Physician Profile		
Hepatology	0.0899	2.0120
Gastroenterology	0.8676	1.3760
Number of Different Patients	0.0016	0.0059
Number of Different Patients with Disease	-0.8840*	0.3534
Number of Years in Practice	-0.1572	0.1183
Number of New Patients with Disease	0.1170	0.1308
Treatment Record		
Number of Patients with Alcohol Abuse	0.7123*	0.3277
Number of Patients with Hepatitis B	0.7363	0.5926
Number of Patients with Hepatitis C	0.9145*	0.3818
Number of Patients with Viral Infection	0.9774*	0.3924
Number of Patients with Non-Alcoholic Disease	0.7691	0.3951
Number of Patients Required Therapeutic Paracentesis	0.0962	0.1172
Number of Patients Refractory	-0.2672	0.1519
Number of Patients Recommended for Transplant	-0.1408	0.0834
Individual Patient Characteristics		
Number of Months Diagnosed with Disease 1	-0.0138	0.0227
Number of Months Diagnosed with Disease 2	-0.0500	0.0727
Patient's Sex	-0.9566	1.4790
Patient's Age	-0.0163	0.0628
Patient with Alcoholic Abuse	0.2229	1.3250
Patient with Hepatitis B	-0.2103	2.0710
Patient with Hepatitis C	-0.2845	1.5390
Patient with Viral Infection	-0.1501	2.1630
Patient with Non-Alcoholic Disease	0.8395	1.7890
Number of Months since the First Therapy	0.1335	0.0772
New Treatment of Combination Drugs	-0.2475	1.3650

Note: (*) denotes $P < 0.05$

MANAGERIAL IMPLICATIONS

Increasing the chance that the physicians prescribe a new medicine is critical for the success of the new drug launch. As Srivastava and Bodkhe (2018) recommend in their study, there is a strong need for pharmaceutical firms to continue to find ways to be more effective with their marketing investment while curbing the unnecessary and unwanted expenditures to stay competitive. The results of the study can be utilized to help firms fill these gaps.

The Model of Innovative Tendency provides physician's predicted innovative tendency value so the pharmaceutical firm can target the doctors who show higher innovative tendency. The doctors with higher innovative tendency are shown in the estimation results to have higher chance to prescribe the new medicine.

FIGURE 1
PREDICTED INNOVATIVE TENDENCY

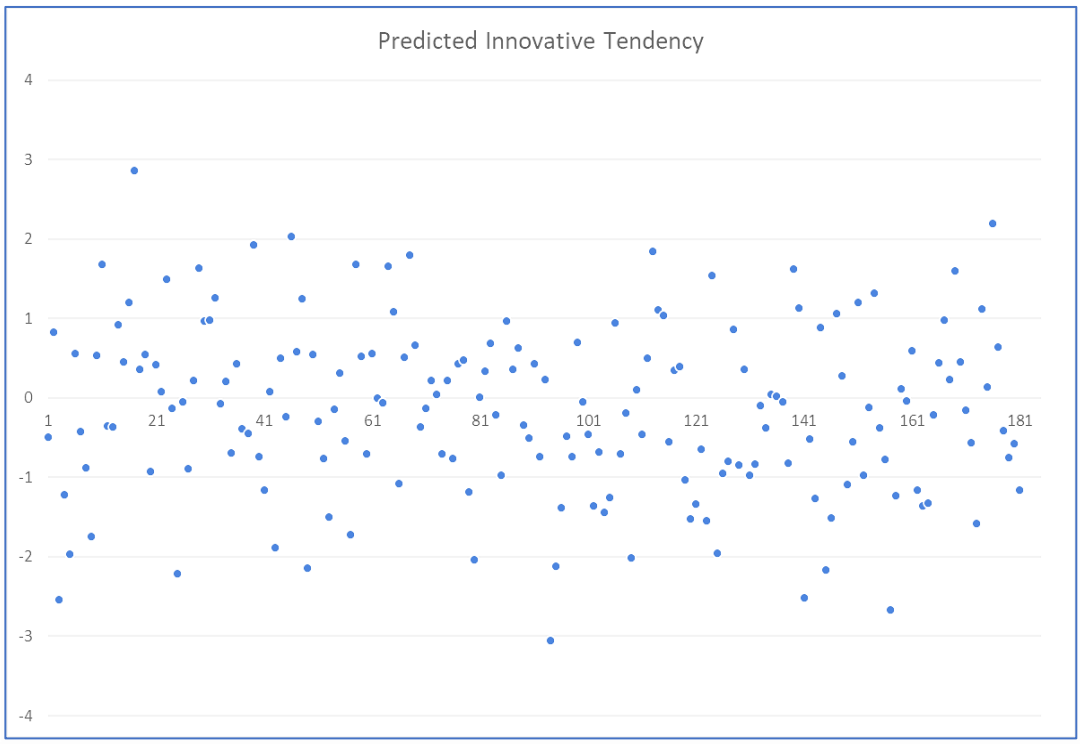

Figure 1 shows predicted innovative tendency value for each of 181 physicians in the data that is innate and unobserved by the firm otherwise. The predicted values are from -3.049 to 2.866 but the value itself does not have any meaning. The relative magnitude of the values shows the degree of innovative tendency.

The Model of the Degree of Doctor-Patient Relationship provides predicted degree of doctor-patient relationship values so the pharmaceutical firm can target the doctors who show shorter doctor-patient relationship. The doctors with shorter relationship with the patient are shown in the estimation results to have higher chance to prescribe the new medicine.

FIGURE 2
PREDICTED DOCTOR-PATIENT RELATIONSHIP

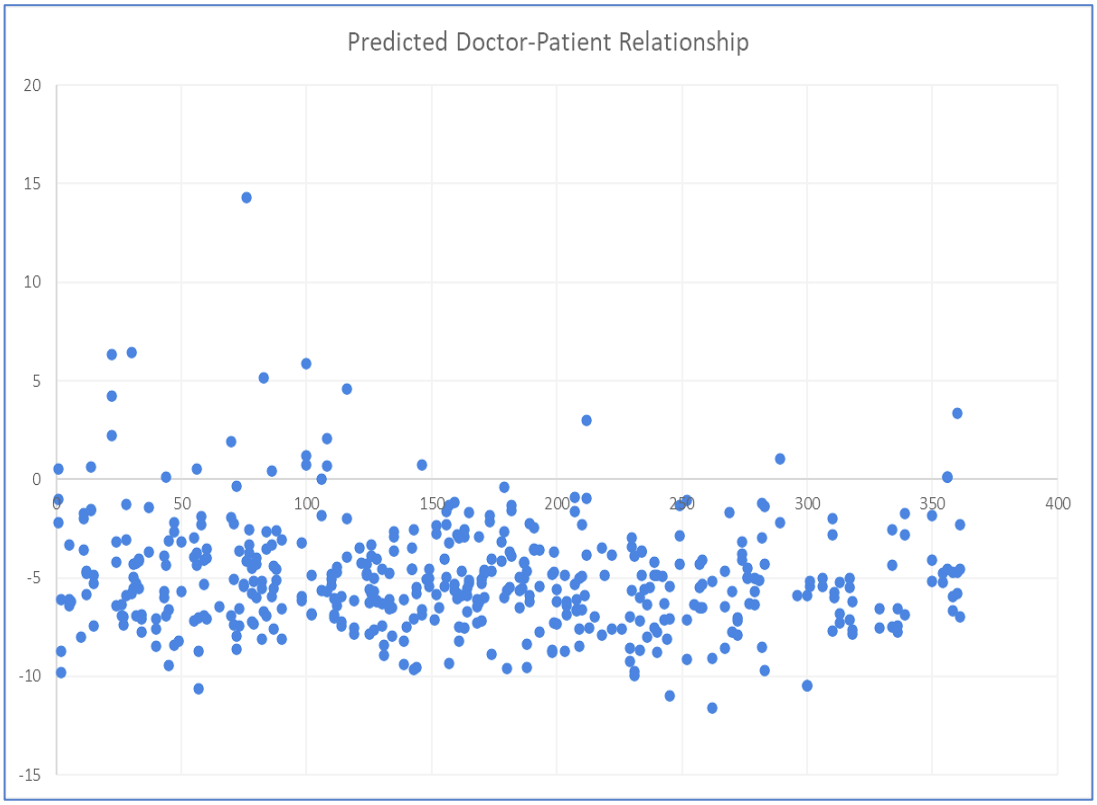

Figure 2 shows predicted degree of doctor-patient relationship value for each of their patient in the data that is unobserved by the pharmaceutical firms otherwise. With up to three patients for each physician, the predicted doctor-patient relationship values are for 464 cases. The predicted values are from -11.60 to 14.28 but as in the earlier case, the value itself does not have any meaning. The relative magnitude of the values shows the degree of doctor-patient relationship.

CONCLUSION

The literature in the area of pharmaceutical demand and detailing, the broad consensus is that detailing is effective in that is affects physician's prescribing behavior, but relatively little prior research studies are done about improving the detailing effort by targeting the right groups of physicians using specifically the latent innovative tendency of the physicians and unobserved degree of doctor-patient relationship. This study fills the gap in the literature by estimating the innate innovative tendency of the physicians and show that there is significant and positive relationship between the doctor's innovative tendency and the prescription intention of the new medicine. It also estimates the unobserved degree of doctor-patient relationship and show that there is significant and negative relationship between the degree of doctor-patient relationship and the prescription intention of the new medicine. The study provides managerial implications for the pharmaceutical firms by the predicted innovative tendency values of the physicians so the firm can target the doctors that show higher innovative tendency. It also provides managerial implications for the firms by the predicted degree of doctor-patient relationship values of the physicians so the firm can target the doctors that show shorter doctor-patient relationship.

The study has several limitations, all of which provide avenues for future research. A future study with a new data set can include the physicians' prescription behavior. The current study is also limited to one type of drug, but a future study can be applied to other medicines.

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