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Evaluation of Factors Affecting Sales of Prescription Medicines by Econometric Methods in Iran

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ABSTRACT

Background: There are many factors that affect the prescribing of a medication. Among them, promotion of a medication by the pharmaceutical companies, the physicians' knowledge base, and pricing are the most important. The objective of this study was to demonstrate how these parameters affect the prescribing behavior and determine their affects on the prescription process. ***Methods***: In order to investigate the effect of price, advertisement, and the physician gender and age on the sales and prescribing process of three medicines, namely fluvoxamine, clopidrogrel and latanoprosta the pooling data method in econometrics (Panel data) was used. ***Results:*** We found that advertisement and medical insurance coverage for the medication had a significant positive effect on prescription of all three medicines. At the same time, a negative relationship was seen between increasing price and the frequency of prescription of a medicine. The gender and age of the physician also affected the behavior of prescribing. Moreover, we found out that advertisement has a direct effect on raising the demand and prescription of all the medicines. ***Conclusions:*** Health policy makers as well as pharmaceutical companies should consider the impact of advertisement and also the age and gender of the prescriber on the prescribing frequency of a particular medicine.

Introduction

Facilitating the access to the medical and sanitary equipment and different medicines is one of the priorities of the health policies of a country, and has an important and determining impact on the health and sanitary condition of individuals in a society. Therefore, policies adopted in line with facilitating the access to the prescribed medicines are placed at the center of attention of the institutes and organs that are involved in the health and sanitary condition in a society. Medicines play a significant role in promotion of health and therapeutic services.

Several studies have been conducted on factors affecting the sale of prescription medicines in the world. In each of these studies, according to the purpose and conditions of the study, various factors were considered. Although, to understand and examine how each of these factors influence the amount of prescription medicines, the study should provide a more comprehensive assessment of all these factors. This present study looks for a comprehensive framework to estimating all factors affecting prescribing of medicines.

Advertisements

Lipsky and Taylor found that although 60% of doctors believe that "Direct-to-consumer advertising" (DTCA) encourages patients to be more responsible to take charge of their health, physicians in general do not agree with DTCA. In this study, 71% of physicians believe that DTCA is not a good concept and it hurts the relationship between the doctor and the patient. Also 68% of physicians believe that when under pressure they prescribe a particular medication or medical equipment which would not be done under normal conditions.[1]

Stevenson et al reported that 21 medical practitioners of Birmingham Health Center had issued prescriptions under the influence of patients, which is most likely correct in Iran due to the cultural characteristics. [2]

Muijrers et al noticed that there is a negative relationship between prescription based on evidence and principles of therapy with development of medical business firms.[3]

Berger and Jeffrey believe that advertisements are effective on the prescription irrespective to this fact whether they are reliable medically and ethically or not. There is evidence that patients affect the physicians and prescription of a medicine.[4]

Traditional advertisements are not too effective;

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however, the pre-disposed advertisements that include some evidences from the advantages of the new medicines are significantly effective if they are properly conveyed to the correct audiences. It should be said that advertisements are most effective on physicians; hence traditional methods of direct advertisement for physicians include 80 % of the costs of advertisements.[5,6]

Advertisement for physician takes place in various forms such as: personal introduction, medical representatives by the company, free sample offerings and other gifts and introduction of new products in medical journals, scientific and promotional lectures.[7, 8] Physicians usually tend to prescribe familiar medicines and are reluctant to prescribe newer medicines. Medicines with commercial brands are more attractive for use, even when there is little information on the quality and quantity of these products.[4] this is more apparent when a medicine with a commercial brand and a generic medicine compete in a same medicinal group.[9]

Mizik and Jacbson noticed that there was statistically significant positive effect of marketing on prescription.[10]

Gonul and Cater[11] showed that there is a significant relation between the extent of advertisements and the frequency of prescription by medical practitioners. Some qualitative works have also been conducted to survey the effect of the scientific information furnished by companies as well as the free samples supplied by them in separate categories, whereby Schumock et al [12] have concluded that free samples are effective in making decision about composition of the prescribed medicines, however, the information published by visitors do not have any clear effect, although separation of these two from each other is difficult.

Majumdar et al[13] suggest that publication of new evidence about the advantages of the medicines in specialized journals is effective; an active advertisement strategy toward achievement of a rapid agreement would require new evidence.

Price

An increase in the cost of prescription is generally due to the medicines with newer brands and higher prices that have been achieved through research and development activities by the medicine manufacturers and support of the governments to conduct research. During a study in 2005, researchers found out that adult persons with no insurance coverage (51%) discontinued taking their medicines, did not take the whole prescribed medicines or gave up medicinal treatment due to its high costs twice as much as those with insurance coverage (15%).

Henry and Kaser[14] found that among the patients over 65 years of age, those with no insurance coverage most probably had a limited prescription or excluded some medicines from their prescription due to their costs as compared to those with insurance coverage (37% against 22%).

Monique and Mrazek[15] remarked that accurate programs for direct regulation of prices have been more successful than more lenient programs or lack of a price regulation program.

Gender

There are many articles about the effect of the gender of consumers on the amount of the sale of a product. Most of the works have been carried out about women who are customers of a particular series of products. A glance at the articles that survey the behavior of customers evaluates men more independent, more certain, competitive, enthusiastic to change and risk taking. Meanwhile, a study conducted about 358 women and men between 18 to 44 years of age show that male physicians attach more importance to new technologies than female physicians. Stevenson et al[2] and Tamblyn et al[27] concluded that female physicians principally prescribe fewer medicines, carry out less diagnostic activities and tend to be more favorable toward prevention of medicine consumption.

Age

In this respect, most of the advertisement experts state and prove the resistance of older individuals against technology in various forms. Peay et al suggest that older physicians are less willing to use the newer Medicines.[16] Monette et al have conducted a study in which they considered that the year of graduation from university is an effective factor in prescription however they did not reach a significant result.[17] Salmivara in his study on COX-2 inhibitors medicine category, confirmed Tamblyn's results while he did not observe any tangible effect of the work record on prescription of medicine.[18]

Various studies although on small scale have been conducted in the world concerning the investigation of the factors that affect the sale of prescribed medicines. Each study has picked up different factors based on the objective and conditions of the study. In order to find out the effect of each factor on the amount of prescription of medicines, a comprehensive framework should be offered and the impact of each component should be studied within that frame. The present research seeks to offer a model in order to study the factors affecting the prescription of medicines and determine the effect of each of them on prescription process in Iran.

Materials and Methods

In an effort to investigate the effect of the factors of price, advertisement and insurance as well as characteristics of the physician such as age and sex, the research selected three groups of medicines and chose a highly consuming medicine from each group whose information could be extracted in Iran. These three Medicines were Fluvoxamine, Clopidogrel and Latanoprost.

1) Fluvoxamine from anti-depressant Medicines

The first and the most important medicine group which is investigated in most of the scientific researches in the world in order to measure the factors effective in prescription of a medicine by a physician is the group

of anti-depressant medicines, particularly "Selective Serotonin Reuptake Inhibitors" (SSRIs). The extensive use and daily increasing sale of these medicines and also the closeness of their pharmacological effects (in which the effect of the selected medicine based on the treatment line is faded while the effect of advertisement and price influences greatly its prescription by the physician in turn) and also attention to this group of medicines that is used in the treatment of chronic diseases such as depression, and that is why we can measure the effects of different factors in longer time spans.

The present study selected Fluvoxamine from this group which is newer as compared with other medicines of the group and facilitates the evaluation of the effect of age and sex in the acceptability of the new medicine while the other reason of its selection is its relatively high demand in the Iranian medicine market, something which shows the general attention of physicians and patients to this medicine.

2) Clopidrogrel from cardiovascular Medicines

The selected medicine of this group is Clopidrogrel. The medicine acts as an anti-platelet medicine (reduces platelet aggregation) and is used to relieve the infarction of myocardium and cardiovascular artery in the patients with arthrosclerosis.

Several brands and generic types of this medicine have so far entered the medicine market and we examined Osvix® (the semi brand type) in this study and compared it with other domestically-produced Clopidrogrel (Iranian generic type) in order to evaluate the effect of the related factors on the frequency of its prescription.

3) Latanoprost from Medicines for ophthalmologic diseases

The next option is eye drops that are useful for diseases such as glaucoma because in addition to generic production, the foreign-made one is also available and we can analyze the effect of advertisement in acceptability of a medicine by physicians. We have evaluated Latanoprost and its foreign-made type, namely Xalatan.

Theory/calculation

In this study, the data concerning three medicines Latanoprost, Fluvaxamine and Clopidrogrel from different physicians were gathered in the time period between2007-2009 and combination data method in econometrics (panel data) was used for estimation of the results. By using Eviews 6.0 software package the models were estimated. The data required for this study was obtained from the data center of FDO (Iranian Food & Drug Organization). The definition of variables showed in table 1.

Table1. Variable of definitions

Variable name	Definition
Sijt	Is the amount of the sale of prescribed medicine J by physician I in time t
Pjt	Is the price of prescribed medicine J in time t
Mt	Is the age of physician I in time t
ADjt	Is the amount of advertisement of the prescribed medicine j in time t
D1	The virtual variable related to the coverage or non-coverage of medicines by insurance
D2	The virtual variable related to the coverage or non-coverage of medicines by insurance

Sijt = F (Pjt, Mt, ADjt, D1, D2)

Results

1. Latanoprost

Both generic and brand (Xalatan®) types of the medicine are estimated. For the generic type which is covered by insurance with no advertisement the analytical model is as follows:

According to the table2, the price of the medicine as an effective factor on its prescription has a negative meaningful relation with the amount of the prescribed medicine. Age of the physician also relates to the amount of the prescribed medicine negatively

Table2. Results of panel data test for Latanoprost (generic type)

Variable	Coefficient	t-static	Prob	R^2	R^2 Adjusted
Intercept	11528064	3.32	0.00		
Gender	-66.06	-2.62	0.00		
Age	-0.0027	-3.62	0.00	$R^2 = 0.39$	$\bar{R}^2 = 0.37$
Price	-3.645	-3.28	0.00		

These results mean that the frequency of the prescription of the generic type of the medicine has a negative relationship with age of physicians. The coefficient of the virtual variable related to the gender too, is also negative and meaningful thus implying that male physicians prescribe the generic type of the medicine less frequently than the female physicians. Furthermore the R^2 of this model equals to 0.39 and its $\bar{R}^2$ equals to 0.37 which conveys a weak relation

between the dependent variable and independent variables of the model.

As for the brand type of the Latanoprost (Xalatan®) which was covered by insurance in 2007 but was not insured in 2008 and 2009, we analyzed the effect of both its advertisement and its coverage or non-coverage of the medicine. Results of the estimation of this model of Xalatan® were showed in Table3.

Table 3. Results of panel data test for Xalatan®

Variable	Coefficient	t-static	Prob	R^2	R^2 Adjusted
Intercept	-1543.75	0.969	0.33		
Gender	-39.68	-4.15	0.00		
Age	-0.00129	-4.32	0.00		
Price	0.079	1.13	0.25	$R^2 = 0.769$	$\bar{R}^2 = 0.759$
Advertisement	3.35×10^{-6}	361.7	0.00		
Insurance	159.54	2.29	0.02		

The results of the estimation of the model showed that the related variables of the model contain the expected signed except the price variable and are meaningful at the level of certainty below 5 percent except the price variable. The coverage of the Xalatan® by insurance has a positive relation with the frequency of prescription causing this amount to rise. Advertisement too, has a positive and significant effect on the sale of the Xalatan®, thus raising the frequency of its prescription. About the effect of the price of the Xalatan® on its prescription we observed a positive effect but not meaningful in this model because the price of foreign medicines is not an important factor for whom consume these medicines. The relation of other variables of the model is similar to that of the genrically-produced medicine which has already been stated. Furthermore the insurance coverage has a positive effect on rate of prescription.

2. Fluvoxamine:

This medicine too, has two generic and brand (Luvox®) types and the brand one is subject of advertisement. The brand type is not covered by insurance. In order to investigate the factors affecting the prescription of the generic and brand types of the Fluvoxamine, two models were estimated as follows:

Table4. Results of panel data test for Fluvoxamine

Variable	Coefficient	t-static	Prob	R^2	R^2 Adjusted
Intercept	27352.89	0.38	0.70		
Gender	360.5	2.44	0.01		
Age	0.0073	4.85	0.00	$R^2 = 0.904$	$\bar{R}^2 = 0.901$
Price	-79	0.328	0.74		

The results of the table4 showed that the coefficients of all independent variables are significant. The results explained that the amount of the sale of the Fluvoxamine falls while the price increases. There was also a positive relation between the age of the physician and the frequency of prescription of this medicine whereby this frequency increases with the raise of the age of the physician. There was also a positive relation between gender of physicians and the frequency of prescription of the Fluvoxamine, as a result being a male physician affects the amount of prescription of the medicine positively. In table5, the results of the estimation Luvox® were showed.

Table 5. Results of panel data test for Luvox®

Variable	Coefficient	t-static	Prob	R^2	R^2 Adjusted
Intercept	**68041.1**	46.94	0.00		
Gender	-525	-1.37	0.17		
Age	-0.0327	-2.61	0.00		
Price	-391.4	-68.8	0.00	$R^2 = 0.716$	$\bar{R}^2 = 0.706$
Advertisement	0.000123	67.3	0.00		
Insurance	68041.1	46.94	0.00		

Based on results of panel data test, the coefficients of the model's variables of Luvox® were significant. Therefore, the increase in the price of Luvox® reduced the amount of sale so there was an opposite relation

between the price and the frequency of prescription. Like the generic type, there was a negative relation between the age of the physician and the frequency of prescription of the Luvox® whereby older physicians prescribed this medicine less than younger ones.
There was also a negative relation between gender of physicians and the frequency of its prescription, in other words male and female physicians had different effects on the frequency of prescription of the Luvox®. Furthermore the results indicated that, advertisements too, had a positive impact on the prescription.

3. Clopidrogrel:

This medicine has two generic and semi brand (Osvix®) types in Iranian medicine market. Both of them were covered by insurance under particular conditions. The estimated results of model for the generic type of the Clopidrogrel, reported in the table5 and indicated that price of the Clopidrogrel had a negative effect on the frequency of its description which is significant at the level of below 1.0 percent. And also, the coefficients of the age and sex of the physicians were significant. According to the estimated model, the gender and age of the attendant physician was a direct effect on the frequency of its prescription respectively.
Furthermore, the estimation showed that advertisement was a positive and significant effect on the amount of prescription. On the contrary, the price of the Clopidrogrel had statistically significant reverse relation with the frequency of its prescription. The coefficient of the virtual variable concerning the sex of the physician is also significant implying a positive relation between the male physicians and frequency of prescription. Finally, the age of the physician had a direct and significant relation with the amount of sale of the prescribed medicine. The results of estimated variables showed in tables6 and 7.

Table 6. Results of panel data test for generic type of Clopidogrel

Variable	Coefficient	t-static	Prob	R^2	R^2 Adjusted
Intercept	32037.2	3.2	0.00		
Gender	272.19	18.39	0.00		
Age	0.001155	4.56	0.00	$R^2 = 0.82$	$\bar{R}^2 = 0.814$
Price	-70.38	-3.16	0.00		

Table 7. Results of panel data test for semi brand type Osvix®

Variable	Coefficient	t-static	Prob	R^2	R^2 Adjusted
Intercept	**114572**	12.2	0.00		
Gender	1291.4	413.2	0.17		
Age	0.0035	1.05	0.00	$R^2 = 0.863$	$\bar{R}^2 = 0.858$
Price	-250	-11.82	0.00		
Advertisement	4.68×10^{-7}	403.3	0.00		
Insurance	114572	12.2	0.00		

Discussion

Results of the estimation showed that the advertisement for the foreign brand of Latanoprost and its coverage by insurance in 2007 had a positive effect on the frequency of its prescription. The age and gender of the attendant physician had a significant effect on the prescription of both generic and brands of the Latanoprost. Moreover, the frequency of prescription of the Latanoprost was respondent to the prices thus creating a statistically negative and significant relation with the frequency of its prescription. The most important phenomenon observed in both generic and brand Latanoprost model was that women and younger physicians prescribed these medicines more than men and older physicians.
Results of the estimation showed that the advertisement for Luvox® were significant. Therefore, the increase in the price of Luvox® reduced the amount of sale so there was an opposite relation between the price and the frequency of prescription. Like the generic type, there was a negative relation between the age of the physician and the frequency of prescription of the Luvox® whereby older physicians prescribed this medicine less than younger ones. There was also a negative relation between gender of physicians and the frequency of its prescription, in other words male and female physicians had different effects on the frequency of prescription of the Luvox®. Furthermore the results indicated that, advertisements too, had a positive impact on the prescription.
The estimated results of model for the generic type of the Clopidrogrel, indicated that price of the Clopidrogrel had a negative effect on the frequency of its description was significant. And also, the coefficients of the age and sex of the physicians were significant. According to the estimated model, the

gender and age of the attendant physician was a direct effect on the frequency of its prescription respectively.
The results of this study are consistent with previous studies which have estimated the positive effect of different kinds of advertisement strategies on prescription frequency by physicians.[4, 5, 8, 19, 20] There are also studies about the effect of price and price-affecting factors -including health insurance coverage with the similar result of this study. [21] The effect of different approach on pricing regulation has also been the subject of many studies. [15]
Empirical evidence shows that insurance coverage is associated with rising health expenditure.[22,23] There are some studies which show it is more likely that a doctor prescribes brand type Medicines or more expensive Medicines to patients with insurance compared to patients without insurance. [24, 25]
There are also many articles about the effect of the gender of consumers and providers on the amount of the sale of a product. Most of the works have been carried out about women as customers of a particular series of products and shows that men are more independent, more certain, competitive, enthusiastic to change and risk. [26] Similarly about physicians, a study conducted on 358 women and men showed that male physicians pay more attention to new technologies than female physicians therefore prescribe newer Medicines. [27] Stevenson et al conclude in a qualitative report that female physicians principally prescribe fewer Medicines, carry out less diagnostic activities and tend to be more favorable toward prevention of Medicine consumption. [2]
About the age, studies have indicated that older physicians are less willing to use the newer Medicines. [16] It has been shown the year of graduation from university is an effective factor in prescription. [17]

Conclusion

As for Fluvoxamine, the results of the estimation imply that advertisements on the foreign brand of the Medicine (Luvox) had a positive and significant effect on the sale of this Medicine. Like the first Medicine mentioned above gender and age of physicians had a significant effect on the frequency of prescription of both the generic and brand type of the Medicine but they have positive effects. As for the responsiveness of prescription to the prices we should say that there is a statistically negative and significant relation between the prices of the generic and brand type of the Medicine and the frequency of its prescription.
Results of the estimation model of Clopidogrel also show that advertisement on Osvix had a positive and significant effect on the frequency of its prescription. Here the price of both the generic type and Osvix had a negative relationship with their prescription which is significant statistically. Gender and age of physicians too, had a significant effect on the frequency of prescription of the Medicine.

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