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Are Price, Income, and Education Expenditure Important in the Iranian households' Demand of Healthcare Services: 2011 to 2017?

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ABSTRACT

Background: In health economics, policymakers need to be aware of the individuals' sensitivity and reaction to change effective factors on the healthcare services demand**.** This study aimed to estimate the healthcare demand function and extract the price, income, and educational elasticity in Iran.

Methods: A panel of macro data was used to estimate the demand function. The data included provincial average of the nominal values of Iranian household healthcare and education expenditure, provincial average of their nominal income, and Consumer Price Index values of the healthcare services from 31 provinces during 7 years (2011 to 2017). This information was obtained from the annual Household Budget Survey Reports and no sampling was performed in this research. The dependent variable was the actual amount of demand for health care services. Robust pre-estimation tests and a robust standard error panel regression were run to estimate the demand function in Stata 15.

Results: All variables were stationary at the first-order differential (P-value < 0.01). All four variables were co-integrated (P-value < 0.01). The cross-sectional and fixed effects existed for each province (P-value < 0.01). Income and educational expenditure had a positive association with healthcare demand. Price elasticity of demand was -0.897 (P-value < 0.01), income elasticity was 0.491 (P-value < 0.1), and elasticity of education expenditure was 0.486 (P-value < 0.01). Noteworthy, 1 % increase was observed in the household incomes and their educational expenditure increased the demand for health care services by about 0.49 % and 0.48 %, respectively.

Conclusion: Healthcare services have been low elastic to price and education expenditure and have also been the essential commodity in the household budget in Iranian households. Later, the price and income coefficients were consistent with the health investment model, but coefficient of the education expenditure was not matched with predictions of the health investment model.

Key words: Healthcare services demand, Robust standard error panel regression, Health investment approach

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Introduction

The healthcare consumers' response to factors affecting the utilization of services has always been a major challenge for health policy makers. In planning the health sector, policymakers seek a package of health services that creates the highest level of health and ensures access to basic health services for the population. To manage utilization of the healthcare services, health system planners should have comprehensive information about the effective factors on the healthcare utilization. Empirical studies addressed various variables in utilization of healthcare services such as income, ethnicity, employment status, education(1); price, distance, provider quality or reputation, health status, insurance status, age, illness attributes(2); household economic status(3); private provider quality, gender, perceived financial situation, mental and physical health, extra-household resources, and price of a private consultation (4); income and health insurance(5); race, income, educational level, and insurance status (6). Therefore, each of these factors can determine the odds of health services utilization. In the health economics' literature, policymakers need to be aware of the individuals' sensitivity and reaction to change in each factor in order to plan better and optimize utilization of the health care services in the community. In economics, the demand function estimation is used to explore the individuals' response to the factors affecting their consumption. Demand function of the medical services models the role of factors such as price, income level, and other variables in predicting the people's consumption patterns. The individuals' demand sensitivity to price and income changes is derived by estimating the demand elasticity. Demand elasticity is the percentage of change in demand quantity divided by the percent of change in effective factors (7). Majority of the studies in the health economics' literature have estimated that value of the healthcare price elasticity was less than one (8-12). The conducted studies in the last decade in Iran also reported that the price elasticity of healthcare services was less than one(13, 14).Various studies have reported different income elasticity for healthcare. Bustamante et al. and Tsai (15, 16) estimated that the income elasticity of the medical care expenditure was less than one. They argued that the healthcare services were essential goods. However, Farag et al. (17) found that the healthcare expenditure was least and most sensitive to changes of income in low-income and middle-income countries, respectively. Furthermore, they reported that spending on the healthcare has normal income elasticity in high-income counties. As mentioned above, different values were reported for elasticity of the healthcare demand by empirical studies. The various results implied that demand elasticity of the healthcare services could depend on the contextual features. Moreover, observable heterogeneities in values of the elasticity may be due to different estimation methodology of the studies. The research conducted in Iran has predominantly used the macro data and barely micro data. High diversity also exists in the used approaches. Some studies estimated the elasticity through modeling the effective factors on utilization. Nevertheless, most studies approximately concluded that the healthcare services were low elastic to price. Values of the demand elasticity could be useful to predict effectiveness of the health expenditure control policies, demand management mechanisms, design of the benefit package, and cost sharing plans (18-20). The health policymakers should be aware of the price and income elasticity of the demand before implementing any health care demand managing policy, because success of any consumption management plan in health sector depends on the values of this elasticity. One application of the demand function in health sector is use of cost-sharing mechanisms to control over-utilization. Policymakers try to control consumption of health services by increasing the individuals' payment share. In order to design an effective cost containment policy, they need to know the precise value of the price elasticity in services. Insurance companies must also prioritize health services to formulate benefits' packages. Price and income

elasticity are important factors in this prioritization. Price elasticity can also be a good guide to effectiveness of the health cost control programs. Policy makers of Iran in health sector also need some evidences about the Iranian consumption pattern and main predictive factors of healthcare services demand. Households' reaction to changes of the healthcare price can affect the households' healthcare expenditure level. Considering importance of the demand elasticity precise values in health care policy making and response of the household welfare to changing prices, the present study was conducted. The aim was to extract the price, income, educational elasticity of the healthcare services' demand, and prediction of the Grossman model in Iran using a robust panel regression model. In this study, we employed a panel regression model by robust standard error. Thus, we could obtain more accurate estimates than other domestic studies over the demand elasticity. Third, we explored prediction accuracy of the health investment model about the healthcare consumption patterns in the Iranian households.

Materials and Methods

Theoretical model of health service demand function based on health investment approach

According to the Grossman's model (21), we maximized the utility function subject to budget constraint in order to extract the demand function. In the beginning, we started with a two-period utility function:

$$U = (t^s(H_0), X_0) + \beta U(t^s(H_1), X_1) \quad (1)$$

Where, β is the discount rate, H_0 represents the amount of health capital at time zero, X_0shows the amount of other goods and services' consumption at time zero, and t^s is the time of illness. To maximize this utility function, we are faced with two constraints: health investment and budget functions:

$$H_1 = H_0(1-\delta) + I(M, t^I) \quad (2)$$

$$A_0 + w_0(1 - t^s(H_0) - t^I) + \frac{w_1(1 - t_1^s(H_1))}{R} = pM + cX_0 + \frac{cX_1}{R} \quad (3)$$

In Equations 2 and 3, δ is the health capital depreciation rate, I is the health investment function, M is the amount of medical services consumption, t^I is the amount of time invested in health, w is the wage rate, c is the unit price of goods and services, p is the unit price of medical service, and R is the amount of interest on savings.To extract the demand function of health care services, we wrote the Lagrange function as follows:

$$L(H_1, t^I, M, X_0, X_1) =$$

$$U[t^s(H_0), X_0] + \beta U[t^s(H_1), X_1] + \mu[H_0(1-\delta) + I(M, t^I) - H_1]$$

$$+\lambda\left[A_0 + w_0(1 - t^s(H_0) - t^I) + \frac{w_1(1 - t_1^s(H_1))}{R} - pM + cX_0 + \frac{cX_1}{R}\right] \quad (4)$$

After solving Equation 4 based on the decision making parameters and some algebraic operations, the demand function of health care investment model will be in the form of the following logarithm:

$$\ln M = a - [1 + \alpha_M(\varepsilon - 1)]\ln p + [1 + \alpha_M(\varepsilon - 1)]\ln w - (1 - \varepsilon)\alpha_E E \quad (5)$$

Based on function 5, in the health investment based on the demand function, amount of the demand for health services has a positive relationship with the level of income and is negatively related to the price of services and the individuals' educational expenditure. Zoeifel (22) provided a detailed explanation about derivation of this equation from the two-period constrained optimization method.

Data

A panel of macro data was used to estimate the demand function. The data included provincial average of the nominal values of Iranian household healthcare and education expenditure, provincial average of their nominal income, and Consumer Price Index values of the healthcare services from 31 provinces during 7 years (2011 to 2017), that is 217 observations. This information was obtained from the annual Household Budget Survey Reports (23) and no sampling was performed in this research. At the time of conducting this study, only data from this period were available. It is worth to

note that we calculated real value of the healthcare services expenditure as the quantity of healthcare service consumed by dividing the provincial nominal average of health care expenditures by the CPI of healthcare according to the following equation:

$$HE_{nominal} = P \times Q, \qquad HE_{real} = Q = \frac{HE_{nominal}}{HCPI}$$

Econometric model of demand function estimation

The empirical model of health care demand using Equation 5 will be as follows:

$$l\,Q_{it} = \beta_0 - \beta_1 lp_{it} + \beta_2 lY_{it} - \beta_3 lE_{it} + \varepsilon_{it} \quad (6)$$

The regression Equation 6 is derived from the theoretical Equation 5 and variables were selected based on that. Instead of the provincial average wage, provincial average of the household income was used to show the households' purchasing power more accurately. Due to the lack of valid data on the literacy and education level, education expenditure was used as a proxy of education. However, a direct causal relationship was observed between them. In the above regression model,β_1, β_2, and $\beta_3$represented the price, income, and education elasticityof healthcare services demand, respectively. Moreover Logarithm of Quantity, Logarithm of Price, Logarithm of Yield, and Logarithm of Education display Logarithm of the provincial average of the real healthcare expenditure as real consumption, Logarithm of the provincial consumption price index of health care services, Logarithm of the provincial average of household income, and logarithm of provincial average of the households' expenditures on education, respectively.

Considering the type of data, we used the panel econometric model to estimate the demand function. However, a robust standard error regression model was employed instead of the conventional methods to estimate the demand function. In conventional panel regression models, it is assumed that there are no cross-sectional and serial correlations in the error components; so, the error components have the same variance. According to the econometrics' literature, if one of the mentioned assumptions is violated while the OLS estimates are still consistent, the system has no efficiency (24). As a result, standard errors of the regression model 4 are calculated by considering the following assumptions: 1) Cross sectional dependency in the errors, 2) Unit specific first order autocorrelation in the errors, and 3) Group-wise heteroskedasticity.

Given the above-mentioned assumptions about errors, the estimates of robust regression model are consistent and efficient (25).Final regression will be estimated in the following steps: 1-Identifing the degree of variables stationary, 2-Doing the co-integration test, 3-Determining the type of effects in regression model, 4-Running the cross sectional dependency, autocorrelation, and heteroskedasticity diagnostic tests, and 5-Estimating the Robust Standard Errors Panel Regressions.

In the panel data, stationary level of the studied variables should be determined before regression estimation. If the variables have a unit root and are not co-integrated, the estimated regression would be false and the obtained coefficients would not be statistically valid. Considering use of a short panel in this study, it was not possible to run a robust unit root test. Thus, Im, Pesaran, Shin (26) applied the common panel unit root test to diagnose the stationary level of variables. This test takes into account a cross-sectional specific unit root. In other words, it hypothesizes that the unit root can be different for each panel unit. In order to examine co-integration of the variables, three Kao, Westerlund, and Pedroni (27-30) tests were also employed. If unobservable factors, which cause interdependence across the units, are correlated with model explanatory variables, estimators of the fixed effects and conventional random effects will be biased and inconsistent (24).Thus, we must ensure about presence or absence of the cross-sectional correlation in the panel data before estimating the model. For figuring out about dependency among the panel units, we ran the Pesaran's (31) CD test. Null hypothesis of this test shows the cross-sectional independency. As

Pesaran and Smith (32) indicated, serial correlations could lead to inconsistent estimates in dynamic panels, while omitting or entering time trends could drastically change the parameter estimates. We employed the Inoue Born & Breitung (33) autocorrelation test providing a robust residual based test in which errors autocorrelation could be examined up to any order. Furthermore, it relaxes the homoscedasticity assumption. We used a Modified Wald Test (MWT) to assess the group-wise homoscedasticity. The null hypotheses of MWT exhibits that variance of errors term is equal across the panel units (33). In the panel models, we need to decide on the cross-sectional effects. These effects can be the same for all units (such as pooled models), can be specific for each section (such as fixed effects models), or can have random features (such as random models). In this study, the Lemaire test was run to distinguish between the pooled model and fixed effects. Furthermore, the robust Hausman test used to distinguish between fixed and random effects is heteroskedasticity consistent and robust to errors autocorrelation and dependency of individual units (25). At last, a robust Fixed Effect (within) regression model was estimated in which the standard errors have been calculated by the Driscoll and Kraay method.

Results

Table 1 provides descriptive statistics of the panel variables. During the 2011-2017, the Iranian households spent about 14824773 Rials on the healthcare services on average. While average of the real Healthcare Expenditure is about 20442 Rials in the same period. Average expenditure on the education was 663640 Rials ($On\ average, 1\ Rial = \frac{1}{130000}\ \$\ during\ 2019 - 2020$) in the same period. They earned about 32347294 Rials from 2011 to 2017 averagely. The average of CPI of the healthcare services was 180 over this period.

Before estimating the demand Function 6, stationary of the study variables must be determined. Results of the Im, Pesaran and Shin panel unit root test are shown in Table 2. As it can be observed, all variables of the model have first-order unit root and are not stationary at level.

Table 3 represents the co-integration test results of three common panel tests. According to the results of this table, all three tests represent that null hypothesis (No Co-integration) is rejected at $\alpha = 0.05$. Thus, a long run relationship exists among the variables.

The results of the serial correlation, heteroskedasticity, and cross-sectional dependency tests are provided in Table 4. Based on this table, null hypothesis (No serial correlation up to order 1) of the serial correlation test is not rejected ($\alpha = 0.05$). In other words, the error components have first-order serial correlations. Moreover, it is evident that the group-wise hemoskedasticity is rejected (P-value < 0.01), which means that variance of the error term is not the same among the panel units. Finally, result of Pesaran CD test does not reject the unobservable correlation across the panel units ($\alpha = 0.05$). Table 4 also represents results of the Leimer and Hausman robust tests. The Leimer test was used to distinguish between the pooled and fixed effect models. Based on the results of this test, the null hypothesis (pooled effect) was rejected (P-value < 0.01). In other words, cross-sectional effects were observed for each province. The robust Hausman test also was run to determine whether the cross-sectional effects were fixed or random. The results of this test rejected the null hypothesis indicating that the cross-sectional effects were random (P-value < 0.01). Consequently, final model of the regression panel showed fixed effects.

Consequently, a robust fixed effects regression model was estimated using the Driscoll and Kraay standard errors and based on the investment model. Coefficients of the final model of demand for the healthcare services are shown in Table 5. The βvalues in Table 8 represent price, income, and educational expenditure elasticity. In the estimated model, all coefficients of price, income, and educational expenditure were statistically significant (P-value < 0.01), but intercept was not significant. Based on the price, income, and education elasticity values, it can be argued that

rise of medical care tariff, income, and educational expenditure by 1 % could increase the healthcare services' demand by 0.9 %, 0.49 %, and 0.48 %, respectively.

Table 1.Descriptive statistics of the panel variables (Rial)

Variable	Mean	Std. Deviation
Nominal Healthcare Expenditure	14824773.83	34153938.65
Education Expenditure	663640.20	1271739.23
Income	32347294.88	53611799.42
Real Healthcare Expenditure	20441.96	37375
Health care CPI	180.27	69.49

Table 2. Results of the Panel Unit Root test

Variable	Method	Individual effects, individual linear trends			
		Level I(0)		First order difference I(1)	
		Statistic	P	Statistic	P
LQ	Im, Pesaran and Shin W-stat	1.83593	-	3.78851	***
	Im, Pesaran and Shin t-bar	1.29449		4.99611	
LP	Im, Pesaran and Shin W-stat	0.05036	-	273.190	***
	Im, Pesaran and Shin t-bar	2.37318		185.126	
LY	Im, Pesaran and Shin W-stat	1.80750	-	3.07810	***
	Im, Pesaran and Shin t-bar	1.31167		4.52111	
LEE	Im, Pesaran and Shin W-stat	1.77537	-	3.07245	***
	Im, Pesaran and Shin t-bar	1.33107		4.51733	

Significance level = 1 %

Table 3. Results of the panel co-integration tests

Test	H0	Type of Statistic	Statistic	P
Westerlund	No Co-integration	-	7.8255	***
Pedroni	No Co-integration	Modified Phillips-perron t	7.9773	***
		Phillips-perron t	- 27.195	***
		Augmented Dickey-fuller t	- 115.84	***
Kao	No Co-integration	Modified Dickey-fuller t	2.2389	**
		Unadjusted Modified Dickey-fuller t	- 2.4702	***

*** Significance level = 0.01, ** Significance level = 0.05

Table 4. Results of the Pre-Estimation Tests

Test	H_0	Statistic	P
Born & Breitung	No serial correlation up to order 1	6.54	**
Modified Wald test	No group wise heteroskedasticity	789.59	***
Pesaran test	No cross-sectional dependency	2.363	**
Lemaire	No cross-sectional effects	5.54	***
Hausman	No correlation of intercept and error term	33.72	***

*** Significance level = 0.01, ** Significance level = 0.05

Table 5. Demand of healthcare service based on the robust standard error panel regression

LQ	β	Drisk/Kraay Std. Err	t	$P > \|t\|$	[95 % Conf. Interval]	
LP	- 0.897	0.0683	- 13.14	***	- 1.037	- 0.7581
LY	0.491	0.1017	4.83	***	0.2834	0.6990
LEE	0.486	0.0961	5.06	***	0.2897	0.6824
Cons	- 0.502	0.2925	- 1.72	***	- 1.099	0.0948

Regression with Driscoll-Kraay standard errors
Method: Fixed effects regression

N of obs = 217
N of groups =31
F(3, 30) = 33450.64
Prob > F = 0.000
Within R^2 = 0.9936

*** Significance level = 0.01

Discussion

In this study, demand function of the health care services was estimated using the health investment approach and macro data from 31 provinces of Iran in 2011-2017.A panel regression model with robust standard error was also employed for estimation. The demand function estimation results showed that the price elasticity of demand for health care services was less than one. Based on the estimated values of price elasticity, it can be argued that rise of medical care tariff by 1 % could decrease the healthcare services' demand by 0.9 %. Indeed, demand for the health care services is low elastic in Iranian households and households are not very sensitive to price changes. Price elasticity in our study is consistent with demand theory and most other studies. Ellis et al. (9), Yu (10), Serivastava & McGuire (11), Ghandra et al. (12), and Alinia et al (14), Bowes and Gerfin (34), also concluded that healthcare demand was low elastic subject to price. Furthermore, some studies mentioned which demand of medicine had weak reaction to price fluctuation (8, 9, 13, 19).According to the theory of consumers' behavior, adverse shockto health could decrease the individuals' utility (35). In some cases, the negative shock on people's health endangers their lives so that consumption of health care services becomes critical to them. In this situation, other decision making parameters such as price, time, etc. lose their importance. So, it is not unexpected that people are less sensitive to the price of health services in such situations. As Duarte (36) mentioned, price elasticity ranged between zero for the most severe medical service (appendectomy) to − 2.08 for the most elective (psychologist visit). Thus, price elasticity can vary between types of the healthcare services and according to the individuals' health status (37). In a study in Switzerland, researchers concluded that healthier individuals responded more strongly to price changes (38). So, more vital and urgent aspects of the health services result in lower price elasticity. Health insurance also can be another factor decreasing price elasticity of demand in the healthcare market. Health economics theory has confirmed the effect of medical insurance on the price elasticity (39). Low elasticity of the demand for health care services gives policymakers the message that price inflation in the health sector can impose significant welfare losses on consumers. Growth of the healthcare price can enmesh households in a catastrophic situation, because after increase of the prices, people do not reduce their amount of consumption. A study in Germany showed that co-payment had no effect on the amount of demand for visiting specialists (18). Based on our estimations, the income elasticity of healthcare in Iranian households was positive and less than one during the study period. In fact, healthcare is an essential service for the Iranian households. Our estimation also figured out a direct correlation between income level and quantity of the health care demand. Estimated values of income elasticity implies with a 1 % increase in the provincial average of the household

income, the demand for health care services rises by about 0.5 % .Considerable inconsistency exists due to the value of income elasticity in the healthcare market. Various studies reported different income elasticity for healthcare. In line with our study, Lobiani et al. (40), in the United States, calculated the short-term and long-term income elasticity of the drug costs as 0.647 and 0.167, respectively. Bustamante et al. (15) and Tsai (16) estimated the income elasticity of medical care expenditure less than one and they argued that the healthcare services were essential .In another study among 36 Asian countries, researchers reported that the long-run GDP elasticity of health expenditure was less than one (41). Baltaji et al. (42) estimated the global long-run income elasticity of health care expenditure less than one and concluded that health care was an essential commodity in the world. Contrary to our findings, Josiclack et al. (2018) calculated the income elasticity of the health care services in European countries as 1.17 using the macro data(43). Blazquez-Fernandez et al. (44) suggested that health care was an essential good in the short run, but it could be a luxury one in the long run. Farag et al. (17) investigated the healthcare demand in developing and developed countries and found that healthcare expenditure was least and most sensitive to changes of income in low-income and middle-income countries, respectively and spending on the healthcare had normal income elasticity in high-income counties. This contradiction could be due to the type of data used in this research. In cross-country studies, income elasticity of demand was estimated using ratio of health expenditure variations to changes of national income. In macro level, response of the health expenditure to income variations could be greater than the household reactions. As a result, macro income elasticity of healthcare demand was expected to be greater than one. Moreover, inconsistency among the empirical evidence could be due to the contextual factors such as setting of health system, culture, and level of population health. Dependency of the health services demand to income implies two important policy making issues. First, level of the healthcare demand could be affected by economic crises. Second, healthcare services are essential for people's well-being. Thus, mechanisms aimed at improving the financial access to health services, such as development of integrated and comprehensive health insurance, exemptions from health charges, and targeted subsidies should be placed in agenda setting of health system reform. According to our findings, a positive relationship was observed between the education expenditure and demand for health care services. Furthermore, the educational expenditure elasticity of healthcare demand was less than one. It means that1 % growth in average of household educational expenditure increases the health care services demand by almost0.5 %. The positive correlation between educational expenditure and demand implies that in Iran people with higher educationl eve utilize healthcare services more than those with low education. Given that in this study we took into account the effect of income on demand individually, positive relationship between educational expenditure and demand cannot be attributed to the unobserved effect of income. This finding is consistent with the results of other studies. In a study in Cameroon, researchers suggested improving women's knowledge as a strategy for using the modern health care services (45). A research in Singapore identified higher levels of education, as a key predictor of participation in screening for the chronic diseases (46). A study in the Republic of Azerbaijan concluded that education was an important predictor of the number and frequency of prenatal care demand, but did not significantly predict the possibility of use (47). Uddin and Mazor (48) indicated a positive relationship between the level of literacy-education and consumption of health care services in Bangladesh. A study in Colombia reported that mothers' educational levelhad a strong positive impact on their frequency of specialist visits (49). Findings of the present study, similar to the results of other studies, are contrary to predictions of the Health Investment Model. This model predicts that education should reduce the demand for health services (22). Because by

increasing the level of literacy, efficiency of the individuals' health production increases and they can yield more health per unit of service (21). Education can also reduce the need for health services and the demand for health services by improving the healthy lifestyles (50). One reason for difference between our finding and Health Investment Model prediction can be that we used educational expenditure instead of literacy and education level. Furthermore, the regression coefficient health expenditure may be negative if it is included in the model with a lag. In other words, the level of household education in the previous period could have a negative effect on the demand for health services of this period.

Conclusion

Our study exhibited that demand for health care services was low elastic to price and educational expenditure in Iranian households. Healthcare is also an essential commodity for the Iranian households. Our estimation also figured out a direct correlation between income level, education expenditure, and quantity of health care demand. Observed relation between education and demand in this study was contrary to predictions of the Health Investment Model. Further research is needed to understand the relationship between education and demand for health services. This study has some limitations. Initially, we used the provincial average of the variables; so, we could not capture the micro analysis at the household level. Second, we used the real healthcare expenditure as the quantity of healthcare demand. Third, this study was restricted to a short period. Further studies could estimate the demand function of healthcare services using a long panel data.

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Conflict of interests

There was no conflict of interests.

Author's contributions

Ahadinezhad B and Khosravizadeh O designed research and estimated the model; Baghian N and Shahsavari S analyzed data; Mohtashamzadeh B contributed to writing the manuscript. All authors read and approved the final manuscript.

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