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The Impact of Health Expenditure Shocks and Real Exchange Rates on the Value-added of the Iranian Health Sector

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Abstract

Background: The health sector directly contributes to economic growth and paves the way for the development of other economic sectors. This study investigates the short-term and long-term effects of health expenditure shocks and real exchange rate fluctuations, as well as the symmetry and asymmetry of these shocks on the logarithm of value-added of the health sector in the Iranian economy.

Methods: The data related to the research variables were extracted from the website of the Central Bank of Iran (CBI) and the website of the World Bank. Using Eviews software (version 9) and applying the Hodrick-Prescott (HP) filter, health expenditure and real exchange rates were assessed as predictable and unpredictable shocks. Then, unpredictable shocks were decomposed into positive and negative components. In the next step, shocks were specified on the logarithm of value-added in the health sector along with control variables for the time period of 1973 to 2014.

Results: Estimation of asymmetric health expenditure model and real exchange rate for the logarithm of value added of the health sector indicated different effects of health expenditure shocks in the short run and the symmetry of these shocks in the long run. But the effect of real exchange rate shocks on the logarithm of value added in the health sector in the short run and the persistence of these shocks in the long run were asymmetric and significant.

Conclusion: The effectiveness of health expenditure shocks on value added of the health sector in the short run is the basis for the growth of the country's macroeconomy and the effectiveness of real exchange rate shocks on the Iranian health sector, both in the short and long run, marks this variable as an important factor in the economic policies of the health sector.

Keywords: Health expenditure, Real exchange Rates, Health sector Value-Added, Econometric models

Introduction

The health sector is considered as one of the most fundamental economic sectors of any society, which directly contributes to economic growth and paves the way for the development of other economic sectors. Accordingly, the value-added created in the health sector (health sector value-added) as an infrastructural sector, is considered as a measure of economic growth and development of countries (1). Access to health services to promote, maintain, and ensure the health of individuals is one of the important elements of the development of any society. All economists believe that the most important goals of economic policy-making are to

achieve full employment, price stabilization, and economic growth in the society (2). Among the most important macroeconomic policies that are applied to increase the rate of production in various economic sectors, including the health sector, are financial policy and exchange rate policies.

One of the salient features of the health sector in Iran is the significant government involvement in this sector (3) including the formulation of laws, policy-making, prioritization of health services, coordination of service delivery, and monitoring and evaluation of services provided (4, 5). Therefore, the political and economic authorities of the country have always been concerned about the growth and development of the health sector, and, consequently, the government is engaged in planning and making investments every year to develop this sector. However, some economists, such as Kandil, argue that the expansionary (positive shocks) and contractionary (negative shocks) effects of government spending on macroeconomic variables are not the same (6-8). According to New Keynesian theories, the effects of shocks on macroeconomic variables are asymmetric, but the neoclassical perspective refutes this hypothesis. Nevertheless, recent empirical studies (6) have demonstrated an asymmetric relation between government spending and macro variables, in that the effect of increasing government spending is different from the effect of decreasing it, challenging the neoclassical idea that the effects of positive and negative shocks to government spending on macroeconomic variables are the same and policymakers can use this financial instrument equally to increase or decrease economic activity. However, the idea that supports the asymmetric effects of health expenditure shocks has not been studied in the Iranian health sector.

Exchange rate policies, as a powerful tool among governments' macroeconomic policies, can have significant effects on various economic variables (2). These types of policies spill over their effects on the economy by making changes in aggregate demand and supply (9). Accordingly, exchange rate fluctuations affect the demand side of the whole economy through the net export channel and the impact of the central bank's foreign exchange reserves, and the supply sector of the economy through the channel of imported intermediate goods (10). New theoretical discussions followed by empirical studies indicate that exchange rate fluctuations have asymmetric effects on macroeconomic variables (10-14). This means that the effects of currency depreciation on macroeconomic variables were different from the effects of currency appreciation.

It is clear that one of the major problems for different sectors of the country is the risk of exchange rate fluctuations, and since the health sector is still highly dependent on foreign goods and services, the cost of health products and services is affected by these fluctuations (14).

Therefore, the significance of this study is in that its findings can be relevant to the health sector development in connection with the structure of government budget in the Iranian economy (15) and the amount of budget that the government assigns annually to the health sector and affects the fluctuations in government spending in the health sector, and the general planning of the health system which has a special place in the Fifth (16) and Sixth (17) Five-Year Economic, Social, and Cultural Development Plan of the Islamic Republic of Iran. Besides, given the recent currency fluctuations and the dependence of the pharmaceutical industry and medical equipment on imports, a fundamental variable such as the real exchange rate can be one of the important factors in the health sector, especially during the peak years of economic sanctions (11, 13).

The present study follows a two-fold objective. First, it investigates the extent to which health expenditure fluctuations, as a tool of fiscal policy in the health sector, affect the logarithm of value-added in the health sector in the short and long term (symmetric or asymmetric effects of the government health expenditure fluctuations). Second, considering different effects of exchange rate depreciation and appreciation shocks on all sectors of the economy (18) and the significance of improving community health for national economic development (19), this study seeks to evaluate the short-term and long-term effects of real exchange rate fluctuations and also the impact of symmetry and asymmetry fluctuations on the logarithm of value-added in the health sector.

The findings of this study can have some implications for policymakers and economic officials in using fiscal policy in the health sector. Besides, the insights from this study can be used for adopting effective policies in the

health sector and increasing the value-added growth of this sector which accounts for about 3.69% of the value-added growth of the entire economy, ultimately paving the way for national economic growth and development.

This study is innovative as it extends the literature on the health sector by exploring positive and negative health expenditure shocks and real exchange rate fluctuations and also the impact of symmetry and asymmetry of these fluctuations on the logarithm of value-added in the health sector as a subsector of the Iranian economy.

Methods

The data used in the study were extracted from the time series database published by the Central Bank of Iran (CBI) (15) and the World Bank (20) and adjusted using the total price index of consumer goods and services at a fixed price in 2016.

Furthermore, to calculate the real exchange rates, informal exchange rate data and Iran and US consumer price indexes (CPI) from 1973 to 2014 were used (11). The real exchange rates were also calculated using the following equation:

$$RER_t = NER_t . (\frac{CPI_{IR}}{CPI_{US}}) \quad (1)$$

Where, RER_t is the real exchange rate, NER_t. is the informal exchange rate, CPI_{IR} stands for the consumer price index in Iran (in year 2016=100), and CPI_{US} is the consumer price index in the United States (in year 2010=100).

Besides, the total health expenditure was calculated as the domestic general government health expenditure (% of current health expenditure) and domestic private government health expenditure (% of current health expenditure), which was converted into per capita expenditure at a fixed price. To decompose the government health expenditure shocks and real exchange rate fluctuations into predictable and unpredictable shocks as well as positive and negative shocks, the Hodrick-Prescott (HP) filter was used (10).

Technically, the Hodrick Prescott filter is estimated from a smoothed trajectory called S_t by minimizing the variance of the y_t time series around S_t relative to the sum of the squares of the two S_t differences such that:

$$Min: \sum_{t=2}^{t} (y_t - s_t)^2 \quad (2)$$

$$s.t: \sum_{t=2}^{t} [(s_{t+1} - s_t) - (s_t - s_{t-1})]^2 = 0 \quad (3)$$

If we turn this problem in a Lagrange form (L), then we have:

$$\min: L = \sum_{t=2}^{t} (y_t - s_t) + \lambda [\sum_{t=2}^{t-1} [(s_{t+1} - s_t) - (s_t - s_{t-1})]^2] \quad (4)$$

It is worth noting that λ is called the smoothing parameter and its value varies depending on the data release period. This parameter eliminates periods with a frequency of fewer than eight years from the time-series data.

Following the above-mentioned approach, the predictable and unpredictable shocks of government health expenditure and real exchange rates were defined as follows. First, the time-trend size of government health expenditure and real exchange rates were extracted based on the Hodrick Prescott filter and called hp-trendx which represents the predictable and unpredictable shocks of the variables under consideration (x). The unpredictable shocks of variables or the fluctuations or the concept of "rotation" in the analysis of business cycles were measured as the difference between the time series of the variable and the predictable shocks of each variable:

$$cycles - hpx = X - (hp - trendx) \quad (5)$$

Where $hp - trendx$ and $cycles - hpx$ represent predictable and unpredictable shocks of the variables in question, respectively.

Following the findings from the New Keynesian model, to break down unpredictable shocks of government health expenditure and real exchange rates into two positive and negative components, and to examine the effect of these shocks on economic fluctuations, it is necessary to first separate the positive shocks of each variable from the negative shocks of that variable.

To this end, following Cover and Kandil's study, the positive and negative shocks to health expenditure and real exchange rates were decomposed as follows (6, 21):

$$Pos_t^g = \frac{1}{2}\{abs(Cycles - Hpg) + (Cycles - Hpg)\} = Max\{0, Cycles - Hpg\} \quad (6)$$
$$neg_t^g = -\frac{1}{2}\{abs(Cycles - Hpg) + (Cycles - Hpg)\} = Min\{Cycles - Hpg, 0\}$$

Where POS_t^grepresents the positive shocks to health expenditure, neg_t^g shows the negative shocks to health expenditure, *abs* is the absolute value, and Cycles-Hpg shows unpredictable health expenditure shocks. Real exchange rate shocks were also decomposed in the same way as shown in Table 1.

Based on a review of the literature and following the theoretical framework of this study, several variables were included as control and moderator variables in the health sector in the model used to explore the effects of health expenditure shocks and real exchange rate fluctuations on the logarithm of value-added in the health sector. However, some variables whose values were not significant were removed from the model based on the adjusted coefficient of determination to obtain the best fit of the regression model. Finally, an econometric model (7, 8) containing control variables of health capital inventory, government size, active population and the inflation rate was selected.

Due to the lack of health capital inventory data, researchers such as Reed, Grossman, Yasayuki, and Naeem concluded that capital inventory indicators such as life expectancy and child mortality rates could be used as indicators of health capital inventory (22). Accordingly, in this study, the life expectancy index was used as a substitute for health capital inventory (23).

Following other studies, the government size was measured as the ratio of total government expenditures (current and development expenditures) to the gross domestic product (GDP) (24).

Since the studied period was from 1973 to 2014 for the Iranian economy and due to the lack of political stability (the revolution, the imposed war, and international sanctions) in some years of the period under study, a dummy variable (dum) was added to the model as an explanatory variable, which is set to one for the revolution years (1977-1978), the imposed war (1980-1988) and the intensification of sanctions (2012-2013), and the corresponding value for the remaining years was set zero.

Table 1. The variables The variables used for the research hypotheses

Variable	Definition
$LVAHS_t$	Health sector value-added logarithm
POS^g_{t-j}	The positive component of unpredictable shocks to health expenditure (with a time lag)
neg^g_{t-j}	The negative component of unpredictable shocks to health expenditure (with a time lag)
POS^{RER}_{t-j}	The positive component of unpredictable shocks to real exchange rates (with a time lag)
neg^{RER}_{t-j}	The negative component of unpredictable shocks to real exchange rates (with a time lag)
$Infr_t$	The inflation rate (the year 2016=100)
Lei_t	The capital stock of the health sector
AP_t	Active population
gs_t	The government size
dum	The dummy variable

To investigate the short-term and long-term effects, as well as the asymmetry of health expenditure shocks and real exchange rate fluctuations on the value-added logarithm of the health sector of the Iranian economy, Kandil methodology (6) and the ordinary least squares (OLS) method, were used. To test the first research hypothesis, a regression model (Eq. 7) was estimated in which the health value-added logarithm was affected by the cumulative effects of positive and negative health expenditure shocks, once without a short-term lag and again with a long-term lag according to the Akaike information criterion (AIC) and the Schwartz criterion (SC) along with other control variables.

To test the second research hypothesis, a regression model (Eq. 8) was run in which the health value-added logarithm was affected by the cumulative effects of positive and negative health expenditure shocks, once without a short-term lag and again with a long-term lag according to the Akaike information criterion (AIC) and the Schwartz criterion (SC) along with other control variables.

$$LVAHS_t = \alpha_0 + \sum_{j=0}^{x} \alpha_1 POS_{t-j}^{g} + \sum_{j=0}^{x} \alpha_2 neg_{t-j}^{g} + \alpha_3 Lei_t + \alpha_4 AP_t + \alpha_5 gs_t + \alpha_6 dum + \varepsilon_{1t} \quad (7)$$

$$LVAHS_t = \beta_0 + \sum_{j=0}^{x} \beta_1 POS_{t-j}^{RER} + \sum_{j=0}^{x} \beta_2 neg_{t-j}^{RER} + +\beta_3 Lei_t + \beta_4 gs_t + \beta_5 Infr_t + \beta_6 dum + \varepsilon_{2t} \quad (8)$$

In Eq. (7), the value-added logarithm of the health sector as an endogenous variable in the model was affected by the cumulative effects of positive and negative health expenditure shocks to show asymmetry in the long run; If Eq. (9) is confirmed, the cumulative effects of positive and negative shocks to health expenditure for the value-added logarithm of the health sector were significantly different from zero, and the null hypothesis $(H_0: \sum_{j=0}^{x}(a_{1j} - a_{2j}) = 0)$ is rejected. This confirms the asymmetry of the health sector value-added logarithm in the long run against government health expenditure policies in the health sector and the effectiveness of government policies is confirmed through health expenditure in this sector.

$$\sum_{j=0}^{x}(\alpha_{1j} - \alpha_{2j}) \neq 0 \quad (9)$$

In Eq. (8), the health sector value-added logarithm of the health sector used as an endogenous variable in the model was influenced by the cumulative effects of positive and negative health expenditure shocks to show asymmetry in the long run. If Eq. (10) is confirmed, the cumulative effects of a positive and negative shock to health expenditure for the value-added logarithm of the health sector were significantly different from zero, and the null hypothesis $(H_0: \sum_{j=0}^{x}(\beta_{1j} - \beta_{2j}) = 0)$ is rejected, showing that positive and negative health expenditure shocks differently affected the health sector value-added logarithm in the long run.

$$\sum_{j=0}^{x}(\beta_{1j} - \beta_{2j}) \neq 0 \quad (10)$$

Equations 7 and 8 were estimated by the OLS method and then the Wald test was used to confirm or reject the research hypotheses.

Results

The augmented Dickey-Fuller test (ADF) was used to check if the research variables were stationary or non-stationary. As can be seen in Table 2, based on the ADF test, the research variables were non-stationary but became stationary after taking the first difference.

Table 2. The results of augmented Dickey-Fuller test (ADF) for the research variables

Variable	Stationary degree	Stationary status	Number of lags	ADF (MacKinnon)	Sig.
$LVAHS_t$	I(1)	C	0	-8.490281	0.01
g_t	I(1)	C	0	-7.419918	0.01
RER_t	I(1)	C	0	-4.431182	0.01
$Infr_t$	I(1)	C	0	-4.541821	0.01
Lei_t	I(1)	C	0	-5.016692	0.01
AP_t	I(1)	C	0	-2.849370	0.05
gs_t	I(1)	C	0	-8.676121	0.01

C: Intercept, g_t: Per capita health expenditures at a fixed price, ReR_t: Real exchange rate.

Equations 7 and 8 were solved using the annual data for the period from 1973 to 2014 to investigate the asymmetry of health expenditure shocks and real exchange rates and their effect on the logarithm of value-added in the health sector in the short term based on the Akaike information criterion (AIC) and the Schwartz criterion (SC) in the model without any time lag.

The same criteria were used to show the long-term effects of health expenditure shocks using Eq. (7). The results showed that the single-lag model was better than the two-lag model. Thus, the single-lag model was estimated via the OLS method.

However, the results of Eq. (8) concerning the long-term effects and real exchange rate shocks showed that the two-lag model was better than the three-lag model. Thus, the two-lag model was estimated using the OLS method.

Table 4 shows the results of estimating Eq. (7) using the OLS method to assess the effect of positive and negative health expenditure shocks on the health sector value-added logarithm in the short run.

Table 3. Determining the optimal lag using the AIC and SC criteria

Equation	Free-lag model (Current period)		Single-lag model		Two-lag model		Three-lag model	
	AIC	SC	AIC	SC	AIC	SC	AIC	SC
Eq. (7)	1.0051	1.2947	1.0333	1.4095	2.0171	2.0293	----	----
Eq. (8)	2.1838	2.473	2.2203	2.5965	2.6597	2.1454	2.7724	2.2079

Table 4. The effects of positive and negative health expenditure shocks on the logarithm of value-added in the health sector in the short run

Values	OLS (Eq. 7)
a_0 (t-ratios)	-7.8615 (-4.400)***
POS_t^g (t-ratios)	0.000266 (2.708)**
neg_t^g (t-ratios)	0.000109 (-1.877)*
$POS_t^g - neg_t^g$ (t-ratios)	0.000375 (2.323)**
Lei_t (t-ratios)	0.12697 (3.880)***
AP_t (t-ratios)	0.00042 (10.598)***
gs_t (t-ratios)	1.81910 (1.529)*
dum	0.2378 (2.481)**
Test wald F-Statistic Chi-square	
POS_t^g=0	F-statistic = (7.333)** Chi-square = (7.333)**
neg_t^g=0	F-statistic = (3.3524)** Chi-square = (3.524)**
$POS_t^g = neg_t^g$	F-statistic = (5.396)** Chi-square = (5.396)**
R^2	0.9883
DW	1.5605

*** Sig. = 0.01, ** Sig. = 0.05, * Sig. = 0.10.

The results of Eq. (7) using the OLS method show that the POS^g_t value is small and positive, and statistically significant confirming the effect of increasing health expenditure shocks on the logarithm of value-added in the health sector in the short run. As the expenditures in the health sector increase, the added value of this sector of the economy also increases. Besides, the neg^g_t value shows that the effect of negative shocks on health expenditure is small and negative, and statistically significant (p = 0.10), confirming the effect of reducing health expenditure shocks on the logarithm of value-added in the health sector in the short run.

The effects of asymmetry of health expenditure shocks on the value-added logarithm of the health sector in the short term were assessed using the null hypothesis ($H_0: (POS_t^g - neg_t^g) = 0$).If the hypothesis is confirmed, the inefficiency of government policies on health expenditure in the health sector is confirmed as shown in Table 4.

The results in the fourth row of Table 4 indicate a significant difference between the effects of POS_t^g and neg_t^g, implying the rejection of the null hypothesis (H0). This difference is symptomatically positive indicating the asymmetrical effects of government health expenditure policies on the logarithm of value-added in the health sector in the short run.

The control variables used in the model (Eq. 7) such as health capital inventory, active population, government size, and dummy variable improved the estimation results. The variables of health capital inventory, active population, and government size have had a positive and significant effect on the logarithm

of value-added in the health sector in the short-term, which follows the theoretical framework of this study. The dummy variables including the revolution, the imposed war, and the intensification of international sanctions have a negative and significant effect on the logarithm of value-added in the health sector (intercept = -7.8615 and the dummy variable = +0.23) (25). This suggests that the country's health sector has faced a decrease in added value over the years. The values of the independent variables are significant and the explanatory power of the model is 98%. Besides, the Durbin-Watson test (DW) statistic is equal to 1.56, which shows the lack of autocorrelation between the error terms.

Table 5 shows the results of estimating Eq. (7) using the OLS method to assess the effect of positive and negative health expenditure shocks on the health sector value-added logarithm in the long run.

Table 5. The effects of positive and negative health expenditure shocks on the logarithm of value-added in the health sector in the long run

Values	OLS (Eq. 7)
a_0 (t-ratios)	-7.5969 (-4.082)***
$\sum_{j=0}^{1} POS^{g}_{t-j}$ (t-ratios)	0.000562 (1.5758)
$\sum_{j=0}^{1} neg^{g}_{t-j}$ (t-ratios)	0.00014 (0.1076)
$\sum_{j=0}^{1} (POS^{g}_{t-j} - neg^{g}_{t-j})$ (t-ratios)	-0.000547 (-1.536)
Lei_t (t-ratios)	0.12290 (3.631)***
AP_t (t-ratios)	0.000427۷ (10.290)***
gs_t (t-ratios)	1.5253 (1.078)
dum	0.3314 (1.650)*
Test wald F-Statistic Chi-square	
$\sum_{j=0}^{1} POS^{g}_{t-j}=0$	F-statistic = (2.4833) Chi-square = (2.4833)
$\sum_{j=0}^{1} neg^{g}_{t-j}=0$	F-statistic = (0.0115) Chi-square = (0.0115)
$\sum_{j=0}^{1} POS^{g}_{t-j} = \sum_{j=0}^{1} neg^{g}_{t-j}$	F-statistic = (2.360) Chi-square = (2.360)**
R^2	0.9883
DW	1.5363

*** Sig. = 0.01, ** Sig. = 0.05, * Sig. = 0.10.

As can be seen in Table 5, the cumulative effects of positive and negative health expenditure shocks to the health sector on the value-added logarithm of the health sector are small and statistically insignificant at the 90% confidence interval, implying the ineffectiveness of government policies enforced through health expenditure on the logarithm of value-added in the health sector in the long run. The difference between the cumulative effects of increasing and decreasing shocks to government health expenditure confirms the symmetry (consistency) of the value-added of the health sector in the long run against these policies as shown in the fourth row of Table 5.

The results of the Wald test confirm the null hypotheses (H0) at the 95% confidence interval showing the symmetric effects on positive and negative shocks on the value-added logarithm of the health sector. The control variables of health capital inventory and active population have a positive and significant effect on the logarithm of value-added in

the health sector in the long run, which is in line with the theoretical framework in this study. However, the government size had a positive but statistically non-significant effect.

The dummy variables, i.e. the revolution, the imposed war, and the intensification of international sanctions negatively affect the value-added logarithm. As can be seen in Table 5, the effect of the dummy variable on the value-added logarithm is positive (+ 0.23). However, as the value of the dummy variable for years of revolution, imposed war, and international sanctions is set 1 and the corresponding value of the rest of the years is 0, according to the econometric rule, the dummy variables should be added to the model intercept (-7.8615), so the result has a negative and significant effect on the value-added logarithm (25), implying that the health sector has faced a decrease in value-added during these years. The values of the independent variables are significant and the explanatory power of the model is 0.98%. Besides, the Durbin-Watson Test (DW) statistic is 1.53.

Table 6 presents the results of estimating Eq. (8) using the OLS method to assess the effects of positive and negative real exchange rate shocks on the health sector value-added logarithm in the short run.

Table 6. The effects of positive and negative real exchange rate shocks on the health sector value-added logarithm in the short run

Values	OLS (Eq. 8)
a_0 (t-ratios)	-20.8181 (-9.658)***
POS_t^{RER} (t-ratios)	0.000170 (1.693)*
neg_t^{RER} (t-ratios)	-0.000228 (-2.148)**
$pos_t^{RER} - neg_t^{RER}$ (t-ratios)	0.000395 (2.381)**
Lei_t (t-ratios)	0.42920 (15.051)***
gs_t (t-ratios)	2.9552 (1.729)*
$infr_t$ (t-ratios)	-0.03368 (-2.502)**
dum	1.3428 (4.420)**
Test wald F-Statistic Chi-square	
$POS_t^{RER}=0$	F-statistic = (2.868)* Chi-square = (2.868)*
$neg_t^{RER}=0$	F-statistic = (2.614)** Chi-square = (2.614)**
$pos_t^{RER} = neg_t^{RER}$	F-statistic = (5.672)** Chi-square = (5.672)**
R^2	0.9612
DW	1.7656

*** Sig. = 0.01, ** Sig. = 0.05, * Sig. = 0.10.

The results of solving Eq. (8) using the OLS method indicate that the POS_t^{RER} value is small and positive, and statistically significant at the 90% confidence level confirming the effects of positive real exchange rate shocks (devaluation of the national currency) on the health sector value-added logarithm in the short run. Moreover, the neg_t^{RER} value shows the effects of negative shocks on health expenditure is small and negative, and statistically significant, confirming the effect of negative real exchange rate shocks (appreciation of the national currency) on the logarithm of value-added in the health sector in the short run.

The effects of real exchange rate asymmetry on health value-added logarithm in the short term were assessed by testing the null hypothesis $(H_0: (POS_t^{RER} - neg_t^{RER}) = 0)$. As

can be seen in Table 6 (Row 4) there is a significant difference between the effects of POS_t^{RER} and neg_t^{RER}. This rejects the null hypothesis, pointing to the asymmetry of real exchange rate shocks on the logarithm of value-added in the health sector in the short run.

The control variables were used to estimate the research model (Eq. 8). The variables of health capital inventory, active population, and government size had a positive and significant effect on the logarithm of value-added in the health sector in the short-term, which follows the theoretical framework of this study. The dummy variables including the revolution, the imposed war, and the intensification of international sanctions had a negative and significant effect on the logarithm of value-added in the health sector (intercept = -20.8181 and the dummy variable = +1.3428), indicating that the country's health sector has faced a decrease in added value over the years. The explanatory power of the model (Eq. 8) is 96%. Besides, the Durbin-Watson Test (DW) statistic is equal to 1.76.

Table 7 presents the results of estimating Eq. (8) using the OLS method to assess the effects of positive and negative real exchange rate shocks on the health sector value-added logarithm in the long run.

Table 7. The effects of positive and negative real exchange rate shocks on the health sector value-added logarithm in the long run

Values	OLS (Eq. 8)
a_0 (t-ratios)	-15.8531 (-5.3101)***
$\sum_{j=0}^{2} POS_{t-j}^{RER}$ (t-ratios)	0.002161 (2.8587)**
$\sum_{j=0}^{2} neg_{t-j}^{RER}$ (t-ratios)	-0.000186 (-0.4611)
$\sum_{j=0}^{2} (POS_{t-j}^{RER} - neg_{t-j}^{RER})$ (t-ratios)	0.002347 (2.7525)**
Lei_t (t-ratios)	0.34902 (8.2221)***
gs_t (t-ratios)	1.56275 (0.8326)
$infr_t$ (t-ratios)	-0.01429 (-0.9085)
dum	0.96745 (2.4620)**
Test wald F-Statistic Chi-square	
$\sum_{j=0}^{2} POS_{t-j}^{RER}=0$	F-statistic = (8.1723)** Chi-square = (8.1723)**
$\sum_{j=0}^{2} neg_{t-j}^{RER}=0$	F-statistic = (0.2126) Chi-square = (0.2126)
$\sum_{j=0}^{2} POS_{t-j}^{RER} = \sum_{j=0}^{2} neg_{t-j}^{RER}$	F-statistic = (2.5763)** Chi-square = (2.5763)**
R^2	0.9671
DW	1.670

*** Sig. = 0.01, ** Sig. = 0.05, * Sig. = 0.10.

As can be seen in Table 7, the cumulative effects of positive and negative real exchange rate shocks to the health sector on the value-added logarithm of the health sector are positive and statistically insignificant, implying the ineffectiveness of positive and negative real exchange rate shocks on the logarithm of value-added in the health sector in the long run.

The cumulative effects of positive and negative real exchange rate shocks to the health sector on the value-added logarithm of the health sector are small and statistically

insignificant at the 90% confidence interval, The difference between the cumulative effects of positive and negative real exchange rate shocks confirms the asymmetry of the value-added of the health sector in the long run under the influence of these shocks as in Table 7 (Row 4). Accordingly, the difference between the cumulative effects of positive and negative real exchange rate shocks to the health sector is positive and significant, confirming the asymmetry of real exchange rate shocks to this sector of the economy in the long run.

The results of the Wald test reject the null hypotheses (H0) at the 95% confidence interval showing the asymmetric effects on positive and negative real exchange rate shocks on the value-added logarithm of the health sector. The two control variables of inflation rate and government size used in estimating the regression (Eq. 8) were statistically insignificant with longer intervals.

Discussion

The present study confirmed the impact of government health expenditure shocks on the logarithm of value-added in the health sector in the long run. Given the economic conditions and the government policies in the Iranian health sectors, the effects of these shocks can be attributed to the following reasons.

In Iran, during the studied period, different governments with different approaches have been in power and these governments, regardless of their specific approaches, have repeated the same health policies in terms of health expenditure (26, 27), except for some fundamental changes that occurred in the years following the 1978 revolution. This indicates the governments followed health policies under the influence of certain social conditions and problems in the health system. Therefore, the Iranian governments have failed to follow a specific approach and refused to pursue long-term goals. Furthermore, there is a non-economic perspective dominating the country's macro decision-making, so that it is not clear how and to what extent the government assigns a budget to the health sector. Moreover, there is no operational budget system to link the annual budget to development plans. What's more, the calculation of costs is accompanied by some shortcomings, so that the released figures hide many problems, errors, and inaccuracies (28).

The results of the present study also suggested the effectiveness of positive real exchange rate shocks (devaluation of the national currency) on the logarithm of value-added in the health sector in the short run. According to economic theories, exchange rates and imports are inversely related, and with increasing exchange rates, the price of imported goods increases (29), thus reducing imports. In Iran, with the increase in prices of products in the health sector, especially during the peak years of economic sanctions, especially in 2013, the adoption of market management policies gave support for domestic production and restrictions on imports of similar domestic goods. Accordingly, drug production was grown so that the volume of drug imports in 2014 decreased significantly compared to previous years (13). For this reason, the share of domestic drug production compared to imported drugs has grown well. Of course, in recent years, the country's dependence on imports has decreased significantly and many problems have been resolved during the sanction period, consequently, leading to the growth of value-added in this sector of the economy.

Positive shocks to government health expenditure in Iran have a short-term positive effect on the logarithm of value-added in the health sector, confirming the important role and leadership of the government in its expenditure in promoting health and increasing the value-added of this sector. One of the serious limitations of this study was that no similar study was found with the same methodology to deal with health expenditure shocks. Therefore, it was not possible to compare the results of this study with previous studies in the literature. This is the first study to break down health expenditure shocks into positive and negative components and address asymmetry in the health sector following Kandil's approach. Most studies conducted in Iran and abroad are about public and private health expenditure, economic growth, and health indicators. The results of similar studies conducted in the health sector concerning health expenditure partly confirm the first hypothesis of the present study that highlighted the short-term impact of health expenditure on economic growth, which also leads to value-added growth. Assadzadeh et al. showed that public health expenditures have a positive and

significant effect on health promotion and increased per capita production and this confirms the strategic role of the government in this economic sector (30). Hadian et al. concluded that health expenditure has a small and significant effect (as a variable of health capital) on economic growth in Iran (31). Furthermore, Asghari and Badpa introduced health expenditure as a vital component in improving the health situation in Iran (32). Ghanberi and Baskha also highlighted the positive and significant effect of the Iranian government's health expenditures on the country's economic growth (33). In another study, Panahi and Aleemran showed a positive and significant effect of government health expenditure on the growth of D8 countries including Iran, Indonesia, Bangladesh, Turkey, Pakistan, Malaysia, Egypt, and Nigeria (34). Raghupathi and Raghupathi examined the impact of health expenditure and economic performance on the US economy and showed a positive correlation between health care expenditures and economic indicators including income, GDP, and labor productivity (35). Moreover, Novignon et al. addressed the impact of public and private health care expenditures and health status in Sub-Saharan Africa using panel data and suggested that increasing the health care costs of these countries is an important step in achieving economic development goals and health care costs showed a positive and significant correlation with health status in sub-Saharan Africa (36).

The present study showed that negative health expenditure shocks have a negative and short-term effect on the value-added logarithm of the health sector in the Iranian economy. It was also shown that the effect of positive shocks on health expenditure is positive and greater than the effect of negative shocks on the logarithm of value-added in the health sector in the short run, confirming the asymmetry of the health value-added logarithm against government health expenditure policies in the health sector in the short run. Using the same approach, Kandil examined the effects of asymmetry of government spending shocks in the United States and confirmed the asymmetry of government spending shocks in the macroeconomic sector of the United States (6).

The assumption of symmetry of the value-added logarithm of the health sector against government policies in the Iranian economy in the health sector through health expenditure, in the long run, cannot be ruled out, and this highlights the ineffectiveness of government health expenditure policies in the health sector in the long run.

Positive real exchange rate shocks in the short and long term are among the factors affecting the logarithm of value-added in the health sector in the Iranian economy. Montazeri showed that exchange rate jumps have a direct and significant effect on the value-added of the health sector (14). The hypothesis of asymmetry of the value-added logarithm of the health sector against real exchange rate shocks in the short and long term is confirmed, highlighting the effect of real exchange rate shocks in the Iranian health sector. In their study, Shahbazi and Asadi also confirmed the impact of exchange rates in the short and long term in the Iranian health sector (29).

Conclusion

The present study showed that government policies on health expenditure are asymmetric only in the short run. Therefore, general policies of the health system and the increasing trend of expenditures in the health sector in recent decades were effective in expanding justice, increasing welfare, and promoting health indicators and health of people in the community in the short term, leading to the growth and development of the country's macroeconomy. However, the lack of integrated long-term planning and the absence of efficient and optimal budget allocation to the health sector have led to the ineffectiveness of government policies on health expenditure in the long run. The results of this study also confirmed the impact of positive and negative real exchange rate shocks for the Iranian health sector in both the short and long term. Therefore, given the fluctuations in exchange rates and their costs to the health system, governmental authorities including the Central Bank must take effective measures to control exchange rate fluctuations and also adopt correct policies to cause further growth of the country's health sector.

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Conflict of interest

The authors declared no conflict of interest.

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