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An Analytical Study on Healthcare Inflation Rate and Its Most Important Components in Iran

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Background: Inflation rate is an important indicator of macroeconomics. The trade-off between inflation rate and the social welfare is an important issue, which leads to decreased access to health services.

Objectives: The aim of the present study was to investigate the relationship between inflation rate of three components of healthcare, namely, hospitalization, medication, and specialist consultation. The study also attempted to determine the overall health inflation rate in Iran and the relationship between general and health inflation rates.

Materials and Methods: The available data on inflation rates from 1985 to 2013 were used to estimate the econometrics' models. The stationary condition of variables was assessed by applying Augmented Dickey-Fuller test. Then, two econometrics models were estimated. The first model was used to evaluate the effect of inflation rate of health subcategories on overall health inflation rate, and the second model was applied to analyze the relationship between the rates of health and general inflation.

Results: With 1% increase in the rates of inflation related to hospitalization, medication, and specialists' consultation, the inflation rate of health would respectively increase by 0.41888%, 0.25372%, and 0.16307% in long term. In Iran, 88% of changes in health inflation rate are related to the changes in inflation rates of aforementioned subcategories. In addition, with 1% increase in health inflation rate, the general inflation rate would rise by 0.3070% in long term and more than 11% of changes in general inflation rate can be explained by changes in health inflation rate.

Conclusions: Inflation rates of hospitalization, medication, and specialists' consultation have the greatest effects on overall health inflation rate. Moreover, general inflation rate is directly correlated with health inflation rate.

Keywords: Health Economics; Economic Inflation; Health Care Sector; Econometrics Model; Consumer Price Index

1. Background

Inflation rate is considered as a key indicator of macroeconomics and always has been an issue of investigation by economists due to its destructive effects (1). The detrimental effects of inflation are associated with redistribution of income in favor of capital owners (2), increased uncertainty and instability in the economy, and reduced long-term investments (3) In addition, the trade-off condition between inflation and the welfare is considered as an important effect of inflation on the community (4). Inflation rate in healthcare sector is usually higher than general inflation rate, probably due to special characteristics of the healthcare system (3, 5). Usually, prices of health services have grown faster than those in other sectors (6). It has been clearly demonstrated that the pattern of inflation rate in the health sector grows faster than general consumer price index (CPI); the same rule applies to other goods and services of the health system (7). The main concern is that the high rate of health inflation in comparison to the income of the general population would definitely result in catastrophic health expenditures, limited access to healthcare services, and finally, reduced level of public health (8). Previous studies have demonstrated that costs of hospitalization, medical consultation (9), medication (10), and diagnostic modalities pose the greatest effect on health inflation rate (3, 6, 11). However, international and even national variations in determinants of health inflation is inevitable due to its structural and economic characteristics (12).

2. Objectives

The main causes of general inflation in Iran are changes in macroeconomic variables, production, liquidity, price indices of imported goods, and exchange rate (3, 4). However, we have shortage of data and evidence regarding the most important components of health inflation rate in Iran and the world. In addition, no previous study in Iran has analyzed the components of health inflation rate using the trends data. Thus, in this study we tried to investigate the leading components of health infla-

tion rate in Iran in a 28-year period. Moreover, we tried to determine the relationship between general and health inflation rates.

3. Materials and Methods

This analytical study investigated the most important components of health Inflation rate in Iran, using an analytical approach to estimate two models of inflation rate through econometrics methods. The study was performed in Shiraz University of Medical Sciences. The first model estimated the impact of inflation rate of health subcategories on overall health inflation rate in relation to hospitalization, medication, and specialists' consultation. The second model analyzed the relationship between the rates of health and general inflation. The models were estimated using data on inflation rates in Iran from 1985 to 2013, a period selected based on the availability of extracted data from the annual reports of the Iranian Central Bank. The analysis of four aforementioned healthcare subcategories was based on the results of other studies in Iran (3) Eviews 5 and Microfit 4 software were used for estimation of inflation rate models. Initially, the variables stationary test was used to estimate the time series models. When a variable is stationary, variance and covariance are constant over time. With regard to non-stationary variables in the model, validity of the coefficient would be low and t test and f test would not be reliable. Therefore, to confirm the validity of the coefficients and avoiding spurious regression, we used Augmented Dickey-Fuller unit root test (ADF) to assess the stationary condition of variables. This test was used in two modes in the current study. The first mode was performed with constant value and the second one with constant value and trend. As most economic variables are not stationary over time, co-integration was applied as a preliminary test in order to avoid spurious regression (13). Co-integration test evaluates long-term relationship between variables. According to this test, if the non-stationary variables are co-integrated, the short-term and long-term relationship of variables could be evaluated and the regression coefficients remain valid. The structures of the used models were as follows:

Model number one, which reflected the impact of the inflation of health subcategories on overall health inflation, was calculated according to following econometrics formula:

Health inflation = f (medication inflation, hospitalization inflation, and specialists' consultation inflation).

$$\text{Log } H_t = \beta_0 + \beta_1 \text{ Log } S_t + \beta_2 \text{Log} M_t + \beta_3 \text{ Log } HO_t + u_t$$

Where Log H_t stands for health inflation logarithm in t period, Log S_t is logarithm of specialist consultation inflation in the same period, Log M_t is logarithm of medication in t period, and Log HO_t is logarithm of hospitalization inflation in the same period, which shows error term with classical assumptions. As this model was a log-log type in which dependent and explanatory variables were expressed in logarithms, β_1, β_2, and β_3 showed the elasticity of overall health inflation with respect to specialist consultation, medication, and hospitalization inflations, respectively. Co-integration approach was used because some of the variables in the first model were non-stationary. Thus, the estimation of the first model was performed using autoregressive distributed lag model (ARDL). Before the estimation by ADRL model, the long-run relationship (co-integration) between variables was investigated using Banerjee, Dolado, and Mestre test with the following formula:

$$t = \left(\sum_{i=1}^{s} a_i - 1\right) / \left(\sum_{i=1}^{s} \mathrm{SE} a_i\right)$$

The model related to the impact of health inflation on general inflation was estimated according to the underlying econometrics formula:

General inflation = f (Health inflation)

$$\text{Log } G_t = \beta_0 + \beta_1 \text{ Log } H_t + u_t$$

Where Log G_t stands for general inflation logarithm in t period, Log H_t is logarithm of health inflation in the same period, and U_t shows error term with classical assumptions. As this model was a log-log type in which dependent and explanatory variables were expressed in logarithms, β_1 showed the elasticity of general inflation with respect to health inflation.

4. Results

The results of ADF test with constant value showed stationary trend regarding the logarithms of some variables of inflation rates, which included general, health, medication, and specialists' consultation. The variable of hospitalization inflation rate logarithm was stationary with single difference (Table 1). The results of ADF test with constant value showed stationary trends in logarithms of general, health, and specialists' consultation inflation rates. The variables related to the logarithms of hospitalization and medication inflation rates were stationary with single difference (Table 2). Result of the co-integration test in the first model indicated that the value of Banerjee, Dolado, and Mestre test was estimated at -9.4278, which was significant at 0.01 level with critical values of the test statistic being -5.04 and -5.53. Thus, there was a long-term relationship between health inflation rate and explanatory variables, while avoiding the spurious regression. The optimal lag length of variables was determined using the Schwarz-Bayesian criterion and the model was finally estimated. The results of the first model showed a significant positive relationship between health inflation and specialists' consultation, hospitalization, and medication inflations ($P < 0.01$) (Table 3). Long-term elasticity of health inflation with respect to hospitalization, medication, and specialists' consultation inflations were 0.41888, 0.25372, and 0.16307, respectively. Among the compo-

nents of health inflation rate, the greatest impact was attributable to hospitalization inflation rate so that with 1% increase in hospitalization inflation rate, health inflation rate would eventually rise by 0.41888%. The results from short-term model indicated that association of variables with the dependent variable was similar to the long-term model ($P < 0.01$) (Table 4), except that elasticity of health inflation rate with respect to its components was different from the long-term model. Short-term elasticity of health inflation rate with respect to hospitalization inflation rate was estimated to be 0.5722, which was more than long-term elasticity. Therefore, hospitalization inflation represented the most effective component in health inflation changes. The elasticity of health inflation rate related to specialists' consultation inflation rate in short-term was more than that of the long-term value. However, the short-term elasticity of health-related inflation rate with respect to medication inflation rate was less than that of the long-term value. Adjusted determination coefficient (R^2) of the short-term model was 0.88931, indicating that more than 88% of changes in health inflation rate were related to hospitalization, medication, and specialists' consultation inflation rates. Moreover, according to the result of F statistics ($P < 0.01$), the model was totally significant. In addition, the Durbin-Watson statistic indicated that there was no autocorrelation between the errors terms in the model. Because of the stationary condition of general and health inflation rate logarithms, we estimated the second model as an ordinary regression, considering that the coefficients were reliable. According to the results of the second model estimation (Table 5), health inflation rate showed a significant and positive relationship with general inflation rate at 90% confidence level ($P < 0.1$). The elasticity of general inflation rate with respect to health inflation rate was 0.3073 so that with 1% increase in health inflation rate, the general inflation rate would increases by 0.3070%. Adjusted determination coefficient (R^2) of the second model was estimated at 0.1163. This value indicates that more than 11% of changes in general inflation rate could be explained by changes in health inflation rate. According to the result of F statistics, the model is entirely significant at 90% confidence level ($P < 0.1$). Finally, the findings of this study revealed that health inflation rate was higher than general inflation rate during the study period.

Table 1. The Results of Dickey-Fuller Test With Constant Value

Variables	Level		Single Difference		Integration Rank
	Statistic	P Value	Statistic	P Value	
General inflation rate log	-3.871	0.0077 [a]	-5.348	0.0003 [a]	I (0) [a]
Health inflation rate log	-4.321	0.0031 [a]	-6.703	0.0000 [a]	I (0) [a]
Medication inflation rate log	-3.115	0.0388 [b]	-6.437	0.0000 [a]	I (0) [b]
Consultation inflation rate log	-3.851	0.0084 [a]	-4.361	0.0031 [a]	I (0) [a]
Hospitalization inflation rate log	-2.126	0.2370	-3.845	0.0081 [a]	I (1) [a]

[a] Significant at 1%.
[b] Significant at 5%.

Table 2. The Results of Dickey-Fuller Test With Constant Value and Trend

Variables	Level		Single Difference		Integration Rank
	Statistic	P Value	Statistic	P Value	
General inflation rate log	-4.206	0.0155 [a]	-5.052	0.0028 [b]	I (0) [a]
Health inflation rate log	-4.318	0.0135 [a]	-6.144	0.0005 [b]	I (0) [a]
Medication inflation rate log	-3.002	0.1518	-6.398	0.0001 [b]	I (1) [b]
Consultation inflation rate log	-3.422	0.0740 [c]	-6.657	0.0003 [b]	I (0) [c]
Hospitalization inflation rate log	-2.016	0.5620	-3.845	0.0342 [a]	I (1) [a]

[a] Significant at 5%.
[b] Significant at 1%.
[c] Significant at 10%.

Table 3. Estimated Long-Term Coefficients of the First Model Using the Autoregressive Distributed Lag Approach [a, b]

Explanatory Variables	Coefficient	t Statistics	P Value [c]
Constant term	0.57906	4.7270	0.000
Consultation inflation rate log	0.16307	3.2296	0.005
Medication inflation rate log	0.25372	6.9391	0.000
Hospitalization inflation rate log	0.41888	8.6776	0.000

[a] X^2 Serial correlation test (1) = 0.023552 (.878) and F (1, 16) = 0.016401 (0.900); X^2 functional specification bias test (1) = 0.21236 (0.645) and F (1, 16) = 0.14910 (0.704); X^2 normality of error term test (2) = 0.79832 (0.671); and X_2 heteroscedasticity test (1) = 0.80569 (0.369) and F (1, 21) = 0.76233 (0.392).
[b] Autoregressive distributed lag model (ARDL) (1,0,1,0) selected based on Schwarz Bayesian criterion; dependent variable is health inflation logarithm.
[c] Significant at 1%.

Table 4. Estimated Short-Term Coefficients of the First Model Using the Autoregressive Distributed Lag Approach [a, b]

Explanatory Variables	Coefficient	t Statistics	P Value [c]
d Constant	0.79109	3.9902	0.001
d Consultation Inflation Rate Log	0.22278	3.2191	0.005
d Medication Inflation Rate Log	0.23711	6.9617	0.000
d Hospitalization Inflation Rate Log	0.57226	6.9617	0.000

[a] R-Squared = 0.91447, R-Bar-Squared = 0.88931; F-statistic: F (4, 18) = 45.4388 (0.000) (significant at 1%), Durbin-Watson-statistic = 2.042.
[b] Autoregressive distributed lag model (ARDL) (1,0,1,0) selected based on Schwarz Bayesian criterion; dependent variable is d health inflation logarithm.
[c] Significant at 1%.

Table 5. The Estimated Coefficient of the Second Model [a, b]

Explanatory variables	Coefficient	t Statistics	P Value
Constant term	1.97288	4.1632	0.000 [c]
Health inflation rate log	0.3073	1.9742	0.061 [d]

[a] R-Squared= 0.156, R-Bar-Squared = 0.1163; F-statistic: F (4, 18) = 3.8975 (0.061) (significant in 10%), Durbin-Watson-statistic = 1.356.
[b] Dependent variable is general inflation rate logarithm.
[c] Significant in 1%.
[d] Significant in 10%.

5. Discussion

General and health inflation rates are constantly interrelated (6) and thus, the variations in each would be attributed to the other (14). The results of this study and similar investigations in Iran show that the rate of health inflation was higher than general inflation rate (3, 5). Based on the results of this study, high rate of health inflation could lead to an increase in general inflation rate. Increased general and health inflation rates reduce the purchasing power in the community (4). Given that health needs under many conditions are considered only next to necessities such as foods, clothing, and housing (11), the increasing inflation rate would restrict access to health services with dramatic impact on equitable delivery health care services (15). The major grounds of increased CPI in health sector are population growth, changes in population composition (9), incomplete coverage of health insurance, increased per-capita health expenditures (9, 16), high-tech healthcare (9, 10, 17), and increasing cost of hospitalization, medication, and specialists' consultation (9, 18-20). The aging population requires special considerations and access to geriatric healthcare services, which are often costly and thus, increase the total health expenditures (21). According to the age-related condition of Iran we will be facing an aging population in near future that demands additional infrastructures and funding to cover healthcare services (4). Studies referred to two conflicting roles for health insurance coverage; some believe that incomplete coverage of health insurance increases out-of-pocket payment that leads to increased CPI (15, 16, 22). On the other hand, others assume that higher health insurance coverage promotes high-tech healthcare, which would lead to higher health expenditures (10, 17). According to the results of this study, inflation rate of hospitalization services has the greatest impact on health inflation rate. These findings are consistent with similar studies from Iran and other countries (3, 4). The growth of hospitalization costs could be caused by several factors including the high ratio of personnel to patients and low productivity of human resources (23). In this situation, payment to the extra staff increases the hospital accommodation costs (3). Lack of appropriate control of hospital overhead costs is another important reason for the increased costs of hospitalization (23, 24). We demonstrated that medication inflation rate was the second important factor affecting health inflation rate. Continuous changes in drug technology and deployment of new and costly pharmaceutics, particularly in treatment of spe-

cial diseases such as cancers and organ transplantations, have increased healthcare costs (18); moreover, the risk of catastrophic health expenditure threatens the families in many cases (4). According to the findings of this study, the specialists' consultation cost was the third important factor affecting the health inflation rate. Although the medical consultation tariffs are approved by Supreme Council of Insurance in Iran, they are often disregarded in the private sector and are associated with some informal payments in the public sector. These irregularities can lead to increased costs of medical consultation (3). In addition, unreal estimation of medical consultation tariffs and inappropriate supervision are additional factors involved in this situation (3, 4). Finally, as a technical point, quality of healthcare services has improved over time, which is reflected in CPI and inflation rate of various parts of health sector (25). Therefore, for estimation of health inflation rate, most important components should be determined initially (9), and followed by adjusting indices according to the new changes in health services (15). In conclusion, in Iran the components of health inflation rate, in order of importance, are the inflation rates related to hospitalization, medication, and specialists' consultation. These three important components of healthcare inflation should be considered in strategies aimed to improve access to health services and for the rightful universal healthcare coverage. In addition, health inflation rate is directly correlated with general inflation rate.

Authors' Contributions

Yaser Sarikhani designed the study, gathered data, wrote most parts of the manuscript, and managed the project. Mohsen Bayati designed the study, analyzed data, done statistical analysis, and wrote some parts of the manuscript. Enayatollah Homaie Rad gathered data, analyzed data, performed statistical analysis, and critically revised the manuscript. Kamran B. Lankarani designed the study; critically revised the manuscript, and supervised the project. Seyed Taghi Heydari analyzed the data, performed statistical analysis, critically revised the manuscript, and obtained funding for the project.

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