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Predicting the health expenditures in Iran using TVP models

Masoomeh Masoodi, Bahram Sahabi*, Hossein Sadeghi, Lotfali Agheli

Faculty of Management and Economics, Tarbiat Modarres University, Tehran, Iran

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Abstract

The healthcare sector is one of the main sectors of a country's economy which is considered as an infrastructure for the process of development, so most countries believe in special care for this sector. Due to this fact, in this study, the TVP-DMA model is used to identify the affective factors of healthcare expenditures in Iran's economy. Regarding the subject and purpose of the research, the appropriate method in this research is a regression-type correlation. In this study, seasonal data from (1991-92) to (2015-16) was used. The results of the research based on the output of TVP, DMS, and DMA models reflect the fact that the growth rate of liquidity 30, the economic growth rate 50, unemployment 11, the exchange rate 49, the financial development index 66, oil revenues 54, the misery index 7, the deficit budget of 84 periods out of 104 periods which were under study, All have a significant effect on the factors affecting the healthcare expenditures. It can be stated that budget deficit, financial development index, oil revenues and economic growth are the highest and most important indicators for predicting healthcare expenditures in Iran.

Keywords: health care expenditure, financial condition indicator, dynamic models, time variable parameter models
2020 MSC: 03H10, 60G25

1 Introduction

The provision of health services is one of the most important tasks of governments. At the beginning of the third millennium, the World Health Organization (WHO) considered health as a gateway to prosperity, as well as social and economic development. Increased healthcare expenditures are not only worrying in developing countries; but in rich (developed) countries, it also accounts for a large part of the population's income [34]. Per capita, health costs mean how much money a national health system spends and pays for each person in a country. According to various theories, such as what has been provided by Welsch [36], people's health index and their subjective well-being depend on the state of macroeconomic indices of society. Inflation, economic growth, liquidity and employment are among the most important macroeconomic indices.

The main problem in most studies conducted in the field of financial indicators and health research is the lack of attention to the fact that estimation coefficients are not constant over time. Using time variable parameter models, the present study addresses the issue of the volatility of estimated coefficients over time. In classical regression methods, it is assumed that a relation with constant coefficients can be applied at different times. The false results of this unrealistic assumption result in the emergence of dynamic models that are more similar to the reality of the outside world. According to Stock and Watson [35], one of the most important problems of the previous models (traditional

*Corresponding author
Email addresses: masoodi_masoomeh@yahoo.com (Masoomeh Masoodi), sahabi_b@modares.ac.ir (Bahram Sahabi), sadeghih@modares.ac.ir (Hossein Sadeghi), aghelik@modares.ac.ir (Lotfali Agheli)

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models consistent with classical restrictive assumptions) was the fact that they could not predict correctly over time, and sometimes it was observed that these models could predict well only during the recession, and some other models could have a good prediction only during the boom periods. As a result, there was no model capable of providing more reliable predictions at all times. The time variable parameter approach is one of the newest econometric techniques that allow the estimation of non-visible variables or state variables in the system of equations. Accordingly, the main issue of this research is the way of predicting healthcare expenditures using the financial condition indicator with the dynamic model approach of the time variable parameter.

Considering the specific situation of the Iranian economy (a state and the oil-based economy as well as the existence of an inflationary recession situation) and the complexity of the relations between the variables in this research, the weight of the factors affecting the financial-monetary index is determined using dynamic Model Average (DMA). In previous studies, the weight of the factors influencing the financial-monetary index was considered constant, which was not consistent with the facts. In this research, the weight of the factors affecting the financial index as well as the factors influencing healthcare expenditures is assumed to be variable. In this regard, the capacity of predicting healthcare expenditures using traditional approaches as well as the approaches expanded in terms of time variation are compared with each other. By increasing the capacity of predictability, policymakers can better understand the realities of the national economy and pursue more effective healthcare policies.

Economic factors affecting health

In the following, the greatest and the most important economic variables that affect the health of the community are discussed: Economic Growth: One of the ways to analyze the impact of macroeconomics on the health sector is to examine the relationship between economic growth and the growth of health indicators. High economic growth enhances people's ability to contribute to health financing. According to WHO [38], higher income generates better health through improved livelihoods such as access to safe drinking water, better roads, proper nutrition, etc. Higher earnings also create more purchasing power that can directly improve the quality and quantity of healthcare and increase education, which will appear in the form of increased income in the future. Education is an effective factor for economic growth. Education directly increases people's health level, because it turns them into capable managers who can manage their lives and make reasonable use of healthcare resources. Parkin [27] sees healthcare as a luxury product, which increases with increasing income. Quadrado and Lopez [28], Wilkinson [37] and Heshmati [15], also confirm the strong relationship between economic growth and health level.

Inflation: In a severe inflationary environment (together with unemployment), the rate of theft, delinquency of youth, financial and moral corruption, as well as addiction and social problems in the society increases, resulting in a high cost of treatment for such patients who ultimately become mental patients. Since inflation influences the government budget, it leads to a lack of financial resources in the health sector and recession, and affects consumer behavior. As a result, during inflation, the rate of demands for treatment decreases. Service providers also reduce the quality of their services due to inflation and inadequate wages; and as a result, the effectiveness of their services and even medical care is reduced [17].

Unemployment: While causing a lot of social dilemmas, unemployment reduces household income. Unemployed people are less likely to seek healthcare due to lack of income; and increased unemployment rate reduces the health level of people in the society [28]. Unemployment also increases the rate of divorce, theft, crime, delinquency, nutritional poverty, immigration and other health-threatening factors in the society. Floud et al. [10] found that reduced unemployment rate and improved wages could be effective in improving nutrition and reducing mortality. With increased unemployment, the number of people hospitalized in psychiatric hospitals also increases [21].

Misery index: Unemployment has many consequences not only for unemployed people but also for other members of their families. In addition to income, employment also has a lot of non-financial benefits. Unemployment leads to the loss of employment-related financial and non-financial benefits, including the reduction of family income and the degradation of social status and mental health, which impose many costs on society. Unemployment also reduces the quality of human capital, because people with lower income will not be able to afford healthcare expenditures [24]. Inflation also affects healthcare expenditures as another component of the misery index. Increasing inflation, along with rising unemployment, has numerous social and economic costs for the families and the entire community. Increasing rate of inflation will create instability, class distinctions and reduce purchasing power as well as economic and social security, etc. and will negatively influence people's health costs and economic growth.

Resource curse: Theoretically, the abundance of natural resources can boost growth, because resource richness can put a "big push" on the economy by investing more in economic infrastructures and further development of human capital [30, 25]. These studies attribute the curse of resources to the lack of good governance. There is not much research to indicate how much the "curse of resources" phenomenon is associated with the lack of good governance; and how much this factor is effective in reducing the level of health indicators.On the other hand, Iran's economy is heavily dependent on oil. An institutional-structural framework in an oil-rich country will have a determinant role in the rate and manner of entry of rents from oil resources into the economic system, changes in productive and non-productive sectors and, ultimately, the economic growth and development of the country. As a result, the expansion of non-productive sectors and increased corruption cause the weakening of factors affecting health and its indicators. Accordingly, the level of health of the society is weakened by the increase in income inequality, the decline of economic growth and increase in counterproductive volume [liquidity], which generally increase inflation and reduce purchasing power.

Financial development index: The financial (monetary) condition index indicates the state of the economy in the future based on the current financial variables [14]. In other words, the financial [monetary] condition index is a summary of current financial variables that are partially able to predict the future state of the economy of a country [8]. Boivin et al. [5] divided the mechanism of money transfer into two main types: the neoclassical channels, in which financial markets are complete, and non-neoclassical channels that include incomplete financial markets.

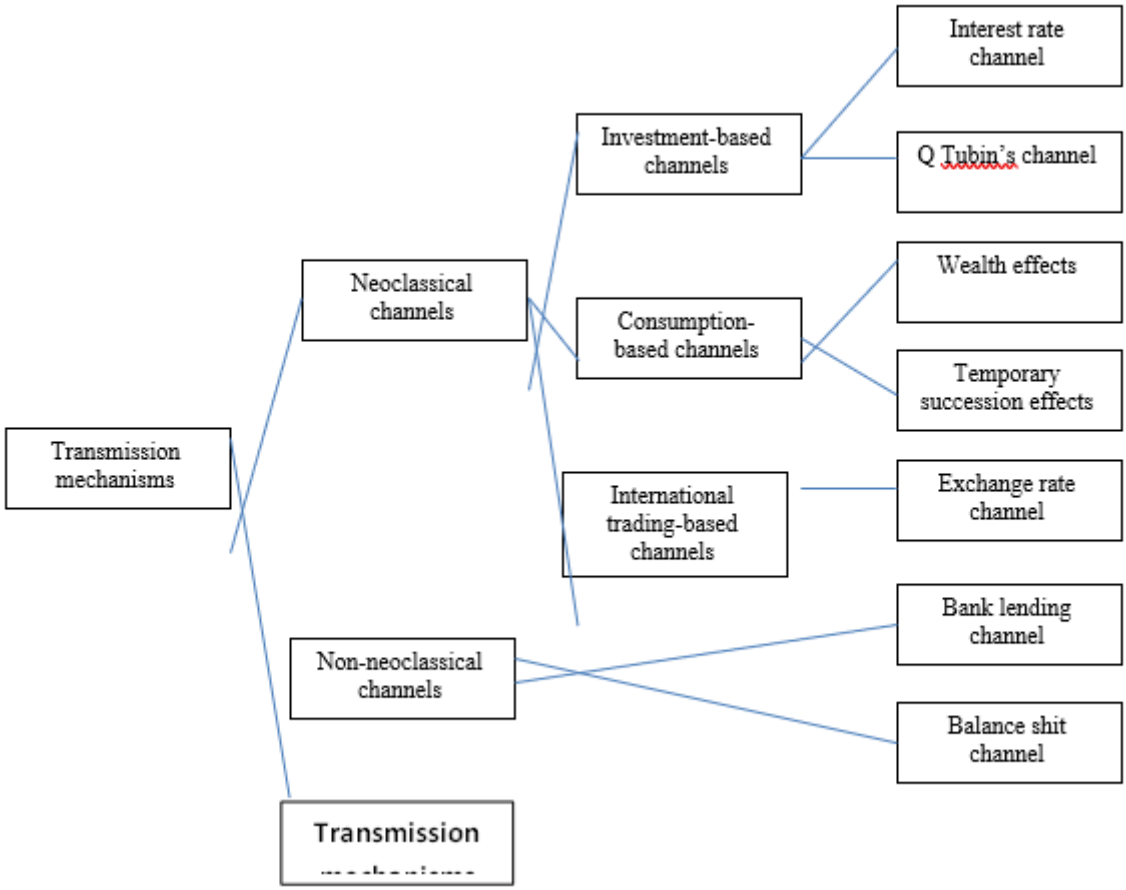

Figure 1: Money transmission mechanismsSource: Boivin et al. [5]

literature Review: In this section, a summary of the results of national and international studies is presented in Table 1.

Table 1: Summary of the results of national and international studies

Author	Year	Title	Main variables	Results
Shahabadi, Ghorbani, Golparvar	2016	The impact of misery index on health costs in Iran	Government size, urbanization rate, per capita income, education and inequality of income, health costs, oil revenues	There is a negative and significant relationship between misery index and health costs.
Case and Deaton	2015	The relationship between the level of work and the level of health	Working hours, health expenses, medical expenses	Since a threshold limit, in which a healthcare receiver devotes a large part of his income to improve his health capital, is not included in traditional health functions, a negative relationship is found between the level of work and the level of health.
Koop and Korobilis	2013	A new index of financial conditions	Inflation, liquidity, rate of stock liquidity, risk premium	Assuming the variability of factors influencing the Financial Conditions Index (FCI) and the variability of coefficients improved the results of the predictions
Gupta and Hammoudeh	2014	Forecasting China's foreign exchange reserves using dynamic model averaging	Currency, inflation, budget deficit, trade balance, economic growth	DMA and DMS not only perform better than linear models such as OLS and AR (1), but also they perform better than BMA to predict the potential growth of the reserves of China.

2 Analysis method

The methodology of the present research is applied in terms of purpose. The data are of time-series type. Accordingly, the model used is of time-series type and it is estimated using the dynamic model of the moving average of parameters that can be modified during TVPDMA time. The software used in this study is MATLAB 2014. The statistical population of this research is seasonal data of Iran during the period March 1991 to July 2016. The data of this research have been collected from the Central Bank of the Islamic Republic of Iran. Then, basics of TVPDMA and TVPDMS (Time Varying Parameters- Model Averaging Selection) methods are explained below. The standard forms of the space-mode models for TVP models are as follows (Relations (1) and (2)):

$$y_t = z_t\theta_t + \epsilon_t \tag{1}$$

$$\theta_t = \theta_{t-1} + \mu_t \tag{2}$$

where y_t is the dependent variable of the model, $z_t = [1, x_{t-1}, y_{t-1}, \cdots, y_{t-p}]$ is a $1 \times m$ vector of the intercept estimators and interrupt of the dependent variable of the model and $\theta_t = [\varphi_{t-1}, \beta_{t-1}, \gamma_{t-1}, \cdots, \gamma_{t-p}]$ is a $m \times 1$ vector of the coefficients (states). The values of $\varepsilon_t \sim N(0, H_t)$ and $\mu_t \sim (0, Q_t)$ have a normal distribution with zero mean and variances of H_t and Q_t, respectively. The main advantage of these types of models is that they allow the change of estimated coefficients at any given time, but their disadvantage is that if z_t is increased greatly, the estimates will not be very reliable. The generalized TVP model, like TVP-VAR, also has the same problems. To describe the process of DMA method, it is assumed that there are K models of the subset of z_t variables as an estimator, and $z(k)$ with $k = 1, 2, \cdots, K$ represent K model of the above-mentioned subset. On this basis, assuming that there are K models of the subset at any point in time, the state-space model is described as follows:

$$y_t = z_t^{(k)}\theta_t^{(k)} + \varepsilon_t^{(k)} \tag{3}$$

$$\theta_{t+1}^{(k)} = \theta_t^{(k)} + \mu_t^{(k)} \tag{4}$$

The difference between the two TVPDMA and TVPDMS models is that in the TVPDMA model, the average probability of occurrence of a variable is used to predict the probability of the presence of that variable in the estimation; but in the TVPDMS model, the highest probability level throughout the studied period is the criterion for the possibility of occurrence; because it is assumed that once a variable has met this probability, it will be able to repeat this probability in the following years.

In these equations, $\varepsilon_t^{(k)} \sim N(0, H_t^{(k)})$ and $\mu_t^{(k)} \sim (0, Q_t^{(k)})$ and $\nu_t = \left(\theta_t^{(1)}, \cdots, \theta_t^{(k)}\right)$. $L_t \in \{1, 2, \ldots, K\}$ indicate which model of K subsets of the model is better at which time. A method that makes it possible to estimate a different model at any given moment is called the "dynamic model of averaging" [19].

The DMA method provided by Raftery et al. [29] includes two parameters α and β that are called "forgotten" factors. Their name, i.e. the forgotten factors, is based on the fact that the observations of last j periods have a βj weight. The value of β which is close to one indicates the more gradual changes of the coefficients. The choice of β is very important, which is usually considered between 90% and 99%. However, compared to other predictive methods, DMA has many potential benefits. The biggest advantage of this method is that it has reduced the weakness of other methods, i.e. the need to reduce the number of equations and variables, and can predict large models with a large number of variables. In this situation, there will be a high number of models that should be estimated. DMS and DMA methods are capable of reducing variables and subsequently models, so that using Equation (5), models with more weight in prediction are determined. The advantage of this method is that the variables that are less related to the dependent variable are eliminated from the final prediction due to the low probability of occurrence; and by giving more weight to the more important variables, and just their inclusion in the model; the problem of over-fitting in the estimation is avoided.

$$E\left(\text{Size}_t\right) = \sum_{k=1}^{K} \pi_{t\left|t-1,k\right.} \text{Size}_{K,t}. \tag{5}$$

2.1 Research data

The present research was conducted from March 1991 to March 2016, and the data were of seasonal type. The data sources are presented in Table 2.

Table 2: Research data sources

Healthcare expenditures	Central bank of Islamic Republic of Iran
Liquidity	Central bank of Islamic Republic of Iran
Nominal oil revenues (In IRR)	Central bank of Islamic Republic of Iran
Unofficial market exchange rates	Central bank of Islamic Republic of Iran
Economic growth	Central bank of Islamic Republic of Iran
Financial development index	Calculations conducted by the researcher
Budget deficit	Central bank of Islamic Republic of Iran
Unemployment	Central bank of Islamic Republic of Iran
Misery index (the sum of inflation rate and unemployment rate)	Calculations conducted by the researcher

3 Research findings

In this section, the results of the research are presented using the TVPDMA method. In Table 3, the values of goodness of fitness indices are presented to determine the optimal model. The values of prediction probability logarithm indices, Mean Absolute Forecast Error (MAFE) and Mean Square Forecast Error (MSFE), are derived from estimating different models of DMA and DMS.

In the present paper, the primary MATLAB code of the study of Koop, G., and D. Korobilis [19], entitled "Forecasting Inflation using Dynamic Model Averaging" was used, but it should be noted that in the MATLAB code used in this paper, many changes have been made in order to make the model more flexible which, if deemed appropriate by the distinguished referee, they can be provided for doing related comparisons.

Table 3: Comparison of different models based on Kaufman Filter

Prediction method	MAFE	MSFE	log(PL)	Prediction method	MAFE	MSFE	log(PL)
DMA $\alpha = \beta = 0.99$	0.117	0.040	-0.288	DMA $\alpha = 1; \beta = 0.99$	0.117	0.041	-0.492
DMS $\alpha = \beta = 0.99$	0.108	0.035	-0.290	DMS $\alpha = 1; \beta = 0.99$	0.110	0.036	-0.361
DMA $\alpha = \beta = 0.90$	0.124	0.046	-0.355	DMA $\alpha = 1; \beta = 0.95$	0.125	0.046	-0.341
DMS $\alpha = \beta = 0.90$	0.100	0.041	-0.325	DMS $\alpha = 1; \beta = 0.95$	0.114	0.039	-0.439
DMA $\alpha = \beta = 0.95$	0.121	0.043	-0.315	DMA $\alpha = 1; \beta = 0.90$	0.128	0.052	-0.430
DMS $\alpha = \beta = 0.95$	0.106	0.037	-0.378	DMS $\alpha = 1; \beta = 0.90$	0.116	0.046	-0.421
DMA $\alpha = 0.99; \beta = 0.90/5$	0.127	0.051	-0.250	DMA $\alpha = 0.99; \beta = 1$	0.117	0.040	-0.303
DMS $\alpha = 0.99; \beta = 0.90$	0.114	0.045	-0.317	DMS $\alpha = 0.99; \beta = 1$	0.107	0.034	-0.412
DMA $\alpha = 0.99; \beta = 0.95$	0.124	0.045	-0.295	DMA $\alpha = 0.95; \beta = 1$	0.117	0.038	-0.429
DMS $\alpha = 0.99; \beta = 0.95$	0.112	0.039	-0.347	DMS $\alpha = 0.95; \beta = 1$	0.101	0.033	-0.459
DMA $\alpha = 0.90; \beta = 0.99$	0.115	0.037	-0.334	DMA $\alpha = 0.90; \beta = 1$	0.101	0.030	-0.267
DMS $\alpha = 0.90; \beta = 0.99$	0.093	0.031	-0.280	DMS $\alpha = 0.90; \beta = 1$	0.091	0.029	-0.236
DMA $\alpha = 0.95; \beta = 0.99$	0.117	0.039	-0.259	DMA $\alpha = 1; \beta = 1$	0.116	0.046	-0.353
DMS $\alpha = 0.95; \beta = 0.99$	0.101	0.033	-0.331	DMS $\alpha = 1; \beta = 1$	0.110	0.035	-0.382

Reference: Researcher's calculations

The results of Table 3 indicate that the DMS $\alpha = 0.90$; $\beta = 1$ and DMA $\alpha = 0.90$; $\beta = 1$ are more accurate. As a result, the rest of the results are reported based on this model.According to Table 4, the variables that affect the health expenditure index in each period is observed. For example, during the first trimester of 1992, the first interruption of healthcare, liquidity, unemployment and economic growth affected healthcare expenditures; or during the first trimester of 1993, it is seen that the first interruption in healthcare and unemployment had the highest impact on healthcare expenditure, respectively. The most important effect in these models is the effect of the desired variable at that time period. In traditional models, over the entire time period, independent variables has a significant or non-significant effect on the variables; but in the TVPDMA method, an independent variable can have a significant effect over a period of time and cannot have any significant effect in the another period. In other words, this model examines the significant or non-significant effect of an independent variable on the dependent variable in different years. Such an analysis can be presented for other periods.

Table 4: A part of the table of variables affecting health expenditure in different time periods

Time (season)	The variables affecting healthcare expenditures in each period					
May 1991	ARY_1					
June 1991	ARY_1					
July 1991	ARY_1					
April 1992	ARY_1	M_0	UN_0	GDP_0	-	-
May 1992	ARY_1	SR_0	UNP_0	-	-	-
June 1992	ARY_1	SR_0	UNP_0	-	-	-
July 1992	ARY_1	ER_0	UN_0	-	-	-
March 1993	ARY_1	UN_0	-	-	-	-
May 1993	ARY_1	M_0	UN_0	-	-	-
June 1994	ARY_1	ER_0	-	-	-	-
March 1995	ARY_1	ER_0	-	-	-	-
April 1995	ARY_1	ER_0	BD_0	SR_0	GDP_0	-
Mary 1995	ARY_1	ER_0	BD_0	SR_0	GDP_0	-
June 1995	ARY_1	ER_0	BD_0	SR_0	GDP_0	-
July 1995	ARY_1	ER_0	BD_0	SR_0	GDP_0	-
April 1996	ARY_1	ER_0	BD_0	SR_0	-	-
May 1996	ARY_1	M_0	BD_0	UN_0	GDP_0	UNP_0
June 1996	ARY_1	M_0	-	-	-	-
July 1996	ARY_1	M_0	-	-	-	-

Source: calculations conducted by the researcher

In this table, ARY1: First interruption of healthcare expenditures, ER0: Exchange rate, m0: Liquidity growth rate, gdp0: Economic growth, sr0: Financial development index, troil0: Oil revenues, unem0: Unemployment, unp0:

Misery index, bd0: Budget deficit.

To achieve a general conclusion in Table 4, it is necessary for each variable to count the number of particular periods (In each row), during which that variable has been effective on health expenditure. The total effects of each variable over the entire period represent the number of periods during which that variable is effective in predicting health expenditures. For example, the rate of liquidity growth is provided for 30 periods in Table 4, but the exchange rate is provided for 49 periods. The results of this summation are summarized in Table 5.

Table 5: Prioritizing variables effective on healthcare expenditure

Reference	Variable	Symbol	Effective period	Prioritization
1	Unemployment	un_0	11	7
2	Exchange rate	er_0	49	5
3	Liquidity growth	m_0	30	6
4	Economic growth	gdp_0	50	4
5	Financial development index	sr_0	66	2
6	Oil revenues	troil_0	54	3
7	Misery index	unp_0	7	8
8	Budget deficit	bd_0	84	1

According to the results, the budget deficit, financial development index, oil revenues, economic growth, exchange rate, liquidity, and unemploymentas well as misery index were the most important indices affecting healthcare expenditures. In the following, the best estimation model is presented and the coefficients of variables and the probability of occurrence of each coefficient over time are reported. Figure 2 shows the probability of occurrence of the best model in predicting the healthcare expenditures with the presence of the variables included in the model, and the alpha and beta proposed by the researcher.

According to this figure, the probability level of the occurrence of the best estimation model in all periods is higher than 50 percent. As a result, initial fixation has the minimum initial conditions for predicting healthcare expenditures. Then, the probability of the effect of each variable on health expenditures in different periods was investigated. Investigating the probability of the presence of each variable in predicting healthcare expenditures helps policymakers, when implementing a policy, to have a proper view of how and how much and how likely that policy is to affect healthcare expenditures.

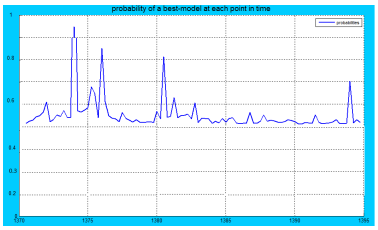

Figure 2: The probability of the occurrence of the best predicted model

Chart 3 shows the coefficients and the probability of the effect of economic growth on the prediction of healthcare expenditures. According to Figure 3, the effect of economic growth on healthcare expenditures is oscillating with positive or negative effects, and the probability of its occurrence in the study period is higher than 50% and, as a result, the effect of this variable on healthcare expenditures and has been strengthened in recent years. The positive impact of economic growth on healthcare expenditures reflects the fact that the Iranian economy has not seen economic growth from the supply side, and if the level of growth in the country increased, this increase was due to the implementation of demand side policies. The negative impact of economic growth on healthcare expenditures can also be due to the appropriate economic growth in those periods.As the probability level of this variable is higher than 50%, it can be said that the economic growth variable plays an important role in the correct prediction of healthcare expenditures.

The coefficients and the probability of the effectiveness of liquidity in predicting healthcare expenditures are

According to Koop et al. [20], which is based on the TVP-DMA method, the optimal model is selected based on minimizing the mean absolute error. The researcher only reported the results based on the probability of occurrence (not the estimated coefficients). Based on the results, the probability of the occurrence and presence of a variable in the whole period has been estimated to be close to zero. In this research, the output of the coefficients is presented only to better explain the results.

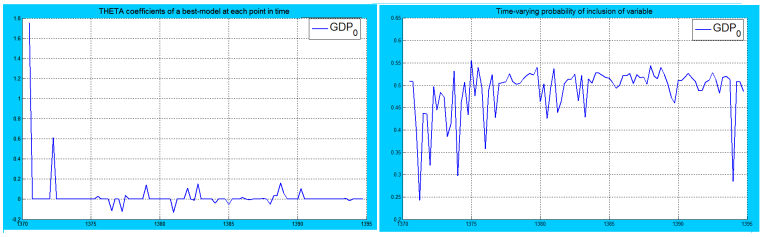

Figure 3: Coefficients and probability level of the effects of economic growth on the prediction of healthcare expenditures

reported in chart 4. According to this chart, liquidity has a positive impact on healthcare expenditures. The structural reforms of 1993, recent economic sanctions and government budget deficits are the most important factors influencing liquidity in these periods. As the probability level of this variable is higher than 50%, it can be concluded that the liquidity variable plays an important role in the correct prediction of healthcare expenditures.

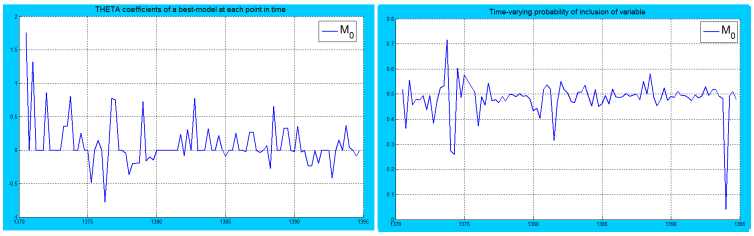

Figure 4: Coefficients and probability level of the effects of liquidity on the prediction of healthcare expenditures

Financial development is one of the greatest and the most important economic variables, which has a significant effect on the growth of healthcare expenditures. Increased financial development index and, consequently, the impact of inflation, exchange rates and interest rates variables, as well as the stock returns index cause the increase in healthcare expenditures in Iran. As the probability level of this variable is higher than 50%, the financial development index plays an important role in the correct prediction of healthcare expenditures.

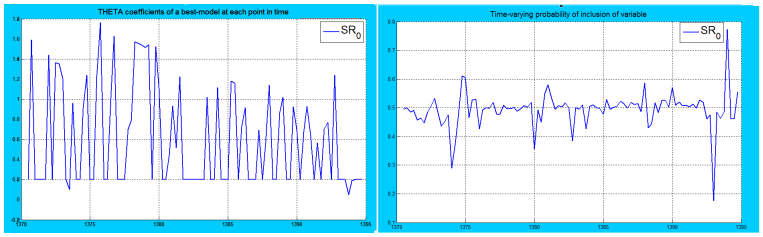

Figure 5: Coefficients and probability level of the effects of changes in the financial development index on the prediction of healthcare expenditures

Chart 6 shows that the probability of the effects of misery index on healthcare expenditures is at its peak in 2011-2011. The volatility in the foreign exchange and monetary markets and the intensification of financial and commodity sanctions in this period as well as the formation of extreme inflationary expectations are due to the increase in the misery index in the country's economy during this period. The probability level of this variable increased since the middle of this period; and therefore, the misery index has an important role in the correct prediction of the healthcare expenditures in this period.

According to Chart 7, in general, the exchange rate has had a positive impact on healthcare expenditures during the studied period. Structural reforms in the 1990s, rising liquidity as well as intensifying inflation expectations, severe budget deficits, discrepancies in monetary policies, and increasing economic, financial and trade sanctions in the 1990s have been the most important factors contributing to the positive effect of the exchange rate on the growth of healthcare expenditures. As the probability level of this variable exceeds 50%, as a result, the exchange rate plays a significant role in the correct prediction of health expenditures.

According to Chart 8, rising oil revenues at the end of the period have had a positive impact on healthcare expenditures, and this effect during 2011-2013 was due to a sharp increase in oil revenues and consequently the

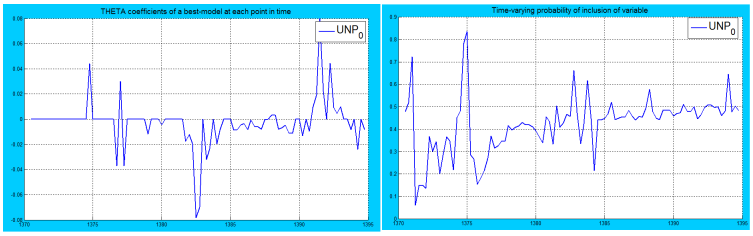

Figure 6: Coefficients and probability level of the effects of misery index on the prediction of healthcare expenditures

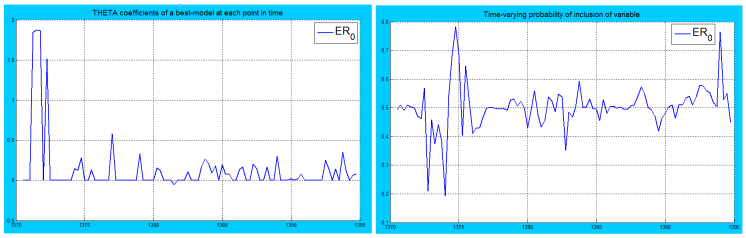

Figure 7: Coefficients and probability level of the effects of exchange rate on prediction of healthcare expenditures

overflow of these revenues into the public sector and increased demand for current and construction expenditures. As most of the healthcare expenditures are due to government expenditures; and government expenditures are dependent on oil revenues, these two effects offset each other in the first years and the effect of oil revenues [on correct prediction of healthcare expenditures] is little or near zero.

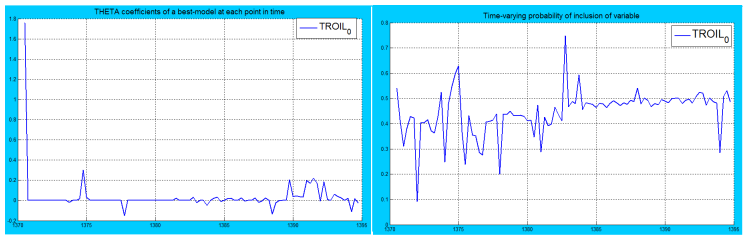

Figure 8: Coefficients and probability level of the effects of oil revenues on the prediction of healthcare expenditures

According to Chart 9, budget deficits have had a positive impact on healthcare expenditures in most [financial] periods, especially at the end of the study period. Monetization of budget deficits, pressures on the government due to the size of the public sector, the existence of rents and corruption in the public sector, as well as the high volume of the budget deficit to cover the current government expenditures are among the most important factors affecting the positive impact of the budget deficit on healthcare expenditures in Iran. On the contrary, the negative impact of the budget deficit arises from repayment of government debts to banks or the central bank.

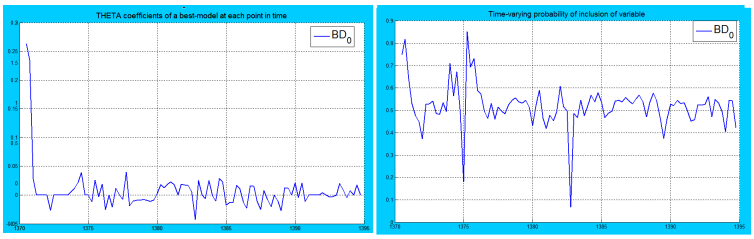

Figure 9: Coefficients and probability level of the effects of government budget deficit on the prediction of healthcare expenditures

According to Chart 10, unemployment rate at the beginning of the period had a positive effect and, at the end of the period, had a negative impact on healthcare expenditures. The positive impact of unemployment on healthcare expenditures can be a sign of the low purchasing power of people in affording healthcare expenditures. The negative impact of this factor is due to the implementation of the Health System Reform Plan since 2014 and the government's

specific attention to the health sector.

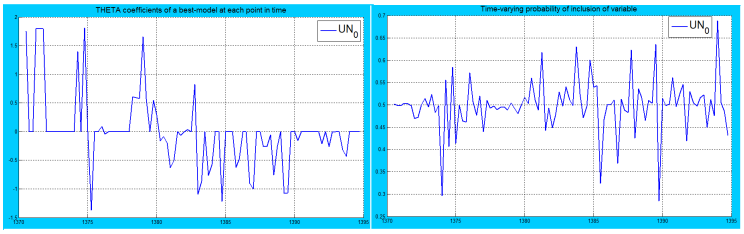

Figure 10: Coefficients and probability level of the effects of unemployment on the prediction of healthcare expenditures

4 Discussion

In this study, dynamic nonlinear models of TVP-DMA and TVP-DMS were used to simulate healthcare expenditures in the Iranian economy. These models provide the probability of changes in input variables as well as changes in the coefficients of variables over time. Relationships between financial variables are usually considered static, and the evolution of these relationships over time that changes the coefficients of the equations is ignored. In static modeling, it is assumed that a relationship with constant coefficients can be used at different times. Incorrect results from this unrealistic assumption create the dynamic models that are more realistic in the real world. One of the main features of dynamic systems is that their behavior can be described through changes in their components. The results of TVPDMA model estimation indicate that the variables of budget deficit, financial development index, oil revenues and economic growth were the most important factors affecting health expenditures during the period of 1991-2016.

5 Conclusions and recommendations

The results of the research reflect the fact that healthcare expenditures are influenced by the variables of economic growth and budget (real variables), and the index of financial development and oil revenues (nominal variables), simultaneously. Accordingly, the prediction of healthcare expenditures in Iran has a multi-dimensional and complex process; and therefore, this problem cannot be resolved only by implementing monetary and fiscal policies (demand-side policies) that merely lead to changes in the demand side and are effective on nominal variables in the long run. On the other hand, the high level of the probability of the effects of variables on health expenditures at different time periods reflects the fact that in each period, several factors affect health care expenditures. Therefore, in order to improve the state of health care expenditures in the society, a systemic viewpoint is needed in order to have a more realistic view of the factors affecting healthcare expenditures.

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