The Econometric quantitative analysis of the relationship among Medical Expenses Growth, Aging of Population and Economic Growth

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Abstract. According to the statistical data in recent years,we make cointegration test and Granger causality test on the correlation of medical expenses growth ,economy and the aging of the population and find out that when it is adjusted by price deflation factor, the Income elasticity of China's medical spending is around 1; It is a long-term relationship of the influence of economic growth,aging of population on the growth of medical expenses,but the short-term impact is not serious;the impact of aging of population on medical expenses growth is significantly lower than the role of economic growth; economic growth ,medical expenses growth are all Granger reasons why the proportion of elderly people increase.

Introduction

Economic growth will affect consumer income changement in the first place. As consumer income changes, consumer's purchasing power will change. It will affect the consumer demand for medical and health services, which will affect the medical expenditure. In general,the higher the country’s economic growth, the higher its medical expenditures accordingly[1-2]. In the empirical research, there is much debate about the income elasticity of medical expenditures. Most studies have found that income elasticity is greater than 1, which indicates that health care is luxury. Such as Kleiman (1974), Newhouse (1977), Leu (1986), Gerdthamet al. (1992), Anderson and Josson (1992), Bloqvist and Carter (1997), Zhao Yuxin (2000),etc. But there are also many scholars found that the income elasticity of medical expenditure is about 1,such as Parkinetal(1987), Hitiris and Posnett (1992), Taiwanese scholar Xie Qirui (1998). Therefore, intuitively correct assumption is that medical expenditure increase as the population rate of elderly people increase. However, the empirical research in this field of scholars also have two different results. Such as the study of Fujino on Japan showed that the health care spending of elderly is 3.2 times of young people. Study of JohnBryant on Singapore found that the average medical expenditure of aged 65 and older is 5 times of the population under 65 years old.The scholar Huang Chengli of our country also found that in the mid 1990s the average medical expenditure of aged 65 and older is 2.7~4.8 times of the population under 65 years old. But Zweifel using data from 1983 ~ 1992 of Switzerland found that age is limited for the effects of medical expenditure, the aging of population is not the cause of growth of medical expenditure[3-4].

Research methods

Data Sources and Processing. In this paper, we use the data from 1978 ~ 2008 in our country, total health expenditure and GDP data were derived from the Chinese Health Statistics Yearbook and China Statistical Yearbook. To eliminate the effects of changes in population size, we use the total health expenses per capita and GDP per capita as indicators. Including 1978, 1990 and 2000 data as the census data, the rest of the year is 1% of the population sampled data. Firstly, the total health expenses per capita and GDP per capita indicators take austerity measures respectively by medical price and retail price index deflation. So the total health expenses per capita and GDP per capita has does not contain the price factors. In order to reduce the error produced in the process of data processing, for each variable indexation treatment. In 1978 as the base period, the value of 100, then put the annual data in the same proportion transformation. The total health expenses per capita,

per capita GDP, the proportion of elderly people with h, y, and p65 said respectively. The following are based on the numerical, accordingly, the logarithmic sequence are donated by lnh, lny and lnp65 respectively.

Unit root test. In the analysis of time series data, Should first test if the data generation process is subject to unit root process.the Unit root test results are shown in table 1

Tab.1

	Variable	ADFtest	pp test	kpss test
The level of item	Lnh	-2.24	-1.44	13.74
	Lny	-2.79	-1.62	11.83
	Lnp65	-3.09	-2.14	8.97
first difference	Lnh	-3.25*	-3.47*	0.26*
	Lny	-3.46*	-2.78*	0.18*
	Lnp65	-8.46*	-4.76 *	0.11*

According to the results of table 1, No one variable of item level is smooth ,while After the first order difference they become stationary series.so Lnh,Lny,Lnp65 all obey the I (1) process.

Co-integration test. For the reason that Lnh,Lny,Lnp65 all obey the I (1) process.,we can take co-integration test. Maximum likelihood ratio test methods include trace statistical test and the maximum characteristic root test.because statistical test method is more accurate in traditional, we take Johnson trace statistical test. Test results are shown in table 2.

Tab.2

Ho characteristic value	Track number of statistics	critical value	P value	conclution
R=0*	0.67	37.44	25.28	0.0005 refuse
r≤1	0.38	10.31	13.32	0.0121 accept
r≤2	0.20	3.26	4.56	0.0037 accept

Note.*means refused to assume under 5% significance level；**stand for Mackinnon p value；r stand for the **number** of cointegration .

Johnsen trace statistical test results show that under the 5% significance level Lnh,Lny,Lnp65 exist only cointegration,and the long-term equilibrium equation is :

$$\ln h_t = 2.24 + 1.05 \ln y_t + 0.44 \ln p65_t \qquad (1)$$

By equation (1) we can know that the growth of medical expenses of our country economic growth plays a very important role. For the reason of population aging in our country the growth of medical costs is not enough to pose a threat to China's medical and health undertakings, if the calculated at current prices, medical expenses growth rate is faster than economic growth. The change of medical price, therefore, is the real reason for the rapid growth of medical expense.

Error correction model. Because of the existence of cointegration relationship between lnh, lny, lnp65, and single whole order is 1, so it can be through the establishment of error correction model to analyze the short-term dynamic relationship further. Error correction model can be expressed in the following form:

$$\Delta \ln h_t = \alpha + \sum_{i=1}^{t} \beta_i \Delta \ln h_{t-i} + \sum_{j=1}^{m} \gamma_j \Delta \ln y_{t-j} + \sum_{k=1}^{n} \Phi_k \Delta \ln p65_{t-k} + \delta EC_{t-1} + \varepsilon_t \qquad (2)$$

Type (2) is the short-term dynamic equation, the coefficient $\beta_i jk$, γ_j Φ_k (i =1, =2,..., l j = 1,2,..., m ; k =1,2,..., n)for short-term adjustment coefficient, adjustment coefficient D represents the adjustment coefficient that error correction term on the endogenous variables fluctuations, theory should be negative, indicating it towards long-term direction adjustment. We now use the OLS toestimate the parameters in the model. The estimated results are shown in Table 3.

Table.3

error correction model	explained variable D(lnh)	
	Cofficient	(t-statistic)
EC	-0.14	(-0.97)
D(lnh(-1))	0.25	(1.03)
D(lnh(-2))	-0.14	(-0.39)
D(lny(-1))	0.20	(1.26)
D(lny(-2))	0.17	(1.09)
D(lnp65(-1))	0.09	(1.13)
D(lnp65(-2))	0.02	(0.09)
C	0.04	(1.03)
Determinant resid covariance (dof adj)	8.44E-10	
Determinant resid covariance	2.95E-10	
Log Likehood	160.87	
Schw arz criterion	-17.39	
Akaike information criterion	-14.87	

From table 3, the variable error correction (EC) coefficient is not significant, that is the effect of error correction mechanism is not so big.

Granger causality test. Cointegration test results show that, there is a long-run equilibrium relationship between economic growth, population aging and the growth of medical expenses, but the equilibrium relationship whether it constitutes a causal relationship still need for further testing. Granger causality is based on vector autoregressive system (VAR) to define. To facilitate the presentation, we use two variables (Xt, Yt) to be analyze.

$$Y_t = c + \sum_{i=1}^{p} \alpha_i X_{t-i} + \sum_{i=1}^{p} \beta_j X_{t-j} + \varepsilon_t \quad (4)$$

$$X_t = c + \sum_{i=1}^{p} \alpha_i X_{t-i} + \sum_{i=1}^{q} \beta_j X_{t-j} + \varepsilon_t \quad (5)$$

If accepted the $H_{01}: \alpha_1 = \alpha_2 = \alpha_P = 0$ means that X is not the Granger reason of Y; if accepted $H_{02}: \alpha_1 = \beta_2 = \beta_Q = 0$ means Y is not the Granger reason of X. In this way, the use of F test can realize the Granger causality test.

$$F = \frac{(RSS_R - RSS_U)/q}{RSS_U/(T-p-q-1)} \sim F(q, T-p-q-1)$$

In which RSSR and RSSU were expressed as residual sum of squares in H01 (or H02) under theconstrained and unconstrained, P, q are lag order of respectively X and Y, by the SchwarzInfoCriterion determinated. RSSR and RSS are respectively selected variable lag order is 1,2. Test results are shown in table 4.

Tab.4

Lag Intervals for Endogenous	Granger causality	F-statistics	P-value	conclusion
1	Lny → lnh	3.66	0.06	refuse
	Lnh → lny	3.08	0.09	refuse
	Lnp65 → lnh	0.18	0.67	refuse
	Lnh → lnp65	11.00	0.01	accept
	lnp65 → lny	0.02	0.90	refuse
	lny → lnp65	10.60	0.00	accept
2	Lny → lnh	3.66	0.06	accept
	Lnh → lny	3.79	0.04	accept
	Lnp65 → lnh	0.35	0.71	refuse
	Lnh → lnp65	4.87	0.02	accept
	lnp65 → lny	0.63	0.54	refuse
	lny → lnp65	4.60	0.02	accept

According to the causal relationship between the variables and variable lag ,we know the causal relationship is correlation with the relationship of variables and variable lag order which may be due to the non-stationary of three variables lnh, lny, lnp65 nonstationarity . However, nomatter the choice of variable lag order is 1 or 2, economic growth, health care cost growth is the aging of our population Granger reasons. This can be explained from the following aspects, economic growth caused the growth of people's incomes and improve people's medical needs, causing an increase in health care spending[5].

Conclusions

On the basis of statistics since the reform and opening in our country,this paper uses unit root test, cointegration test and causality test to investigate the correlation between economic growth, population aging and the growth of medical expenses[6].The result is as follows:(1)The ADF, PP, KPSS unit root test shows that the per capital GDP, the proportion of elderly people and the per capital health expenses are all non-stationary variables, and their whole order are all 1.(2)Economic growth, an aging population have a a cointegration or long-term equilibrium relationship with the medical expense growth.The key drivers of the excessively rapid growth of medical expenses include not only the rapid economic growth, but also the fast medical price’s increase in China.Relative to the growth of the economy, population aging has a little impact on the growth of the medical expenses .Population aging to the growth of medical expenses is not enough to pose a threat to China's medical and health undertakings.(3)The impact of economic growth and population aging on the growth of medical expenses is long. In relative to long-term equilibrium values,actual medical expenses has been fixed by 17% (0. 17) in a shot time. (4)The increases of economic and medical expense are all the Granger causes of population aging increasing in our country.But the population aging increasing is neither a Granger cause of economic growth, nor the Granger cause of increasing health care costs in our country.

References

[1] Geten,T.E. Population Aging and the Growth of Healtb Expen-ditures. Journal of Gerontolgy:Social Science,1992,(9):95-110.

[2] Zweifel.et.al.Ageing of Population and Health Care Expenditure:A Red Herring.Journal of Health Economics,1999,(8):48

[3] Newhouse,J.P..Medical-care Expenditure:A Cross-national Survey. The Journal of Human Resources.1977,(12):115-125

[4] Parkin,D..A.Mcgure and B.Yule.Aggregate Health Care Expen-ditures and National Income:Is Health Care A Luxury Good.Journal of Health Economics,1987,(6):109-127.

[5] Gerdtham,U.-G,Lothgren,B..On Stationarity and Cointegra-tion of International Health Expenditure and GDP.Journal ofHealth Economics,1991,(10):227-234.