

# Ageing Population on Health Expenditure in China

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## ABSTRACT

*A rise in the ageing population will lead to change in the health care spending. Health care system will be expected to accommodate care for ageing population to other population such as young population. As an increase in ageing population the health care systems will have to adapt. In China, ageing population will rise to 26 percent of the total population by 2050 as the demographic projection forecasts. Hence, the issues of the study is whether ageing population have an impact to the health expenditure. In this study using the ADRL approach to test the relationship between the variables with the data from China from 1970 to 2016. From the analysis using ARDL testing, the results shows that there have a long run relationship and the results is significant between ageing population and healthcare expenditure. The control variable such as life expectancy, gross domestic product per capita and hospital beds also have a relationship with health expenditure. This findings support the hypothesis that, ageing population spend more in health expenditure on medication and consultation.*

**Keywords:** Ageing population, health expenditure, ARDL model.

## 1. Introduction

The share of ageing population in the population is growing faster than the other group such as young population, both of this group result of longer life expectancy and lower birth rate. Life expectancy for ageing population is much higher life expectancy until 85 years in developing countries (Friedrich, Stefan and Joan, 2011). In developed countries, the percentage increases from 7 percent to 17 percent is 60 years for the population above 65 years, but in China, this percentage only take 30 years to reach the same level of ageing population in developed countries. By 2050, the expected projection of the population ages 65 years and above will reach 34 percent, which comparable with Denmark and much higher than the United States as 26 percent.

Figure 1 shows the young children and older people as a percentage of global population from 1950 to 2050. This trend indicates that, older people will intercept with young children at year 2020 and then increases but total young children decreases after 2020. Ageing population will increases in the demand for the healthcare, because at this ages of the population, some of them will get a chronic diseases and the cost of the treatment is highly expensive with involve the expertise and technology of the hospitalization.

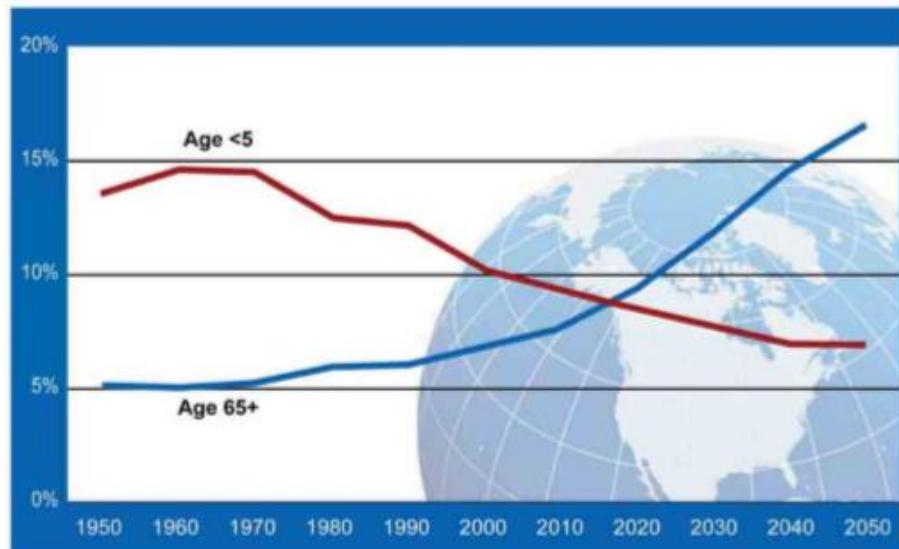


Figure 1: Young Children and Older People as a Percentage of Global Population: 1950-2050

(Source: United Nations. World Population Prospects: The 2011 Revision. Available at: <http://esa.un.org/unpd/wpp/>.)

The main factor to contribute the higher ageing population are higher life expectancy or increased longevity and lower fertility rate. In China, the implementation of the family planning policy in 1980 which is “One Child Policy” has played a role in the country for the change in the population structure. This policy will lower the birth rate and increases in the ageing population. Thus, increase in ageing population poses challenges to healthcare, with rising the healthcare expenditure such as cost, access and quality of healthcare or “iron triangle” (Marc, 2014). In the Figure 2, the total population in China has increases from 1960 to 2018, but the growth rate of the population is decreases because of the implementation One Child Policy. The population ages 0-14 years shows the trend is increasing at the first three chart from 1960 to 1970 and the trend shows the decreasing total population ages 0-14 after 1980 and this also one of the objective of the government policy with decrease the birth rate, so total population ages between 0-14 also decreases. In China, total number of ageing population or population ages 65 and above shows as an increasing trend and this will continue increased from 1960 to 2018.

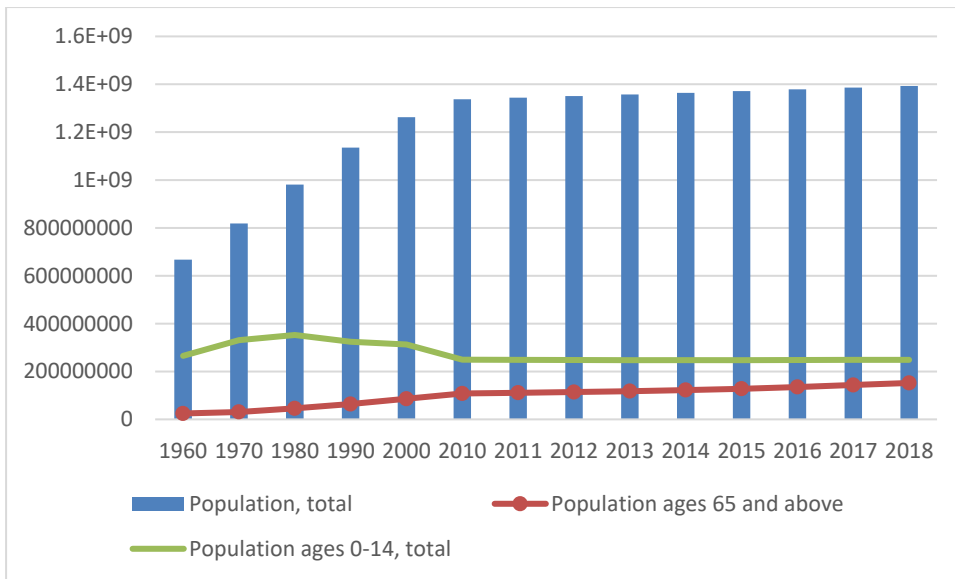


Figure 2: The total population, population ages 0-14 year and population ages 65 in China during 1970 to 2018  
(Source: World Bank Indicator, 2020)

In the reformation, Chinese government has started to control healthcare expenses with implement pharmaceutical policy but as higher ageing population, the healthcare system will need to prepare for the increasing incidences of chronic conditions such as hypertension, high cholesterol, arthritis, diabetes, heart disease, cancer, dementia, and congestive heart failure. Thus, the healthcare expenditure for this group much be higher than the other group of population. From the Figure 3, indicate the trend of the domestic private health expenditure per capita, out-of-pocket expenditure per capita and current health expenditure per capita from year 2000 until 2016. This figure shows that, total health expenditure for this indicator is increases from year to year.

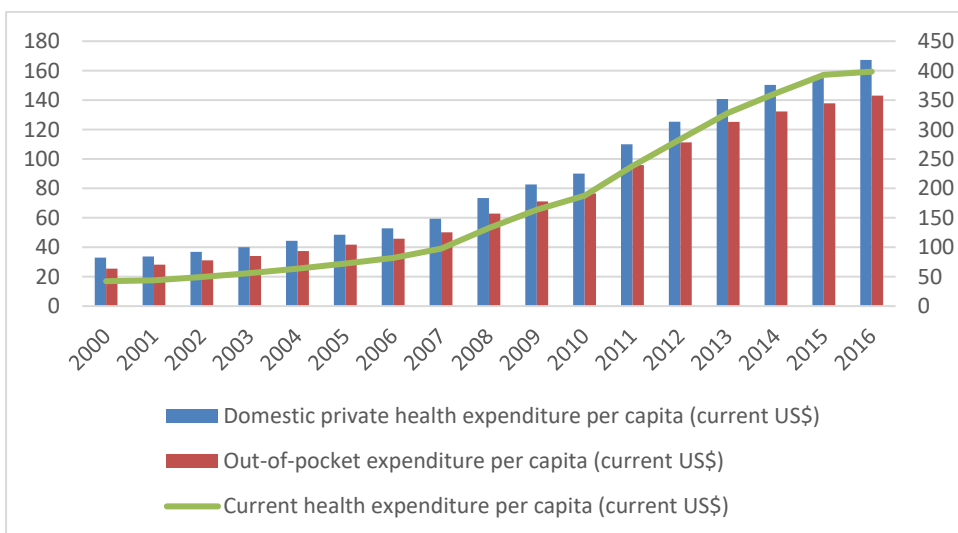


Figure 3: Domestic private health expenditure per capita (current US\$), out-of-pocket expenditure per capita (current US\$) and current health expenditure per capita (current US\$) in China during 1970 to 2018  
(Source: World Bank Indicator, 2020)

## 2.0 Literature review

Ageing population will have effects on local, regional and global economies. Most importantly, this group of aged will effect to the financial expenditure, labor supply and total savings. Besides that, ageing population will strain some national budgets and nation should provide extensive social programs to this group such as health care and income support programs. As a countries reach higher ageing population, the proportion of workers tends to be decreases. Thus, with the higher proportion of the ageing population is expected to increases in the healthcare expenditure.

In Italy, ageing population have more impact to the healthcare expenditure compared to the life expectancy and per capita GDP (Milena and Marianna, 2017). This because, the impact of the ageing population with the disability and disease fall in the long-term sector. In Italy, government do the effective health intervention, such as health promotion and disease-prevention program can help to reduce the cost of health.

Another studied by Ya-Ming (2020) at Taiwan. Cost of healthcare among ageing population for the diabetic patients is 75 percent of growth expenditure, which is diabetes prevalence rate (45%) and disease severity (30%). The growth of health expenditure for the diabetic patients because of the technological innovation to treatment the patients. As conclusion, the ageing population may contribute significantly to the future growth of the healthcare sector in Asian countries such as Taiwan.

Besides that, some of the studied for the issues of health economics and demographic impact have found the relationship between healthcare expenditure, gross domestic product and population over 65 years. The relationship between ageing population or population over 65 years with the healthcare expenditure per capita in Spanish is positive correlated (Marta, David and Daniela, 2017). In England and Wales, per capita healthcare expenditure among population age 65 and over increased by 8 percent (Meena and Alastair, 2002).

Social factors also important impact to the healthcare expenditure. Societal factors such as underlying health and disability have a direct effect on ageing population. Commonly used like age or mortality, insufficiently capture complex dynamics in health. Claudine et al. (2013), found that ageing population is moderately increases expenditure on acute care but strongly increases expenditure on long-term care.

Some of the studied found that a rise in ageing population will increases in cost of hospital. They demonstrate that hospital expenditure increases among ageing population because of increases in the cost at the time of dying. Ageing population will increases the cost of hospitalization as a prescription drugs at Danish (Kildemoes et al., 2006). Robson (2001) and Mayhew (2000) population ageing pressure in medical expenditure compare to the other group of population. Zweifel, Felder and Meiers (1999), Felder, Meier and Schmitt (2000), and Seshamani and Gray (2004) also found that healthcare expenditure will increases to the group of ageing population. This group increases the cost of medical which in return, controls the proximity of death.

Other factors such as age distribution, income and time also used to examine the effects to real per capita health expenditure. According to Di Matteo (2005), in their studies there have a several variables for the health care include urbanization, foreign aid, per capita income, public share of healthcare spending, population over 65 years and population age 15 years and number of physicians per capita. Thus the results was found that population aged 65 years and

above had moderately effects to healthcare expenditure and results for population aged 18-44 also have positively and significant effect to the healthcare expenditure.

### 3. Methodology

In this study using the autoregressive distributed lags (ARDL) or the bounds test as introduced by Pesaran et al. (2001) to testing the long run and short run relationship between the dependent and independent variables. To test the stationary, unit root test will be employed. The data cover from 1970-2016 for China. The dependent variable will measured by the healthcare expenditure per capita GDP, otherwise the independent variable are ageing population, life expectancy, gross domestic product per capita and hospital beds. The data collected from the World Development Indicator 2020. For the model estimation as below:

$$Health_t = f(POP65_t, GDPC_t, Life_t, Hosp_t) \quad (1)$$

Where:

Health Expenditure = Health

Ageing population = POP65

Life expectancy = Life

Gross domestic product per capita = GDPC

Hospital beds= Hosp

$$Health_t = \beta_0 + \beta_1 POP65_{t-1} + \beta_2 GDPC_{t-1} + \beta_3 Life_{t-1} + \beta_4 Hosp_{t-1} + \mu_t \quad (2)$$

$$LNHealth_t = \beta_0 + \beta_1 LNPOP65_{t-1} + \beta_2 LNGDPC_{t-1} + \beta_3 LNLife_{t-1} + \beta_4 LNHosp_{t-1} + \mu_t \quad (3)$$

$$\begin{aligned} \Delta LNHealth_t = & \beta_0 + \beta_1 LNPOP65_{t-1} + \beta_2 LNGDPC_{t-1} + \beta_3 LNLife_{t-1} + \beta_4 LNHosp_{t-1} \\ & + \sum_{i=1}^3 \beta_{5i} \Delta LNPOP65_{t-1} + \sum_{i=1}^3 \beta_{6i} \Delta LNGDPC_{t-1} + \sum_{i=1}^3 \beta_{7i} \Delta LNLife_{t-1} \\ & + \sum_{i=1}^3 \beta_{8i} \Delta LNHosp_{t-1} + \mu_t \end{aligned} \quad (4)$$

## 4.0 Results

### 4.1 Unit root test

To testing the unit root test, Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) is using to test the stationary of the variables at the I(0) or I(1) for non-stationary or containing unit root (Pesaran et al. 2001). From the Table 1, shows the result for the ADF and PP test. The results indicates that, after differentiating the variables once, all the variables confirm to be stationary. Based on the table, it was found that the health care expenditure was stationary at different level. The variable stationary at I(0) only ageing population (POP65), whereas the others variable GDPC, life expectancy and hospital beds are stationary at the I(1). The result for PP test, only life expectancy integrated at the I(0), whereas the other variable are integrated at the I(1).

Table 1: Augmented Dickey Fuller (ADF) and Philip-Perron (PP) unit root test

Indicator	ADF				PP			
	Level		First Difference		Level		First Difference	
	Intercept	Trend & Intercept	Intercept	Trend & Intercept	Intercept	Trend & Intercept	Intercept	Trend & Intercept
LNHCE (Health Expenditure)	-0.5870 (0)	-3.5410 (1)**	-4.9017 (0)***	-4.1780 (0)***	-0.7801 (2)	-2.6890 (2)	-4.4781 (3)***	-4.460 (4)***
LNAGEING (Ageing Population)	0.8121 (4)	-4.4029 (3)***	-4.3679 (3)***	-5.3792 (3)***	-1.0723 (5)	-2.1901 (5)	-4.9815 (2)***	-4.5412 (2)***
LNGDPC (Gross Domestic Product per capita)	3.0456 (0)	0.0550 (1)	-5.2801 (0)***	-4.4521 (1)***	3.5611 (4)	0.2910 (3)	-5.1833 (2)***	-6.1890 (4)***
LNLife (Life Expectancy)	-2.6210 (0)	-2.7651 (0)	-6.5410 (0)***	-6.6710 (0)***	-2.7810 (2)*	-2.7629 (1)*	-8.2300 (13)***	-8.2568 (13)***
LNBEDS (Hospital beds)	-1.6109 (0)	-2.9017 (0)	-6.3981 (0)***	-6.4192 (0)***	-1.3401 (8)	-2.5610 (3)	-7.6799 (16)***	-7.4321 (16)***

Note: Significant level at \*\*\*1% \*\*5% and \*10%.

From the Table 2, the results shows for the long run co-integration test analysis and the existence of the long run relationship among the variables. The result for F-Statistic is 4.9672 and significant at the five percent significant level, it is means that the model have the co integration between the variables. Thus, the null hypothesis of the no long run relationship between the variable can be rejected. Having the co integration between the variables, thus we can proceed to test long run and short run analysis.

Table 2: Bounds Test for Co-integration Analysis Based on Equation (4)

	10 percent level		5 percent level		1 percent level	
k	$I(0)$	$I(1)$	$I(0)$	$I(1)$	$I(0)$	$I(1)$
4	2.696	3.898	3.276	4.630	4.590	6.368

Notes: The reported bounds critical values were taken from Narayan (2004), Table C[III].  $k$  is the number of regressors. (n=36, k=4)

The results for the long-run and short run coefficients between health expenditure with respect to ageing population, GDPC, life expectancy and the number of hospitals beds are reported in Table 3. The impact of ageing population on health care expenditure in China is 0.7871. A 1 percent increase in ageing people will increase 0.7871% of health care expenditure in percentage to GDP. This findings support that ageing population will spend more money for the healthcare such as medicine and consultation for their disease compared to the young population. Thus the hypothesis is supported with ageing population account more on healthcare expenditure. This result is consistent with those of Ya-Ming (2020), Marta, David and Daniela (2017), Zweifel, Felder and Werblow (1999) and Seshamani and Gray (2004). Based on the literature, the common belief is that the effects of ageing on health care are “red-herring” and the proximity to death, which is also related to age, has significance. If expenditure increases with age because of the direct effect, the hike in the ageing population will significantly increase health care expenditure for the society. Based on the results of the population aged structure, it will conclude that, this ageing population is an important factor in

determining the increases in health care expenditure for China. But, results for the GDPC are not significant in the estimation the long run. Thus, this variable does not influence the effects of an ageing population on healthcare expenditure. The results for the life expectancy is positively correlated with the health care expenditure and with that being said, when the life expectancy increased, health care expenditure will increased and the result will be significant. Lastly, the total number of hospital beds also positive effects to healthcare expenditure in China. The number of hospital beds for health care proxy indicators play an important role in China.

Error Correction Model (ECM) will used to estimate the short run estimation. Results for the ECM shows the negative sign and it confirm that there is a long run relationship between the variables. From the Table 3, result for the short-run coefficient is 0.3193 significant at 5 percent level. This confirm that, the positive relationship between ageing population with the healthcare expenditure. This results is support by Ya-Ming (2020) and Milena and Marianna (2017). All the variables of the control variable are significant and positively effects to the healthcare expenditure. The result for GDPC is 0.019 percent which means that increases in GDP will increases in the healthcare expenditure. This because expenditure one of the aggregate expenditure by the government, thus as increases in economic growth will increases in the expenditure (Marta, David and Daniela, 2017). Others variables such as life expectancy and hospital beds also positive and significant effects to the healthcare expenditure. It is means that, longer a life, will increases in the healthcare expenditure. In China, total ageing population also higher and their life expectancy also higher until 78 years in year 2016 (World Bank Indicator, 2020).

Table 3: Results for coefficient of the long-run and short-run

Indicator	Long run (1,0,0,0,0)	Short run
Ageing population (AGEING)	0.7871 (0.5032)***	0.3193 (.5187)***
Gross Domestic Product per Capita (GDPC)	0.0487 (.0911)	0.0197 (.0320)*
Life Expectancy (Life)	0.0841 (2.0616)**	0.0132 (3.5985)***
Hospital beds (BEDS)	.6298 (1.9514)	.1896 (1.6415)***

Note: significant level at \*\*\* 1% \*\* 5% and \* 10%.

To complete the test of the ARDL, the test for diagnostic test should be estimate. Table 4 shows the results for the serial correlation, functional form and normality test. From the results shows that this model are free form the econometric problems. To ensure the model is stability or fitted as proposed by Brown et al. (1975), a cumulative sum of a recursive residual test and cumulative sum of the squares of the recursive residuals test. Figure 4 and Figure 5, shows the stability of the model with fit in the line.

Table 4: Diagnostics testing for the model

Test	F-Statistic
A. Serial correlation test	2.0768 [0.1890]
B. Functional form test	0.0293 [0.8517]
C. Normality test	1.1447 [0.5490]

Figure 4: Graph for the CUSUM

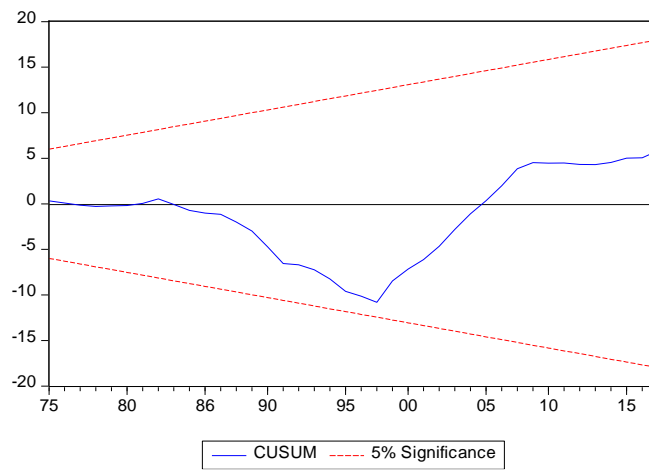
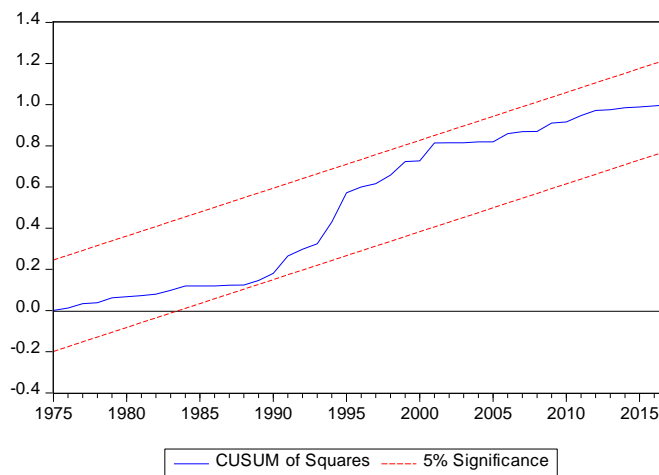


Figure 5: Graph for the CUSUMQ





## 5.0 Conclusion and Recommendations

The objective of this study is to examine the short run and long run relationship between ageing population and healthcare expenditure; the three controlled variables used which is life expectancy, gross domestic product per capita and hospital beds using time series data. From the analysis, ageing population have a short run and long run relationship with the healthcare expenditure in China. As an increases in the total number of ageing population in China will enlarge the healthcare expenditure. A disease especially a chronic disease affect the older people and will increasing the number of sick population. The policies aim at the encouraging expenditure especially in health sectors, they should require to build a healthy ageing people to support the China economic growth. On the other hand, China should ensure the distribution of healthcare among people should be equal. This is because, the cases of the chronic disease will have a high cost of the health expenditure. Lastly China, the number of people in rural area is higher in China, thus government should ensure the provision of health from rural to urban area is more effective.

As a recommendation, determinant of healthcare expenditure such as technological progress, infrastructure and out of pocket expenditure; demographic indicator such as young population, rural population, urban population; indicator for health such as mortality rate, birth rate and infant mortality rate and variable for the healthcare expenditure such as private health expenditure, public health expenditure, out of pocket expenditure, domestic private health expenditure and total number of nurses should be used in the future research. The implication of the combination of all variables has been discuss either increasing expenditure on healthcare or not. In the future research also, using another approach and using panel data can be beneficial to future research.

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