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Impact of an Ageing Society on Healthcare Expenditure of National Health Insurance in Taiwan

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Abstract: The increase in healthcare expenditure always becomes an issue considered by the National Health Insurance (NHI) program in Taiwan. Accordingly, analyzing the root cause is a significant first step in dealing with this issue. This study hypothesized that the greying population in Taiwan is the main reason that devours a vast health care expenditure. Samples of the population in Taiwan's National Health Insurance databases together with age-expenditure profile analysis and decomposing approach of the components of healthcare expenditure will analyze the impact of population ageing and estimate the contributions of population ageing shifting to NHI's expenditure in Taiwan. The result could be considered for policymakers and the government to overcome this issue in Taiwan.

Keywords: Population shifting, NHI expenditure, Age-expenditure profile approach, Decomposing approach.

Introduction

Health and economic prosperity have a positive correlation in which almost all wealthy nations provide universal healthcare for their people. As one of the developed countries in Asia, Taiwan facilitates its people with the National Health Insurance (NHI) Program. Taiwan NHI was founded in 1995 as a compulsory social insurance plan which centralizes the disbursement of healthcare funds under the jurisdiction of the Ministry of Health and Welfare. All citizens and foreign residents who have lived for a certain period in Taiwan are required to enroll. Through the NHI Program, the government provides the people health services needed without suffering financial hardship for the payment. The sustainability of this program depends on how NHI systems carry out four vital functions, which are the provision of health care services, resource generation, financing, and stewardship. It could be said that all the vital functions are supported by its financial. The arrangement of NHI's financials is an importing issue to ensure the sustainability of NHI's program in the future. For that reason, there is a need to analyze any factors that influence NHI's finances that cause any possible congestion inside the NHI program.

There are many researchers already tried to identify, such as symptoms happening in healthcare provisioned by the country, any correlation between health and other variables, future healthcare system. Increases in healthcare expenditure are linearly associated with increasing age, and it could be projected that the older people need a vast service of healthcare that will account for an increasing portion of healthcare budgets in the next period. In OECD countries, the average per capita expenditure for people sixty five years old and older has the possibility of becoming two to eight times more than those for the working-age population and steadily increases with age (Mayhew [1]). Many researchers claimed that demographic shift and population growth accounted for 68%, 44%, and 34% in Japan, Canada, and Australia, respectively (Seshamani and Gray [2]). In other hands, there was study stated that population ageing is not a significant cause of increasing expenditures, but the expenditures before death are a significant reason behind the high cost (Lubitz and Riley [3]). The relationship between age, time to death and health expenditure has been extensively studied in recent years using data from different countries.

For the last several decades, population ageing in most countries has proceeded with economic growth. According to the classification of ageing society for a country defined by the United Nations, Taiwan is qualified as an "ageing nation" because the proportion of those aged over 65 had exceeded 7% of the country's population. As an ageing nation, the Taiwanese government gave attention to the ageing population and executed new policies in response to this demographic transition (Lin [4]). This condition should be viewed to be identified, whether it becomes the primary cause of increasing expenditure. To the best of our knowledge, there has been no examination that the ageing population contributes to the increase in Taiwan healthcare expenditure. This study will

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attempt to track the cost changes from year to year and the influence of age shifting for NHI's expenditure in Taiwan, find the contribution of several components that influence NHI's expenditure cost and build a model to predict the NHI's expenditure cost in future. Age expenditure profiles are proposed to project the impact of demographic changes on healthcare spending. However, this profile shows the relationship between age cohorts and healthcare expenditure and does not consider other factors that influence healthcare expenditures except the age variable. Thus, secondly, we investigate the determinants of healthcare expenditure by spelling out the cost into several components to measure the contribution of population ageing on health care expenditures. The result could be considered for policymakers and the government to overcome this issue in Taiwan.

Methods

The study uses the National Health Insurance Research Database (NHIRD) as data sources that contain around 1,000,000 sample data of beneficiaries or 5% of all enrollees, which is randomly selected as study cohort from National Health Insurance (NHI) data. NHIRD contains several data of medical information such as gender, birthday, diseases, medicine, treatment, medical institution, patient's job, physician, etc. The patient's name, physician's name, and the doctor's name are encrypted to protect the patient's privacy. NHIRD contains a comprehensive and longitudinal healthcare record for patients to provide valuable assets that could help with medical research. Data used in this study included outpatient and inpatient cases with attributes used including the cost of the patient, such as the drug cost, the surgery cost, the diagnosis cost, the therapy cost, and the total cost, and the patient age. The cost data we have is the real cost of their expenditure, without the adjustment affected by floating-point value.

The study cohort in this research consists of all patient that is diagnosed on the year 2002-2011. The patient in all the year will be assumed as the population of the sample data. For this, the patients that are identified as the new patients in the year 2003-2011 will be withdrawn back to the year 2002 to get their information, especially for their age in the year 2002. For example, patients with 70 years old, who is just identified in the year 2007 will be withdrawn back to the year 2002. In the year 2002, the age of that patient (with 70 years old) is identified in 65 years old. This principle is used to identify all the patient cohort in the year 2003 until 2011 as the virtual patient in the year 2002. Aggregating all the patients from the year 2002-2011 is considered as the number of data population for the living patient. The number of dead patients identified every year in each age will update the remaining number of living patients to gain the cost per capita in each age that is renewed year by year. However, the cost aggregation of all patients based on their age in each year will provide the cost per capita in each age. We averaged costs per capita every five years old into a group that results as the average cost at interval age. For example, the cost for 0-5 years old, 6-10 years old, 11-15 years old, etc. to build the graph according to the cost per capita for each year.

Age-Expenditure Projecting Approach

The population of a nation always dynamically moves through the year. Segmenting a population into demographics will provide population's characterristics for many purposes, including policy development and economic market research. Demographic analysis, together with the sets of methods, could be applied to measure the dimensions and dynamics of populations. These methods have primarily been developed to study human populations but are extended to a variety of areas where researchers want to know how populations of social actors can change across time. Traditionally, previous researchers utilize the methods of projecting the impact of demographic change onto health care expenditure. Gray [5] in his research already calculated the actual health care expenditure per capita in different age groups, and then multiplied through by the projected number of people in each age group. Typically, this approach will show the likely growth in future National Health Insurance spending that was required due to demographic change.

Decomposing of Health Care Expenditure Components Approach

Decompose approach is already used in many researched areas, such as for analyzing the electrical problem (Michielssen [6]), for exploring the driving factors ofcarbon emission intensity (Zhang [7]), for solving operational problems in airline industries (Rusdiansyah [8]). In this paper, decomposing approach is proposed to identify the contribution of each elements considered as the variables that build health care expenditure. Dormont *et al.* [6] observed three components ofhealth expenditures: ambulatory care, pharmaceutical, and hospital expenditures in their study. They want to compare the magnitude effect between the increasing function of age with other drivers of health care expenditures. Gray [5] provided a statement that most projections have traditionally calculated the actual health care expenditure per capita in different age (or age and sex) groups, and then multiplied through by the projected number of people in each age group, as in equation 1. In another study, Tchoe and Nam [10] stated that the increase in health care expenses could be broken down into several components: the increase

in population coverage, the ageing of population structure, the increased fees for services, and the increased volume of services used. Through this analysis, the effect of population ageing could be singled out. Equation (2-11) is used to find the contribution of population shifting in health care expenditure.

$$NHI\ exp = Pop \times C_{pcap} \quad (1)$$

$$NHI\ exp = Pop \times Vd_{pcap} \times C_{pvd} \quad (2)$$

Where $NHI\ exp$ is the total expenditure of NHI, Pop is the covered population, C_{pcap} is the cost per capita, Vd_{pcap} is the number of visit days per capita, and C_{pvd} is the cost per visit day. The visit days per capita are likely to be longer as people get old. The expenditure per visit day is also considered to increase according to the population ageing. Because of this, the visit day extension for per capita and the increase in the spending will also be affected by the demographic structure change and the other factors. Mayhew [1] states that demographic structure change (a) means the effect of demographic change (population ageing) on the visit days per capita. Then, demographic structure change (b) means the effect of demographic change (population ageing) on the cost per visit day per capita.

$$Vd_{pcap} = dsc\ (a) \times Vd_{pcap_{adj}} \quad (3)$$

$$C_{pvd} = dsc\ (b) \times C_{pvd_{adj}} \quad (4)$$

Where $dsc\ (a)$ is the demographic structure change on the visit day, $dsc\ (b)$ is the demographic structure change on the cost per visit day per capita, $Vd_{pcap_{adj}}$ is the adjusted visit day per capita, and $C_{pvd_{adj}}$ is the adjusted cost per visit day. In equation (3), the visit days per capita are composed of the effect of demographic structure change on the visit days and adjusted visit days per capita. In equation (4), the cost per visit day for per capita are composed of the effect of demographic structure change on the expenditure and adjusted expense per visit days for per capita. Then, the decomposition of adjusted cost per visit day will be written as:

$$NHI\ exp = Pop \times dsc\ (a) \times Vd_{pcap_{adj}} \times dsc\ (b) \times C_{pvd_{adj}} \quad (5)$$

Equation (5) could be transformed into equation (6) by taking natural logarithm

$$Rate\ of\ NHI\ \exp = Rc\ in\ Pop + Rc\ in\ dsc\ (a) + Rc\ in\ Vd_{pcap_{adj}} + \mathrm{Rc\ in}\ dsc\ (b) + Rc\ in\ C_{pvd_{adj}} \quad (6)$$

Where $Rc\ in\ Pop$ is the rate of change in covered population, $Rc\ in\ dsc\ (a)$ is the rate of change in demographic structure change (a), $Rc\ in\ Vd_{pcap_{adj}}$ is the rate of change in adjusted visit days per capita, $Rc\ in\ dsc\ (b)$ is the rate of change in demographic structure change (b), and $Rc\ in\ Vd_{pcap_{adj}}$ is the rate of change in adjusted cost per visit day. The rates of change in demographic structure change (a) and the rates of change in demographic structure change (b) from the Equation (6) can be calculated by equations (7) and (8), where "age" denotes age cohort of the patient cohort. We will estimate the rate changing of National Health Insurance from certain year to another year, we express the present time with index "a", then the year in the next period will be called with index "b".

$$Rc\ in\ dsc\ (a) = \frac{\sum_{age}\left[Pop_{b,age} \times \left(\frac{Pop_a}{Pop_b}\right) \times Vd_{pcap_{a,age}}\right]}{\sum_{age}\left(Pop_{a,age} \times Vd_{pcap_{a,age}}\right)} \quad (7)$$

$$Rc\ in\ dsc\ (b) = \frac{\sum_{age}\left[Vd_{b,age} \times \left(\frac{Tot\ Vd_a}{Tot\ Vd_b}\right) \times C_{pvd_{a,age}}\right]}{\sum_{age}\left(Vd_{b,age} \times C_{pvd_{a,age}}\right)} \quad (8)$$

where $Tot\ Vd_a$ is the total visit days in the present time, and $Tot\ Vd_b$ is the total visit days in the future. Then, the rate of changes in adjusted visit days per capita in Equation (10) can be expressed in Equation (13), in which the change in visit days is separated from change in demographic structure.

$$Rc\ in\ Vd_{pcap_{adj}} = \frac{Rc\ in\ Vd_{pcap}}{Rc\ in\ dsc\ (a)} \quad (9)$$

where $Rc\ in\ Vd_{pcap}$ is the rate of change in visit days/capita. Then, the rate of change in adjusted cost per visit day can be expressed in two stages. In the first stage, the change in adjusted cost is separated from the change in demographic structure, as in Equation (10). In the second step, change in readjusted expense is separated from change in service fees, as in Equation (11).

$$Rc\ in\ Vd_{pcap_{adj}} = \frac{Rc\ in\ C_{pvd}}{Rc\ in\ dsc\ (b)} \quad (10)$$

$$Rc\ in\ C_{pvd_{readj}} = \frac{Rc\ in\ C_{pvd_{adj}}}{Rc\ in\ fee\ level} \quad (11)$$

Where $Rc\ in\ C_{pvd_{readj}}$ is the rate of change in readjusted cost per visit day, $Rc\ in\ fee\ level$ is the rate of change in fee level.

Results and Discussions

Age Distribution of the Patient Cohort

By identifying the number of patients in the year 2002 together with the virtual patients in the year 2002 (the age of patients just identified in the year 2003-2011 is withdrawn back to the year 2002 for

having their age in the year 2002), we have the number of the patient cohort. Patient cohort refers to the sample of total NHI member that consists of the various age from the 0 to 90 years old with the mean of the age is 34.688 (σ = 20.14). From the age distribution, we gain the information that in the year 2002, the number of children (0-14 years old) places 19%, the people in age 15-64 years old places 72%, and the person in age 65 years old and over places around 9% from all the sample data of patient cohort. The real population in Taiwan for the year 2002 have a similar proportion for these three categories, which are 20.4%, 70.65%, and 9% respectively. Based on this similarity proportion, we assumed that our sample data could be considered as the expenditure fee for NHI's expenditure estimation if in the real case, 95 per cent of the NHI's members utilized the health care facilities. In the beginning, to provide hypothesis, we aggregated all the patient cost in the year 2002 per age together with the patient cohort number in 2002, as shown in figure 1. The line graph shown in figure 1 represents a total patient cost for every age, and the bar graph represents the patient cohort in the year 2002.

This figure provides some information, such as for the children and teenagers (supposed the patients under 17 years old), there are two patterns. The first pattern is for children under 5 years old, in which their expenditure cost is relatively high because most infection occurs in those under 5 years old and immunity increases with age until adulthood (Vyse *et al.* [11]). Hence, children under 5 years old usually see the doctors for getting any treatment. The second pattern is for the children over 5 years old in which their expenditure cost is relatively lower than the children under 5 years old. This result also proves that the immunity system for children above 5 years old increases, so their probability to be infected with the virus are lower than the children under 5 years old.

The patient cohort in the age of 18 to 50 years old, increase their expenditure costs according to their age. When the number of the patient cohort is high, the expenditure cost also becomes high to cover their health care costs and vice versa. The graphic also depicted a condition in which the patient cohort at an age interval between 51 to 60 years old needs a constant high expenditure cost. From the interval age of 61 to 80 years old, the cost expenditure was soaring significantly. NHI had to spend a vast cost expenditure for their members while the identified member of NHI is lower than the other because of the number of visit day and their cost per visit are getting higher and higher. It provides us with the information that the elder will cost highly for their health care fee. Hewitt *et al.* [12] proved that the average per capita

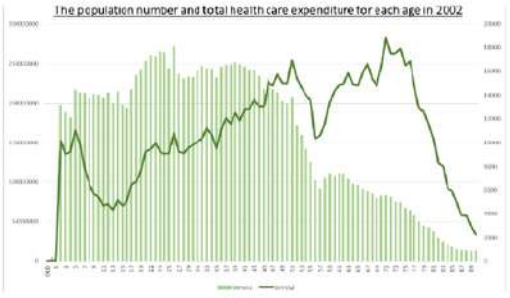

Figure 1. Total expenditure cost for all patient cohort in year 2002 for every age

Table1. Cost per capita in 5 years age interval based on 2002

Age interval (old)	Cost /capita (NTD)	Age interval (old)	Cost /capita (NTD)
0-5	12085	46-50	16265
6-10	7778	51-55	21811
11-15	5325	56-60	27240
16-20	7068	61-65	34058
21-25	8252	66-70	43319
26-30	9268	71-75	52904
31-35	9965	76-80	60940
36-40	10982	81-85	66344
41-45	12775	86-90	62264

expenditure for people sixty-five years old and older has the possibility of becoming two to eight times more than those for the working-age population and steadily increases with age. The last pattern of the graph is shown for the patients in 83-90 years old in which their expenditure cost is lower than the previous interval age. This pattern has commonly happened in which the cost per capita for people 85 years old above is less than the older people with age 85 years old below. Surgeons are trained to save lives, but with older people, there is less length of life to protect. Because of this, many doctors avoid surgery for older people. High-cost spending is due to the surgery process. If the surgery process is avoided for older people because of its risk, their cost per capita will decrease in any way (Span [13]). Then, the cost per capita in each age interval is counted to provide a detailed cost of interval age.

After calculating the cost per capita in each age, every age interval shows its typical cost. The older one needs more expenditure compared to the younger one. From Table 1, the highest cost of health expenditure has resulted from the people in the age interval above 65 years old. The possibility for older people to suffer Non-Communicable Disease (NCD) is higher than the younger people. Taiwan's ministry report in Statistics and Trends in Health and Welfare declared that major NCDs are cancer (malignant) and cardio

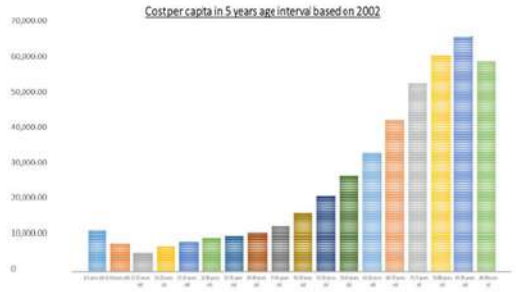

Figure 2. Cost per capita in 5 years age interval based on 2002

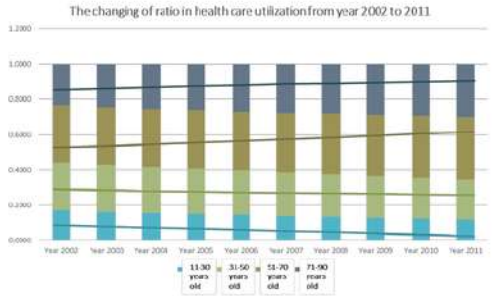

Figure 3. The ratio of health care utilization cost from the year 2002-2011

vascular diseases (CVDs). Taiwan Ministry of Health and Welfare also reported that 64.2% of all deaths among the top 10 causes, and 69.1% of all deaths are the patient among 65 years old and over (this is reported in Statistical Analysis of Causes of Deaths in Taiwan). The patients who already reached 83 years old and over, their expenditure cost will decrease. Overall, the increasing expenditure cost of NCDs in Taiwan will impact the serious implications for NHI expenditure. Figure 2 depicts clearly the pattern of National Health Insurance spending for each interval age.

Moreover, Taiwan is predicted to experience the shifting of population demographics, in which people are living longer, but fewer children are being born. The growth of the greying age population, which is not balanced with the growth of the working one (the younger people) will issue in the burden for working people is heavier than before. A fewer number of working people in the future will bear a higher cost for older people (because their number becomes higher in the future). The increase of older people will increase NCD cases for them. Age-expenditure cost examination suggests that the most critical problem should be considered for handling the increasing cost of Taiwan NHI is the population shifting issue. Hence, this issue will become our hypothesis that will increase the expenditure cost for NHI in our study.

Result of Age-Expenditure Profile Analysis

Segmenting a population into demographics will provide population's characteristics for many purposes, including policy development and economic market research. Here, demographic analysis is utilized by dividing the sample of NHI members into four age interval categories to measure the cost dimensions and dynamics of populations as presented in Table 2. The interval for each category is 20 years, starting at 11 years old. By using the method of Age-Expenditure Profile Analysis in NHI's data based on the expenditure of the year 2002, the biggest proportion is 32.16% in the interval 51-70 years old

Table2. The proportion of population vs NHI's expenditure based on year 2002

Age Interval (old)	Population	NHI Expenditure
11-30	37.41%	16.86%
31-50	37.60%	27.58%
51-70	18.21%	32.16%
71-90	6.78%	23.41%

that accommodate only 18,21% of the population. NHI Taiwan had to pay above 55% of total NHI expenditure for people above 50 years old (24,99% of the population). Method of Age-Expenditure Profile Analysis applied to gain the proportion of NHI expenditure for the year 2002-2011 produces the information depicted in Figure 3. Table 3 shows the detailed proportion of the expenditure cost based on Age-Expenditure Profile Analysis. Through the year, the proportion of older spending tends to increase, and the proportion of younger people expenditure tends to decrease. The cause of this phenomenon is older people who live longer have a probability of having higher health costs that influence the proportion of health care utilization. This implies that NHI resources allocated for older people will increase from year to year.

Result of Components Decomposition Method in NHI's Expenditure

The decomposition method will help us to identify the contribution of several factors that influence the increase of NHI expenditure. The data for calculation is provided in Table 4 that consists of the population number for each age interval, annual visit days per capita by age group, and the cost per day per capita for age group year 2002, year 2005, and year 2011. These numbers show how the demographic structure changes into population ageing and how the volume of health care utilization and their expenses change in response to the population ageing.

When the period from the year 2002 to 2011 is observed, the contribution of population ageing to the rising of health care expenditure appears to be 56.19

Table3. The proportion of NHI's expenditure based on age-expenditure profile analysis

Age Interval (old)	Year									
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
11-30	0.1686	0.1622	0.156	0.1513	0.1459	0.1395	0.1354	0.1294	0.1239	0.1189
31-50	0.2758	0.2689	0.2618	0.2563	0.2498	0.2444	0.2403	0.2355	0.2303	0.2252
51-70	0.3216	0.3243	0.3278	0.3315	0.3355	0.3399	0.3439	0.3485	0.3535	0.3575
71-90	0.2341	0.2446	0.2544	0.2609	0.2687	0.2761	0.2804	0.2865	0.2924	0.2983

Table4. Data for calculation of demographic structure changes by age cohorts

Age (old)	Population	Visit days/ capita	Cost/visit days (NTD)	Population	Visit days/ capita	Cost/visit days (NTD)	Population	Visit days/capita	Cost/visit days (NTD)
11-15	68,850	8.27	642.81	69,868	8.86	656.45	66,336	9.35	591.37
16-20	75,997	8.44	831.78	68,217	8.70	832.71	69,760	8.65	803.08
21-25	86,151	9.19	898.42	83,226	9.38	965.58	67,910	9.43	925.01
26-30	80,192	9.95	924.76	85,338	9.97	951.63	80,335	10.43	930.33
31-35	80,397	10.63	924.81	78,765	10.84	1,004.35	86,729	11.25	960.86
36-40	82,869	11.20	970.77	80,740	11.61	1,066.94	77,752	11.63	1,024.18
41-45	78,595	11.82	1,070.02	82,210	12.45	1,154.96	80,237	12.28	1,161.91
46-50	70,938	13.28	1,221.13	75,752	13.94	1,300.87	82,012	13.83	1,288.37
51-55	53,732	15.62	1,363.88	65,962	16.03	1,446.47	76,317	15.59	1,497.75
56-60	34,586	17.67	1,502.16	41,030	18.30	1,653.09	67,671	17.98	1,702.32
61-65	34,639	20.25	1,632.49	36,090	20.78	1,748.44	45,020	20.47	1,816.67
66-70	28,490	24.81	1,698.40	31,238	24.54	1,884.92	33,420	23.81	1,912.53
71-75	25,542	28.58	1,836.11	26,921	27.94	1,980.99	30,894	25.80	2,187.37
76-80	17,293	30.23	1,996.15	22,002	28.94	2,239.57	25,191	25.87	2,381.73
81-85	8,961	30.26	2,187.60	13,063	27.08	2,413.49	21,176	23.68	2,650.17
86-90	4,640	24.81	2,344.24	6,198	23.03	2,624.81	13,115	17.80	3,116.46

Table5. Result of components decomposition method in NHI's expenditure

Period (year)	Population	Demographic change (aging)	Adjusted visit days per capita	Adjusted expense per visit day
2002-2005	4.18%	64.77%	1.36%	29.68%
2005-2011	6.61%	63.92%	0.68%	29.00%
2002-2011	11.06%	56.19%	1.69%	31.06%

Table6. Log expenditure for inpatient and outpatient case per age

Quantile	Expenditure for Inpatient Case per Age				Expenditure for Outpatient Case per Age			
	Year 2002 (NTD)	Year 2005 (NTD)	Year 2011 (NTD)	Change (%) 2002/ 2011	Year 2002 (NTD)	Year 2005 (NTD)	Year 2011 (NTD)	Change (%) 2002/ 2011
Mean	5,461.25	6,621.89	7,229.57	24%	10,926.27	12,352.82	14,803.22	26%
10th percentile	1,496.86	1,382.11	1,624.20	8%	5,246.99	5,633.35	6,103.49	14%
25th percentile	2,686.30	2,908.33	3,344.15	20%	6,646.62	7,076.20	8,343.86	20%
Median	4,872.01	6,135.75	6,093.59	20%	12,461.35	14,213.48	15,873.29	21%
75th percentile	15,770.60	19,309.33	18,651.54	15%	24,401.51	25,550.31	29,384.23	17%
90th percentile	30,639.23	36,958.20	29,482.47	-4%	30,979.45	31,502.47	35,227.65	12%
95th percentile	36,090.59	41,281.66	30,946.58	-17%	31,590.42	32,809.88	36,048.73	12%

per cent, as shown in Table 5, which presents the result that already excluded the price inflation as a factor that influences the health care expenditure rising. This table shows that the contribution of

change in demographic structure was 56.19 per cent from 2002 to 2011, and 63.92 per cent in 2005 to 2011, which shows that population ageing became a more influential factor in medical expenditure increases. The effect of population ageing on the increase in health care expenditure is more than 50 per cent. The volume of health care utilization, which is a quantitative factor, affects the health care expenditure increase by around 1.69 per cent. The contribution of increased medical fee levels is around 31.06 per cent. The medical fee here includes all the service charges that consist of doctor's service fees, expenses for operating the institution, and the increasing cost of pharmaceuticals and medical supplies and will also include the intensity of treatment and the increased services due to the expanded coverage of health insurance.

Through deeper identifying in adjusted expense per visit day data, this paper obtains more information, as shown in table 6 that reports statistic summary for each category of inpatient and outpatient cases in several quantiles. Mean real expenditure for Taiwanese increased 24% and 26% for inpatient cases and outpatient cases respectively as Meijer *et al.* [14] also has proven for the increasing of Netherland healthcare people around 28 %. This growth is mostly triggered by increases in the upper half of the distributions that are dominated by people above 50 years old. From the data analysis, we also obtained that most patients under 20 years old are under 10th quantile. Then, by comparing the health care expenditure data in 2002, the 10th quantiles and the median of this statistic, people above 50 years old spend 3.25 times higher than people under 20 years old. Meanwhile, in 2011, people above 50 years old will spend 3.75 times higher than people under 20 years old. This rate changing is caused by the discovery of the new medical technology for improving health care that tends to introduce more expensive treatment and promotes widespread use, particularly on pharmaceutical (Hakkinen [15]). The percentage for most quantiles interval always increases from year to year for both inpatient and outpatient cases, except in 90th and 95th quantiles. The rate decreasing inpatient expenditure for a high level of expenditures is dominated by the people above 80 years old. For this, the government paid attention to their life quality so that older people may have better health.

Figure 4 presents the empirical quantile functions of the logarithm of the expenditure for inpatient and outpatient cases. At the beginning of the quantile, expenses for inpatients case looks smaller than the outpatient case, whereas commonly inpatient case requires a higher expenditure than the outpatient cases. This indicates that the number of patients who utilized health care facilities without staying is higher than the inpatient cases. Children tend to get an infection, and most younger people choose to visit the doctor to get some medicine without staying at the health care facilities. Thus, caused the expenditure for an outpatient case to look higher than inpatients cases. The growth expenditure of outpatient cases is continuously increasing throughout the year.

Conclusion

The objective of this study is to analyze the impact of population ageing on National Health Insurance in the case of Taiwan and its contribution to National Health Insurance Expenditure. We applied two approaches to do the analysis. After studying some literature review and analyze the observation data, we firstly state our hypothesis that the population shifting in Taiwan's demograph is an important issue that should be considered in the increasing of health care expenditure (Gray [5]). The first approach in this study uses age-expenditure profile analysis

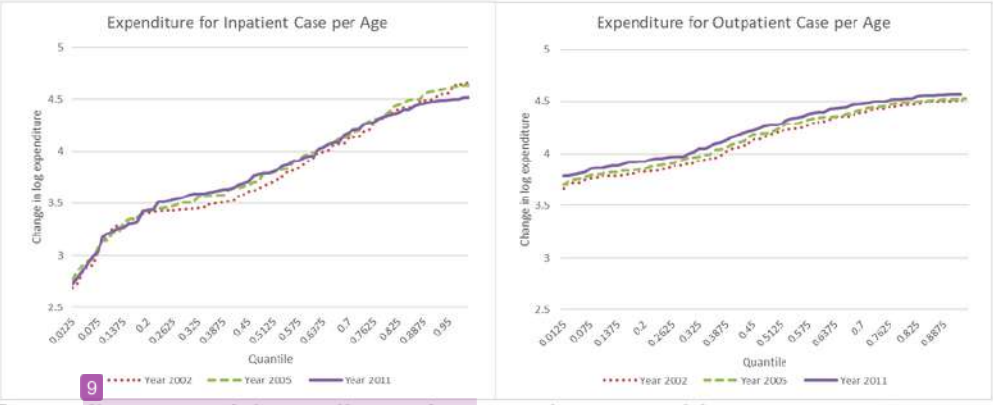

Figure 4. Change in quantile function of log expenditure per age for inpatient and the outpatient in year 2002, 2005, and 2011

that projects the impact of demographic change onto health care spending. The result shows the increase of health care expenditure proportion for the group with older age throughout the year, which is closer to the present year. Also, for the group with younger age, their expenditure proportion decreases compared with the previous year. This reveals that the proportion of health care expenditure to the older age groups is growing, due to the increased resources applied to extend the expected life. For this, the sources will be allocated more for the elderly. Several researchers, such as Zweifel *et al.* [16] stated that the most attributes of the increase in health care expenditure are related to the population ageing.

The second approach we used in this study is decomposing the components of National Health Insurance expenditure. We decompose the expenditure cost into several components that are the increase in population coverage, the ageing of population structure, the increased fees for services, and the increased volume of service used. Through the analysis, the effect of population ageing can be estimated. We estimate the contribution of demographic shifting to health care expenditure in three years data, year 2002, 2005, and 2011. When the period from 2002-2011 is selected, the contribution of population ageing to the increase of health care expenditure appears to be 56.19 per cent, that shows that population ageing became a more important factor that influences the magnitude of health care expenditure. Yang *et al.* [17] confirm that monthly health care expenditures for older people do increase substantially with age because their mortality rates increase with age and health care expenditures increase with closeness to death. They also found that the time to death was the main reason for higher inpatient care expenditures, but that an increasing elderly population was the main reason for higher long-term care expenditure.

The volume of health care utilization that affects health care expenditure increased by around 1.69 per cent. This reflects the increasing demand for health care services being relatively lower than the other factors. The contribution of increased medical fee levels is high enough, around 31.06 per cent because technology innovation is found as an important factor in high and rising health care costs (Bodenheimer [18]). To improve the performance of health care services, hospitals and other health facilities are making significant investments in health information technologies (Sharma [19]). In this study, we found that the main drivers of the health care expenditure rising in Taiwan appeared to be both the impact of population shifting and the increasing medical fee level.

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