WKU Applied Economics Final Project

Who's Still Going Broke?
An Updated Comparison of Healthcare Costs in Ten OECD Countries

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Introduction

This paper extends the work of Hagist and Kotlikoff (2005) in "Who's Going Broke? Comparing Healthcare Costs in Ten OECD Countries" using an updated dataset. It was published in December 2005 by the National Bureau of Economic Research. The premise of their project was examining healthcare expenditures in developed countries that were rising sharply to discover if they were rising due to an increase in benefit levels or if due to a sharp demographic change. Their data came from the Organisation for Economic Co-operation and Development (OECD) along with various governmental and academic sources, spanning from 1970 to 2002 using 1995 prices.

I was able to procure enough data to adapt their methodology, but with additional 10 years of observations. With changes in economics, healthcare markets, and governmental legislation I was not expecting to have the same results. Beyond that, scarcity of data related to the project was also a blockade that I attempted to overcome.

Government healthcare expenditures for developed nations have continually been growing at a faster rate than their economies. This was the case at the time of Hagist and Kotlikoff's original drafting, as well as projections published by the Center for Medicare and Medicaid Services (2018) that forecast healthcare spending growing at .8% faster than GDP per year from 2018 to 2027 in the United States alone. Due to this issue, Hagist and Kotlikoff decided to investigate deeper by asking the question of how much is expenditure growth due to demographic change and how much is due to increases in health expenditures per person at a given age, characterized as benefit levels. The distinction is important because demographics are outside of a policy control but benefit levels are driven almost entirely by governmental

decisions. Data for ten OECD countries were examined - Australia, Austria, Canada, Germany, Japan, Norway, Spain, Sweden, the United Kingdom (UK), and the United States (U.S.).

Healthcare expenditures have grown tremendously over the last several decades and do not appear to be slowing down for any country. Growth in benefit levels could be a driving factor. My research, as detailed in the appendix attached, has shown that over the 42-year period between 1970 and 2012, healthcare expenditures have grown at 4.25% annually on average across the countries examined. That is 1.7 times what GDP has grown on average during the same period. Remove the growth from benefit levels and expenditures continue to rise on average. Instead, they would have grown at 1.47%, or .58% of the growth that GDP experienced through the period. This growth is most likely associated with changes in demographics, mainly changes in age groups as individuals move from one age group to another and require regular medical treatment. Tables 3, 4, and 5 have further information on these issues.

Moving forward, expenditures will continue to grow as more individuals move into the older brackets and on average use more care, and thus increase costs. The elderly made up 17.4% of the population in 2012. Meanwhile, projections by the United Nations (2005) and the OECD (2019) suggest that those populations are only going to grow across the ten countries examined. By 2040, the elderly share of the population will make up 26.2% on average in each country. Table 1 displays projections for the future up to 2050, when the elderly will make up 27.3% on average with Japan having 38.8% of its population made up of citizens 65 years or older. Meanwhile, the U.S. and Australia will have the lowest shares of elderly with 20.9% each.

This is a dangerous trajectory to be on for countries like Japan. With expenditures and benefit levels increasing at faster paces, having a larger share of elderly will only drain the nation of valuable resources. While the U.S. has a smaller elderly population relative to other groups,

between 1970 and 2012 real per capita healthcare spending increased by 6.48% in Table 3 and by a factor of 1.77 over GDP growth as seen in Table 5. Without benefit level additions, that factor would have been .52 and only grown by 1.44%. Yet U.S. costs continue to increase, leading to larger expenditures by the only country in the study that does not have a universal healthcare system. The story isn't entirely on benefit levels though. Age demographics play an important role in healthcare expenditure increases but have been overtaken by swarming benefit level hikes.

Tables 3 and 4 list annual benefit growth and expenditure growth rates. Japan with an extensive elderly population has seen a 2.71% growth rate in benefit levels that has led to healthcare expenditures growing at 4.18% annually. Without the benefit level hike, it would have been 1.48% and expenditures would not have grown at a factor of 1.67 that of GDP. Japan's future healthcare industry seems destined for further hurdles. Beyond just Japan and the U.S., every nation in this study was found to have a real healthcare expenditure growth rate that is higher than their national GDP growth rate. Additionally, each can be seen to be driven largely by the benefit level of the residing country. The point of this study is to examine past and present healthcare expenditure growth rates and detail what role benefit level changes have played. First, I start with featuring literature on the topic, detailing the data used and how it was obtained, explaining the methodology, presenting findings, and discussing the long-term fiscal issues that face the nations.

Literature Review

In "Income Inequality and Health Care Expenditures over the Life Cycle" by Serdar Ozkan, he examines the impact of healthcare spending between low and high-income groups.

Using data from the Medical Expenditure Panel Survey (MEPS), he finds that the rich tend to spend more on healthcare than the poor until midway through life where the poor begin to spend more. The point of the study is to examine the distribution of medical expenses on population groups. Oskan details that as individuals age, the poor cannot afford preventive medical care. This leads to higher spending during old age for physical medical care. The paper then suggests a hypothetical universal healthcare system that results in welfare gains even after increased taxes. The results of further spending by the poor for severe medical issues over preventive issues, suggests that as populations grow older, they cause expenditures to increase for that population group and thus overall expenditures for the nation increase.

In "What is the Distribution of Lifetime Healthcare Costs from Age 65?" by Anthony Webb and Natalia Zhivan, the authors research medical and long-term care costs for individuals over age 65 in the U.S. They detail that these costs are a substantial risk for retired households. By using U.S. expenditure data, they find that the present value of lifetime uninsured health care costs for a typical married couple over 65 is $197,000. This figure includes all premiums, out of pocket costs, home health costs, but excludes nursing home care. Although, they state there is a 5% risk that these costs may exceed $311,000. When nursing homes costs are included, the figure increases to $260,000 on average. With the 5% risk included, the cost could exceed $570,000. This study puts into stark contrast the issues with healthcare costs for a nation with a rising elderly population.

Aris Angelis, David Tordrup, and Panos Kanavos studied macroeconomic and health-related variables that impact the financial sustainability of national healthcare systems in "Is the Funding of Public National Health Systems Sustainable over the Long Term? Evidence from Eight OECD Countries." This study provides insight on financial resources required to meet

healthcare demand. Through their statistical analysis of eight OECD countries, they find that a funding gap between required and committed levels of health care spending will exist in the near future. Their estimations were that the gap could be between 39 and 61 percent of 2012 expenditure levels over the 2013-2017 spending periods. They suggest that policy makers will need to focus on outcome-based reimbursement, prioritize efficiency rules, and implement organizational innovations in order to afford and sustain their health care systems. They also suggest that removing services is an unlikely option for the nations.

In "Population Ageing and Health Care Expenditures: The Role of Life Expectancy", Friedrich Breyer and Thomas Niebel discuss whether an ageing population is a driving factor in higher healthcare expenditures or if it falls into a "red-herring" hypothesis. They question whether the correlation between rising expenditures and age is really caused by proximity to death. They use German sickness fund data from 1997 to 2008 in a fixed-effects regression to find that age, mortality rate, and life expectancy all have a positive impact on healthcare expenditures per capita. They also project that per capita healthcare expenditures will rise between 76 and 200 percent by 2060.

Data

In Hagist and Kotlikoff's original paper, their data came from the 2004 report by the OECD regarding healthcare statistics. They used aggregate annual real healthcare expenditures from 1970 to 2002, adjusted for 1995 prices. They also used population counts for eight age groups also published by the OECD. Otherwise, they used age-healthcare expenditures profiles for each country for either the year 2000 or 2001, adjusted to 2002 prices. They were obtained from different academic and governmental sources.

For this project, I obtained similar data from mostly the same sources. To stay in line with the original purpose, I used OECD data that ranged from 1971 to 2012. One small issue arose upon inspection, as the original paper used data for all countries from 1970 to my understanding. The data I obtained did not include a measurement for Australia in 1970. For the sake of comparison, I use the values presented in the original paper for Australia in 1970 in statistical representation of benefit and healthcare expenditure data. Otherwise, I used data from 1971 to 2012 instead for model analysis so that I had data points for all countries for all years. The reasoning behind my data ending in 2012 was due to coinciding with my demographic materials. I attempted to obtain the same demographic population groups as listed in the original paper. This was rather difficult to procure, but with effort I found the population groups for all ten countries. The list has been discontinued by the OECD with the last year for full observations for all ten countries being 2012. This list featured several age groups that started at less than a year of age and moved at five-year intervals, ending at age 85+. This was the closet data I could obtain that was similar in scope to the original product. To complete this continuation of the work done by Hagist and Kotlikoff, I merged several of the age groups together in order to have the eight age groups present in the study. From my research, this is the only way that the authors could have performed their study as neither the OECD nor any of the agencies they credit regularly use the eight age groups they reference.

As mentioned above, the authors obtained healthcare profiles from a variety of sources. These profiles detailed the average benefit for each age group in each country. Some of these profiles I was able to obtain. According to their paper the data for Australia, Canada, Germany, the UK, and the U.S. came from the following respective government agencies: the Australian Institute of Health and Welfare, the Minister of Public Works and Government Services Canada,

the German Federal Insurance Authority, the United Kingdom Department of Health, and the Centers for Medicaid and Medicare Services. Austria's profile came from Hofmarcher and Riedel (2002). Japan's profile came from Fukawa and Izumida (2004). Norway's profile came from Fetzer, Grasdal, and Raffelhüschen (2005). Profiles for Spain and Sweden are based on the work of Catalán., et. al. (2005) and Ekman (2002), respectively.

Despite these leads, I was only able to obtain the age-profiles for five of the ten countries: Australia, Austria, Canada, the U.S., and Japan. Without these profiles, I was not able to replicate the age-benefit table which was listed as Table 2 in the Hagist and Kotlikoff paper. In my research, I found no trace of the German profile, with all links leading to the work done by Hagist and Kotlikoff. The source that is credited for the UK profile does not mention age-group expenditures, only expenditures at large. It is possible they were able to produce the needed values through some mathematical modeling that I have not performed at this time. Meanwhile, the credited works relating to Norway, Spain, and Sweden do not credit any figures to create the age-expenditure profiles, only feature graphs relating to the information. The data for these figures is not readily available, and while I did consider messaging the authors to obtain further figures, I logically assumed it would remain not readily available due to such an extensive time period since publication. The age-expenditure data for Japan was also not featured in the work cited. Due to these issues, I was not able to accurately duplicate the findings nor update the statistics offered in the original paper. As such, I have attached Table 2: A and Table 2: B, with the latter being a duplicate of the original table and the first being the creation using the data I obtained from various governmental agencies.

Other data used for this project came from the OECD (2019) statistical database and the United Nations (2005). This includes information related to healthcare expenditures as well as gross domestic product (GDP), GDP per capita, and GDP growth.

Methodology

To measure healthcare expenditures along with the benefit and demographic changes in a given country by year, I used the same methodology used by Hagist and Kotlikoff. For their paper, E_t represents the value of real healthcare expenditures in a given country in year t. This consisted of a summation of healthcare expenditures, $\varepsilon_{i,t}$, as the average expenditure per age group i at time t, with another parameter, $P_{i,t}$, standing for the population age i at time t. The below equation is what gives us the annual expenditure in healthcare given age group population counts and the annual expenditure per age group.

(1)

$$[?][?]_t = \Sigma \varepsilon_{i,t} P_{i,t}$$

As of this writing, the current OECD website provides past population counts for various age groups. The age groups used in the original study were 0-14, 15-19, 20-49, 50-64, 65-69, 70-74, 75-79, and 80 plus. The OECD no longer uses these age groups and has discontinued any datasets that included them. As mentioned previously, I used the discontinued data published by the OECD to create the eight age groups. The subscript i references these age groups.

I assumed that health spending was constant through time for these age groups in mind. In order to analyze the benefit levels, with the available data for expenditures per age group I normalized these age groups by dividing each by the average expenditures for the 50-64 age

group in year t. As such, this provides the ratio of expenditures per age group in comparison to the average expenditure for the 50-64 age group as a base. Defined as:

(2)

$$\frac{\varepsilon_{0-14,t}}{\varepsilon_{50-64,t}} = \alpha_{0-14};\ \frac{\varepsilon_{15-19,t}}{\varepsilon_{50-64,t}} = \alpha_{15-19};\ \frac{\varepsilon_{20-49,t}}{\varepsilon_{50-64,t}} = \alpha_{20-49};\ \frac{\varepsilon_{50-64,t}}{\varepsilon_{50-64,t}} = \alpha_{0-14} = 1;$$

$$\frac{\varepsilon_{65-69-,t}}{\varepsilon_{50-64,t}} = \alpha_{65-69};\ \frac{\varepsilon_{70-74,t}}{\varepsilon_{50-64,t}} = \alpha_{70-74};\ \frac{\varepsilon_{75-79,t}}{\varepsilon_{50-64,t}} = \alpha_{75-79};\ \frac{\varepsilon_{80\ plus,t}}{\varepsilon_{50-64,t}} = \alpha_{80\ plus}$$

Hagist and Kotlikoff treat absolute average real expenditures of the 50-64 age group as the country's benefit level. My assumption is that the age group encompasses both relatively healthy individuals as well as aging ones with deteriorating health, who may be using the system more. 1970 is the base year, denoted as b, assuming benefit levels grow at a constant annual rate provides

(3) $$\varepsilon_{50-64,t} = \varepsilon_{50-64,b}(1+[?][?])^{t-b}$$

By doing this, we redefine (1) by inserting (2) and (3) into the equation to render

(4) $$E_t = \varepsilon_{50-64,b}(1+[?][?])^{t-b} \sum_i \alpha_i P_{it}$$

In equation 3, by taking the average healthcare expenditure for the 50-64 age group in the base year of 1970, then using an estimated annual growth rate we can determine the current and future projected expenditures in healthcare for that age group. Per the equation, when t=b we are given the value of aggregate healthcare spending in the base year (E_b). Along with the age-health expenditure profile ($\alpha_i S$) and the age-specific population counts ($P_{it} S$), equation (4) can

be used to determine healthcare expenditures. In the original composition, the authors set t=2002 in (4) to determine the value for λ. With newer data, I set t=2012. Beyond that, the authors also assumed for possible measurement error, with equation (5) being used to account for this by taking logarithms of both sides of (4).

(5) $$\ln ln\, E_t - ln[?][?][?]\left(\sum_i \alpha_i P_{it}\right) = \ln ln\, \varepsilon_{50-64,b} + (t-b)\ \ln ln\left(1+[?][?]\right) + v_t$$

In the above, v_t stands for any measurement error and E_t stands for measured aggregate healthcare expenditures. Through (5) an estimate for $\varepsilon_{50-64,b}$as λ can be found. With λ found for each nation, comparing benefit growth rates across countries and decomposed total healthcare expenditures growth between benefit levels and demographics can be determined.

I also review projected future aggregate healthcare expenditures for each country by comparing its present value with the country's present value of GDP. I assume that real per capita GDP grows in the future at the average rate observed in each country over their sample period of 1971 to 2012. I consider rates of 3, 5, and 7 percent in forming present values of future healthcare spending relative to GDP.

Table 1 provides projections for the elderly share of the population for each country up to 2050. These projections were taken from the OCED (2019). Projections featured in the original project were credited to the Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat (2005). Projections from the United Nations published in 2017 were obtained but not featured in favor of more recent data.

Findings

Tables 3 and 4 compare real levels and real growth rates of per capita healthcare expenditures, per capita benefits, and per capita GDP from 1970 to 2012. My study focused on 1971 to 2012, I included the statistics from the original paper as a continuation, with an adjustment from 2002 to 2010 U.S. Dollars in good faith due to the absence of age-health expenditure profiles available for all countries. In my analysis, I include the 1970 entry.

Table 3 includes the 1970 and 2012 per capita expenditure, per capita GDP, benefit level, and the annualized growth rates for each. As with the original paper, the per capita expenditures grew faster than per capita GDP for every country. Benefit level growth rates across the ten nations were larger than GDP growth but did not incline at such a steep rate as per capita expenditures. In fact, the growth in benefits has slowed compared to the results in the original paper. Expenditures have also seen an increase in growth. This expenditure growth in comparison to the slowed growth in benefit levels suggest that demographics are playing more of a role in the expenditure increase.

Table 4 continues the per capita expenditure and GDP topic. In 1970, the expenditures made up less than 5 percent of per capita GDP in all countries but Sweden. 42 years later per capita expenditures as a share of per capita GDP were 8% or more in nine of ten countries. The highest share of GDP in 2012 belonged to the U.S. with 16.4%, with the UK having the lowest at 7.8%. Sweden had the highest level of both per capita expenditure, and the highest share of GDP in 1970. The largest change since 1970 goes to the U.S., which had a $583 expenditure per person in 1970 before raising it to $8,134 in 2012. Meanwhile, Sweden had the highest level of share of GDP per person in 1970 yet fell to third behind the U.S. and Germany by 2012.

Benefits grew the most in Norway from 1970 to 2012, at 3.82%. This is a bit peculiar as Norway's per capita expenditures grew slower than several other countries, but its per capita GDP grew at a larger rate than any other at 2.44%. The countries behind Norway include the UK at 3.50% and in benefit growth and Spain with 3.51%. Meanwhile, the per capita GDP of Austria and Japan grew at 2.17% and 2.12%, respectively.

Table 5 takes a further look at the relationship between benefit growth levels and GDP. It examines the growth rates of healthcare expenditures and the real GDP growth rate with and without benefit growth levels obtained in Table 3. Real healthcare expenditure grew 4.25% on average from 1970 to 2012. Australia, Norway, the U.S., and Spain all grew at a higher rate than the average during that interval. When considering the growth in benefit levels, the average drops to 1.47%. That drastic drop sheds light on the effect that benefit growth has on the overall expenditure allocated to healthcare yearly. Even then, Australia, Canada, the UK, and Japan all grow a higher rate than the average. Despite the stark increase in benefit levels, the average growth rate of GDP was less than the expenditure growth rate for all ten countries. The average GDP growth rate for the period was 2.5%, with the U.S., Spain, Norway, Japan, Canada, and Australia all having higher rates. On average, the rate of healthcare expenditure growth exceeded the GDP growth rate by a factor of 1.70. Austria, Germany, Norway, Spain, the U.S., and the UK all outgrew the average rating. Canada and Sweden grew at the lowest rates of 1.44 and 1.53 percent. With benefit growth removed, the average rating becomes .58. Without benefit growth levels, GDP would grow at a quicker interval than healthcare expenditures.

Accounting for Measurement Error

Hansen and King (1996) showed that health expenditure time series may not be stationary. Now that I move from calculating λ, to estimating it, I tested my dependent variable for stationarity using the Augmented-Dickey-Fuller (ADF) test. This was performed for each country and is represented by Table 6. Except for Austria, Japan, and the U.S., all other countries proved to be non-stationary according to my calculations. As such, estimating by OLS for these nations could result in spurious inference. My Dickey-Fuller results were different from the results by Hagist and Kotlikoff, though I'm not certain for what reason. Autocorrelation is another potential problem examined by Hagist and Kotlikoff, which resulted in using several techniques such as Prais-Winsten estimation, Cochrane-Orcutt estimation, Maximum Likelihood estimation, and an Autoregressive Moving Average Model (ARMA). I used OLS, Prais-Winsten, and Cochrane-Orcutt to estimate benefit growth rates for each country. Although, the results are in the range expected and do fall within the same error range of the numbers published by Hagist and Kotlikoff.

Table 7 provides the estimated benefit growth rates for each country in my study. The largest OLS estimated rate is for the UK with 3.05 percent, followed by Japan with 2.90 percent, then Sweden with 2.89. This changes with Prais-Winsten, as the U.S., Australia, and Germany become the largest with 3.46 percent, 3.03 percent, and 2.97 percent. This remains the same for Cochrane-Orcutt, as the U.S., Germany, and Australia have the highest with 3.68, 3.25, and 2.57 percent.

Who's Still Going Broke?

Table 8 presents future values of health expenditure share of GDP in current values if benefit levels continue to grow out of hand. It starts with 2012 healthcare expenditure share of 2012 GDP. Using the 2012 benefit level as a base, it calculates increases of 3, 5, and 7 percent for four different time periods. After determining the benefit growth, it combines it with present value healthcare expenditures and determines what share it the new figure would be with present value GDP. The four time periods are less than 1 year, 20 years, 40 years, and 60 years of historic benefit level growth. This gives a projection of what the future costs of healthcare will be relative to present value GDP. When Hagist and Kotlikoff published their paper, 3 percent may have been a good decision based on their reasoning of long-term inflation and index bond rates, but today it may be a bit high as 3% is almost double current inflation. Despite that, to compare previous results with updated figures, I used the same historic rates. The first growth rate was determined in Table 3, which shows the 2012 per capita expenditure share of per capita GDP. The remaining values are determined using the full 2012 healthcare expenditure value along with 2012 GDP for each country. Under the first period, the growth immediately stabilizes. This was also true for Hagist and Kotlikoff's results, however my values are a bit lower on future shares of GDP. With these projections, Germany, the U.S., and Japan have the largest present value costs against present value GDP. This isn't surprising for either nation, with Japan having a growing elderly population, the U.S. having the largest per capita expenditure, and Germany having both the third largest per capita expenditure and the third largest projected share of elderly in its population by 2050.

In the second period with historic growth rates over 20 years, Sweden and the U.S. top the charts for largest shares of GDP. Healthcare expenditures and benefit levels are both growing

faster than GDP in Sweden, while it is projected to have a less than average elderly population. Meanwhile, Australia has the lowest present value share of GDP than any other nation at all discount rates. At 7 percent, Australia's cost will only be 6.54% of future GDP. In comparison, the U.S. had 16.31% of future GDP. Austria and Germany have similar results but that is expected from two nations with similar demographics and economies.

In the third period, Australia continues to have the lowest shares of present value GDP. This is a good thing as the country in 40 years at a 7% rate will only pay 7.85 for every dollar, while nations such as Norway, Sweden, and the U.S. will pay 20.87, 17.54, and 16.43. The UK on the other hand will have a situation similar to Australia, as it is projected to only have to pay 8.11 per dollar. In the last period after 60 years of rate increases, Sweden, Norway, and Austria will pay the most per dollar with 43.67, 64.42, and 41.63. Australia and the UK will pay the least at 12.93 and 10.96 per dollar.

Conclusion

Aggregate healthcare expenditure growth since 1970 reflects the real role that benefit levels play in rising growth rates. With the current rates of benefit level growth, healthcare expenditures will continue to outgrow GDP. These issues seem to only continue in the far future as several nations see the introduction to larger shares of elderly individuals. This influx that will alter the age group demographics in some countries and pressure benefit levels upwards, only continuing the rise in healthcare expenditures. With nations like Sweden, Austria, and Norway projected to spend 40 percent or more of every dollar of future GDP on healthcare, these systems may become unsustainable without action. If benefit levels continue to grow without obstacle, it

will continue to be a driving factor in healthcare spending and the determinant for increases in per capita healthcare expenditures.

Looking at the projections for future shares, no nation can spend a rising share of its GDP solely on healthcare and be a viable economy. Benefit growth must eventually line up with either per capita GDP or per capita income. If governments continue to increase benefit levels with wild abandonment, the cost down the line will be severe. Of all the nations examined, Norway had the highest healthcare expenditure growth rate, while Spain had the highest expenditure growth to GDP growth. Norway is also projected to spend the most per dollar of future GDP, along with the highest benefit level growth rate. Based on the material findings in the data, I'd suggest that Norway is the most likely to have financial hardships if it continues this path of benefit growth.

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Calculation Tables and Visualizations

Table 1
Elderly Share of the Population

Country	2012	2020	2040	2050
Australia	14.20%	16.10%	20.00%	20.90%
Austria	17.90%	19.70%	27.10%	28.20%
Canada	14.90%	18.50%	24.00%	24.60%
Germany	20.70%	22.40%	30.50%	31.60%
Japan	24.10%	29.10%	36.10%	38.80%
Norway	15.50%	18.00%	22.90%	23.20%
Spain	17.50%	20.40%	32.70%	36.50%
Sweden	19.00%	20.30%	23.80%	24.10%
United Kingdom	16.60%	19.00%	23.70%	24.10%
United States	13.70%	16.80%	21.00%	20.90%
Average	**17.41%**	**20.03%**	**26.18%**	**27.29%**

Table 2: A
Healthcare Benefit-Age Profiles

Country	0-14	15-19	20-49	50-64	65-69	70-74	75-79	80+
Australia	0.30	0.29	0.65	1.00	1.68	2.01	2.83	6.59
Austria	0.33	0.10	0.92	1.00	0.45	0.54	0.69	2.87
Canada	0.40	0.52	1.75	1.00	0.73	1.10	3.46	10.49
Germany	N/A	N/A	N/A	1.00	N/A	N/A	N/A	N/A
Japan	0.56	0.08	0.34	1.00	0.34	0.31	0.07	0.26
Norway	N/A	N/A	N/A	1.00	N/A	N/A	N/A	N/A
Spain	N/A	N/A	N/A	1.00	N/A	N/A	N/A	N/A
Sweden	N/A	N/A	N/A	1.00	N/A	N/A	N/A	N/A
United Kingdom	N/A	N/A	N/A	1.00	N/A	N/A	N/A	N/A
United States	0.29	0.08	0.47	1.00	0.21	0.32	0.53	3.76

Table 2: B
Hagist and Kotlikoff (2005) Healthcare Benefit-Age Profiles

Country	0-14	15-19	20-49	50-64	65-69	70-74	75-79	80+
Australia	0.60	0.57	0.64	1.00	1.81	2.16	3.90	4.23
Austria	0.28	0.28	0.46	1.00	1.42	1.75	1.98	2.17
Canada	0.43	0.61	0.65	1.00	2.45	2.44	4.97	7.54
Germany	0.48	0.43	0.58	1.00	1.52	1.80	2.11	2.48
Japan	0.44	0.22	0.43	1.00	1.70	2.20	2.76	3.53
Norway	0.57	0.34	0.52	1.00	1.70	2.21	2.69	3.41
Spain	0.57	0.39	0.48	1.00	1.46	1.73	1.97	2.11
Sweden	0.43	0.43	0.63	1.00	1.50	1.50	1.96	1.99
United Kingdom	1.08	0.65	0.76	1.00	2.07	2.07	3.67	4.65
United States	0.88	0.82	0.77	1.00	5.01	5.02	8.52	11.53

Table 3
Per Capita Healthcare Expenditures, Benefit Levels, and Per Capita GDP, 1970 to 2012
(2010 U.S. Dollars)

Country	1970 Per Capita Expenditure	2012 Per Capita Expenditure	Annualized Expenditure	1970 Benefit Level	2012 Benefit Level	Annualized Benefit	1970 Per Capita GDP	2012 Per Capita GDP	Annualized GDP
Australia	$ 439.00	$ 3,704.00	5.21%	$ 518.78	$ 1,637.54	2.77%	$ 21,549.80	$ 43,334.80	1.68%
Austria	$ 476.00	$ 4,307.00	5.38%	$ 711.50	$ 2,290.86	2.82%	$ 17,548.90	$ 43,203.00	2.17%
Canada	$ 714.00	$ 4,170.00	4.29%	$ 784.23	$ 1,636.33	1.77%	$ 20,596.80	$ 41,194.50	1.66%
Germany	$ 804.00	$ 4,460.00	4.16%	$ 1,020.58	$ 2,881.15	2.50%	$ 18,513.50	$ 41,507.20	1.94%
Japan	$ 554.00	$ 3,633.00	4.58%	$ 898.16	$ 2,756.31	2.71%	$ 14,755.40	$ 35,613.10	2.12%
Norway	$ 782.00	$ 4,908.00	4.47%	$ 935.74	$ 4,511.42	3.82%	$ 21,303.10	$ 58,567.60	2.40%
Spain	$ 212.00	$ 2,658.00	6.20%	$ 305.45	$ 1,301.79	3.51%	$ 13,864.90	$ 30,554.70	1.90%
Sweden	$ 1,139.00	$ 4,435.00	3.29%	$ 1,444.82	$ 3,043.57	1.79%	$ 21,163.00	$ 41,988.00	1.64%
United Kingdom	$ 640.00	$ 2,843.00	3.61%	$ 564.84	$ 1,676.33	2.62%	$ 16,452.30	$ 36,587.50	1.92%
United States	$ 583.00	$ 8,134.00	6.48%	$ 404.84	$ 1,715.12	3.50%	$ 23,203.00	$ 49,517.60	1.82%
Average	**$ 634.30**	**$ 4,325.20**	**4.77%**	**$ 758.89**	**$ 2,345.04**	**2.78%**	**$ 18,895.07**	**$ 42,206.80**	**1.93%**

Table 4
Per Capita Healthcare Expenditures and GDP, 1970 to 2012
(2010 U.S. Dollars)

Country	1970 Per Capita Expenditure	1970 Per Capita GDP	1970 Expenditure Share of GDP	2012 Per Capita Expenditure	2012 Per Capita GDP	2012 Expenditure Share of GDP
Australia	$ 439.00	$ 21,549.80	2.04%	$ 3,704.00	$ 43,334.80	8.55%
Austria	$ 476.00	$ 17,548.90	2.71%	$ 4,307.00	$ 43,203.00	9.97%
Canada	$ 714.00	$ 20,596.80	3.47%	$ 4,170.00	$ 41,194.50	10.12%
Germany	$ 804.00	$ 18,513.50	4.34%	$ 4,460.00	$ 41,507.20	10.74%
Japan	$ 554.00	$ 14,755.40	3.75%	$ 3,633.00	$ 35,613.10	10.20%
Norway	$ 782.00	$ 21,303.10	3.67%	$ 4,908.00	$ 58,567.60	8.38%
Spain	$ 212.00	$ 13,864.90	1.53%	$ 2,658.00	$ 30,554.70	8.70%
Sweden	$ 1,139.00	$ 21,163.00	5.38%	$ 4,435.00	$ 41,988.00	10.56%
United King	$ 640.00	$ 16,452.30	3.89%	$ 2,843.00	$ 36,587.50	7.77%
United State	$ 583.00	$ 23,203.00	2.51%	$ 8,134.00	$ 49,517.60	16.43%
Average	**$ 634.30**	**$ 18,895.07**	**3.33%**	**$ 4,325.20**	**$ 42,206.80**	**10.14%**

Table 5
Annual Growth Rates of Real Government Healthcare Expenditures and Real GDP, 1970-2012

Country	Real Healthcare Expenditure Growth Rate (RHEGR)	RHEGR Absent Growth in Benefit Levels	Real GDP Growth Rate	Ratio of RHEGR to GDP Growth Rate	Ratio of RHEGR Absent Growth in Benefit Levels to GDP Growth Rate
Australia	4.78%	2.01%	3.06%	1.56	0.66
Austria	4.11%	1.29%	2.34%	1.76	0.55
Canada	3.92%	2.15%	2.72%	1.44	0.79
Germany	3.39%	0.89%	1.95%	1.74	0.46
Japan	4.18%	1.48%	2.51%	1.67	0.59
Norway	5.10%	1.29%	2.93%	1.74	0.44
Spain	4.82%	1.31%	2.54%	1.90	0.52
Sweden	3.12%	1.33%	2.03%	1.53	0.65
United Kingdom	4.10%	1.47%	2.17%	1.89	0.68
United States	4.94%	1.44%	2.78%	1.77	0.52
Average	**4.25%**	**1.47%**	**2.50%**	**1.70**	**0.59**

Table 6
Unit Root Test Statistics

Country	Augmented Dickey Fuller Test (ADF) Value
Australia	-1.20
Austria	-3.44***
Canada	-0.52
Germany	-1.82
Japan	-2.64*
Norway	-0.27
Spain	-1.58
Sweden	-1.58
United Kingdom	-1.09
United States	-4.04***

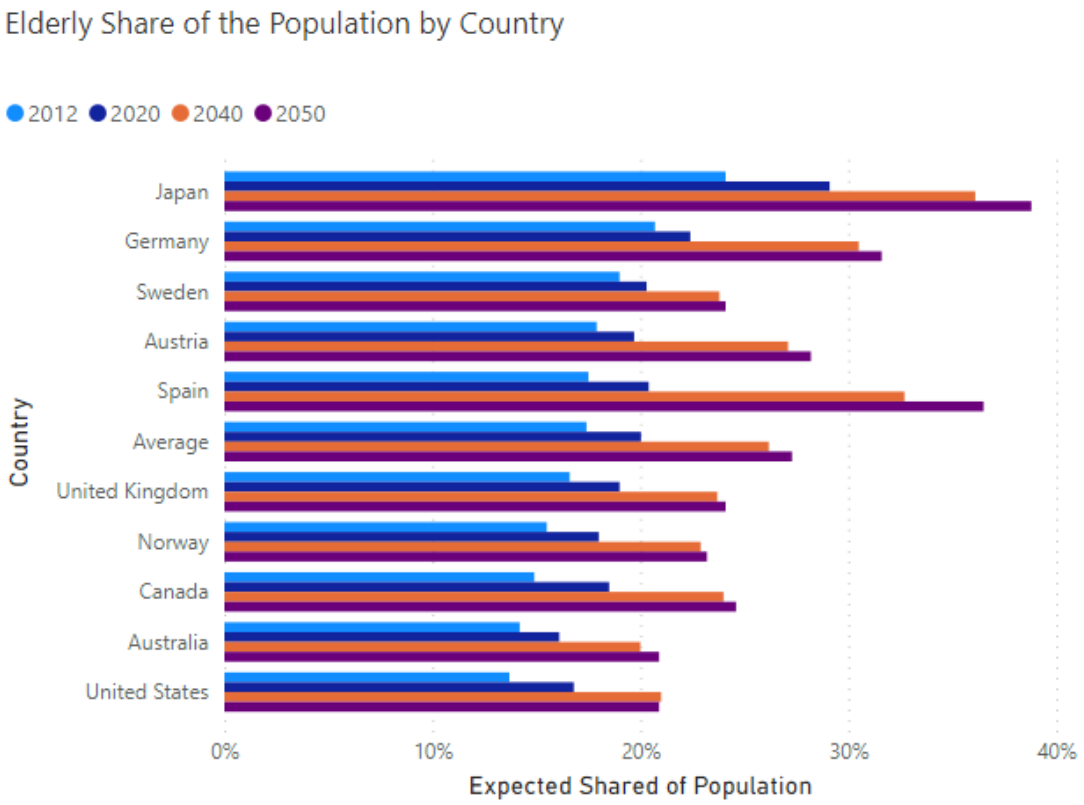
Table 7
Estimation Benefit Growth Rates

	No Measurement Error	OLS	Prais-Winsten	Cochrane-Orcutt
Australia	2.77%	2.57%	3.03%	2.57%
Austria	2.82%	2.82%	2.06%	2.53%
Canada	1.77%	1.69%	2.67%	2.63%
Germany	2.50%	2.23%	2.97%	3.25%
Japan	2.71%	2.90%	2.16%	2.11%
Norway	3.82%	2.82%	2.53%	2.53%
Spain	3.51%	2.45%	1.93%	1.75%
Sweden	1.79%	2.89%	2.02%	2.03%
United Kingdom	2.62%	3.05%	2.43%	2.41%
United States	3.50%	1.78%	3.46%	3.68%

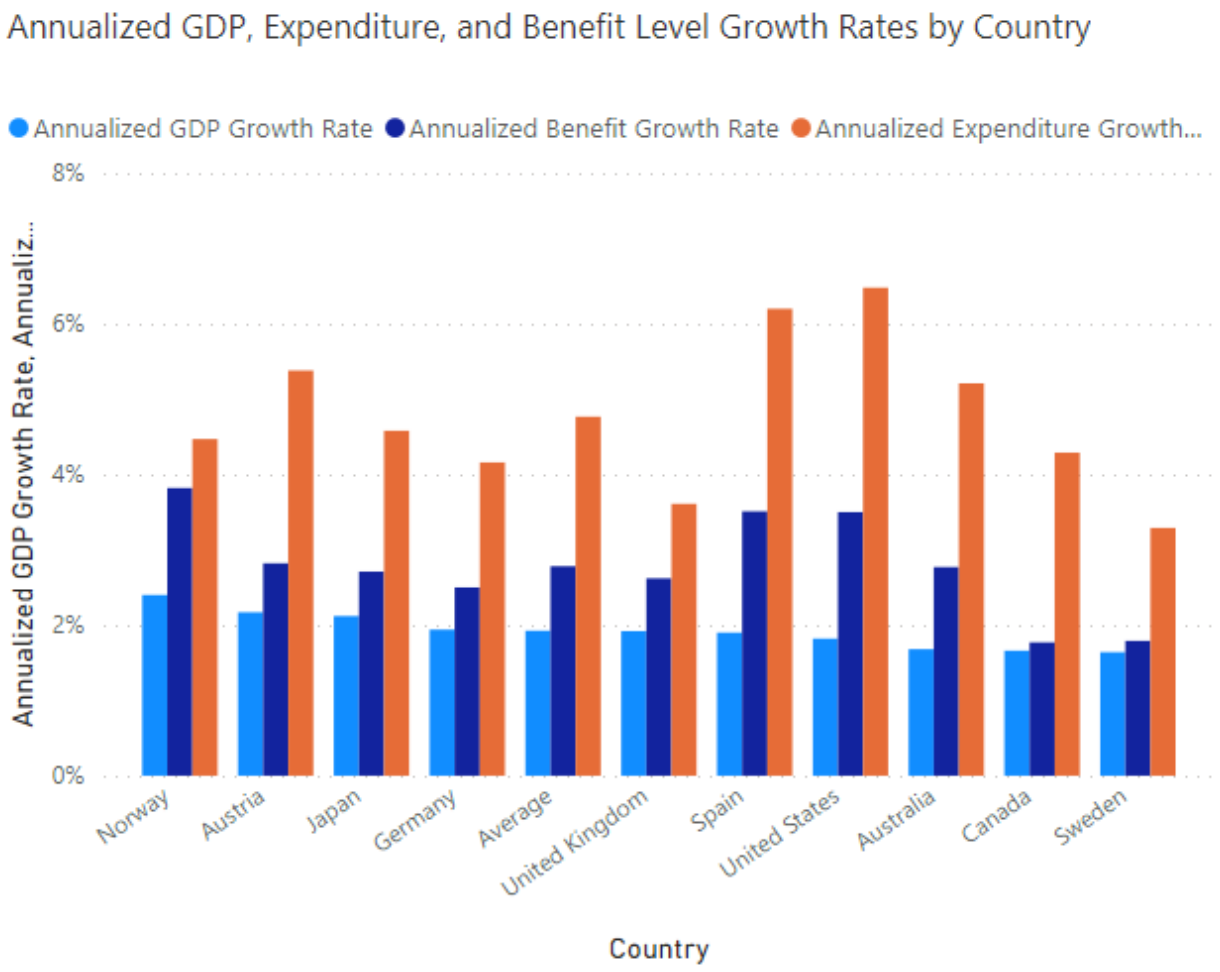
Table 8
Present Value of Government Healthcare Expenditures as a Share of the Present Value of GDP

Country	Start 2012	Benefit Levels Grow at Historic Rate for 0 Years			Benefit Levels Grow at Historic Rate for 20			Benefit Levels Grow at Historic Rate for 40 Years			Benefit Levels Grow at Historic Rate for 60 Years		
		r=3%	r=5%	r=7%	r=3%	r=5%	r=7%	r=3%	r=5%	r=7%	r=3%	r=5%	r=7%
Australia	8.55%	6.08%	6.08%	6.09%	6.29%	6.39%	6.54%	6.46%	6.91%	7.85%	6.77%	8.29%	12.93%
Austria	9.97%	8.96%	8.97%	8.98%	9.96%	10.44%	11.12%	10.78%	12.91%	17.39%	12.26%	19.48%	41.63%
Canada	10.12%	8.54%	8.54%	8.54%	8.71%	8.79%	8.91%	8.85%	9.22%	9.98%	9.10%	10.34%	14.12%
Germany	10.74%	10.08%	10.08%	10.08%	10.22%	10.29%	10.39%	10.34%	10.65%	11.29%	10.55%	11.59%	14.77%
Japan	10.20%	8.27%	8.28%	8.28%	8.36%	8.40%	8.46%	8.43%	8.61%	8.99%	8.55%	9.16%	11.04%
Norway	8.38%	5.72%	5.74%	5.76%	7.52%	8.38%	9.61%	9.00%	12.83%	20.87%	11.66%	24.62%	64.42%
Spain	8.70%	8.63%	8.63%	8.63%	8.79%	8.87%	8.99%	8.93%	9.29%	10.04%	9.18%	10.39%	14.11%
Sweden	10.56%	8.45%	8.47%	8.48%	9.53%	10.05%	10.79%	10.42%	12.72%	17.54%	12.02%	19.79%	43.67%
United Kingdom	7.77%	7.12%	7.12%	7.12%	7.24%	7.29%	7.37%	7.33%	7.58%	8.11%	7.51%	8.36%	10.96%
United States	16.43%	16.26%	16.26%	16.26%	16.28%	16.29%	16.31%	16.30%	16.34%	16.43%	16.33%	16.47%	16.90%

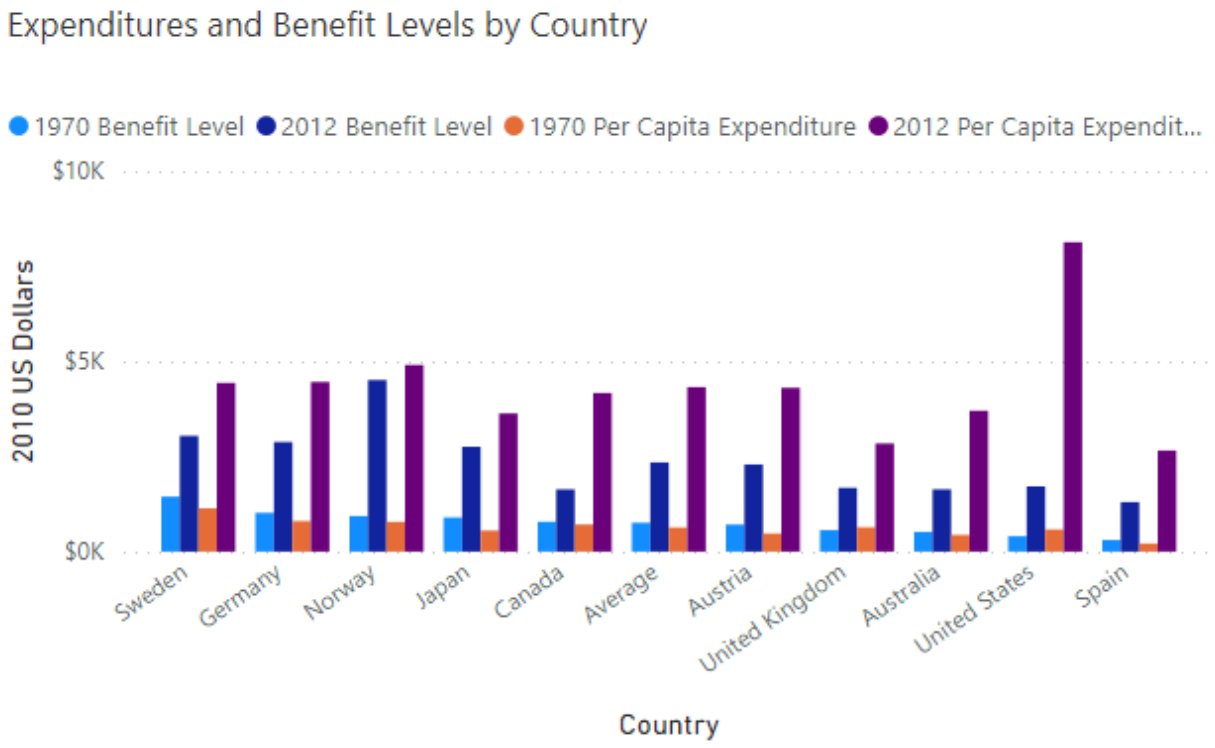
Visualization 1



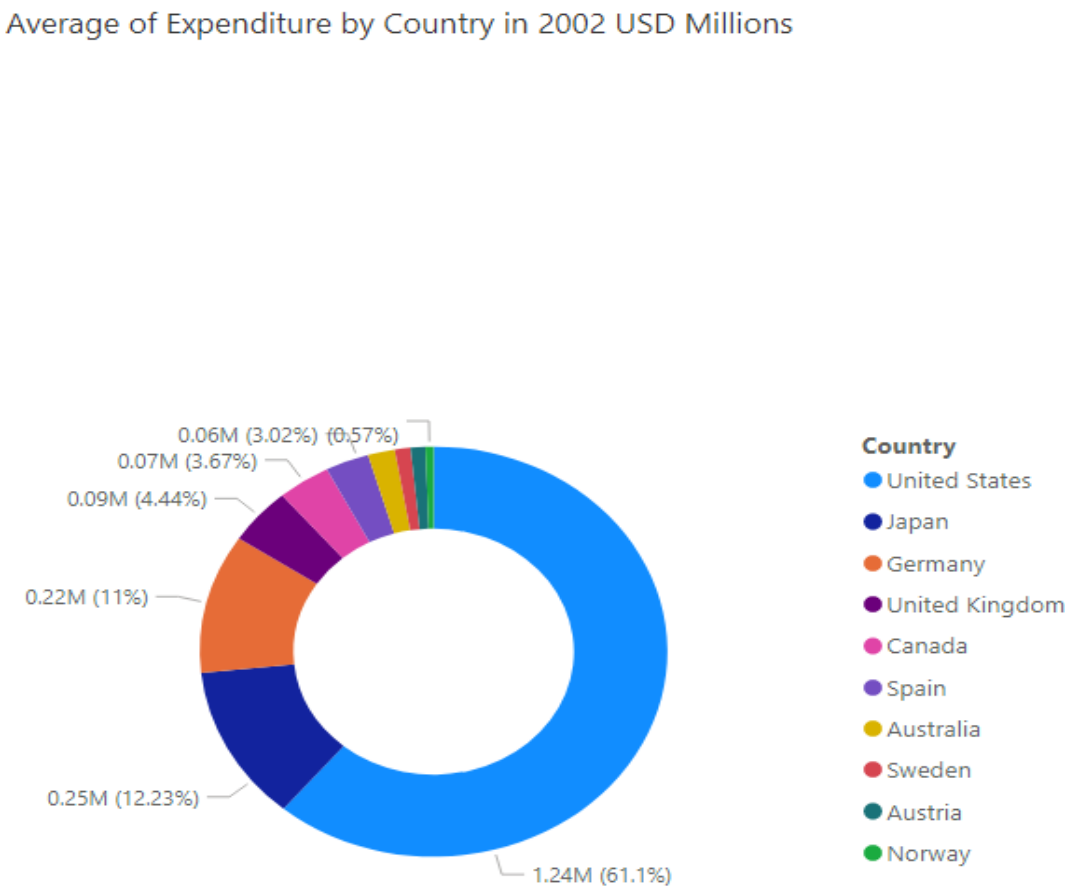
Visualization 2



Visualization 3



Visualization 4



Visualization 5