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Abstract In this study I have made efforts towards investigating healthcare in two arenas. First, can a model with life expectancy as a proxy for healthcare quality be used to objectify the study of efficiency in the G7 countries and Korea? Table 1 and the results section have illuminated many factor variables which vary between countries and characterize the environments in which different healthcare systems have developed. The analysis also illuminates an inherent structural difference in the mechanism of delivering healthcare throughout the developed world. Secondly, can these aggregate data be used to show us anything new about the studies performed by Peter Zweifel and Friedrich Breyer? Did the SISYPHUS Syndrome disappear in the early 1990s as Zweifel suggested in 2002? No, in Table 2 I have demonstrated through SURS that over the time period 1990-2009 there are clear statistically significant SISYPH variables in at least Canada, Germany, Korea, and Britain. Lastly, can I confirm Breyer's model of HCE in Germany and can it be useful in other countries? Yes to extent possible the methodologies were replicated in a SURS fashion in an effort to simultaneously test and examine different variables in different countries. I was unable to confirm the results of Breyer in his 2011 examination of the sickness fund members for Germany. However, I was able to offer primitive characterizations of the other G7 countries and Korea and how their HCE move.

JEL Codes: I11· I12 · I15 · I18

Key Words: healthcare expenditures · healthcare factor variables · sisyphus syndrome

Introduction and Literature Review

As technological advances lead to longer lives, it is critical to understand the mechanism of healthcare delivery. This increased livelihood results in more time spent retired and is bound to cause severe burdens on tax bases. In the United States for example, as the baby boom generation has aged, an increasing financial burden is being placed on a shrinking taxable population to provide medical care. Although this conclusion is simple arithmetic it is not so clear if the increasing longevity of populations will necessarily increase health care expenditures. If government programs are going to survive there will have to be substantial structural and financial reforms broach this clear accounting divide.

Policy debates in the US are currently taking place over whether to transform Medicare to a voucher based system or restructure a system of reimbursements to physicians. These decisions will require further empirical studies if we are to propose therapeutic reforms. Specifically how do the healthcare systems in the industrialized world react to the same factor variables, if at all? This study is developed in an effort to characterize general models for the determinants of life expectancy as a proxy variable for healthcare quality.

In economic circles, the nature of the correlation between healthcare expenditures, hereafter HCE, and an ageing population has been discussed actively for over a decade but is not well defined (Breyer 2011). This relationship was theorized long ago to be positive (Fuchs 1984) but in 1999, Zweifel et al. posit this to be erroneous. They show in studies of individual healthcare costs, after controlling for proximity to death, calendar age is not a significant regressor of HCE (Zweifel 1999). This result was confirmed multiple times, in 2004 and 2007 (Stearns and Norton 2004, Seshamani and Gray 2004, Zweifel 2004, and Werblow 2007). This study will examine aggregate HCE as a percentage of GDP with respect to population distribution in an effort to shed some light on the relevant policy implications.

More recently, efforts have been made to appreciate specifically what effect life expectancy will have on HCE in a dynamic panel data context. Initially Zweifel et al. developed a variable that showed statistical significance in predicting HCE (Zweifel 1999). This variable, termed SISYPH (for Sisyphus effect) was constructed as the product of life expectancy and percent of the population above 65. The economic theory behind the SISYPH variable is quite interesting; that health care delivery is similar to pushing a boulder up a hill until just before the edge it comes crashing back down upon you, just as in the myth of Sisyphus. In economic terms, Zweifel postulates an increase in HCE, for example a new government spending bill to have a positive effect on life expectancy, for a time more people will survive what used to be fatal. However, without structural reform this will simply increase demand on the same amount of supply until the current system is overtaxed and it's not possible for more people to be treated even with more resources.

This relationship is a prime example of diminishing marginal returns, potentially culminating in a state of negative returns where increased HCE actually reduce life expectancy. When SISYPH was regressed on HCE it was statistically significant, however, it is impossible to determine what significance is arising from the life expectancy component and what significance is arising from the ageing population component.

Breyer et al. make an effort to detangle these correlations in their 2011 working paper. They use a 12 year dataset used to calculate risk adjustment payments between insurance funds including, age, life expectancy and HCE in Germany. They cite specific issues with previous studies related to the cross-sectional nature of the data and believe they should have more success in using their pseudo-panel. They report age, mortality rate, and life expectancy as all statistically significant positive regressors on HCE in a fixed-effects model.

This study will use a 17 year dataset including similar information in an effort to attempt to confirm the results published by both Zweifel and Breyer on an aggregated panel dataset for each of the G7 Countries and Korea in a SUR fashion.

Data and Testable Hypotheses

The data for this study were collected from two different sources. Data on HCE, pharmaceutical expenditures, # of physicians, # of hospital beds, vaccination rates against measles, vaccination rates against diphtheria, vaccination rates against influenza, life expectancy, remaining life expectancy at 65, tobacco consumption, and alcohol consumption were all obtained from the OECD iLibrary for the 8 countries in question. Data on incidence of tuberculosis, unemployment rates and percent population distribution, were all obtained from the World Bank Development Indicators Databank.

Different variables tend to have data from differing start dates. The only consistently collected time period for all the variables was from approximately 1989-2009. Some variables were not reported for certain countries and year; any gaps were dealt with by combining World Bank and OECD data to form one coherent and continuous variable. As a result, 17 years in the above range, have observations for all variables and were regressed upon.

Also certain variables had to be generated following literature sources. The SISYPH variable was generated for each of the 8 countries. It was constructed as the product of remaining life expectancy at 65 and percent of the population aged 65+.

As the goals of this paper are essentially two fold there are two separate applications of SURS. First are the theoretical predictions for signs of variables in the life expectancy model:

- *Year*: As medical technology advances it follows with conventional wisdom that there would be a positive trend on life expectancy.
- *HCE*: Intuitively increasing health expenditures should increase life expectancy. This is assuming that the additional resources are spent pseudo-efficiently.
- *Pharmaceutical Expenditures*: A subset of the HCE is how resources are devoted to the pharmaceutical industry; this variable should capture some of the significance of increased production of advanced drugs and research and should be positive.
- *# Physicians per 1,000 Pop*: The density of physicians with respect to population would intuitively be positive if this was the only factor allowing people who needed treatment to receive it.
- *# Hospital Beds per 1,000 Pop*: The density of hospital beds with respect to population should also be positive. This variable has the potential to indicate the size of the demanded medical services industry.
- *Alcohol Consumption, Liters per Pop Aged 15+*: Alcohol consumption in excess is clearly associated with a negative effect on life expectancy. However, depending on consumption habits this variable has the potential to be negative or positive.
- *Tobacco Consumption, % of Adults who Smoke Daily*: Tobacco consumption is a terrible habit in medical terms. This variable should be a negative regressor on life expectancy.
- *Vaccination Rates against Diphtheria*: Diphtheria is a bacterial infection which wreaks havoc on the upper respiratory tract with horrible consequences. Vaccination rates towards this disease should be positive.

- *Vaccination Rates against Measles*: The MMR vaccine provides protection from measles, mumps and rubella and would intuitively be a positive regressor on life expectancy.
- *Vaccination Rates against Influenza in Pop 65+*: Influenza in elderly population has potentially life threatening consequences. This variable should be a positive regressor on life expectancy.
- *Incidence of Tuberculosis per 100,000 Pop*: Tuberculosis is a disease which persists in the respiratory tract for prolonged periods causing bouts of pneumonia and eventually causing death if left untreated. It is extremely contagious and is especially prone in high population density areas. This variable should be a negative regressor.
- *Unemployment Rate*: Unemployment rate was added to capture any impact on life expectancy resulting from the economic state. This regressor should be negative.

The second model is that on HCE in an effort to predict the main driving forces on the ever ballooning costs in the healthcare industry. The theoretical predictions for this model follow:

- *Year:* Coupled with increasing technology comes increased costs to develop and implement these new technologies. This regressor should be positive.
- *Log Life Expectancy*: This is one of the main controversial regressors; theoretically a longer life presents more opportunities for health issues to arise. This should be a positive regressor but its magnitude is not clear.
- *Remaining Life Expectancy at 65*: RLE captures people spending more of their life in an elderly state and should intuitively increase HCE; older people get sick more often.
- *Pop014*: Very young populations generally require more care relative to middle aged, this should be a positive regressor but the magnitude is not clear.

- *Pop1564*: Middle aged populations generally require less care, this should be a negative regressor on HCE.
- *Pop65up*: The percentage of people in their elderly years indicates a population which is generally not as healthy and should be a positive regressor on HCE.
- *SISYPH*: The variable first constructed by Peter Zweifel in 1992 is composed of remaining life expectancy at 65 and the percentage of population 65+. This should be a positive regressor on HCE.

Estimation Strategy

The dataset for the 8 countries over 17 years is a dynamic panel. The SUR technique proposed by Arnold Zellner in 1962 is a method of simultaneously estimating a set of equations. Under the assumption that the error processes experience correlation, that is shocks effect each of the systems in a similar way, the technique can produce more efficient estimates than OLS. It also allows for simple tests of equality on parameters between. Its construction requires time periods, T to be greater than the number of equations, N.

$$\begin{aligned} lnLE_{CAN,t} = \beta_0 &+ \beta_{CAN,t}Year + \beta_{CAN,t}Pop014 + \beta_{CAN,t}Pop1564 + \beta_{CAN,t}Healthexpend + \beta_{CAN,t}Phexpend + \beta_{CAN,t}Physicians \\ &+ \beta_{CAN,t}Hospbeds + \beta_{CAN,t}AlcCons + \beta_{CAN,t}AlcCons^2 + \beta_{CAN,t}TobCons + \beta_{CAN,t}Tob * Alc + \beta_{CAN,t}Immundtp \\ &+ \beta_{CAN,t}Immunmmr + \beta_{CAN,t}Immunflu + \beta_{CAN,t}CO_2 + \beta_{CAN,t}Tuberculosis + \beta_{CAN,t}Unemploy \end{aligned}$$

$$\vdots$$

$$\begin{aligned} lnLE_{USA,t} = \beta_0 &+ \beta_{USA,t}Year + \beta_{USA,t}Pop014 + \beta_{USA,t}Pop1564 + \beta_{USA,t}Healthexpend + \beta_{USA,t}Phexpend + \beta_{USA,t}Physicians \\ &+ \beta_{USA,t}Hospbeds + \beta_{USA,t}AlcCons + \beta_{USA,t}AlcCons^2 + \beta_{USA,t}TobCons + \beta_{USA,t}Tob * Alc + \beta_{USA,t}Immundtp \\ &+ \beta_{USA,t}Immunmmr + \beta_{USA,t}Immunflu + \beta_{USA,t}CO_2 + \beta_{USA,t}Tuberculosis + \beta_{USA,t}Unemploy \end{aligned}$$

In my construction, T=17 and N=8. We tested the general models below and determined relative significance of the country specific factor variables on log life expectancy for each country CAN to USA. Here the dependent variable is log life expectancy for each country, the single-log transformation was used to reduce the extrema in the data and more closely fit a linear estimation.

The second set of models regressed were those of the form originally proposed and developed by Peter Zweifel; that which examines the SISYPHUS Syndrome. This study differs in that the models are estimated via SUR in an effort to examine differences between the countries. The construction of those models followed the form:

$$HCE_{CAN,t} = \beta_0 + \beta_{CAN,t}Year + \beta_{CAN,t}SISYPH$$

$$\vdots$$

$$HCE_{USA,t} = \beta_0 + \beta_{USA,t}Year + \beta_{USA,t}SISYPH$$

The third and final set of models regressed were related to the work by Friedrich Breyer and his efforts to detangle the effects of age composition of population and the remaining life expectancies, hereafter RLE, of the aged population. In our model we performed a similar estimation but for 8 countries with macro data as opposed to individuals with micro data. They were of the form:

$$lnHCE_{CAN,t} = \beta_0 + \beta_{CAN,t}Year + \beta_{CAN,t}lnLE + \beta_{CAN,t}lnRLE + \beta_{CAN,t}Pop1564 + \beta_{CAN,t}Pop65up$$

$$\vdots$$

$$lnHCE_{USA,t} = \beta_0 + \beta_{USA,t}Year + \beta_{USA,t}lnLE + \beta_{USA,t}lnRLE + \beta_{USA,t}Pop1564 + \beta_{USA,t}Pop65up$$

Regression Results and Discussion

Examining Log LE Regressions:

In Table 1 are the results for log LE as the dependent variable. Along the top row is each of the country specific models. In the first column are the country specific factor variables. Significance is denoted in two forms, first estimates are labeled with *, **, or *** to denote the pval; also the actual pval lies below each estimate in parentheses. The models were refined by removing insignificant variables, at the .05 level, a – denotes insignificance in the model.

All of the models have strong explanatory power, denoted by their R^2, ranging from 0.9952-0.9998 and pvals all equal to 0 to the fourth decimal place. All of the nations modeled are experiencing significant positive time trend on log LE. Within the time trend variable we see strikingly similar estimates for France, Germany, and Korea. A cross equation test of equality yields a pval=0.9260, it is not possible to reject the null of equality for the time trend.

Roland Berger Consulting provides some descriptive statistics in their publication *Trends in European Health Care* of 2007, which would be of use in this analysis. Firstly, all three of these countries have a universal healthcare program of one form or another which have been, generally speaking quite successful. Germany has about 85% covered by the government; the other 15% opt for private insurance which often covers more. In France the entire population must pay compulsory government insurance. In Korea healthcare is provided to all citizens and residents by a mixed public-private system, much of the care is private with a few community hospitals. Insurance is delivered by the government through the levy of a tax to the entire population. In all three cases government spending comprises close to 75% of total HCE, per OECD data. In contrast the British National Health System has been largely criticized for having rundown hospitals, shortages of specialists, long waiting lists, and an undersupply of equipment, issues which many universal health care systems have avoided largely due to efficient funding (Light 2003). This may contribute to the relatively small magnitude of the British time trend and its relative insignificance compared to the other nations, more than 3 times less significant than the second most insignificant time trend, Italy.

Table 1: Results of SURS on Log Life Expectancy for the G7+Korea Nations

Country Variables	Canadian Life Expectancy	French Life Expectancy	German Life Expectancy	Italian Life Expectancy	Japanese Life Expectancy	Korean Life Expectancy	British Life Expectancy	American Life Expectancy
Model Stats	R^2=0.9990 Pval=0.0000	R^2=0.9973 Pval=0.0000	R^2=0.9998 Pval=0.0000	R^2=0.9951 Pval=0.0000	R^2=0.9971 Pval=0.0000	R^2=0.9993 Pval=0.0000	R^2=0.9978 Pval=0.0000	R^2=0.9989 Pval=0.0000
Constant	-0.33154 (0.535)	-9.51575*** (0.000)	-3.07080*** (0.000)	1.37398 (0.311)	-1.16157 (0.333)	-6.95200*** (0.000)	1.32609* (0.015)	-8.35410*** (0.000)
Year (1989-2009)	0.00160*** (0.000)	0.00511*** (0.000)	0.00532*** (0.000)	0.00173** (0.007)	0.00292*** (0.000)	0.00559*** (0.000)	0.00051* (0.026)	0.00597*** (0.000)
% Pop Aged 0-14	-	0.02870*** (0.000)	0.04495*** (0.000)	-0.01327*** (0.000)	-	-	0.01613** (0.001)	0.02358*** (0.000)
% Pop Aged 15-64	0.01913*** (0.000)	0.03046*** (0.000)	-0.06594*** (0.000)	-	-	-	0.02327*** (0.000)	-
Total Expenditures on Healthcare %GDP	-0.00788*** (0.000)	-0.00325** (0.004)	-0.00417*** (0.000)	-	-0.02150*** (0.000)	0.00616*** (0.000)	-	-
Pharmaceutical Expenditures on Healthcare %HCE	0.00328*** (0.000)	-	0.00491*** (0.000)	-0.00148*** (0.000)	-	0.00175*** (0.000)	-	-0.00326*** (0.000)
# Physicians per 1,000 Pop	-	0.01216** (0.008)	-0.01278*** (0.000)	-	-0.05083*** (0.000)	-	-	-0.01354*** (0.000)
# Hospital Beds per 1,000 Pop	0.00921*** (0.000)	0.03214*** (0.000)	0.02315*** (0.000)	-	-0.00226*** (0.000)	-	-	0.03331*** (0.000)
Alcohol Consumption, Liters per Pop Aged 15+	-	-0.00624*** (0.000)	0.00299*** (0.000)	-0.00674*** (0.000)	0.00811*** (0.000)	0.00240** (0.001)	0.00598*** (0.000)	-0.16345** (0.002)
Alcohol Consumption Squared	-	-	-	-	-	-	-	0.00782* (0.013)
Tobacco Consumption, % of Adults Smoking Daily	0.00106*** (0.000)	0.00340*** (0.000)	-	-	-0.00156** (0.001)	-	-	0.00333*** (0.000)
Vaccination Rates Against DTP	-	0.00717*** (0.000)	-0.00007*** (0.000)	-0.00106*** (0.000)	-0.00018*** (0.000)	-	0.00110*** (0.000)	-
Vaccination Rates Against MMR	0.00143*** (0.000)	-	-	-	-	-	0.00049*** (0.000)	-0.00140*** (0.000)
Vaccination Rates Against Influenza 65+	0.00034*** (0.000)	0.00211*** (0.000)	0.00014*** (0.000)	-0.00065*** (0.000)	0.00037*** (0.000)	-	0.00029** (0.007)	0.00064*** (0.000)
Incidence of Tuberculosis per 100,000 Pop	-	-0.00426*** (0.000)	-0.00114*** (0.000)	-	-0.00091*** (0.000)	-	0.00056*** (0.005)	-
Unemployment Rate	0.00106* (0.016)	0.00159*** (0.000)	-0.00311*** (0.000)	-0.00405*** (0.000)	0.00717*** (0.000)	0.00051* (0.010)	-	-0.00291*** (0.000)
Observations								17

p-values in parentheses: * $p<0.05$, ** $p<0.01$, *** $p<0.001$

Population distribution variables in the sense of affecting life expectancy are difficult to interpret except that they have the potential to affect the tax base for any social spending programs. When you have a high percentage of population in the tails of the age distribution, 0-14, and 65+, not only are these populations more likely to experience health issues which could influence LE but they also contribute little to the national accounts for social programs based on an income tax. The signs for the 0-14 coefficient are positive in France, Germany, Britain, and the US, then negative in Italy; all are statistically distinguishable from zero. For the 15-64 coefficients, the signs are positive in Canada, France, and Britain; then negative in Germany; again all are statistically distinguishable from zero. The data do not conclusively point either way on this issue, likely as a result of the structural differences of health care delivery in the different countries.

The more interesting and economically significant findings are found in the interpretation of the coefficients on HCE. Throughout developed world HCE is in a state of insignificance, in Italy, Britain, and the US, or significantly negative in France, Germany, and Japan. The only outlier here is Korea with a significantly positive HCE coefficient. This result adds credence to the theory set forth by Zweifel where countries can enter states of negative returns as a result of inefficiency in funding allocations. At the writing of this manuscript no studies have examined any causal relationship to explain this apparent divide. This healthcare delivery dichotomy warrants significant additional study and is potentially invaluable to future structural reforms.

Pharmaceutical expenditure on healthcare is a measure of research and development into advanced drug therapies as well as a measure of the sophistication of healthcare delivery in a country. In many countries it is either statistically insignificant, as in France, Japan, and Britain, or significant but negative as in Italy and the United States. This would seem to indicate inefficiencies in spending or just a labored return on investment for researching new drugs due to regulatory or fiscal environments. The only countries with significant positive coefficients were Canada, Germany, and Korea.

Busse et al. in 2005 discussed new regulation of the pharmaceutical market in Germany. They cited spending caps for pharmaceutical expenditure per physicians' association and discussed changes in efficiency of fund allocation. Although many of these countries have experienced shifts in regulatory environment over the past 20 years, it appears that Germany is doing something right and further models should be examined to explain this relationship.

The effect of the number of physicians in the market reflect to what degree the number of medical graduates have matched the increase or decrease in demand in the population. This interpretation lends itself nicely to determine generally whether a market is oversaturated or under saturated with respect to licensed physicians. Countries with extensively subsidized health care have been plagued by decreasing interest in the medical field due to declining returns to the extensive investment in education, both money and time. This likely contributes to the insignificance of the physician variable in Canada, Italy, Korea, and Britain. For example, Britain has chronically lacked specialists (Light 2003).

The variable is positively significant in only France and negatively significant in Germany, Japan and the US. The positive correlation would support the training and licensure of more physicians to meet a growing need. The negative significance supports the notion that either doctors aren't being licensed in specialties appropriately to suit the population demand or that the market itself is overly saturated and the country needs fewer doctors. This is likely to change in the US very soon as the demand for physicians soars with nearly 32 million additional Americans to be insured under the new health care bill (Congressional Budget Office 2010).

There is a similar interpretation for the coefficient on hospital beds. Italy, Korea, and Britain all have insignificant hospital bed variables. Only Japan has a significant negative coefficient. Canada, France, Germany, and the US all have a positive coefficient. This variable can capture significance in healthcare delivery as a result of infrastructure, specifically hospitals. For the positive coefficient nations, populations would live longer if their hospital infrastructure was expanded whereas Japan should look at finding more elastic methods of providing infrastructure to better approximate the ebb and flow of its demand function.

Interestingly, where we see significant estimates for both, physicians and hospital beds, the sign is the same in two of the four cases. In Japan we see significant negative coefficients for both physician and hospital bed variables. In France we see significant positive coefficients for both physician and hospital bed variables whereas in Germany and the US we have one positive and one negative coefficient. This only serves to reinforce the idea that there is some systematic difference in efficiency between healthcare delivery mechanisms in these countries.

Alcohol consumption is significant in seven of eight regressions. It is significantly positive in Germany, Japan, Korea, and Britain whereas it is negative in France, Italy, and the US. This difference is likely related to the relative attitudes and behaviors of individuals in the various countries. In countries where binge drinking is more prevalent, this variable should be negative and large in magnitude; whereas countries with generally responsible drinking populations have the potential to experience a positive coefficient. There have been studies which show significant decreases in mortality by all causes in individuals who partake in moderate drinking

(Lee 2009). In terms of magnitude, these negative coefficients are quite significant, the US coefficient is the largest magnitude coefficient in the model. The alcohol squared term for the US exhibits the expected sign, namely that this negative relationship between life expectancy and alcohol consumption is diminishing as the number of liters consumed increases. From this information it is reasonable to infer that there is some difference in societal behavior with respect to alcohol consumption amongst these countries.

Tobacco consumption is significantly negative in only Japan, positive in Canada, France, and the US and insignificant in all other cases. The sign is for these three nations is completely unexpected and a mysterious result. However, rates of tobacco consumption in the industrialized world have decreased rapidly since the 1960s, perhaps a larger time series would provide more revealing coefficients in these countries. Perhaps tobacco consumption is also collinear with some unobserved factor.

The vaccination rate for diphtheria is insignificant for three of eight models, Canada, Korea, and the US. It maintains the expected result, a positive coefficient where ceteris paribus getting vaccinated against diphtheria increases life expectancy in two of the remaining models, France, and Britain. In Germany, Italy, and Japan it is negative in sign, however the German and Japanese coefficients are relatively insignificant in magnitude. One possible explanation for this phenomenon is that the incidence rate of diphtheria is so small across these countries that the negative side effects of the vaccine itself are influencing overall life expectancy more than the potential averted disease instances.

The vaccination rate for measles is insignificant in five of eight models, all except Canada, Britain, and the US. In Canada and Britain it carries the expected positive sign. In the US it carries a negative sign. Measles could be another example where the rate of incidence has become so asymptotically close to zero that these coefficients need more years of data when vaccination rates were lower to provide more telling results.

Vaccination against influenza for the elderly has long been encouraged to prevent potentially debilitating bouts of pneumonia. In this log LE model we see that in Korea it is insignificant. In six other cases it is significantly positive, Canada, France, Germany, Japan, Britain, and the US. It is only negative in Italy. In Italy it may be the case that the incidence of influenza is similar to that of diphtheria, quite low and these vaccinations may not be necessary. Despite the fact that influenza is a virus that experiences a high frequency mutation rate making it difficult to combat these data clearly show an appreciable benefit from immunization in the elderly.

Incidence of tuberculosis is a statistically significant negative variable in France, Germany, and Japan. It follows intuition in sign in all three cases, higher rates of this contagious and long lived disease decrease life expectancy. France, Germany, and Japan are all countries which experience significant positive immigrant populations. This is an interesting correlation because in general immigrant populations cause higher rates of tuberculosis due to tighter quarters and less access to health care due to financial limitations. However, Britain also has significant immigration and has a significant positive relation which is not easily explained. It would be an interesting side study to attempt to characterize any structural relationship between tuberculosis and immigration.

The final variable in the first model is the unemployment rate for each country over the 20 year period. Unemployment is significant in all but one case, Britain. It is significantly positive in Canada, France, Japan, and Korea. In Germany, Italy, and the US it follows the intuition of a negative sign. It is reasonable to say in times of elevated unemployment disposable income decreases. This shift away from exotic to practical expenditures is one that may result in increased LE, however at some point it would obviously become a significant enough hardship to reduce LE. The logic follows that in order for unemployment, a generally cyclical macro factor to affect someone's ability to access healthcare in a life expectancy impacting situation; it must have been at a high rate for a substantial duration, something that is generally rare. It would be interesting if it were possible to perform a similar analysis over a greater time period.

Examining HCE Regressions:

Next this study examines the results of applying Zweifel's and Breyer's methodologies for detangling the driving forces behind rising HCE. In Table 2 are the results of applying Zweifel's SISYPH variable construction and regressing that upon HCE with a time trend. We see clear evidence for a significant positive SISYPH variable in Canada, Korea, and Britain. The German model shows a negative SISYPH variable and the rest of the models do not show significance.

Table 2: Testing Zweifel's SISYPH Regressor on the G7+Korea

Country Variables	Canadian HCE	French HCE	German HCE	Italian HCE	Japanese HCE	Korean HCE	British HCE	American HCE
Model Stats	R^2=0.7374 Pval=0.000	R^2=0.8269 Pval=0.000	R^2=0.8373 Pval=0.000	R^2=0.6469 Pval=0.000	R^2=0.9453 Pval=0.000	R^2=0.9562 Pval=0.000	R^2=0.8979 Pval=0.000	R^2=0.9295 Pval=0.000
Constant	769.51*** (0.000)	-241.21 (0.119)	-563.72*** (0.000)	105.42 (0.632)	-334.90 (0.051)	257.48*** (0.000)	27.076 (0.607)	-447.02*** (0.000)
Year	-0.39441*** (0.000)	0.12529 (0.117)	0.29068*** (0.000)	-0.05149 (0.647)	0.17168* (0.049)	-0.12872*** (0.000)	-0.01643 (0.548)	0.23045*** (0.000)
SISYPH	0.12291*** (0.000)	0.00313 (0.849)	-0.02443*** (0.000)	0.01667 (0.230)	-0.00274 (0.665)	0.03888*** (0.000)	0.04727*** (0.000)	0.00096 (0.967)
Observations								17

p-values in parentheses: * p<0.05, ** p<0.01, *** p<0.001

In his 2002 paper, Zweifel suggests that over the course of the early 1990's policy implementations had led to a suppression of the SISYPHUS Syndrome. However, these results seem to suggest that there are still SISYPH operative nations well into the 2000's.

Table 3: Testing Further HCE Models on the G7+Korea

Country Variables	Ln Canadian HCE	Ln French HCE	Ln German HCE	Ln Italian HCE	Ln Japanese HCE	Ln Korean HCE	Ln British HCE	Ln American HCE
Model Stats	R^2=0.9152 Pval=0.000	R^2=0.9009 Pval=0.000	R^2=0.9381 Pval=0.000	R^2=0.8592 Pval=0.000	R^2=0.9886 Pval=0.000	R^2=0.9568 Pval=0.000	R^2=0.9589 Pval=0.000	R^2=0.9839 Pval=0.000
Constant	-97.798** (0.001)	-26.918 (0.132)	-24.509** (0.008)	137.09* (0.025)	151.63*** (0.000)	207.80* (0.036)	-78.703*** (0.000)	-20.258*** (0.000)
Year	0.07111*** (0.000)	0.03171 (0.078)	0.02810*** (0.000)	-0.07390 (0.26)	-0.06482** (0.003)	-0.13351* (0.025)	-0.01012** (0.009)	0.02157*** (0.000)
Ln Life Expectancy	-9.8456*** (0.000)	-3.8511 (0.343)	-2.4871* (0.015)	6.2102 (0.088)	-7.6599** (0.001)	15.769* (0.018)	25.263*** (0.000)	-5.7296*** (0.000)
Ln Remaining LE at 65	3.8733*** (0.000)	0.29702 (0.773)	-0.05063 (0.910)	-0.15139 (0.866)	2.09198*** (0.000)	-4.6459* (0.021)	-4.4916*** (0.000)	0.74286* (0.013)
% Pop 15-64	-0.07199* (0.033)	-0.25289* (0.036)	-0.23518*** (0.000)	-0.23159*** (0.000)	0.06170*** (0.000)	-0.03384 (0.642)	0.04125* (0.018)	0.05894*** (0.000)
% Pop 65+	-0.44079*** (0.000)	-0.10926 (0.295)	-0.14548*** (0.000)	0.08842 (0.208)	0.18918*** (0.000)	0.40951** (0.008)	0.06457 (0.377)	-0.11314* (0.03)
Observations								17
p-values in parentheses: * p<0.05, ** p<0.01, *** p<0.001								

In Table 3 are the results of a SUR study following the construction detailed by Breyer et al in their 2011 paper. Although Breyer uses a fixed effects intrinsic estimator for his individual observations; I have attempted a similar construction using SUR in an effort to characterize the differences in HCE experienced by different countries.

In the Log HCE estimator we see significant time trends in every country except France, and Italy. Canada, Germany, and the US experience positive time trend coefficients whereas Japan, Korea, and Britain show a significant negative time trend. This is further evidence for a structural difference in policy or mechanism of delivery of healthcare between the nations and possibly even more generally, the East and West.

Log LE is significant in six cases. In Korea and Britain it is significantly positive and in Canada, Germany, Japan, and the US it experiences the opposite sign. It appears that in Korea and Britain longer life for the entire population drives HCE up whereas in Canada, Germany, Japan, and the US, longer life for the entire population drives HCE down.

Log RLE is significant in Canada, Japan, Korea, Britain and the US. In Canada, Japan, and the US it is significantly positive whereas in the Korea and Britain it is negative. The effects of elderly living longer is not consistent across countries and likely differs as the result of societal attitudes towards death dictating treatment at older age, limits of healthcare systems, or other unobserved factors. Breyer et al describe a negative relation with RLE and explain that physicians may treat those with what have appeared to be full lives less aggressively than younger patients with similar ailments or when resources are limited (Breyer 2011). If we are to attempt to apply this logic to the US it is possible that either doctors do not practice this ethical caveat or patients dictate more of their treatment in the US than in other countries. Interestingly it holds the opposite sign as Log LE in every case where both are statistically significant, Canada, Japan, Korea, Britain, and the US. This relationship deserves greater attention.

The two remaining variables describe the age composition of a countries population, 15-64 or 65+ where 0-14 is the omitted category. Of the five cases where pop65+ is significant, three are negative indicating that ceteris paribus more elderly population decreases HCE in Canada, Germany, and the US. It is not crystal clear whether or not ageing population alone drives HCE in the other countries and in future studies hopefully the data will be more illuminating. Breyer finds statistically revealing positive coefficients for his age composition variables in his Germany specific fixed effects study, however; in this case we find negative significance in the middle aged and elderly segments.

Conclusions and Areas for Future Research

In this study I have essentially answered three main questions. First, how does life expectancy as a proxy for healthcare quality differ throughout the world? My SUR model has provided many factor variables that vary across country and characterize healthcare programs worldwide. Secondly, has the SISYPHUS Syndrome disappeared as Zweifel suggested in 2002? No, I have demonstrated through SURS that over the time period 1990-2009 there are clear statistically significant SISYPH variables in at least Canada, Germany, Korea, and Britain. Lastly, can we confirm Breyer's model of HCE in Germany and can it be useful in other countries? Yes to a reasonable extent the methodologies were replicated in a SURS rather than fixed effects technique in an effort to simultaneously test and examine different variables in different countries. I was unable to confirm the results of Breyer in his 2011 examination of the sickness fund members. I was able to offer primitive characterizations of the other G7 countries and Korea and how their HCE move with respect to the same factor variables. Another area of future study would be to further analyze any causal relationship between HCE and life expectancy using instrument variables for HCE.

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