National Wealth and Health Care Expenditures, Micro Problem or Macro Problem?

Abstract

This study takes a cursory glance at some of the elements of health care expenditures across fourteen OECD countries for a period of eleven years. Observationally, it could be said that health care is both a micro- and a macro-economic problem, as individuals, as well as their governments, wrestle with the rising price of health. Historically, humans living in industrialized countries have never lived so long or so well as in the past century. I probe the relationship between national wealth and health expenditures between nations and across time to reveal an underlying cause of the increase in health expenditures.

Introduction

The purpose of this paper is to study, briefly and in a very narrow fashion, the impact national wealth has had on the length of life and thus on the cost of health care. Since the mid-nineteenth century, increasing national wealth enabled industrial countries to build infrastructure such as water treatment systems and interstate highways. The introduction of public health features, such as filtered water systems and waste sewage systems undoubtedly have influenced the length of life in every industrialized country. The decline in infant mortality has been linked with effective personal hygiene. Likewise, the increase in availability of food, like corn, potatoes and proteins, added the needed caloric intake to enable human bodies to resist infections and diseases. Folland, Goodman, and Stano's (2004) basic overview of the effects that these features of industrialized countries have had on the general health level is the observation that the majority of advances in medical technology occurred after the need for the advance arose. (p. 78) For this brief study, we first need to take a brief look back into history, to gain a viewpoint that many economists do not include in their research.

It may be stating the obvious to say that as the national wealth of the United States grew, so too did our knowledge and application of public health measures. In 1860, the entire population of the United States was a bit over 30 million, 50 years later, the 1910 population exceeded 50 million, and the 2000 census pegged the population at greater than 280 million. (Johnson, p. 541-5) As America's citizens, cities and states grew wealthier and more densely populated the need for water delivery and sewage evacuation became a necessity. In 1913 the city of Los Angeles finished construction on an aqueduct 250 miles long, and in the process of all that building and engineering employed 5,000 workers, built 142 tunnels, 120 miles of railroads, and 500 miles of roads. (Johnson, p.688) Large cities across America followed the same trail as Los Angeles, constructing water, sewer and surface infrastructure to support the vast population. By 1913, medical advice insisted on physicians washing hands and sterilizing operating sites, but no cure for typhoid had been found and the "pneumonia-diarrhea" complex was just beginning to be alleviated via rising living standards and cleaner water. (Folland, Goodman, and Stano, p.78-80)

After World War II, many countries including the United States loaned money, offered ingenuity, and engineering to help rebuild Europe, parts of the Middle East and countries in Asia, effectively improving their ability to produce wealth, impact the general health level of their citizens and, ultimately influence their length of life. Taken as a whole, and looking over a great length of time, the impact of increased industrialization and wealth of a country clearly added to the length of life.

In Microeconomic theory, perfect competition assumes consumers and firms have perfect information and, in the market, price balances supply with demand. However, in the study of health care economics some idiosyncrasies percolate to the top. First, information is asymmetric for both the consumer (patient) and the firm (doctor or hospital). Consumer's know little about what makes their physiology work well or efficiently, and doctors, while very learned, know little about how to improve human's health. Second, and given that information is asymmetric, we observe that industrialized nations, as well as their citizens, spend an increasing amount of their income on health care. This leads one to believe that health care may be an area of economics that spans both Micro- and

Macroeconomics, neither one of which provides the entire answer, and each contributes to only part of the solution. Finally, we observe an unprecedented rise in the length of life in all industrialized countries, broaching the question of causality between income, medical care, and an increasingly aged population.

Literature Review

Literature in the area of economics concerning health care, the cost of health care and how medicine fits into it abounds with research and methods. While there are many theories about why health care costs are rising, I review a few that look narrowly at the contributions medicine and wealth has had on the general level of health.

McKinlay and McKinlay attribute the masterstroke of research into the area of medicine versus mortality to Thomas McKeown, a British physician and researcher. They cite McKeown's conclusion that, "the main influences on the decline in mortality were improved nutrition on air-borne infections, reduced exposure (from better hygiene) on water- and food-borne diseases…" (McKinlay & McKinlay, p. 49 and McKeown et al., p. 422) Following McKeown, McKinlay and McKinlay discover a continuous decline in the mortality rates since 1900, which continues well into the 1970s. During the 1930s, the mortality rate declines continuously, and tracking the portion of GNP spent on medical care begins. One notices immediately that it rises continuously. In fact, McKinlay and McKinlay point out that at the time when medical care expenditures began its continuous rise (c. 1929), 92% of the decline in mortality had already taken place. (p. 414)

Victor Fuchs, in his quest to understand the postindustrial society emerging after WWII, looks extensively at the service industry, the emergence of women in the labor force, declining birth rates due to oral contraception and the declining mortality rates. Fuchs observes that the "health sector with its nonprofit institutions and professional dominance" appeared to distort the distribution of demand while editing out the consumer's input in the decision-making process. (p.3) While Fuchs admits that over time the advances in medicine have generally contributed to the decline in morbidity and mortality, his research shows that at any given point in time the "difference in health level within or between developed countries are not primarily related to differences in quantity or quality of medical care." (p.3)

Burton Weisbrod looks at the health care industry from a different perspective, one that includes the historic and unprecedented degree of change in medical science in the forty years since WWII. He notes that health care, as a commodity, appears to behave differently than other commodities in three ways. First, it involves the preserving of human life and impacts the quality of life. Second, health care involves asymmetric information where consumers have little or no information, and third, because of this lack of information, the suppliers of health care are in the position of influencing decisions of consumers to their (the supplier's) advantage. (p.524-5)

Weisbrod also observes that in the forty years since the end of the war, the American public seems to generally acknowledge that health care is a right and privilege and ought to be available to everyone. His point is that the assignment of property rights puts the government under pressure to provide this to the public in a way that redistributes health care. [(p. 525) and (Anderson & Newman, p.95)]

A common theme in health care economics is the observation that physicians have transformed from diagnosticians to actual healers. Prior to WWII, the technology was not yet invented that allowed physicians to peer inside the human body. So doctors were limited to trying to identify the illness, predict a likely outcome, and let the disease run its course. (Weisbrod, p. 526) Yet as the wealth of the industrialized countries increases over time, research and development of new and better medical technologies allows modern-day doctors to intervene in the disease process and change the "likely" outcome.

Ulf-G. Gerdtham et al. studies health care expenditures in 1987 across nineteen OECD countries in relation to aggregate income, institutional, and socio-demographic characteristics. Gerdtham and colleagues contrast results from the micro level (in previous studies), which reveal a weak relationship

between household income and utilization with macro data results, and allows that while the individual consumer may not be faced with the full cost of health resource utilization, his (or her) country is the ultimate payer. (p. 65)

Thomas Getzen, concurs with Gerdtham's observation of aging population in 1992, acknowledges that substitution away from informal care to institutional care for the elderly had already begun and suggests that the consumption of health care is unevenly distributed over the life cycle. (Gerdtham, p. 67, and Getzen, p. S98) Getzen points out that too many studies concentrate on cross-section data, and suggests that a snapshot in time is too limited a viewpoint for detecting causality. He uses OECD data for 24 countries for the time period 1960-1988, citing the longitudinal effects of aging can be teased out in time series analysis.

Analysis

Admittedly, there are a plethora of studies and research to be found using all manner of models, methods and data. I limit myself to combining Gerdtham et al.'s model with a simple log-linear model for this study. I use data published by the OECD Health Database, 2001 Edition, for 14 countries over the period 1990 to 2001.[1] The variables representing total expenditure for health care, GDP, and out-of-pocket expenses, are in terms of 1995 US dollars, converted using purchasing power parity data supplied by the OECD.[2] These variables, plus the variable for population, are regressed in logarithmic form. The rest of the variables are in the form of percentages.

Dummy variables representing the twelve years of the study (1990-2001) and the fourteen countries (see footnote 1) are included to give depth and insight into the macro- and time-impacts of wealth on health care expenditures.

Following Gerdtham et al. (1992) and Goodman (2000), I model health care expenditures for country k in year t as:

$$HXP_i = f[\ (X{=}GDP_i,\ USSGDP_i,\ RX_i,\ SSP_i,\ INPAT_i,\ PUX_i,\ TOOP_i,\ L40_i,\ LVF_i,\ ),YR_t,\ C_k,]$$
$$(\ +\quad +\quad +\quad +\quad +\quad +\quad +\quad -\quad +\quad +/-\ \ +/-)$$

(expected signs of the partial derivatives)

The $f(\cdot)$ is a log-linear function to be specified as follows:

$$\ln HXP_i = \beta_0 + \Sigma\beta_i X_i + \Sigma\gamma_t YR_t + \Sigma\delta_k C_k$$

HXP is the logarithmic value of total expenditures on health per capita in US dollars (1995 =100). GDP is logged value of gross domestic product by country in constant 1995 dollars. USSGDP is the logged value of the gross domestic product for each country converted to US dollars, and indexed to 1995. RX is the total expenditure on pharmaceuticals and other medical non-durables as a percent of total expenditure on health. SSP is the percent of public expenditure spent on health by social security schemes in each country. INPAT is the total expenditure on in-patient care as a percent of total expenditures on health. PUX is public expenditure on health as a percent of gross domestic product. TOOP is the logged value of total out-of-pocket payments in US dollars (1995=100). L40 is the percent of the population in each country under the age of 65. LVF is the logged value of life expectancy for females born 1990 to 2001 in each country. YR is the dummy variable for the years 1990-2001, and measures the difference in the intercept due to variations in time. The control year is 2001, therefore left out of the regression, and is the year to which all other year dummies are compared. C is the dummy variable for the following countries: Australia, Austria, Canada, Denmark, France, Germany, Italy, Japan, Korea, Mexico, Spain, Switzerland, United Kingdom, and the United States. The C dummy measures the change in the intercept due to a cross-sectional change from country to country. The

[1] The fourteen countries are: Australia, Austria, Canada, Denmark, France, Germany, Italy, Japan, Korea, Mexico, Spain, Switzerland, United Kingdom, United States.

[2] Purchasing power parity is a country's rate of exchange that equilibrates its price of a basket of tradable commodities with another country's tradable commodities basket. Purchasing power parity rates come from OECD National Accounts. (Goodman, 2000)

control country is the United States, therefore left out of the regression, and is the country to which all other countries in the cross-sectional countries are compared.

Results

In each of the four models in Table 1 (see appendix), the mean square error is 0.085 (Model 1), 0.0797 (Model 2), 0.238 (Model 3), and 0.016 (Model 4). Model 1 is regressed without any dummy variables, Model 2 includes only the year dummies, Model 3, the country dummies only, and Model 4 includes year and country dummies. The R^2 and Adjusted-R^2 values for Models 1-4 move steadily toward 1, indicating that more of the fraction of variation in the dependent variable is explained by the independent variables. The independent variables in the fourth model explain nearly all the variation in the dependent variable. However, if any of the independent variables are correlated with each other, the interpretation of coefficients is less meaningful, which, conceivably could occur in these four models.

The log-linear model lends itself to easy interpretation of the variable's coefficients for models that involve growth over time of the dependent variable since each coefficient can be interpreted as the percent change in total health care expenditure per capita (the dependent variable) for each unit change in the independent variable, *ceteris paribus*.[3] Some interesting results are immediately apparent in each of the four models. First, there are inconsistent signs on several of the variables: RX (Models 1 & 2), SSP (Models 1-4), USSGDP (Models 1-4), and INPAT (Models 1 & 2). In addition to having the wrong sign, the above variables, in Models 1 & 2, are significant at the 10% level and higher. In Models 3 & 4, the variable SSP is not statistically different from zero, as is USSGDP in Model 4. Moreover, in all four models, the variable L40, the percent of population under the age of 65, while displaying the wrong sign, appears to have no impact on total health expenditures. In every country in the OECD data used, except Denmark, the percent of the population under the age of 65 is falling. In other words, in thirteen countries, the population is aging, so it stands to reason then, that the younger set of people have less impact on health expenditures because their numbers are fewer and fewer each year.

Several variables that display the expected sign and are significant at high levels are GDP (except in Model 2) and LVF (the logged value of female life expectancy). These two variables seem to indicate that the richer the country and the older its citizens, the more money is spent on health care. Not surprisingly, in Models 1 & 2, the variable representing the percent of public expenditures spend on health paid by a social security scheme, SSP, has the appropriate negative sign, and is significant at the 10% level. This seems to imply that employment of this type of third party payer lowers the cost of health.

The dummy variables for years and countries display a myriad of signs and significance levels. In Models 2 & 4, the normalized year is 2001, so I interpret a negative sign as a smaller amount of health expenditures compared to the year 2001, and note that no positive signs occurred in these regressions. I also observe that from 1990 to 2000 the coefficients become steadily smaller in both models. This is an interesting movement over time and I believe it indicates an increasing rate of change in the percent of wealth spent on health expenditures over time for all industrialized countries. I believe it also indicates that the relationship between national wealth and health care is the propensity to spend more discretionary income by a country's citizens and a country's government on health.

In Models 3 & 4, the normalized country is the United States. I interpret a negative sign as a lesser percentage of health expenditures in that country compared to the United States. In addition, I interpret a coefficient in excess of 1 as that country's health expenditures increasing at an increasing rate compared to the US. So, for example, I interpret the 1.055 (Model 3) for the United Kingdom country-dummy as health care expenditures increasing at a rate 5.5% faster than the United States. When the year dummy is included in the model, however, the coefficient drops to 0.405 (Model 4), which I interpret as the United Kingdom health expenditures increasing at a rate slower than the United States' health expenditures.

[3] I use Ramanathan's *Introductory Econometrics with Applications* to aid my interpretation of regression results.

It is interesting that in Model 3 (without the year dummies) Japan and Korea spent a decreasing percentage of national income on health compared to the United States. While in Model 4 (with year dummies) that list expands to include Mexico. All other countries spent an increasing percentage of income on health compared to the United States.

Finally, I bring forth one last contrast, that of the decrease in magnitude of the country-dummy coefficient between Models 3 and 4. The decrease, I believe, is brought about by the time element included in Model 4. I interpret the decrease in magnitude as a two-fold impact. First, each industrialized country's expenditures on health are increasing over time, and second, compared to the US, every country's health expenditures is increasing, but at a slower rate.

Discussion and Conclusion

I believe that what we are observing in the increasing expenditures on health has some very simple origins. Looking back into world history I note some interesting correlations between war and uncertainty, medical research, and the rise of technology. First, the end of World War II and the years of the Cold War found the expenditures on health and health care rising at a time when human deaths were reported in large numbers and in graphic detail. I think as a recoil effect people in industrialized nations began in earnest the search to put off the inevitable.

Also, I think that humans regard health care as they would any other commodity, like toothpaste or fine wine, that the higher the price the better the care. And I think they operate pretty much like our micro-principles say they will…as price increases, quantity demanded decreases, if price is known. Anecdotally, it is interesting that with the advent of managed care, the known price of health care became nearly nonexistent, and as micro-theory assumes, if the price is "free", the quantity demanded increases, which is what we have been observing in all industrialized countries over the last 50 years.

In addition, I think that a natural extension of the human desire to live longer combined with the increase in individual, as well as national, wealth had led to increased expenditures on health care, medical research and medical technology. I think it is a natural human desire to live as long as possible, and the fact that all the research and development in the area of medicine lends itself to allow the outcome to be "different." In other words, individual's desires to live long, productive, healthy lives has led them to search out all possible ways of attaining that goal. This search includes spending more on doctors for advice, tests, prescriptions, as well as spending money on diets, exercise, all manner of devices and surgeries. I believe the human desire to avoid the ultimate end drives us to find an answer to the question for which there is no answer.

I believe that one of the determinants of health care expenditures, and one that I have not seen in research, is the impact of lifespan uncertainty (the fear of death) on health care expenditures. If it is the unconscious (or even conscious) desire of humans to avoid illness and death that drives them to purchasing health care for themselves, and demanding it of their governments, using research and higher technology to influence it, then even if we cannot curb this desire, knowing of it's existence can certainly serve to guide incentives for policy. Knowing one of the determinants of health care expenditures will aid us in designing policies that at least can herd people in a general direction of spending less money and using fewer resources.

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Appendix

Table 1: Dependent Variable: Total Health Expenditures per Capita

	Model (1)	**Model (2)**	**Model (3)**	**Model (4)**
Constant	**-15.577** ***	**-13.911** ***	**-16.684** ***	**-10.145** ***
	(1.410)	(1.374)	(1.969)	(3.286)
L40	**-0.0037**	**-0.001**	**-0.002**	**-0.0006**
	(.007)	(.007)	(.0021)	(.001)
GDP	**0.023** **	**0.0146**	**1.26** ***	**0.6685** ***
	(.009)	(.009)	(.0867)	(.076)
LVF	**8.1** ***	**7.545** ***	**4.888** ***	**4.1745** **
	(.758)	(.728)	(1.281)	(1.741)
RX	**-2.083** ***	**-2.269** ***	**0.255** *	**0.0366**
	(.201)	(.194)	(.133)	(.1006)
SSP	**-0.038** *	**-0.035** *	**-0.038**	**-0.029**
	(.019)	(.018)	(.067)	(.046)
USSGDP	**-0.533** ***	**-0.377** ***	**-0.215** ***	**-0.045**
	(.076)	(.078)	(.0705)	(.05)
INPAT	**-0.48** ***	**-0.321** ***	**0.064**	**0.1789** **
	(.083)	(.084)	(.0988)	(.071)
PUX	**12.807** ***	**10.98** ***	**5.738** ***	**3.043** ***
	(1.051)	(1.064)	(.670)	(.527)
TOOP	**0.609** ***	**0.475** ***	**0.305** ***	**0.1185** ***
	(.066)	(.067)	(.0558)	(.041)
YR 1990		**-0.123** ***		**-0.1305** ***
		(.0325)		(.018)
YR 1991		**-0.1099** ***		**-0.112** ***
		(.031)		(.016)
YR 1992		**-0.103** ***		**-0.0877** ***

			(.031)		(.016)
YR 1993			**-0.096** ***		**-0.072** ***
			(.030)		(.016)
YR 1994			**-0.079** **		**-0.0608** ***
			(.030)		(.016)
YR 1995			**-0.043**		**-0.043** ***
			(.031)		(.015)
YR 1996			**-0.048**		**-0.0376** ***
			(.031)		(.013)
YR 1997			**-0.034**		**-0.0307** ***
			(.030)		(.011)
YR 1998			**-0.043**		**-0.0313** ***
			(.030)		(.009)
YR 1999			**-0.031**		**-0.0189** **
			(.030)		(.007)
YR 2000			**-0.0125**		**-0.009**
			(.030)		(.007)
C1	Australia			**1.244** ***	**0.503** ***
				(.1176)	(.098)
C2	Austria			**1.897** ***	**0.86** ***
				(.1539)	(.132)
C3	Canada			**0.978** ***	**0.397** ***
				(.1025)	(.083)
C4	Denmark			**0.962** ***	**0.386** ***
				(.087)	(.078)
C5	France			**0.737** ***	**0.238** ***
				(.099)	(.079)
C6	Germany			**0.578** ***	**0.197** ***
				(.076)	(.059)
C7	Italy			**0.768** ***	**0.228** ***
				(.094)	(.077)
C8	Japan			**-2.66** ***	**-1.617** ***
				(.163)	(.153)
C9	Korea			**-2.622** ***	**-1.708** ***
				(.181)	(.144)
C10	Mexico			**0.083**	**-0.338** ***
				(.058)	(.062)
C11	Spain			**1.081** ***	**0.327** ***
				(.119)	(.100)
C12	Switzerland			**1.516** ***	**0.734** ***
				(.136)	(.111)
C13	United Kingdom			**1.055** ***	**0.405** ***
				(.1175)	(.095)
Mean Square error		0.085	0.0797	0.02386	0.01628
R-square		0.8963	0.9152	0.9925	0.9968
Adj. R-square		0.8904	0.9037	0.9914	0.996

Coefficients in **bold** type.

Standard errors in parenthesis.

Coefficient significance at the 1% level: ***, 5% level **, 10% level *