

Health Outcomes And The Cost-Quality Trade-Off In Health Care: Empirical Study Of OECD Countries

Adora D. Holstein, (E-mail: Holstein@rmu.edu), Robert Morris University

Abstract

This study applies multivariate regression analysis to cross-section data of 30 OECD countries to determine if there is a trade-off between health care cost and the quality of the health system on one hand, and better health outcomes on the other. It also investigates whether a higher quality health system leads to superior health outcomes. The empirical results provide positive answers to the above two questions. Indices of responsiveness, fairness or accessibility, and overall efficiency of the health system developed by the World Health Organization were used in this study to measure health system quality. The rate of infant mortality and a disability-free or healthy life expectancy measure developed by the WHO are used as indicators of health outcomes. The empirical models control for the effects of cross-country differences in literacy level and health-risk or lifestyle. The study finds evidence that the more responsive and accessible the country's health system is, the longer is the healthy life expectancy of its people. Moreover, the more accessible and efficient the country's health system is, the lower is the rate of infant mortality.

Introduction

Proposals for a single-payer health insurance in the U.S., either on a national or state level, have been much discussed since the 1930s (Vladeck 2003, Bodenheimer 2003), but widespread support has faltered largely because of concerns about the huge tax burden it would entail, and the trade-off in quality that would result. In lieu of a big leap into universal coverage, various incremental approaches (Etheredge and Uhlig 2003) have been, and still are being considered to address the twin problems of high cost and low access to health insurance, and the trade-off between cost containment and quality of outcomes. Tax-funded health insurance has so far been limited to the elderly, disabled and the poor. Thus, there remains an estimated 15% of the population, mostly low-income workers, without health insurance coverage. To protect consumers and to enhance competition, antitrust laws have been supplemented over time with legislation in some states geared at reducing adverse selection, such as guaranteed renewability and community ratings.

It may be argued that if health care cost can be contained, then so will the tax burden of universal coverage. This study applies multivariate regression analysis to a 30-country cross-section data on health system quality and health indicators to explore two questions:

1. Is there an international evidence of the trade-off between health care cost and the quality of the health system, on one hand, and better health outcomes on the other?
2. Does a higher quality health system lead to superior health outcomes?

Review of Related Studies and Databases

The World Health Organization (WHO) has gone a long way towards developing and continuously improving measures of health system performance. In 2000, it ranked 191 countries as to the overall efficiency (technical and allocative) of their health systems. A composite index of overall efficiency was derived from the

weighted average of indices gauging the health system’s responsiveness, the average healthy (disability-free) life expectancy, and fairness in the distribution of financial burden. The U.S. ranked 37th, in a list in which France, Italy, San Marino, Andorra and Malta were the top five. The index of responsiveness, in particular, was based on an international survey asking respondents to rate the promptness of intervention, choice of provider, and respect for patient’s privacy, among others. The U.S. ranked first in responsiveness, followed by Switzerland, Luxembourg, Denmark and Germany. As to healthy life expectancy, the estimated 70.1 years of healthy life expectancy of an American male puts the U.S. in the 24th place, in a list topped by Japan, Australia, France, Sweden and Spain. A heavy weight is said to have been given to the fairness component in which the U.S. ranked 54 -55 (a tie with Fiji) in a list headed by Columbia, Luxembourg, Belgium, Denmark and Germany (World Health Report 2000).

Separately, the Organization for Economic Cooperation and Development (OECD) has also published a Health Systems Report and time-series database for its 30 member countries (OECD Health Data 2002). Descriptive statistics for variables of interest in this study are summarized in **Table 1**, to show how figures for the U.S. compare with the mean for 30 countries, and where the U.S. ranks relative to other countries. Comparative means are also presented for two subgroups: 22 OECD countries with per capita health expenditure (PCHC) above \$1,000 and seven countries with PCHC below that cut-off figure. In the full sample of 30 countries, three are in N. America (U.S., Canada and Mexico); four are in the Pacific Basin (Japan, S. Korea, Australia and New Zealand), four in Eastern Europe (Hungary, Poland, the Czech Republic and Slovakia), and 19 in Western Europe. Of these countries, only the U.S., Mexico, and S. Korea do not have national health insurance.

**Table 1 Health System and Health-related Indicators:
Descriptive Statistics for OECD Countries, 1999**

Indicators	Range	U.S.		n=30	n=22	n=7
		Rank	Value			
Per Capita Health Expenditure (\$, PPP)	341 – 4373	1	4373	1800	2051	645.3
Public Financing to Health Expenditure (%)	43 – 93	29	44.3	72.5	74.5	70.4
Out-of-Pocket Cost to Health Expenditure (%) ^a	3.1 – 53	20	16.6	21.1	19	526.9
Medical Durables to Health Expenditure (%)	68 – 91	5	88.7	83.2	85.3	75.8
Doctors (per 1000 People)	1.2 – 5.9	19	2.8	2.9	3.1	2.2
Reading Literacy	422 – 546	15	504	498	504	480
Science Literacy	422 – 552	14	499	499	501	491
Combined Score	844 – 1084	14	1003	997	1005	971
Tertiary Education (% of Population)	9 – 41	2	37	23	25	14
Daily Smokers (% of Population)	19.1 - 47.4	30	19.1	28.4	27.9	31.2
Infant Mortality Rate (Deaths per 1000 live births)	2.4 – 40.3	25	7.1	7.0	4.6	14.6
Average (M,F) Life Expectancy (years)	68.4 - 80.5	20	76.6	77	78.3	72.9
Healthy Life Expectancy (years)	62.9 - 74.5	19	70	70.1	71.6	65.4
Health System Index:						
Overall Efficiency	.73 - .99	22	0.84	0.88	0.92	076
Responsiveness	5.2 - 8.1	1	8.10	6.60	6.80	5.60
Fairness/Access	.896 - .98	24	0.95	0.96	0.97	0.93

Note:
^aThe data is for 1997. Data for later years contain a lot of missing values.
Sources: OECD Health Data 2002: A Comparative Analysis of 30 Countries: 2002 Edition.
 World Health Report 2000 (Geneva: World Health Organization, 2000).

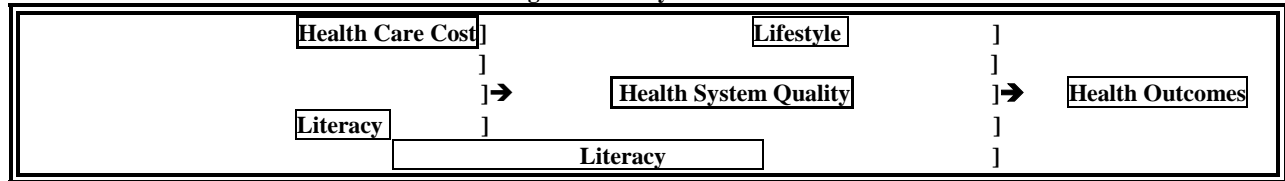
The above table shows that the U.S. exceeds the mean figures for its peer group, in terms of PCHC, the relative importance of private health insurance and medical durables in total health expenditures, and the percentage of the population with post-secondary education. However, it lags behind the mean for its peer group in terms of health outcomes such as the combined male and female average life expectancy, disability-free male life expectancy, and infant mortality rate. Interestingly, it also lags behind the means for its peer group in terms of the share of public financing and the share of out-of-pocket costs to total health expenditure. In this smaller sample of 30 countries (the WHO’s rankings mentioned earlier were based on 191 countries), the U.S. ranks first in the Responsiveness Index, 24th in the Fairness Index, and 22nd in the composite or overall Efficiency Index.

Methodology

This study attempts to obtain empirical evidence for a health system model best depicted by **Figure 1**. It is proposed that the cross-country variance in health outcomes is explained by variances in the quality of the health system, the literacy level, and lifestyle or health-related risks of its users. The better the health system is, the better the health outcomes of the people will be. Literacy affects health outcomes, independently of the health system, by influencing user choices relevant to health outcomes, such as balanced nutrition, regular exercise, care of children, and avoidance of life-threatening activities. The less health-related risks the users of the health system takes or the healthier the lifestyle of these users, the better the health outcomes will be.

Health care cost and the literacy level of its users, in return, influence the quality of the health system. Higher health care cost reflects more and better health care inputs, which is presumed to lead to a better health system. The more educated or literate the users of health care services are, the better they are at obtaining and processing information about the country’s health care system, as well as communicating their needs and preferences to the providers and policy makers.

Fig. 1 Health System Model



The first set of multivariate regression done aims at investigating the existence of a trade-off in cost containment and the quality of a country’s health care system, on one hand, and the population’s health on the other. To measure the quality of a country’s health system, I used the WHO’s Responsiveness Index (RESPOND), the Fairness Index as a measure of accessibility (ACCESS), and the composite Efficiency Index (EFFICIENT). As for health outcomes, I used the OECD data for infant mortality rate (INFMRT), and the WHO’s estimates of healthy or disability-free life expectancy (HLXP).

Per capita health care expenditure (PCHC) is used as an explanatory variable in a set of equations where the above- mentioned quality measures are alternately used as a dependent variable. A positive relationship will confirm a trade-off between cost-containment and the quality of the health care system or the population’s health.

Scattergrams of the PCHC values against the quality measures suggest that a quadratic functional form is appropriate. This also allowed me to test for diminishing returns to health care expenditure. For the health system, diminishing return is due to the presence of fixed inputs like medical durables (hospitals, diagnostic devices and equipment). For health indicators, this may be due to biological or environmental constraints.

To control for the effect of education or literacy level, I used three alternative variables from the OECD database, and picked the one that when entered into the regression yielded the best fit. These are the percentage of the population with a college degree (COLLEGE), the mean score in reading literacy test (READING), and the

combined scores in reading and science literacy tests (LITERACY) at age 15. The latter two capture qualitative differences in the educational system.

$$\begin{aligned}
 &[\text{EFFICIENT}] \\
 &[\text{RESPOND}] \\
 &[\text{ACCESS}] \\
 &[\text{HLXP}] \\
 &[\text{INFMRT}]
 \end{aligned}
 = b_{10} + b_{11}\text{PCHC} + b_{12}\text{PCHC}^2 + b_{13}
 \begin{aligned}
 &[\text{COLLEGE}] \\
 &[\text{LITERACY}] + e_1.
 \end{aligned}
 \qquad \text{Reg. Set 1}$$

The sign of b_{11} will determine whether or not a trade-off exists, while the sign of b_{12} will determine whether or not diminishing return to health care expenditure exists.

I then turn to the interesting question of how well the measures of health care system quality developed by the WHO are associated with health outcomes, after controlling for literacy and lifestyle. The lifestyle or proxy variable for health risk used in this study is the percentage of the population who are daily smokers (SMOKERS). The literacy variable is entered again because it contributes to better health outcomes through health-related choices, independently of the health system. Two components of the Efficiency Index (RESPOND and ACCESS) are regressed on two health indicators (HLXP and INFMRT. The Efficiency Index is regressed only on INFMRT, and not on HLXP because the WHO used its estimates of HLXP as one component of the overall efficiency index. In other words, regression of the composite index on one of its components would be redundant. A semi-logarithmic functional form is used for the second set of regressions to ensure non-negative predicted values for the alternate dependent variables.

$$\begin{aligned}
 &[\ln \text{HLXP}] \\
 &[\text{RESPOND}] \\
 &[\ln \text{INFMRT}] \\
 &[\ln \text{INFMRT}]
 \end{aligned}
 = b_{20} + b_{21} [\text{ACCESS}] + b_{22} \text{LITERACY} + b_{23} \text{SMOKERS} + e_2.$$

$$\begin{aligned}
 &[\text{RESPOND}] \\
 &[\ln \text{INFMRT}]
 \end{aligned}
 = b_{20} + b_{21} [\text{EFFICIENT}] + b_{22} \text{LITERACY} + b_{23} \text{SMOKERS} + e_2.$$

Reg. Set 2

The null hypotheses to be tested are $b_{21} = b_{22} = b_{23} = 0$. A positive sign for b_{21} will confirm the link between the quality of the health system and health outcomes.

Analysis of Findings

The results of the first set of regressions confirm the trade-off between the goals of cost containment and the quality of the health care system and health outcomes. It also confirms the existence of diminishing returns to health care expenditure (see **Table 2**).

Table 2 Cost-Quality Trade-off and Diminishing Returns

Explanatory Variables	EFFICIENT		RESPOND		ACCESS		HLXP		INFMRT	
	Std. Coef.	t	Std. Coef.	t	Std. Coef.	t	Std. Coef.	t	Std. Coef.	t
PCHC	2.61***	7.65	1.20***	6.81	2.00***	5.80	2.26***	6.98	-1.66***	-3.96
PCHC ²	-2.05***	-6.40	-0.37***	-2.23	1.57***	-4.66	-1.73***	-5.42	1.30***	3.15
LITERACY			0.237**	2.09			0.06	0.53	0.30**	-2.16
READING										
COLLEGE	-0.22*	-1.68	0.16**	2.34						
Constant		0.68		4.90		0.81		58.57		61.36
R ²		0.73		0.93		0.72		0.74		0.57
Adj. R ²		0.70		0.92		0.70		0.71		0.52
F		23.09		220.08		22.43		24.80		11.34

Note: Standardized coefficients marked with ***, **, and * are statistically significant at the 99%, 95%, and 90% confidence intervals, respectively.

Of the alternate variables used to measure education or literacy, only the combined score in reading and science literacy tests was found to have a positive contribution to reducing infant mortality. The score in reading literacy alone was found to be positively associated with accessibility or the Fairness Index. For the Responsiveness and Efficiency indices, the percentage of the population with post-secondary education, not the literacy test score, shows up as a significant contributor.

Table 3 Link Between Health System Quality and Health Outcomes

Explanatory Variables	Healthy Life Expectancy		Infant Mortality	
	Std. Coefficients	t	Std. Coefficients	t
RESPOND	0.327 *	1.795	- 0.251	- 1.329
ACCESS	0.494 **	2.596	- 0.344 *	- 1.743
LITERACY	- 0.033	- 0.223	- 0.241	- 1.563
SMOKERS	- 0.181	- 1.238	0.229	1.514
Constant		3.221		13.154
R ²		0.603		0.573
Adj. R ²		0.540		0.505
F		3.503		8.388
EFFICIENCY			- 0.591***	- 5.195
LITERACY			- 0.396***	- 3.402
SMOKERS			0.193	1.662
Constant				8.798
R ²				0.672
Adj. R ²				0.635
F				17.789

Regarding the question of how well the quality of the country's health system contributes to better health outcomes, this study finds that the more responsive and accessible the country's health system is, the longer is the healthy life expectancy of its people. Moreover, the more accessible and efficient the country's health system is, the lower is the rate of infant mortality. As **Table 3** shows, using the overall Efficiency Index as a quality measure proves to yield the best-fit statistics (adjusted R² and F), compared to using either of its two components. Regardless of the overall efficiency of the health system, higher literacy or better quality of the educational system is found to be significantly associated with lower infant mortality. However, the lifestyle or health-risk variable is not.

Conclusion and Policy Implications

This study confirms that a trade-off between cost containment and the quality of the health care system exists. It also finds evidence that higher per capita health care expenditure is associated with better health outcomes, such as longer life expectancy without disability and lower rate of infant mortality. In addition, this study finds evidence of diminishing returns to health care expenditure. Some reduction in per capita health care expenditure can thus be done in the U.S. without a significant loss in the quality of health care delivery and health outcomes.

A statistically significant positive link is found between the quality of the health care system and the health outcomes of the people. The study finds that the more accessible the health care system is in a country (i.e. the higher it ranks in terms of the WHO's Fairness Index), the longer is the healthy life expectancy and the lower is the rate of infant mortality. Making health care financing more equitable, allows more people to benefit from the health care system. Since the U.S. ranks quite low on this index (24th of the 30 OECD countries), some policy changes that could be considered are converting the flat Medicare tax rate to a progressive tax system, increasing the income cap, increasing the eligibility income for Medicaid to cover the working poor, and adding drug benefits for the low-income elderly. In addition, this study finds that the higher a country ranks in the overall Efficiency Index; the lower is the rate of infant mortality. Lastly, the more responsive a country's health system, the longer is the healthy life expectancy of its people.

The independent role of improving the quality of education through middle school in achieving a lower rate of infant mortality also cannot be underestimated. The combined score (1003) in reading and science literacy tests of the average 15-year old American is 81 points below that of Finland who ranked first, and behind those of South Korea, Japan, Canada, Australia, and the U.K., among others. In fact, all of the 13 countries whose literacy scores exceeded that of the U.S. also have lower infant mortality rates.

References

1. Arnesen, T. and E. Nord. The Value of DALY Life: Problem with Ethics and Validity of Disability Adjusted Life Years. B. *Medical Journal*, 1999, 319:1423-5.
2. Bodenheimer, Thomas. The Movement for Universal Health Insurance: Finding Common Ground. *American Journal of Public Health* (Washington: Jan. 2003).
3. Etheredge, Jason and Paul Uhlig. Incremental Approaches to Increasing Health Care Coverage. *Journal of The American Medical Association* (Chicago: AMA, March 2003).
4. Gakidou, E., C. Murray and J. Frank. Defining and Measuring Health Inequality: An Approach Based on The Distribution of Health Expectancy. *Bulletin of the World Health Organization*. 2000;78(1):42-54.
5. Harrison, Bridget. A Historical Survey of National Health Movement and Public Opinion in the United States. *Journal of the American Medical Association*. (Chicago: AMA, March 2003).
6. Organization for Economic Cooperation and Development. OECD Health Data 2002: A Comparative Analysis of 30 Countries (2002 ed.).
7. Vladeck, Bruce. Universal Health Insurance in the United States: Reflections on the Past, the Present, and The Future. *American Journal of Public Health* (Washington: Jan. 2003).
8. Wagstaff, A., E. van Doorslaer, S. Calonge, T. Christiansen, G. Citoni et al. Equity in the Finance of Health Care: Some Further International Comparisons. *Journal of Health Economics*, 1999, 18(3): 263-90.
9. World Health Organization. The World Health Report 2000 - Health Systems: Improving Performance (Geneva: WHO, 2000).