Economics Bulletin

Volume 42, Issue 2

Relative (in)efficiency and its opportunity cost of the U.S healthcare spending: a data envelopment analysis approach

Hyungue Lim
Bryant University

Jongsung Kim
Bryant University

Abstract

Among the OECD countries, the U.S. spends the most on healthcare. However, the health outcome of the U.S. population, measured by life expectancy at birth, is not better than that of other high-income OECD countries. This signals an inefficiency in healthcare spending in the U.S. We use the Data Envelopment Analysis (DEA) to measure such inefficiencies. DEA results provide information about what optimal outcome could have been at certain point in time. We further calculate the aggregated value of inefficient healthcare spending in the U.S. and call this value the opportunity cost. We found that from 2000 to 2017, the opportunity cost was at least 3% of the GDP each year, and the total value of the opportunity cost amounted to at least 26% of 2017 GDP.

Citation: Hyungue Lim and Jongsung Kim, (2022) "Relative (in)efficiency and its opportunity cost of the U.S healthcare spending: a data envelopment analysis approach", *Economics Bulletin*, Volume 42, Issue 2, pages 990-1001
Contact: Hyungue Lim - limhyungue@gmail.com, Jongsung Kim - jkim@bryant.edu.
Submitted: April 14, 2021. **Published:** June 30, 2022.

1. Introduction

The United States spends more on healthcare than any other OECD countries. In 2019, the U.S. spent 17% of its GDP on healthcare, according to OECD health spending data -- an average American spent approximately $11,000 on healthcare. This is a significant amount of money for an individual to spend in one year, but unfortunately this higher spending did not lead to better health outcome.

The healthcare spending gap between the U.S. and other OECD countries is substantial. For example, in 2019, the difference of per capita healthcare spending between the U.S. and Switzerland, the second-highest healthcare spending country, was $3,340, an increase of $164 since 2017. Without the U.S., the highest healthcare spending gap between ranked countries, i.e., from second to third, third to fourth and so on, is approximately $1,100. Additionally, the U.K. spent only 10% of its GDP on healthcare, 7 percentage point less than the U.S., despite providing free healthcare. This evidence shows that the amount of healthcare spending in the U.S. is substantially higher than other OECD countries.

We present evidence to show that U.S. health outcomes are worse than those of other comparable high-income OECD countries (The U.K., Canada, Germany, Australia, Japan, Sweden, France, the Netherlands, Switzerland, and Denmark as used in Papanicolas, Woskie, & Jha 2018). The OECD (2021) data shows that since 2000, the U.S. life expectancy has been the lowest while infant mortality has been the highest when compared to other high-income countries; in fact, the OECD data shows that life expectancy in U.S. decreased by 0.1 years to 78.6 years in 2017. Furthermore, except for Greece, all other OECD countries have almost all their population covered by medical insurance while approximately 10 percent of the U.S. population is without medical insurance (OECD, 2017). Thus, many people in the U.S. are uninsured, less healthy, and live shorter than people living in other OECD countries. The efficiency issue of U.S. healthcare spending is clear -- higher health spending but worse health conditions. Only 13% of the survey respondents in 2006 (Blendon et al., 2006) responded that the U.S. health care system works pretty well, and only a quarter (25.4%) of a public opinion survey in 2020 replied that they were satisfied or very satisfied with health care in the U.S. (Harutyunyan & Harutyunyan, 2020).

The aim of this research is to calculate the opportunity cost of the inefficiency in U.S. healthcare spending. Inefficiency of healthcare spending has been assessed using Data Envelopment Analysis (DEA) by other researchers in the past such as OECD (2010). We take one step further by using inefficiency scores to calculate the opportunity cost of inefficient healthcare spending.

The remainder of the paper is organized as follows. Section 2 presents the relevant results in the literature. Section 3 explains the empirical method adopted for the analysis, followed by a data description and a discussion of the results. Section 4 includes a summary and concluding remarks.

2. Literature Review

The inefficiency of the U.S. healthcare system has been reported since the early to mid-1990s. Mirmirani and Lippmann (2011) found that the U.S. had consistently ranked as the least efficient. A more recent study by Varabyova and Müller (2016) presented that the average healthcare efficiency of the U.S. lags behind the OECD average. Based on 10 studies with 35

different models, the U.S. scored an efficiency score of 0.86 on average, while the average OECD efficiency score is 0.91 (in 0 ~ 1 scale; the higher, the better). OECD (2010) reports that by improving the healthcare system efficiency, public spending savings would be approximately 2% of GDP on average in the OECD, and approximately 3% for the U.S.

Papanicolas, Woskie, & Jha (2018: 1024) attributed the relatively high U.S. healthcare spending to "prices of labor and goods, including pharmaceuticals, and administrative costs." Other factors contributing to the rise in the U.S. healthcare spending are healthcare service price and intensity. In addition, population growth and aging are also positively associated with spending rise (Dieleman, Squires & Bui, 2017). Costly developments in medical technology also put upward pressure on healthcare spending (OECD 2010).

Asandului, Roman, & Fatulescu (2014) also applied the DEA to evaluate the efficiency of public healthcare systems in 30 European countries for 2010 using three output variables (life expectancy at birth, health adjusted life expectancy and infant mortality rate) and three input variables (number of doctors, hospital beds and the GDP share of public health expenditure). Their findings show that the majority of the states in the sample are inefficient, although several developed and developing countries are on the efficiency frontier.

Ahmed and coauthors (2019) applied an output-oriented DEA approach to estimate the technical efficiency of the health systems in 46 Asian countries. They used two output variables (healthy life expectancy at birth and infant mortality per 1000 live births) and per-capita health expenditure as input variable to find that more than 90% of the studied countries were inefficient in terms of utilizing healthcare system resources.

However, the opportunity costs of inefficient healthcare systems based on DEA have not been measured in literature. Kuosmanen, Cherchye & Sipilainen (2006) and Barreto and coauthors (2014) mention opportunity cost while using DEA but opportunity cost is treated as an implicit measure within the model rather than a tangible value. To calculate concrete value of opportunity cost from inefficient healthcare systems, we regard excess spending of resources as opportunity cost of inefficiency. Furthermore, we calculate the aggregate value of opportunity cost to measure the magnitude of opportunity cost accumulated from the inefficiency in healthcare systems.

3. Methodology

We use the DEA to calculate healthcare spending efficiency. The DEA used in this research is modeled after the OECD publication (Joumard, Andre & Nicq, 2010) and includes three input variables and one output variable.

The output variable is Life Expectancy at birth (years). Input variables are Health spending per capita (dollars), Gross National Income per capita (dollars) measured as income per capita, and Alcohol consumption (Liters per capita). The time range of the variables is from 2000 to 2017, a time period that is close to the present and without missing observations. While Joumard, Andre & Nicq (2010) used PISA socio-economic status data for socio-economic variable, we use income per capita as a socio-economic proxy because PISA data represents students, not the entire population. Alcohol consumption is included as a proxy for lifestyle. Joumard, Andre & Nicq (2010) used many different combinations of input variables and found that their DEA model was robust to changes in lifestyle variables (smoking, alcohol

consumption, and diet) and produced similar results. Hence, we do not try other variations of the input variables they used.

Moreover, the accuracy of the model is not the main focus of this research. The main focus is presenting a way of calculating opportunity cost of inefficiencies. Hence, we only use alcohol consumption as the lifestyle variable since observing changes in efficiency scores is beyond the scope of this paper. We use the inverse of alcohol consumption in our model to reflect the negative effect of alcohol consumption on life expectancy because an increase in alcohol consumption is undesirable for health in general. We benchmark the U.S. against 10 other high-income countries mentioned in the introduction. We do not benchmark the U.S. against lower income OECD countries because they have relatively different socio-economic environments compared to the U.S.

Since the DEA is a benchmarking tool, variables with insignificant differences in values will not affect the outcome drastically. Also, the DEA tends to inflate the efficiency scores if more input variables are included. This is because more variables will introduce unseen data points, for which the DEA has no point of reference, thus marking that point 100% efficient. In other words, more variables open up points that do not have neighbors to benchmark against, resulting in a higher efficiency score. Hence, we favor our simple model over more complex models.

3.1 Data

The data for the DEA (life expectancy, health spending, gross national income, and alcohol consumption) was collected from the OECD data website. Annual U.S. GDP data, in 2012 chained dollar with average aggregation method, was retrieved from Federal Reserve Economic Data (FRED). We retrieved the U.S. GDP data from FRED instead of OECD to obtain more accurate data. FRED offers more data points for the U.S. than the OECD database. The GDP data was recorded on January 1st of each year. To account for that, we treat the GDP posted a year ahead as the GDP for the year before. For example, we use the data of January 1st of 2001 for the year 2000, and use data of January 1st of 2002 for 2001, and so on. We use the S&P 500 (^GSPC) index values as a proxy for interest rate. The values were recorded monthly and retrieved from Yahoo Finance since OECD does not provide data on stock indexes. To calculate the S&P 500 index growth, we first selected the index value on January 1st of each year and divided the index value of a year ahead by the index value of the year before. For example, for the year 2000, we divide the index value of January 1st, 2001 by the index value of January 1st, 2000, and so on. The calculation can be found in the Excel file along with our R codes and data. R code and data used for this research can be found in the github link provided in the appendix.

3.2 Data Envelopment Analysis

The model specification is as follows:

$$Life\ Expectancy = f(Health\ Spending\ per\ capita, Income\ per\ capita, 1/Alcohol\ Consumption) \quad (1)$$

R package "rDEA" is used to perform the DEA. Robust DEA (dea.robust) was performed with 1000 bootstraps to estimate bias-corrected efficiencies. We assume that the returns to scale would vary because assuming constant proportional changes in life expectancy based on healthcare spending changes would be unreasonable. The model is input-oriented since our goal is to measure the inefficiency in healthcare spending. Table I lists the summary statistics of the data used for the DEA.

Table I Summary Statistics

Variables	N	Min	Mean	Max	S.D.
Life expectancy (years)	198	76.70	80.60	84.20	1.67
Health spending per capita (dollars)	198	1,850.83	4,142.94	10,212.75	1,505.24
Income per capita (dollars)	198	26,518.46	40,914.98	68,443.99	9,012.48
Alcohol consumption (liters per capita)	198	6.20	9.70	14.10	1.81

We perform two different calculations for comparison. First, we calculate DEA scores for each year separately. We measure DEA scores for the year 2000 for all selected countries and repeat the same procedure for 2001 and each year until 2017. Second, we calculate overall DEA scores for all years and all countries to obtain a better efficiency frontier compared to calculating efficiency scores for each year. The comparison of the results are as follows.

Figure 1 (yearly model) and Figure 2 (all-year model) show that the U.S. is the least efficient in both yearly model and all-year model. By comparison, the efficiency score of the U.S. is lower in the overall model as shown in Figure 2. In fact, many countries are found to be less efficient under the all-year model. This is because we could introduce a significant number of decision-making units into our model by not separating by each year. We could capture more examples of countries' best performances from each year to benchmark against, hence creating a more accurate efficiency frontier than in the yearly model.

The efficiency trends in the yearly model (Figure 1) and all-year model (Figure 2) somewhat differ from each other. Nonetheless, we observed that, in most cases, countries reported lower efficiency in 2017 compared to 2000. It is interesting to see that, in the yearly model, most countries are found to have higher efficiency scores during the great recession (2007 to 2009). This is perhaps because the income decreased during the Great Recession, as shown in Figure 6 in the Appendix. Also, the efficiency trends of yearly model (Figure 1) are similar across countries. On the other hand, the all-year model does not show the general efficiency increase during the Great Recession and trends of each country are less homogenous. This is perhaps because all-year model calculated efficiency scores based on all years available. In contrast, yearly model calculated efficiency scores for each year separately and efficiency score of each year is not dependent on each other. We believe that the all-year model is more accurate than the yearly model because all-year model's efficiency scores are based on all available data points while yearly model's efficiency scores are based on only one year's worth of data points for each year. Details of each DEA score of Figure 1 and Figure 2 are shown in Table II and Table III in the Appendix, respectively. Figures 3 – 6 in the Appendix display trends of variables used for DEA.

In the next section, we calculate the opportunity cost based on efficiency scores from both yearly and all-year models for the U.S.

Figure 1, Input Oriented DEA, Yearly Model

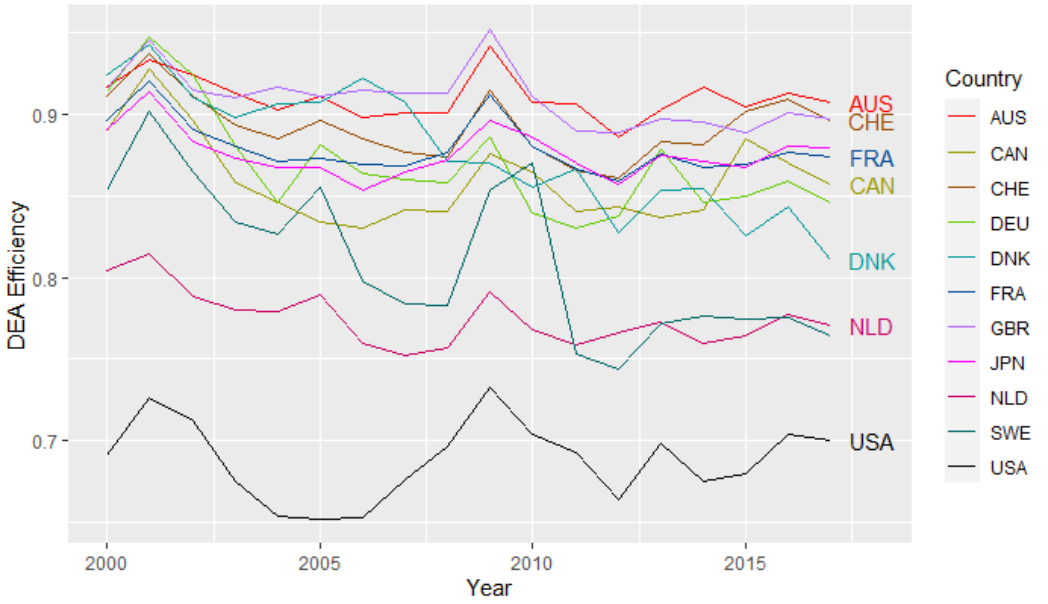
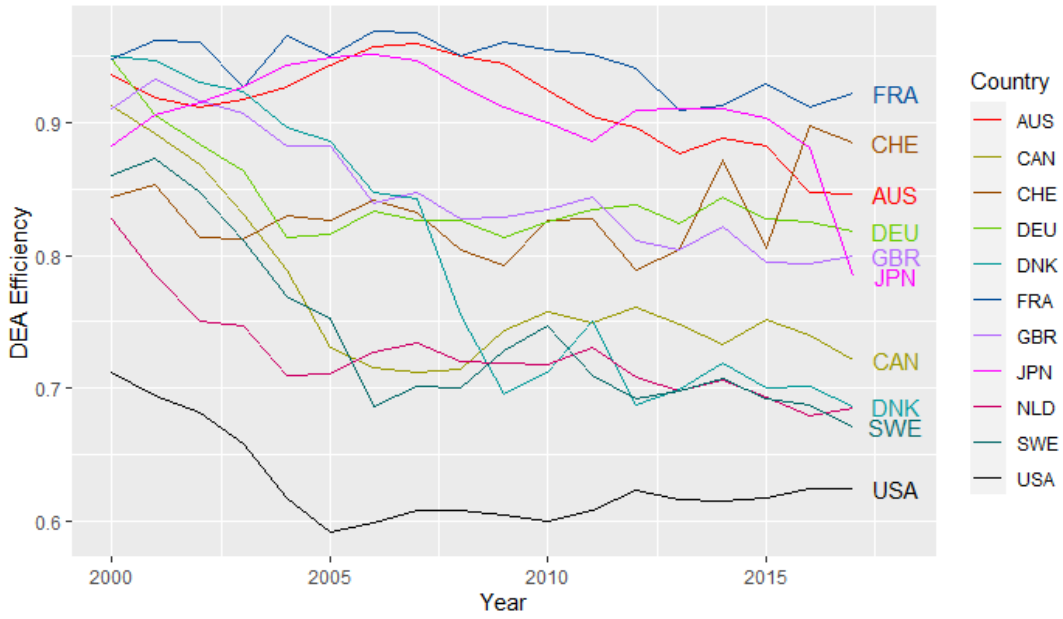


Figure 2, Input Oriented DEA, All-year Model



3.3 Opportunity Cost for the U.S.

We define opportunity cost as the amount of income inefficiently spent on healthcare. The steps for calculating the opportunity cost are as follows:

Let $\boldsymbol{y}$ denote year, $\boldsymbol{E}$ denote efficiency, $\boldsymbol{e}$ denote inefficiency, $\boldsymbol{X}$ denote healthcare spending, and $\boldsymbol{L}$ denote lost income due to inefficient healthcare spending. Then,

$$\boldsymbol{e_y = 1 - E_y} \quad (2)$$

$$\boldsymbol{L_y = X_y * e_y} \quad (3)$$

And we calculate the aggregate value or the accumulation of the past value of $\boldsymbol{L}$ for all $\boldsymbol{y}$'s in 2017, using $\boldsymbol{S}$, which is a proxy for (1+interest rate). We use the S&P 500 (^GSPC) index values as a proxy for interest rate.

$$\boldsymbol{Aggregate\ Value_{2017} = L_{2017} + \sum_{y=2000}^{2016} \{L_y * \prod_{i=y}^{2016} S_i\}} \quad (4)$$

We perform these calculations for efficiency scores from both yearly and all-year models. Table IV and Table V in the Appendix list the results of the calculations. The opportunity cost of each year is generally higher in all-year model, as the efficiency scores were lower than the yearly model. The opportunity cost of inefficient healthcare spending in 2000 was 3% of GDP for both models and continuously grew each year, reaching 5% (yearly model) and 7% (all-year model) in 2017.

In comparison, the OECD (2010) analysis projects that the potential savings from greater efficiency in U.S. public healthcare spending would amount to approximately 3% of 2017 GDP. Shrank, Rogstad, and Parekh (2019) also estimated that approximately 25% of the U.S. healthcare spending (approximately 3.5 to 4.3% of the 2019 GDP) is potentially wasteful, and interventions to reduce waste would save approximately a quarter of the total cost of waste, excluding saving from administrative complexities.

The sum of aggregate values of the opportunity cost amounted to over $70,000 (26% of 2017 U.S. GDP per capita) for the yearly model and over $85,000 (53% of 2017 U.S. GDP per capita) for the all-year model in 2017.

4. Conclusion

An increase in healthcare spending is a common trend in major OECD countries. Among those countries, the U.S. is a peculiar case because it spends significantly more on healthcare, but the population health outcome is worse than many other OECD countries. Against this backdrop, we investigated the healthcare spending inefficiency in the U.S. to estimate the opportunity cost of inefficient healthcare spending. Using the DEA, we benchmarked 11 countries, including the U.S., from 2000 to 2017 to find the optimal healthcare spending level required to achieve each country's population health. Two models were considered: yearly and all-year to calculate DEA efficiency scores. DEA results from the all-year model were generally lower than those of the yearly model. We calculated the amount of inefficient healthcare spending of the U.S. by finding

the difference between the past healthcare spending of the U.S. and the optimal amount. We refer to this inefficiency as the opportunity cost of inefficient healthcare spending.

The aggregate value (2017 value) of the opportunity costs was found to be at least 26% larger than the 2017 GDP. Each year's opportunity cost came out to be at least 3% of the GDP of the same year. This amount is too great to ignore. For many, the amount of opportunity cost could cover their child's college tuition. This leads to further discussion topics that efficient healthcare system could lead to better economic performance in the U.S. For instance, average U.S. household would have been better off if they could have saved the opportunity cost from inefficient healthcare spending. As such, the large amount of this opportunity cost is significant enough to call for a reform on healthcare policy and system.

We believe that wasteful healthcare spending contributes to healthcare inefficiency. Therefore, policy reforms should focus on the well-known sources of wasteful spending in the U.S. such as administrative complexity costs, pricing failure, overtreatment or low-value care, failure of care coordination, failure of care delivery, and fraud/abuse (Shrank, Rogstad, and Parekh, 2019).

References

Ahmed, S., Hasan, MZ., MacLennan, M., Dorin, F., Ahmed, MW., Hasan MM., Hasan SM., Islam, MT., & Khan, JA. (2019) "Measuring the Efficiency of Health Systems in Asia: A Data Envelopment Analysis" *BMJ Open* **9**, e022155.

Asandului, L., Roman, M., & Fatulescu P. (2014) "The Efficienty of Healthcare Systems in Europe: A Data Envelopment Analysis Approach" *Procedia Economics and Finance* **10**, 261-268.

Barreto, A. M., Heineck, L. F., Silveira, L. A., & de Vasconcelos, T. M. (2014) "Data Envelopment Analysis and the Quest for Targets – A Case Study in Connection to Waste Reduction On Site" *International Group for Lean Construction*, 801-810.

Blendon, R., Brodie, M., Benson, J., Altman, D., & Buhr, T. (2006) "Americans' Views of Health Care Costs, Access, and Quality" *Milbank Q* **84(4)**, 623–657.

Dieleman, J., Squires, E., Bui, A, Campbell, M. et al (2017) "Factors Associated with Increases in US Health Care Spending, 1996-2013" *JAMA* **318(17)**, 1668-1678.

Harutyunyan, T. & Hayrumyan, V. (2020) "Public Opinion about the Health Care System in Armenia: Findings from a Cross-sectional Telephone Survey" *BMC Health Serv Res* **20,** 1005.

Joumard, I., André, C., & Nicq, C. (2010) "Health Care Systems: Efficiency and Institutions" *OECD Economics Department Working Papers, 769*.

Kuosmanen, T., Cherchye, L., & Sipiläinen, T. (2006) "The Law of One Price in Data Envelopment Analysis: Restricting Weight Flexibility Across Firms" *European Journal of Operational Research,* **170(3)**, 735-757.

Mirmirani, S., & Lippmann, M. (2011) "Health Care System Efficiency Analysis Of G12 Countries" *International Business & Economics Research Journal (IBER)* **3(5)**, 35-42.

OECD. (2010) Health Care Systems: Getting More Value for Money. *Economics Department Policy Note, 2*.

OECD. (2017) Population Coverage for Health Care. *Health at a Glance 2017: OECD Indicators*, 88-89.

OECD. (2021) Health Spending (indicator).

OECD. (2021) Infant Mortality Rates (indicator).
OECD. (2021) Life Expectancy at Birth (indicator).
Papanicolas, I., Woskie, L. R., & Jha, A. K. (2018) "Health Care Spending in the United States and Other High-Income Countries" *JAMA* **319(10)**, 1024-1039.
Shrank, W., Rogstad, T., & Parekh, N. (2019) "Waste in U.S. Health Care System: Estimated Costs and Potential for Savings" JAMA **322(15)**, 1501-1509.
Varabyova, Y., & Müller, J.-M. (2016) "The Efficiency of Health Care Production in OECD Countries: A Systematic Review and Meta-analysis of Cross-country Comparisons" *Health Policy* **120(3)**, 252-263.

Appendix

For the datasets and R codes used in this paper, please visit the following github repository: limberly/Calculating-Opportunity-Cost-of-Inefficient-Healthcare-Spending-with-Data-Envelopment-Analysis: These are the dataset and R codes for Healthcare Efficiency and the Economic Growth of the United States (github.com)

Figure 3. Alcohol Consumption Trend

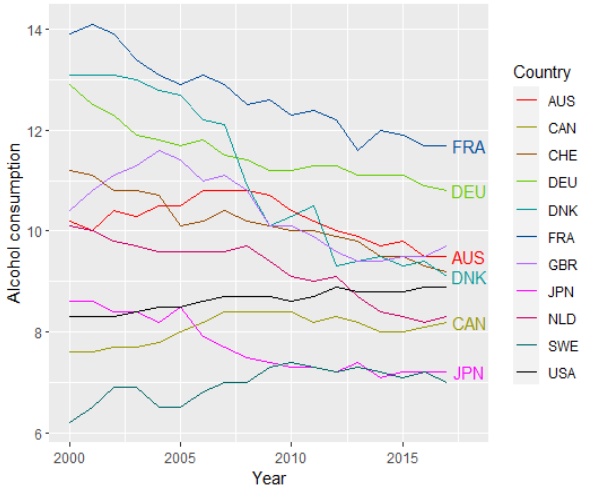


Figure 4. Life Expectancy Trend

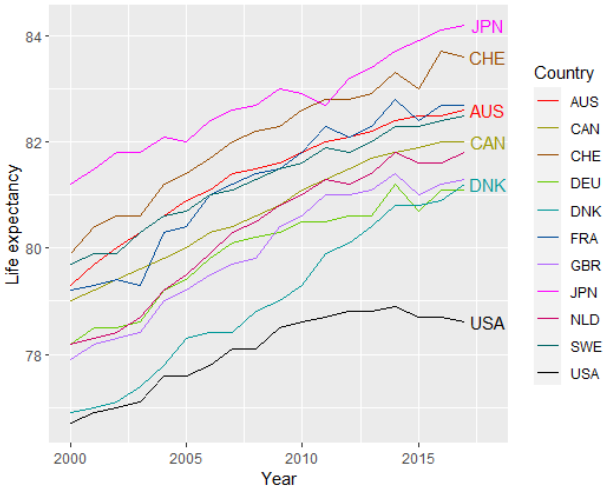


Figure 5. Healthcare Spending Trend

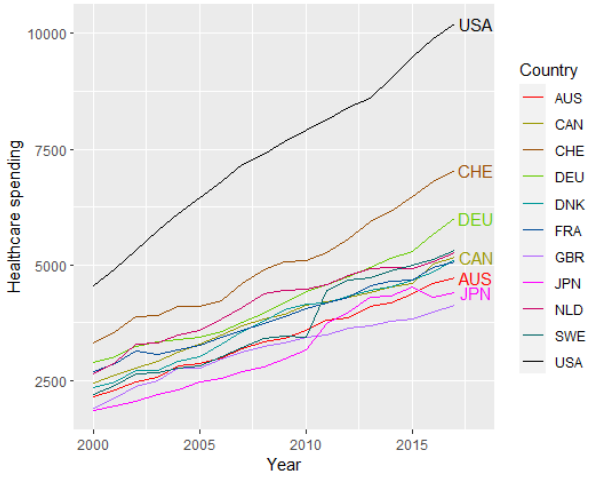


Figure 6. Per Capita Income Trend

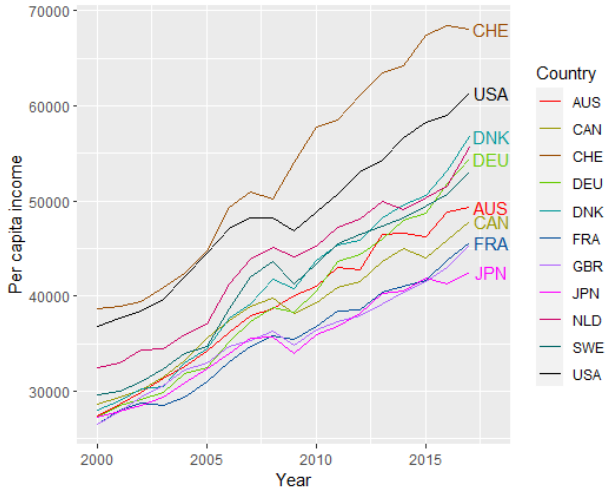


Table II DEA scores, yearly model

Country/ Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
AUS	0.917	0.931	0.928	0.915	0.900	0.914	0.899	0.906	0.902	0.939	0.911	0.906	0.886	0.904	0.916	0.904	0.915	0.909
CAN	0.890	0.928	0.897	0.858	0.845	0.834	0.831	0.841	0.840	0.877	0.866	0.842	0.842	0.838	0.842	0.886	0.871	0.858
DNK	0.924	0.942	0.912	0.900	0.908	0.907	0.924	0.907	0.872	0.871	0.857	0.867	0.827	0.852	0.853	0.826	0.844	0.810
FRA	0.897	0.915	0.893	0.877	0.869	0.871	0.865	0.872	0.875	0.910	0.885	0.869	0.858	0.873	0.871	0.868	0.883	0.876
DEU	0.913	0.946	0.924	0.878	0.846	0.882	0.865	0.861	0.857	0.885	0.845	0.830	0.839	0.874	0.849	0.851	0.860	0.848
JPN	0.892	0.910	0.889	0.877	0.868	0.871	0.857	0.865	0.874	0.905	0.879	0.871	0.860	0.875	0.865	0.869	0.880	0.875
NLD	0.805	0.815	0.789	0.779	0.778	0.789	0.762	0.753	0.756	0.791	0.769	0.760	0.766	0.771	0.759	0.765	0.777	0.771
SWE	0.855	0.901	0.867	0.835	0.828	0.854	0.799	0.784	0.784	0.854	0.869	0.756	0.744	0.772	0.776	0.774	0.777	0.765
CHE	0.914	0.936	0.911	0.892	0.885	0.897	0.889	0.874	0.878	0.918	0.883	0.869	0.858	0.880	0.880	0.903	0.911	0.895
GBR	0.918	0.947	0.919	0.909	0.917	0.910	0.917	0.915	0.912	0.952	0.911	0.894	0.890	0.896	0.896	0.891	0.903	0.898
USA	0.691	0.726	0.712	0.674	0.653	0.653	0.653	0.675	0.695	0.733	0.706	0.692	0.663	0.698	0.675	0.679	0.706	0.700

Table III DEA scores, all-year model

Country / Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
AUS	0.937	0.920	0.912	0.917	0.927	0.943	0.957	0.959	0.950	0.945	0.925	0.905	0.896	0.877	0.888	0.883	0.848	0.847
CAN	0.913	0.892	0.869	0.831	0.789	0.731	0.716	0.712	0.715	0.743	0.758	0.750	0.762	0.748	0.733	0.752	0.740	0.722
DNK	0.952	0.948	0.931	0.924	0.897	0.887	0.848	0.843	0.756	0.696	0.712	0.751	0.687	0.699	0.720	0.700	0.702	0.687
FRA	0.949	0.963	0.961	0.928	0.965	0.950	0.969	0.968	0.951	0.961	0.955	0.952	0.942	0.910	0.914	0.931	0.914	0.924
DEU	0.948	0.906	0.884	0.863	0.814	0.817	0.834	0.827	0.827	0.814	0.825	0.835	0.839	0.824	0.844	0.828	0.826	0.818
JPN	0.884	0.906	0.917	0.928	0.944	0.949	0.950	0.945	0.927	0.912	0.901	0.886	0.909	0.910	0.910	0.902	0.882	0.786
NLD	0.828	0.787	0.752	0.748	0.710	0.711	0.727	0.734	0.721	0.719	0.718	0.731	0.709	0.698	0.706	0.694	0.680	0.685
SWE	0.861	0.873	0.847	0.810	0.769	0.752	0.687	0.701	0.700	0.729	0.747	0.710	0.692	0.698	0.708	0.692	0.689	0.672
CHE	0.844	0.853	0.814	0.813	0.831	0.827	0.841	0.832	0.804	0.792	0.827	0.828	0.790	0.805	0.873	0.806	0.897	0.884
GBR	0.912	0.934	0.917	0.908	0.884	0.883	0.840	0.847	0.828	0.829	0.835	0.844	0.811	0.805	0.822	0.795	0.794	0.799
USA	0.712	0.695	0.682	0.659	0.618	0.593	0.599	0.608	0.608	0.605	0.600	0.608	0.623	0.616	0.616	0.617	0.624	0.625

Table IV Opportunity cost calculation, yearly model efficiency scores

Year	X, Healthcare spending per capita	GDP per capita	E	S	e	L	% GDP	AV 2017
2000	$ 4,557.15	$ 46,497.25	0.691	0.98	0.309	$ 1,408.36	3%	$ 2,301.58
2001	$ 4,908.72	$ 46,497.00	0.726	0.83	0.274	$ 1,347.02	3%	$ 2,247.19
2002	$ 5,326.08	$ 46,858.00	0.712	0.76	0.288	$ 1,533.24	3%	$ 3,091.55
2003	$ 5,735.51	$ 47,754.50	0.674	1.32	0.326	$ 1,871.80	4%	$ 4,984.92
2004	$ 6,094.19	$ 49,123.50	0.653	1.04	0.347	$ 2,111.71	4%	$ 4,254.43
2005	$ 6,443.26	$ 50,380.75	0.653	1.08	0.347	$ 2,234.97	4%	$ 4,311.63
2006	$ 6,806.91	$ 51,329.50	0.653	1.12	0.347	$ 2,360.21	5%	$ 4,201.78
2007	$ 7,157.34	$ 51,793.50	0.675	0.96	0.325	$ 2,325.81	4%	$ 3,685.21
2008	$ 7,395.89	$ 51,241.25	0.695	0.60	0.305	$ 2,252.95	4%	$ 3,724.34
2009	$ 7,669.63	$ 49,501.00	0.733	1.30	0.267	$ 2,050.96	4%	$ 5,659.25
2010	$ 7,922.20	$ 50,354.50	0.706	1.20	0.294	$ 2,332.39	5%	$ 4,949.59
2011	$ 8,131.47	$ 50,769.50	0.692	1.02	0.308	$ 2,503.59	5%	$ 4,436.09
2012	$ 8,404.94	$ 51,548.00	0.663	1.14	0.337	$ 2,833.27	5%	$ 4,919.69
2013	$ 8,610.60	$ 52,141.25	0.698	1.19	0.302	$ 2,602.28	5%	$ 3,958.49
2014	$ 9,034.17	$ 53,076.00	0.675	1.12	0.325	$ 2,934.82	6%	$ 3,751.88
2015	$ 9,498.29	$ 54,319.50	0.679	0.97	0.321	$ 3,048.40	6%	$ 3,482.18
2016	$ 9,880.16	$ 54,861.25	0.706	1.17	0.294	$ 2,901.61	5%	$ 3,408.03
2017	$ 10,212.75	$ 55,789.75	0.700		0.300	$ 3,063.48	5%	$ 3,063.48
							Total	$ 70,431.32
							Total / 2017 GDP per capita	1.26

Table V Opportunity cost calculation, all-year model efficiency scores

Year	X, Healthcare spending per capita	GDP per capita	E	S	e	L	% GDP	AV 2017
2000	$ 4,557.15	$ 46,497.25	0.712	0.98	0.288	$ 1,311.58	3%	$ 2,143.42
2001	$ 4,908.72	$ 46,497.00	0.695	0.83	0.305	$ 1,496.12	3%	$ 2,495.93
2002	$ 5,326.08	$ 46,858.00	0.682	0.76	0.318	$ 1,693.10	4%	$ 3,413.87
2003	$ 5,735.51	$ 47,754.50	0.659	1.32	0.341	$ 1,954.93	4%	$ 5,206.30
2004	$ 6,094.19	$ 49,123.50	0.618	1.04	0.382	$ 2,328.39	5%	$ 4,690.96
2005	$ 6,443.26	$ 50,380.75	0.593	1.08	0.407	$ 2,625.27	5%	$ 5,064.59
2006	$ 6,806.91	$ 51,329.50	0.599	1.12	0.401	$ 2,732.50	5%	$ 4,864.56
2007	$ 7,157.34	$ 51,793.50	0.608	0.96	0.392	$ 2,806.86	5%	$ 4,447.43
2008	$ 7,395.89	$ 51,241.25	0.608	0.60	0.392	$ 2,898.99	6%	$ 4,792.29
2009	$ 7,669.63	$ 49,501.00	0.605	1.30	0.395	$ 3,026.91	6%	$ 8,352.23
2010	$ 7,922.20	$ 50,354.50	0.600	1.20	0.400	$ 3,169.76	6%	$ 6,726.58
2011	$ 8,131.47	$ 50,769.50	0.608	1.02	0.392	$ 3,185.10	6%	$ 5,643.66
2012	$ 8,404.94	$ 51,548.00	0.623	1.14	0.377	$ 3,167.85	6%	$ 5,500.66
2013	$ 8,610.60	$ 52,141.25	0.616	1.19	0.384	$ 3,304.37	6%	$ 5,026.49
2014	$ 9,034.17	$ 53,076.00	0.616	1.12	0.384	$ 3,471.66	7%	$ 4,438.19
2015	$ 9,498.29	$ 54,319.50	0.617	0.97	0.383	$ 3,636.10	7%	$ 4,153.50
2016	$ 9,880.16	$ 54,861.25	0.624	1.17	0.376	$ 3,712.22	7%	$ 4,360.12
2017	$ 10,212.75	$ 55,789.75	0.625		0.375	$ 3,833.10	7%	$ 3,833.10
							Total	$ 85,153.89
							Total / 2017 GDP per capita	1.53