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Does health insurance decrease out-of-pocket health expenses?

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Abstract

Some researchers have found that health insurance increases out-of-pocket heath expenses while other researchers have found the opposite. I estimate the change in per capita out-of-pocket health expenses verses per capita health insurance (dOOPHE/dinsurance) for 44 countries using a statistical technique that uses the vertical position of observations to capture the effects of omitted variables. This technique produces a separate dOOPHE/dinsurance for every observation which makes it possible to see how dOOPHE/dinsurance varies between countries and over time due to omitted variables. Between 2005 and 2017, I find that dOOPHE/dinsurance varies from a low of 0.081 in France in 2005 to 0.950 in India in 2005; however, by 2015 India's dOOPHE/dinsurance had fallen to 0.752. These estimates are for what happens on average in each country in each year, and, thus, do not show the catastrophic effects on those hit by the highest OOPHE. These results are consistent with health insurance reducing the OOPHE associated with any given visit to a medical facility; however, health insurance increasing the number of visits to medical facilities can result in total OOPHE increasing.

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1 Introduction

Different researchers have found opposite effects of insurance on out-of-pocket health expenses (OOPHE). These seemingly conflicting empirical results could easily be due to different countries having extremely different insurance schemes, different types of health problems, and/or different medical facilities. Galarraga et al. (2010) found that Seguro Popular (a public, voluntary insurance for the unemployed and self-employed in Mexico) caused catastrophic health expenditures on the national level of Mexico to fall by 54 percent. Finkelstein and McKnight (2008) find that introducing Medicare in 1965 in the USA "was associated with a 40% decline in out of pocket spending for the top quartile of the out of pocket spending distribution." Nguyen (2011) found that those with voluntary health insurance make 45% more annual outpatient visits and 70% more inpatient visits than those without voluntary health insurance; "however, the effect of voluntary health insurance on out-of-pocket expenses on health care services is not statistically significant." His results seem to imply that the per-visit OOPHE of those with voluntary health insurance is lower, but that the increase in the number of visits produces approximately the same annual OOPHE. The report **"**Out-of-pocket…older Americans" (2000) found that privately-purchased supplemental health insurance in the USA is positively correlated with higher OOPHE, but participation in an HMO was correlated with a lower OOPHE. You and Kobayashi (2011) find that in China, "certain types of insurance programmes tend to increase out-of-pocket health expenditures" and that the share of OOPHE in total health expenditure "has increased in the past 25 years in China, from 20% in 1980 to 49% in 2006, with a peak of 59% in 2000. Barros and Bertoldi (2008) point out that **"**the Brazilian public health system, free and universal, should limit out-of-pocket health expenses. However, Brazil was reported as one of the countries with the highest proportion of families experiencing catastrophic expenditure." These papers are part of a large literature that examines the relationship between income, insurance, and health (for examples see Devaraj and Patel (2017), Kouassi et. al. (2017), and Ghimire (2018)).

In this paper, I estimate *d*OOPHE/capita in US dollars versus a one dollar increase in total health insurance for 44 countries (*d*OOPHE/*d*insurance). I use a technique that is designed to solve the omitted variables problem with regression analysis that produces a separate slope estimate for each observation. This allows a researcher to see how the estimated relationship is changing over time due to omitted variables. I find that *d*OOPHE/*d*insurance varied from 0.081 for France in 2005 to 0.950 for India in 2005.

2 Data

I used the maximum amount of data available on the OECD website. In order to save space, Table 1 provides the *d*OOPHE/*d*insurance estimates for 2005 and afterwards. However, the actual data used started in 1970 for Finland, France, Germany, Korea, and the USA; 1971 for Australia and Denmark; 1979 for Turkey; 1980 for New Zealand and UK; 1983 for Ireland; 1985 for Iceland; 1988 for Canada and Italy; 1990 for Czech Republic, Norway, and Poland; 1991 for Hungary and Spain; 1995 for Israel, Japan, Luxembourg, and Switzerland; 1997 for Slovakia; 1998 for the Netherlands; 1999 for Estonia and Mexico; 2003 for Belgium and Slovenia; 2008 for Greece; 2010 for Chili; and in 2000 for the remaining countries in Table I. However, there was missing data for France in 1971 - 1974, 1976 - 1979, 1981 - 1984, and 1986 – 1989, for Germany in 1991, for New Zealand in 1981, 1983, and 2003, and for the UK in 1981-1989. The right hand side of Table I shows when the data ended for each country. There was a total of 1103 observations.

3 Methods

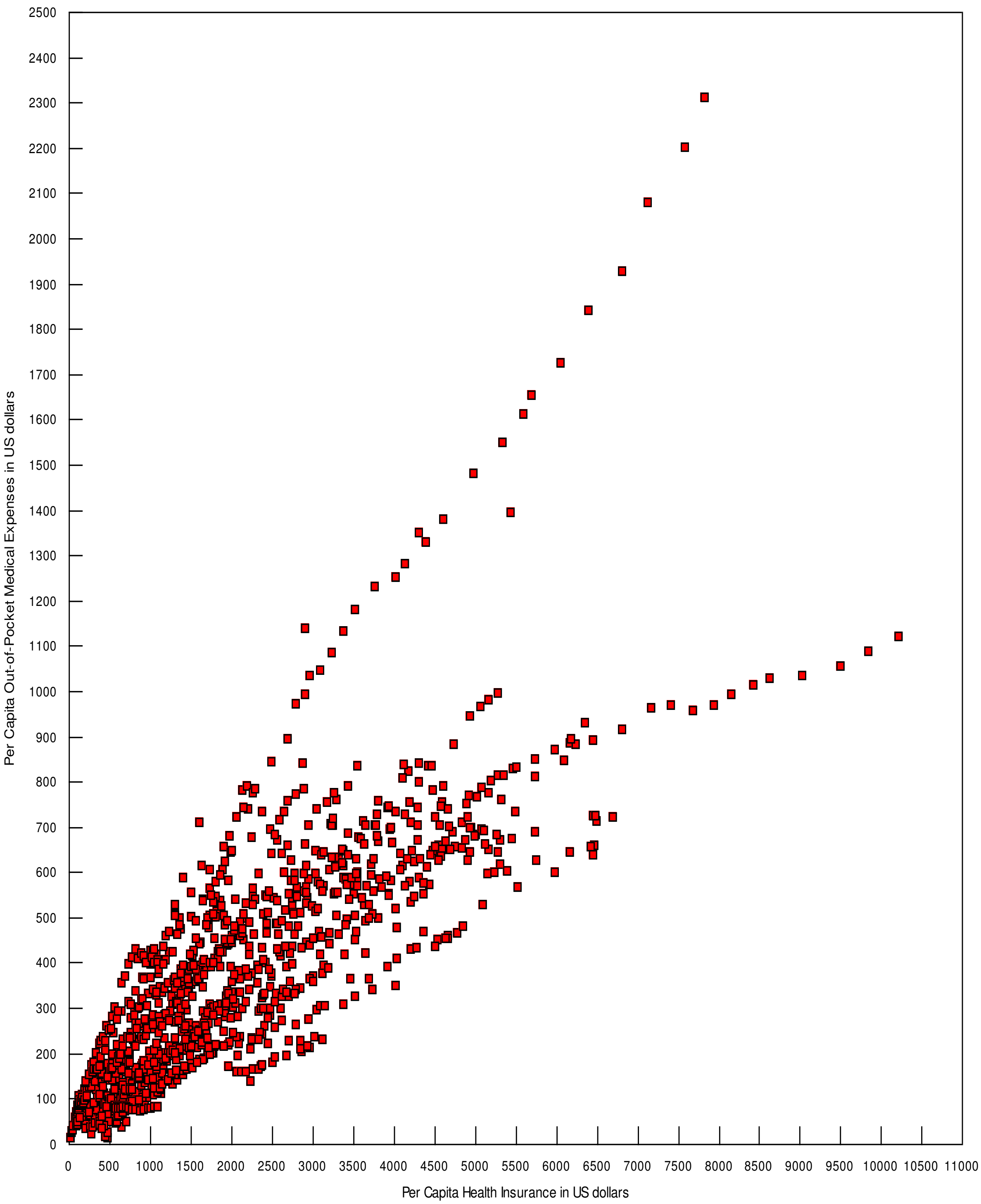
To correctly use traditional econometric methods to estimate *d*OOPHE/*d*insurance, a researcher would need to create a structural model that correctly modelled all the ways that OOPHE and insurance are connected, estimate every equation in that model, and then solve that model for the desired reduced form equation. For example, this model would need to include how insurance affects the number of and out of pocket cost of each medical visits, how insurance affects the risk taking behavior (and thus the health) of people, how deductibles and co-payments of different insurance programs are calculated, how insurance decides what medical conditions are covered by its policies, the incidence of medical conditions covered and not covered, etc. If the researcher would try to directly estimate *d*OOPHE/*d*insurance without going through this process, then his or her estimates would be biased from simultaneous equation bias and omitted variable bias.

To avoid omitted variable bias, this paper uses a statistical technique – Reiterative Truncated Projected Least Squares (RTPLS) -- that uses the relative vertical position of observations to capture the influence of omitted variables (and there by eliminates simultaneous equation bias). This technique produces a separate slope estimate for every observation where differences in these slope estimates are due to omitted variables. The major advantage of this technique is that the researcher does not need to construct and justify a correct structural model, get all the data required by that model, and then solve the model after all the equations are estimated. A major disadvantage of this technique is that it cannot tell the researcher the mechanisms via which the independent variable is affecting the dependent variable. Thus, this technique is not a substitute for traditional econometric methods and theory; it is a compliment to them.

Consider Figure 1 which plots this paper's data and shows that OOPHE and health insurance are positively related. Furthermore, the strands of this data that emanate from the origin (which often correspond to a specific country's data, for example the top strand is for Switzerland) seem to imply that the variation from a least squares line could not reasonably be attributed to just random error; instead, much of this variation must be due to omitted variables. RTPLS is built on the intuition that the observations on the upper left side of Figure 1 correspond to the least favorable values of omitted variables – the omitted variables that create the highest OOPHE for any given level of insurance. Likewise the lower observations correspond to the most favorable values of the omitted variables – the omitted variables that create the lowest OOPHE for any given level of insurance. RTPLS uses the relative vertical position of observations in order to capture the effect of omitted variables.

Leightner (2015) explains how the Central limit Theorem can be used to create confidence intervals for RTPLS estimates: confidence interval = mean $\pm$ $(s/\sqrt{n})t_{n-1,\,\alpha/2}$ where "s" is the standard deviation, "n" is the number of observations, and $t_{n-1,\,\alpha/2}$ is taken off the standard t table for the desired level of confidence. Leightner (2015) uses a given estimate and the 2 estimates before and after it, and a 99% confidence level, in order to create a moving confidence

Figure 1: Per Capita: Out-of-Pocket Medical Expenses versus Health Insurance



interval (much like a moving average) for a given set of RTPLS estimates. This 99% confidence interval can be interpreted as meaning that there is only a one percent chance that the next RTPLS estimate will lie outside of this range if the omitted variables maintain the same amount of variability that they recently have. Likewise 99% confidence intervals for this paper's results were calculated for each country and none of these confidence intervals contained zero. RTPLS is explained in depth in Leightner (2015) and in the open access article Leightner and Inoue (2012).[1]

4 Results

In Table I, the lowest value for *d*OOPHE/*d*insurance was 0.081 for France in 2005 which means that every dollar of health insurance per capita was correlated with an increase of 0.081 dollars of OOPHE. It should be emphasized that all the numbers in Table I show what is happening on average in each country. Thus these figures do not show the effects on those hit by the most catastrophic health problems. The highest value for *d*OOPHE/*d*insurance in Table I was 0.950 for India in 2005 but India's *d*OOPHE/*d*insurance had dramatically fallen to 0.752 in 2015. Perhaps health insurance reduces the OOPHE associated with each visit to a doctor but increases the number of visits so that total OOPHE increases (see Nguyen, 2011).

Scholars do not agree on what criteria should be used to judge health care systems, much less on which countries have the best health care systems. Possible criteria include the healthiest population, the longest living populations, the most equitable systems, the most technically advanced systems, the lowest cost systems, the most efficient systems (the lowest cost for a given result), etc. Likewise scholars do not agree on what criteria should be used to judge health insurance systems. Possible criteria include the most comprehensive insurance, the insurance that covers the most common health problems, the system that gives the greatest range of choices to consumers, the most equitable system, the quickest system, the easiest to understand system, and the system that reduces out-of-pocket-health expenses the most. This paper has dealt with only this last criteria. Thus the paper has dealt with only one piece of a very complex and important puzzle. Most importantly, if (as Nguyen, 2011 suggests) *d*OOPHE/*d*insurance is high because health insurance makes it possible for people to go to the doctor more often, and thus live healthier lives, then high values for *d*OOPHE/*d*insurance may not be an indication of something being wrong.

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[1] Academic journals that have published applications of RTPLS include *International Journal of Contemporary Mathematical Sciences, European Journal of Operations Research, Journal of Central Banking Theory and Practice, International Journal of Financial Research, Economies, China Economic Policy Review, Applied Economic Letters, Frontiers of Economics in China, China & World Economy, Pacific Economic Review, The Japanese Economy: Translations and Studies, Journal of Productivity Analysis, Economy, International Economics & Finance Journal, Advances in Decision Sciences, International Journal of Economic Issues, Global Economy Journal, and Contemporary Social Science.*

Table I: Dollars Per Capita: Change in OOPHE per Change in Health Insurance

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Australia	0.205	0.205	0.198	0.198	0.197	0.204	0.198	0.206	0.203	0.201	0.195		
Austria	0.199	0.195	0.194	0.188	0.186	0.192	0.193	0.192	0.197	0.196	0.195	0.194	0.261
Belgium	0.184	0.190	0.194	0.185	0.183	0.183	0.182	0.179	0.180	0.177	0.170	0.164	
Brazil	0.386	0.368	0.354	0.331	0.333	0.314	0.312	0.314	0.300	0.298	0.300		
Canada	0.161	0.165	0.162	0.160	0.156	0.159	0.153	0.151	0.150	0.151	0.150	0.151	0.153
Chili						0.364	0.363	0.350	0.343	0.341	0.336	0.333	0.338
China	0.667	0.627	0.558	0.507	0.471	0.444	0.429	0.418	0.410	0.388	0.356		
Columbia	0.234	0.244	0.259	0.274	0.241	0.232	0.210	0.198	0.188	0.201	0.211		
Costa Rica	0.364	0.343	0.338	0.321	0.290	0.278	0.278	0.265	0.251	0.262	0.244	0.240	
Czech Rep.	0.128	0.133	0.152	0.175	0.162	0.165	0.162	0.165	0.146	0.151	0.147	0.160	
Denmark	0.155	0.152	0.152	0.147	0.142	0.149	0.151	0.147	0.143	0.143	0.142	0.142	
Estonia	0.235	0.279	0.244	0.226	0.221	0.237	0.232	0.231	0.241	0.240	0.241	0.239	0.235
Finland	0.199	0.206	0.207	0.203	0.201	0.207	0.200	0.194	0.196	0.196	0.203	0.209	
France	0.081	0.099	0.100	0.105	0.107	0.107	0.108	0.107	0.105	0.104	0.103	0.103	
Germany	0.147	0.150	0.150	0.146	0.144	0.145	0.144	0.144	0.135	0.131	0.131	0.129	0.125
Greece				0.402	0.302	0.290	0.319	0.312	0.348	0.378	0.373	0.354	
Hungary	0.275	0.267	0.280	0.280	0.278	0.289	0.296	0.308	0.297	0.297	0.302	0.309	
Iceland	0.180	0.173	0.167	0.166	0.173	0.189	0.192	0.193	0.189	0.186	0.182	0.174	0.168
India	0.950	0.928	0.899	0.875	0.839	0.818	0.783	0.777	0.813	0.787	0.752		
Indonesia	0.696	0.661	0.607	0.605	0.598	0.638	0.631	0.594	0.560	0.537	0.565		
Ireland	0.143	0.147	0.122	0.125	0.133	0.143	0.140	0.141	0.146	0.147	0.141	0.134	
Israel	0.316	0.269	0.279	0.265	0.265	0.249	0.248	0.244	0.235	0.237	0.236	0.239	
Italy	0.226	0.222	0.224	0.221	0.214	0.213	0.228	0.224	0.225	0.229	0.239	0.238	0.242
Japan	0.167	0.174	0.164	0.161	0.160	0.153	0.138	0.136	0.133	0.134	0.135		
Korea	0.408	0.386	0.383	0.392	0.364	0.359	0.359	0.361	0.358	0.353	0.350	0.342	0.351
Latvia	0.447	0.383	0.392	0.395	0.411	0.394	0.365	0.399	0.404	0.410	0.438	0.461	
Lithuania	0.357	0.344	0.306	0.300	0.286	0.293	0.298	0.334	0.343	0.329	0.331	0.336	0.335
Luxembourg	0.134	0.138	0.107	0.105	0.103	0.106	0.113	0.108	0.106	0.112	0.114	0.116	0.116
Mexico	0.579	0.569	0.554	0.514	0.501	0.483	0.453	0.450	0.436	0.439	0.437	0.427	
Netherlands	0.113	0.098	0.093	0.113	0.102	0.103	0.104	0.109	0.121	0.127	0.121	0.119	0.117
New Zealand	0.152	0.148	0.124	0.141	0.132	0.128	0.129	0.130	0.131	0.135	0.140	0.142	0.142
Norway	0.173	0.170	0.166	0.161	0.157	0.155	0.157	0.152	0.150	0.148	0.145	0.149	0.150
Poland	0.307	0.299	0.287	0.265	0.263	0.255	0.256	0.259	0.252	0.246	0.247	0.243	0.238
Portugal	0.244	0.262	0.267	0.268	0.255	0.255	0.272	0.292	0.279	0.286	0.286	0.286	0.281
Russia	0.359	0.343	0.343	0.338	0.366	0.375	0.363	0.353	0.366	0.376	0.405	0.423	
Slovakia	0.258	0.285	0.290	0.225	0.237	0.240	0.248	0.244	0.245	0.192	0.196	0.189	
Slovania	0.143	0.135	0.148	0.137	0.138	0.137	0.132	0.134	0.134	0.139	0.134	0.129	0.129
South Africa	0.160	0.152	0.144	0.133	0.122	0.113	0.110	0.106	0.105	0.102	0.099		
Spain	0.231	0.223	0.220	0.219	0.203	0.216	0.219	0.237	0.248	0.252	0.245	0.246	
Sweden	0.180	0.178	0.177	0.176	0.176	0.176	0.156	0.159	0.160	0.160	0.159	0.157	0.156
Switzerland	0.309	0.305	0.302	0.295	0.293	0.295	0.289	0.292	0.287	0.296	0.294	0.299	
Turkey	0.360	0.263	0.189	0.205	0.199	0.195	0.208	0.228	0.203	0.196			
UK	0.109	0.112	0.113	0.103	0.102	0.106	0.107	0.105	0.154	0.153	0.155	0.157	
USA	0.142	0.138	0.138	0.134	0.128	0.125	0.125	0.123	0.122	0.117	0.114	0.113	0.112

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