Supplemental Materials for

Measuring Healthcare Value in OECD Countries

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Section 1. Definitions and sources for all data

The following section includes a summary table (**Table 1**) of the variables included in this analysis, including a definition and information regarding the source from which each variable was obtained. It also includes a list of countries included in the analysis and a brief description of inclusion criteria.

Table 1 Summary of Key Variables Included in Analysis

Variable	Full Definition	Source
Spending		
Personal health care spending (unadjusted)	Healthcare spending estimates by country. These estimates were inclusive of all payers (private health insurance, out-of-pocket, and development assistance for health) and of all health goods and services including hospital services, physician and clinical services, dental services, home healthcare, nursing care facilities, drug and other nondurable products, and durable medical equipment.	Financing Global Health Study[1]
Regional price-adjusted personal health spending	Healthcare spending estimates by country. These estimates were inclusive of all payers (private health insurance, out-of-pocket, and development assistance for health) and of all health goods and services including hospital services, physician and clinical services, dental services, home healthcare, nursing care facilities, drug and other nondurable products, and durable medical equipment. These values were inflation and price adjusted to reflect economy-wide country-specific 2019 US dollars, using implicit regional price deflation.	Financing Global Health Study[1]

Cause-specific deaths and incidence		
Cause-specific deaths	Estimates of cause- and age- specific death counts for people under the age of 75 in each of the 36 OECD countries studied, 1995 to 2017, for each of the 141 causes studied	Global Burden of Disease Study[2]
Cause specific incidence	Estimates of cause- and age- specific incidence rates for people under the age of 75 in each of the 36 OECD countries studied, 1995 to 2017, for each of the 141 causes studied	Global Burden of Disease Study[2]
Covariates		
Population over 65 (proportion)	Proportion of population over the age of 65.	Global Burden of Disease Study[2]
Tobacco use (cigarettes per capita)	Number of cigarettes or cigarette equivalents consumed per adult aged 15 years or older per year.	Global Burden of Disease Study[2]
Education (years per capita)	Average years per capita of education (for 15+ population only), aggregated by age and sex.	Global Burden of Disease Study[2]
Prevalence of obesity	Proportion of the population with Body Mass Index ≥30 kg/m^2.	Global Burden of Disease Study[2]
Total Physical Activity, 10-year lag	Average per capita physical activity per week (in metabolic-equivalent minutes), age-specific.	Global Burden of Disease Study[2]
Policy Variables*		
Insurance coverage, total	Percent of the population covered by public and primary private health insurance	OECD Stat[3]
Insurance coverage, private	Percent of the population covered by any type of private health insurance	OECD Stat[3]
Insurance coverage, public	Percent of the public covered by government-funded or social health insurance	OECD Stat[3]
Physician consultations	Average number of consultations/visits with a physician per person per year, inclusive of all settings	OECD Stat[3]
Inpatient length of stay	The number of bed-days divided by the number of discharges during the year, inclusive of all hospital settings and all diagnostic categories	OECD Stat[3]
Inpatient discharges	Number of releases of patients formally admitted into a hospital for treatment and/or care and who stayed for a minimum of one night, per 100 000 population	OECD Stat[3]
Inpatient occupancy rate	The number of beds effectively occupied (bed-days) for in any inpatient setting divided by the number of beds available multiplied by 365 days, with the ratio multiplied by 100	OECD Stat[3]
Physician density	Number of actively practicing licensed physicians per 1000 population	OECD Stat[3]

Nurse density	Number of actively practicing licensed nurses per 1000 population	OECD Stat[3]
Midwife density	Number of actively practicing licensed midwives per 1000 population	OECD Stat[3]
Hospital bed density	Number of hospital beds regularly maintained and staffed and immediately available for the care of admitted patients per 1000 population. Inclusive of curative (acute) care beds, rehabilitative care beds, long-term care beds; and other hospital beds	OECD Stat[3]

*All policy variables were in logarithmic form in the final regression analysis.

Country Sample

This analysis was conducted using data from the following 36 countries: Australia, Austria, Belgium, Canada, Chile, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Latvia, Lithuania, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Republic of Korea, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States of America.

The selected countries were all member states of the Organization for Economic Cooperation by 2017. Colombia, which joined the Organization in April 2020, was not included in the analysis because of a lack of availability of data about its healthcare delivery system.

Section 2. Descriptive Statistics for Key Variables

The following section includes the descriptive statistics for key variables, including spending (unadjusted and adjusted for state-specific prices) (**Table 2.1**), a listing of all covariates included in the primary analysis (**Table 2.2**), a summary of all included policy variables and health system characteristics (**Table 2.3**), and the mean mortality incidence (MI) ratio for all 136 health causes included in this analysis (**Table 2.4**).

Table 2.1. Descriptive Statistics for Key Spending Variables

Variable	Mean	Standard Error	Number of State-Years Available	Number of years available
Spending (unadjusted)	2972.367	2130.293	828	23
Price-adjusted spending	3287.399	1830.112	828	23

Table 2.2. Descriptive Statistics for Covariates Included in Analysis

Variable	Mean	Standard Error	Number of State-Years Available	Number of years available
Population Over 65 (proportion)	0.146	0.036	828	23
Tobacco (cigarettes per capita)	1476.961	499.953	828	23
Education (years per capita) aggregated by age (15+) and sex	12.288	1.538	828	23
Prevalence of obesity	0.182	0.059	828	23
Total Physical Activity (MET-min/week), Age-specific, 10 year lag	5201.581	1427.634	828	23
Population Density (over 1000 ppl/sq km, proportion)	0.584	0.186	828	23

Table 2.3. Descriptive Statistics of Policy Variables Included in Analysis

Variable	Mean	Standard Error	Number of State-Years Available	Number of years available
Insurance coverage, total	97.663	6.255	714	23
Insurance coverage, private	31.511	29.727	507	23
Insurance coverage, public	2.282	0.509	712	23
Physician consultations	6.374	2.771	596	23
Inpatient length of stay	9.242	5.352	726	23
Inpatient discharges	16,415.310	4,813.831	709	23
Inpatient occupancy rate	75.482	8.520	598	23
Physician density	3.031	0.721	630	23

Variable	Mean	Standard Error	Number of State-Years Available	Number of years available
Nurse density	8.027	3.440	554	23
Midwife density	0.361	0.202	447	23
Hospital bed density	5.313	2.608	757	23

Table 2.4. Mean Mortality Incidence (MI) Ratio Table

Health condition	Mean	Standard Error	Number of State-Years Available	Number of years available
HIV/AIDS resulting in other diseases	0.195	0.231	828	23
Diarrheal diseases	0.000	0.000	828	23
Lower respiratory infections	0.005	0.003	828	23
Upper respiratory infections	0.000	0.000	828	23
Otitis media	0.000	0.000	828	23
Other meningitis	0.011	0.011	828	23
Encephalitis	0.027	0.018	828	23
Whooping cough	0.000	0.001	828	23
Varicella and herpes zoster	0.000	0.000	828	23
Maternal hemorrhage	0.000	0.001	828	23
Maternal sepsis and other maternal infections	0.000	0.000	828	23
Maternal hypertensive disorders	0.000	0.000	828	23
Maternal obstructed labor and uterine rupture	0.000	0.000	828	23
Ectopic pregnancy	0.002	0.005	828	23
Neonatal preterm birth	0.016	0.013	828	23
Neonatal encephalopathy due to birth asphyxia and tr auma	0.132	0.140	828	23

Neonatal sepsis and other neonatal infections	0.023	0.016	828	23
Protein-energy malnutrition	0.000	0.001	828	23
Syphilis	0.001	0.002	828	23
Chlamydial infection	0.000	0.000	828	23
Gonococcal infection	0.000	0.000	828	23
Acute hepatitis A	0.000	0.000	828	23
Acute hepatitis B	0.000	0.000	828	23
Acute hepatitis C	0.000	0.000	828	23
Acute hepatitis E	0.000	0.000	828	23
Esophageal cancer	0.859	0.095	828	23
Stomach cancer	0.662	0.143	828	23
Liver cancer due to hepatitis C	0.882	0.113	828	23
Liver cancer due to alcohol use	0.862	0.117	828	23
Larynx cancer	0.403	0.148	828	23
Tracheal, bronchus, and lung cancer	0.841	0.092	828	23
Breast cancer	0.236	0.061	828	23
Cervical cancer	0.333	0.067	828	23
Uterine cancer	0.136	0.049	828	23
Prostate cancer	0.173	0.086	828	23
Colon and rectum cancer	0.399	0.100	828	23
Lip and oral cavity cancer	0.373	0.125	828	23
Other pharynx cancer	0.443	0.113	828	23
Gallbladder and biliary tract cancer	0.732	0.152	828	23

Pancreatic cancer	0.947	0.059	828	23
Malignant skin melanoma	0.180	0.094	828	23
Ovarian cancer	0.559	0.061	828	23
Testicular cancer	0.061	0.043	828	23
Kidney cancer	0.329	0.066	828	23
Bladder cancer	0.267	0.068	828	23
Brain and central nervous system cancer	0.521	0.163	828	23
Thyroid cancer	0.086	0.028	828	23
Non-Hodgkin lymphoma	0.367	0.126	828	23
Multiple myeloma	0.585	0.125	828	23
Other malignant neoplasms	0.411	0.177	828	23
Rheumatic heart disease	0.636	0.173	828	23
Ischemic heart disease	0.394	0.168	828	23
Ischemic stroke	0.130	0.082	828	23
Intracerebral hemorrhage	0.467	0.131	828	23
Subarachnoid hemorrhage	0.211	0.093	828	23
Atrial fibrillation and flutter	0.023	0.006	828	23
Peripheral artery disease	0.004	0.003	828	23
Endocarditis	0.060	0.020	828	23
Chronic obstructive pulmonary disease	0.042	0.017	828	23
Asthma	0.002	0.002	828	23
Interstitial lung disease and pulmonary sarcoidosis	0.196	0.087	828	23
Cirrhosis and other chronic liver diseases due to hepatitis B	0.206	0.082	828	23

Cirrhosis and other chronic liver diseases due to hepatitis C	0.238	0.097	828	23
Cirrhosis and other chronic liver diseases due to alcohol use	0.271	0.090	828	23
Cirrhosis and other chronic liver diseases due to other causes	0.099	0.054	828	23
Peptic ulcer disease	0.022	0.015	828	23
Gastritis and duodenitis	0.000	0.000	828	23
Appendicitis	0.001	0.001	828	23
Paralytic ileus and intestinal obstruction	0.026	0.012	828	23
Inguinal, femoral, and abdominal hernia	0.000	0.000	828	23
Inflammatory bowel disease	0.011	0.006	828	23
Vascular intestinal disorders	0.126	0.076	828	23
Gallbladder and biliary diseases	0.005	0.002	828	23
Pancreatitis	0.041	0.022	828	23
Alzheimer's disease and other dementias	0.123	0.015	828	23
Parkinson's disease	0.141	0.022	828	23
Idiopathic epilepsy	0.048	0.029	828	23
Alcohol use disorders	0.006	0.004	828	23
Opioid use disorders	0.045	0.036	828	23
Cocaine use disorders	0.012	0.019	828	23
Amphetamine use disorders	0.006	0.006	828	23
Anorexia nervosa	0.001	0.001	828	23
Bulimia nervosa	0.000	0.000	828	23
Acute glomerulonephritis	0.001	0.002	828	23
Chronic kidney disease due to hypertension	0.120	0.071	828	23

Chronic kidney disease due to glomerulonephritis	0.055	0.051	828	23
Chronic kidney disease due to other and unspecified c auses	0.008	0.005	828	23
Urinary tract infections	0.000	0.000	828	23
Urolithiasis	0.000	0.000	828	23
Uterine fibroids	0.000	0.000	828	23
Polycystic ovarian syndrome	0.000	0.000	828	23
Endometriosis	0.000	0.000	828	23
Genital prolapse	0.000	0.000	828	23
Other gynecological diseases	0.000	0.000	828	23
G6PD deficiency	0.003	0.002	828	23
Rheumatoid arthritis	0.019	0.012	828	23
Congenital heart anomalies	0.100	0.069	828	23
Congenital musculoskeletal and limb anomalies	0.006	0.003	828	23
Urogenital congenital anomalies	0.025	0.028	828	23
Digestive congenital anomalies	0.038	0.052	828	23
Cellulitis	0.000	0.000	828	23
Pyoderma	0.000	0.000	828	23
Decubitus ulcer	0.002	0.002	828	23
Other skin and subcutaneous diseases	0.000	0.000	828	23
Pedestrian road injuries	0.027	0.050	828	23
Cyclist road injuries	0.003	0.003	828	23
Motorcyclist road injuries	0.013	0.017	828	23
Motor vehicle road injuries	0.015	0.018	828	23

Other road injuries	0.002	0.004	828	23
Other transport injuries	0.018	0.015	828	23
Falls	0.001	0.000	828	23
Fire, heat, and hot substances	0.007	0.004	828	23
Poisoning by carbon monoxide	0.018	0.023	828	23
Poisoning by other means	0.003	0.003	828	23
Unintentional firearm injuries	0.010	0.007	828	23
Other exposure to mechanical forces	0.001	0.000	828	23
Adverse effects of medical treatment	0.002	0.002	828	23
Venomous animal contact	0.000	0.001	828	23
Non-venomous animal contact	0.000	0.000	828	23
Pulmonary aspiration and foreign body in airway	0.103	0.111	828	23
Foreign body in other body part	0.001	0.001	828	23
Other unintentional injuries	0.001	0.001	828	23
Physical violence by firearm	0.134	0.166	828	23
Physical violence by sharp object	0.019	0.012	828	23
Physical violence by other means	0.005	0.007	828	23
Environmental heat and cold exposure	0.010	0.010	828	23
Chronic lymphoid leukemia	0.264	0.124	828	23
Acute myeloid leukemia	0.754	0.161	828	23
Non-melanoma skin cancer (squamous-cell carcinoma)	0.116	0.118	828	23
Executions and police conflict	0.008	0.001	828	23
Drug-susceptible tuberculosis	0.064	0.037	828	23

Myocarditis	0.008	0.004	828	23
Myelodysplastic, myeloproliferative, and other hemat opoietic neoplasms	1.407	1.616	828	23
Other benign and in situ neoplasms	0.000	0.000	828	23
Non-rheumatic calcific aortic valve disease	0.004	0.002	828	23
Non-rheumatic degenerative mitral valve disease	0.001	0.001	828	23
Cirrhosis due to NASH	0.288	0.097	828	23
Diabetes mellitus type 1	0.299	0.285	828	23
Diabetes mellitus type 2	0.016	0.010	828	23
Maternal abortion and miscarriage	0.000	0.000	828	23
Chronic kidney disease due to diabetes mellitus type 2	0.044	0.040	828	23

Section 3. Frontier Analysis Methodology

This study estimated healthcare value by assessing inefficiency of healthcare delivery systems for each country, year, and health condition using frontier analysis. Health conditions with more than 3 incident cases per 100,000 population across the 36 countries analyzed in 2017 were selected from the Global Burden of Disease Study[2] at the most granular level of the study's health condition hierarchy. Several disease conditions, including measles and zika virus, were dropped from the analysis due to negligible incidence in a majority of countries for a significant portion of the study period. Despite being a leading cause of death, suicide was not included in the analysis because the mortality-incidence ratio, this study's outcome, was assessed to reflect the methods used in self-harm rather than the ability of a country's healthcare delivery system to prevent death.

The efficiency relationship between healthcare spending and cause-specific mortality-incidence ratio was evaluated using a stochastic frontier meta-analysis approach detailed elsewhere.[4] Each model was run on each of the 141 health conditions included in the analysis on 1000 draws of mortality-incidence ratio to account for uncertainty of measurement. The covariates for which the model controlled (educational attainment per person, the fraction of the population greater than 65 years, obesity rate, the number of cigarettes sold per person, and physical activity rate from 10 years prior) were included in a two-step process. A cause-specific frontier analysis was run with all covariates and the covariate coefficients were assessed compared to our prior of how we anticipated they would correlate with the outcome – education and physical activity were predicted to be protective factors while smoking, age, and obesity were predicted to be risk factors. Covariates whose direction did not correspond with our prior were dropped and the model was rerun. As a result, not all models have the same set of covariates even within draws of the same cause.

Section 4. Primary Frontier Analysis - Estimated Covariate Coefficients

This section summarizes the regression coefficients from the meta-stochastic frontier model. For each condition-specific model, a health spending frontier was estimated and the covariate coefficients were evaluated. As described above, oefficients whose direction did not correspond with our prior were dropped from the condition-specific model and the model was rerun. **Table 4.1** summarizes the number of models (out of the 1000 models run per cause) included each covariate. **Table 4.2** summarizes the mean value of each covariate, by cause, for the models in which it was included.

Table 5.1. Number of Models (out of N=1000) Including Named Covariate, by Health Condition

	Number of models using covariate				
Health condition	**% population over 65**	**Cigarettes per capita**	**Education**	**Physical activity**	**Obesity**
Acute glomerulonephritis	580	32	7	986	226
Acute hepatitis A	331	75	12	979	187
Acute hepatitis B	265	107	17	798	268
Acute hepatitis C	483	72	14	978	386
Acute hepatitis E	318	57	18	976	274
Acute myeloid leukemia	865	759	52	218	944
Adverse effects of medical treatment	673	74	55	944	435
Alcohol use disorders	813	28	7	932	176
Alzheimer's disease and other dementias	623	82	48	985	891
Amphetamine use disorders	739	244	3	977	658
Anorexia nervosa	630	54	20	980	204
Appendicitis	370	54	13	982	309
Asthma	581	81	11	977	171
Atrial fibrillation and flutter	868	396	156	845	493
Bladder cancer	966	40	187	787	926
Brain and central nervous system cancer	779	423	795	244	955
Breast cancer	966	646	571	390	968
Bulimia nervosa	445	65	10	974	226
Cellulitis	694	37	207	964	635
Cervical cancer	954	150	18	807	915
Chlamydial infection	142	132	24	894	75
Chronic kidney disease due to diabetes mellitus type 2	119	101	833	417	343

Chronic kidney disease due to glomerulonephritis	105	15	820	157	799
Chronic kidney disease due to hypertension	441	703	693	959	305
Chronic kidney disease due to other and unspecified causes	616	200	225	914	542
Chronic lymphoid leukemia	815	252	187	293	959
Chronic obstructive pulmonary disease	938	21	568	990	881
Cirrhosis and other chronic liver diseases due to alcohol use	972	76	55	418	899
Cirrhosis and other chronic liver diseases due to hepatitis B	931	91	285	493	834
Cirrhosis and other chronic liver diseases due to hepatitis C	982	233	329	202	964
Cirrhosis and other chronic liver diseases due to other causes	927	409	407	745	845
Cirrhosis due to NASH	978	88	475	288	915
Cocaine use disorders	856	76	6	976	628
Colon and rectum cancer	899	258	333	552	932
Congenital heart anomalies	933	147	510	965	919
Congenital musculoskeletal and limb anomalies	482	106	168	975	641
Cyclist road injuries	486	34	62	883	214
Decubitus ulcer	450	104	237	842	504
Diabetes mellitus type 1	936	140	49	47	991
Diabetes mellitus type 2	121	171	507	960	776
Diarrheal diseases	323	68	10	988	156
Digestive congenital anomalies	111	325	814	935	989
Drug-susceptible tuberculosis	973	90	480	384	595
Ectopic pregnancy	509	106	107	913	688
Encephalitis	904	24	246	662	593
Endocarditis	933	422	329	930	749
Endometriosis	477	65	30	948	277

Environmental heat and cold exposure	945	31	6	720	589
Esophageal cancer	55	965	925	630	995
Executions and police conflict	640	161	20	948	227
Falls	589	65	36	977	349
Fire, heat, and hot substances	883	59	19	931	546
Foreign body in other body part	533	32	11	987	295
G6PD deficiency	847	140	96	914	168
Gallbladder and biliary diseases	763	74	164	915	532
Gallbladder and biliary tract cancer	956	322	777	122	863
Gastritis and duodenitis	182	18	3	995	76
Genital prolapse	175	33	5	915	120
Gonococcal infection	298	105	58	871	184
HIV/AIDS resulting in other diseases	980	23	924	27	988
Idiopathic epilepsy	900	145	27	904	715
Inflammatory bowel disease	744	169	46	978	609
Inguinal, femoral, and abdominal hernia	345	36	9	926	312
Interstitial lung disease and pulmonary sarcoidosis	804	72	659	979	918
Intracerebral hemorrhage	797	599	396	509	861
Ischemic heart disease	999	917	4	947	986
Ischemic stroke	949	53	26	380	875
Kidney cancer	984	12	2	1000	63
Larynx cancer	974	760	814	211	983
Lip and oral cavity cancer	1000	585	250	23	949
Liver cancer due to alcohol use	486	752	272	277	961
Liver cancer due to hepatitis C	257	839	250	209	974
Lower respiratory infections	468	74	15	964	269
Malignant skin melanoma	966	697	712	349	983
Maternal abortion and miscarriage	488	72	13	981	389
Maternal hemorrhage	447	52	49	966	210

Maternal hypertensive disorders	338	39	9	981	196
Maternal obstructed labor and uterine rupture	501	81	26	979	365
Maternal sepsis and other maternal infections	441	79	8	990	362
Motor vehicle road injuries	207	122	223	972	711
Motorcyclist road injuries	395	36	342	662	602
Multiple myeloma	950	846	812	207	830
Myelodysplastic, myeloproliferative, and other hematopoietic neoplasms	668	998	748	1000	992
Myocarditis	812	100	53	946	413
Neonatal encephalopathy due to birth asphyxia and trauma	224	921	690	998	994
Neonatal preterm birth	547	208	267	953	747
Neonatal sepsis and other neonatal infections	593	90	452	698	748
Non-Hodgkin lymphoma	586	113	751	277	679
Non-melanoma skin cancer (squamous-cell carcinoma)	997	477	16	440	249
Non-rheumatic calcific aortic valve disease	560	122	128	978	609
Non-rheumatic degenerative mitral valve disease	407	12	4	995	193
Non-venomous animal contact	663	114	77	908	572
Opioid use disorders	935	418	14	979	805
Other benign and in situ neoplasms	347	54	68	983	379
Other exposure to mechanical forces	344	45	6	990	243
Other gynecological diseases	267	44	20	975	278
Other malignant neoplasms	938	816	814	123	975
Other meningitis	305	77	484	799	826
Other pharynx cancer	679	846	88	329	757
Other road injuries	450	118	33	974	496
Other skin and subcutaneous diseases	184	96	23	927	140
Other transport injuries	840	124	72	790	735

Other unintentional injuries	444	52	15	980	337
Otitis media	86	93	14	894	62
Ovarian cancer	883	403	14	948	939
Pancreatic cancer	394	614	709	875	945
Pancreatitis	951	45	452	536	838
Paralytic ileus and intestinal obstruction	879	87	490	688	736
Parkinson's disease	842	225	104	952	539
Pedestrian road injuries	440	66	448	683	699
Peptic ulcer disease	858	30	264	547	664
Peripheral artery disease	792	126	110	955	540
Physical violence by firearm	358	14	836	93	988
Physical violence by other means	267	16	23	716	83
Physical violence by sharp object	889	100	20	703	640
Poisoning by carbon monoxide	881	58	19	797	585
Poisoning by other means	684	39	112	897	316
Polycystic ovarian syndrome	222	94	30	899	171
Prostate cancer	972	882	786	195	877
Protein-energy malnutrition	374	36	14	987	260
Pulmonary aspiration and foreign body in airway	991	4	891	41	115
Pyoderma	628	63	153	849	436
Rheumatic heart disease	998	909	8	992	957
Rheumatoid arthritis	955	15	20	891	222
Stomach cancer	987	771	991	279	1000
Subarachnoid hemorrhage	948	65	33	441	899
Syphilis	578	64	162	917	399
Testicular cancer	965	116	373	494	929
Thyroid cancer	952	111	519	587	905
Tracheal, bronchus, and lung cancer	462	8	950	87	996
Unintentional firearm injuries	829	176	52	962	772
Upper respiratory infections	121	132	45	922	64
Urinary tract infections	617	47	62	919	429
Urogenital congenital anomalies	212	33	717	492	910

Urolithiasis	452	51	9	960	359
Uterine cancer	379	89	624	593	788
Uterine fibroids	641	134	28	966	480
Varicella and herpes zoster	514	179	72	959	640
Vascular intestinal disorders	996	10	186	112	995
Venomous animal contact	570	21	21	979	316
Whooping cough	561	226	51	987	574

Table 4.2. Mean Value for Included Covariates, by Health Condition

	Number of models using covariate				
Health condition	**% population over 65**	**Cigarettes per capita**	**Education**	**Physical activity**	**Obesity**
Acute hepatitis A	0.108	-0.089	0.029	0.002	0.185
Acute hepatitis B	0.994	0.121	-0.760	-0.027	0.827
Acute hepatitis C	0.053	-0.014	0.010	0.002	-0.028
Acute hepatitis E	0.925	0.040	-1.013	-0.013	0.104
Acute myeloid leukemia	1.363	-0.026	0.065	0.017	0.567
Adverse effects of medical treatment	1.463	-0.019	0.011	-0.014	0.757
Alcohol use disorders	0.269	-0.012	0.034	0.001	0.029
Alzheimer's disease and other dementias	5.040	-0.133	0.162	-0.022	1.027
Amphetamine use disorders	0.274	-0.013	-0.019	-0.002	0.092
Anorexia nervosa	0.184	-0.018	-0.058	-0.004	0.662
Appendicitis	0.377	-0.017	-0.030	-0.001	0.008
Asthma	0.580	-0.028	0.025	-0.009	0.255
Atrial fibrillation and flutter	3.640	-0.182	0.057	-0.065	1.952
Bladder cancer	1.900	-0.044	0.345	-0.115	1.270
Brain and central nervous system cancer	3.095	-0.096	0.033	-0.064	1.693
Breast cancer	0.750	-0.010	0.003	-0.026	0.466
Bulimia nervosa	0.377	-0.001	0.006	0.001	-0.511
Cellulitis	0.089	-0.004	0.006	0.003	-0.007
Cervical cancer	4.422	-0.058	0.164	-0.080	1.369
Chlamydial infection	1.250	0.001	-0.005	-0.002	0.853
Chronic kidney disease due to diabetes mellitus type 2	1.937	-0.117	0.032	-0.090	1.324
Chronic kidney disease due to glomerulonephritis	0.149	-0.010	0.002	-0.001	0.125
Chronic kidney disease due to hypertension	1.440	-0.095	0.062	-0.092	0.627
Chronic kidney disease due to other and unspecified causes	2.003	-0.074	0.097	-0.034	0.855
Chronic lymphoid leukemia	0.377	-0.041	0.023	0.006	0.782
Chronic obstructive pulmonary disease	1.054	-0.030	0.083	-0.044	0.377

Cirrhosis and other chronic liver diseases due to alcohol use	1.479	-0.050	0.288	-0.043	0.560
Cirrhosis and other chronic liver diseases due to hepatitis B	2.769	-0.260	0.183	-0.041	1.527
Cirrhosis and other chronic liver diseases due to hepatitis C	0.996	-0.045	0.020	0.027	0.525
Cirrhosis and other chronic liver diseases due to other causes	5.240	-0.263	0.174	-0.164	1.050
Cirrhosis due to NASH	1.771	-0.008	0.031	0.013	0.550
Cocaine use disorders	7.438	-0.212	0.014	-0.085	2.786
Colon and rectum cancer	0.686	-0.079	0.028	0.001	0.406
Congenital heart anomalies	4.523	-0.080	0.391	-0.285	2.206
Congenital musculoskeletal and limb anomalies	0.477	-0.026	0.026	-0.007	0.082
Cyclist road injuries	0.196	-0.036	0.010	0.003	0.128
Decubitus ulcer	0.320	-0.014	0.017	-0.003	0.060
Diabetes mellitus type 1	0.827	-0.003	0.019	0.031	1.136
Diabetes mellitus type 2	0.301	-0.034	0.066	-0.032	0.488
Diarrheal diseases	0.005	-0.001	0.000	0.000	0.002
Digestive congenital anomalies	0.767	-0.016	0.019	-0.039	0.561
Drug-susceptible tuberculosis	0.917	-0.193	0.010	0.007	0.180
Ectopic pregnancy	0.918	-0.015	0.052	-0.012	0.244
Encephalitis	2.206	-0.463	0.082	-0.079	1.159
Endocarditis	2.295	-0.093	0.129	-0.082	0.861
Endometriosis	0.426	-0.001	0.032	-0.003	0.006
Environmental heat and cold exposure	0.572	-0.023	0.026	-0.001	0.155
Esophageal cancer	-0.065	0.016	-0.026	-0.013	0.702
Executions and police conflict	0.721	-0.040	0.025	-0.002	0.072
Falls	0.078	0.035	-0.064	-0.001	0.037
Fire, heat, and hot substances	0.622	-0.190	0.009	-0.025	-0.066
Foreign body in other body part	0.503	-0.074	0.004	-0.001	0.043
G6PD deficiency	0.220	-0.017	0.030	-0.004	0.003
Gallbladder and biliary diseases	0.328	-0.009	0.025	-0.009	0.134
Gallbladder and biliary tract cancer	1.843	-0.092	0.076	-0.001	1.392
Gastritis and duodenitis	0.020	0.015	-0.066	0.000	0.007
Genital prolapse	0.636	-0.001	2.614	-0.009	-0.155
Gonococcal infection	0.046	-0.001	0.000	0.000	0.004
HIV/AIDS resulting in other diseases	0.944	0.000	0.028	0.023	1.211

Idiopathic epilepsy	6.379	-0.619	0.321	-0.122	2.475
Inflammatory bowel disease	2.224	-0.110	0.114	-0.046	1.719
Inguinal, femoral, and abdominal hernia	0.023	-0.004	0.073	-0.002	-0.003
Interstitial lung disease and pulmonary sarcoidosis	4.417	-0.116	0.238	-0.285	2.284
Intracerebral hemorrhage	8.534	-0.562	0.316	-0.069	2.568
Ischemic heart disease	1.058	-0.009	0.007	0.007	0.567
Ischemic stroke	1.585	-0.030	0.019	0.011	0.408
Kidney cancer	0.166	-0.028	0.061	0.020	-0.216
Larynx cancer	0.862	-0.025	0.006	0.009	1.242
Lip and oral cavity cancer	1.150	-0.006	0.032	0.065	0.310
Liver cancer due to alcohol use	0.790	-0.016	0.025	-0.001	0.612
Liver cancer due to hepatitis C	1.261	-0.018	0.035	-0.008	0.677
Lower respiratory infections	0.550	-0.099	0.005	0.006	-0.177
Malignant skin melanoma	0.514	0.001	-0.002	-0.003	0.477
Maternal abortion and miscarriage	0.288	-0.004	0.031	0.000	0.345
Maternal hemorrhage	0.302	0.033	0.009	-0.004	0.034
Maternal hypertensive disorders	0.959	-0.458	0.334	-0.001	-1.228
Maternal obstructed labor and uterine rupture	0.337	-0.009	0.022	0.000	0.157
Maternal sepsis and other maternal infections	0.129	-0.007	0.041	0.001	0.015
Motor vehicle road injuries	2.101	-0.130	0.037	-0.025	0.321
Motorcyclist road injuries	2.950	-0.015	0.064	-0.057	0.972
Multiple myeloma	2.728	-0.123	0.044	-0.025	0.522
Myelodysplastic, myeloproliferative, and other hematopoietic neoplasms	0.749	0.119	-0.110	-0.318	0.775
Myocarditis	2.015	-0.284	0.027	-0.035	1.019
Neonatal encephalopathy due to birth asphyxia and trauma	1.759	0.013	0.012	-0.087	1.133
Neonatal preterm birth	0.605	-0.046	0.029	-0.034	0.307
Neonatal sepsis and other neonatal infections	2.852	-0.052	0.295	-0.199	1.806
Non-Hodgkin lymphoma	0.281	-0.003	-0.009	0.007	0.354
Non-melanoma skin cancer (squamous-cell carcinoma)	1.432	-0.023	0.009	-0.003	0.437
Non-rheumatic calcific aortic valve disease	0.199	-0.053	0.013	-0.006	0.059

Non-rheumatic degenerative mitral valve disease	0.373	-0.006	0.078	-0.001	0.045
Non-venomous animal contact	0.034	-0.005	0.003	0.001	0.000
Opioid use disorders	9.442	-0.611	0.030	-0.236	2.526
Other benign and in situ neoplasms	0.613	0.246	0.294	-0.094	0.660
Other exposure to mechanical forces	0.058	-0.070	0.009	0.001	-0.021
Other gynecological diseases	0.082	-0.003	-0.011	-0.002	0.076
Other malignant neoplasms	0.936	0.007	0.008	0.016	0.842
Other meningitis	1.111	-0.027	0.095	-0.052	0.717
Other pharynx cancer	0.911	-0.026	0.129	0.006	0.381
Other road injuries	4.155	-0.033	0.275	-0.011	0.835
Other skin and subcutaneous diseases	0.001	-0.001	0.000	0.000	-0.003
Other transport injuries	2.012	-0.043	0.204	-0.026	0.720
Other unintentional injuries	0.445	-0.518	-0.026	-0.028	-0.006
Otitis media	0.961	-0.095	0.121	0.002	-0.340
Ovarian cancer	2.303	-0.101	0.055	-0.025	0.740
Pancreatic cancer	0.312	0.001	-0.002	-0.017	0.210
Pancreatitis	1.116	-0.177	0.007	-0.027	0.407
Paralytic ileus and intestinal obstruction	1.076	-0.061	0.058	-0.070	0.684
Parkinson's disease	6.004	-0.223	0.243	-0.112	1.917
Pedestrian road injuries	1.611	-0.013	0.187	-0.157	1.844
Peptic ulcer disease	1.431	-0.021	0.083	-0.010	0.578
Peripheral artery disease	0.739	0.053	0.026	-0.014	0.226
Physical violence by firearm	0.092	-0.023	-0.007	0.002	0.752
Physical violence by other means	0.087	-0.011	0.041	0.003	0.055
Physical violence by sharp object	1.649	-0.251	0.372	-0.030	0.421
Poisoning by carbon monoxide	1.791	-0.432	0.048	-0.038	0.934
Poisoning by other means	0.324	-0.068	0.025	-0.003	0.095
Polycystic ovarian syndrome	0.103	0.044	-0.026	0.004	0.021
Prostate cancer	1.158	-0.018	0.012	0.007	0.449
Protein-energy malnutrition	0.499	-0.251	0.021	0.002	0.028
Pulmonary aspiration and foreign body in airway	0.499	-0.031	0.002	0.007	0.175
Pyoderma	0.047	-0.001	0.010	0.000	0.000
Rheumatic heart disease	3.545	0.001	0.023	-0.065	0.719
Rheumatoid arthritis	0.791	-0.204	-0.002	-0.011	0.699
Stomach cancer	0.388	0.003	-0.015	-0.006	0.832

Subarachnoid hemorrhage	9.738	-0.567	0.202	-0.143	3.458
Syphilis	0.662	-0.048	0.013	-0.009	0.146
Testicular cancer	1.435	-0.085	0.033	-0.026	0.735
Thyroid cancer	1.225	-0.144	0.015	-0.058	0.653
Tracheal, bronchus, and lung cancer	0.385	-0.007	-0.002	-0.026	0.299
Unintentional firearm injuries	0.806	-0.039	0.031	-0.016	0.336
Upper respiratory infections	2.020	-0.017	0.019	-0.167	0.238
Urinary tract infections	0.060	-0.001	0.024	0.000	0.015
Urogenital congenital anomalies	1.337	-0.244	0.099	-0.166	0.960
Urolithiasis	0.033	-0.005	0.026	0.000	0.007
Uterine cancer	0.253	0.000	0.006	-0.021	0.358
Uterine fibroids	0.071	-0.018	0.061	0.002	0.153
Varicella and herpes zoster	0.021	-0.001	-0.002	0.000	0.013
Vascular intestinal disorders	0.762	-0.102	0.008	0.022	0.621
Venomous animal contact	0.101	-0.007	0.024	0.001	0.105
Whooping cough	0.298	-0.030	0.009	-0.005	0.321

Section 5. Inefficiency Scores with Alternate Specifications

To assess the robustness of the analysis, we modeled estimates with the following eight alternative specifications (**Figures 5.1 – 5.7**). Scatter plots show ranks of the value score from 2017 with the primary model on the X axis and the sensitivity model on the Y-axis. The grey bars represent 95% confidence intervals of the ranks, calculated by ranking each draw of the estimated value score and taking the 2.5th and 97.5th quantiles.

Figure 5.1. Unadjusted spending: *The frontier model was run with healthcare spending without adjusting for differences in purchasing power between countries.*

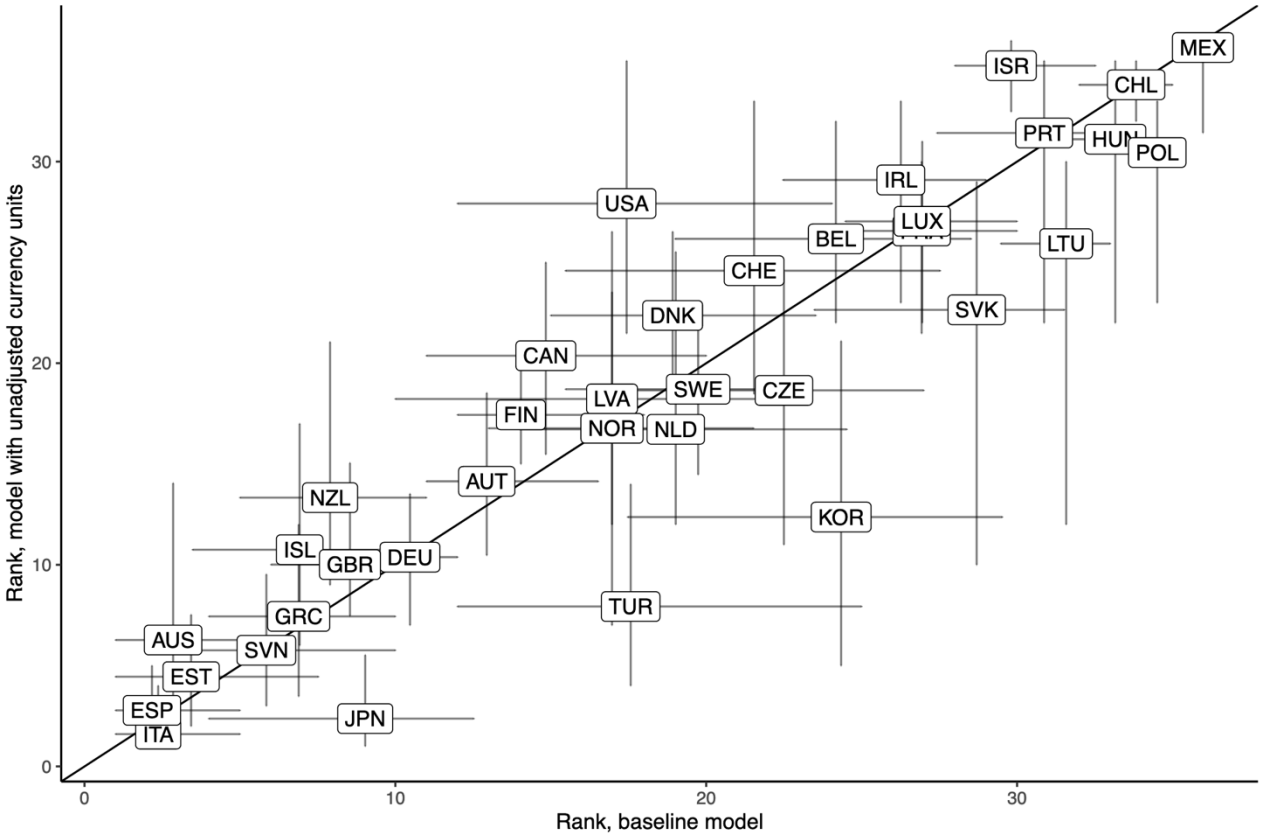


Figure 5.2. All covariates: *The model was run with all covariates from the primary model (obesity, cigarettes consumed per capita, proportion of the population older than 65, education, physical activity) included by default, rather than running the two-step covariate selection process described above.*

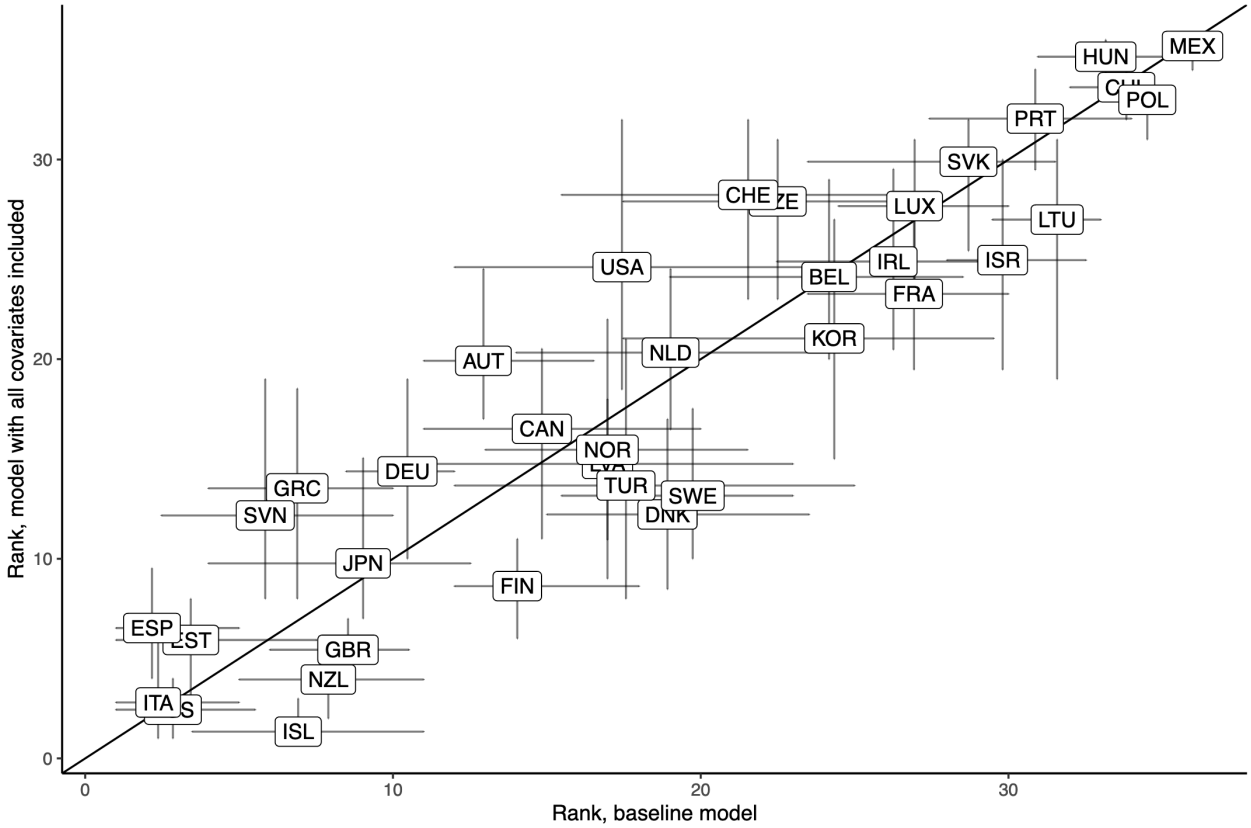


Figure 5.3. No covariates: *The frontier model was run with no covariates.*

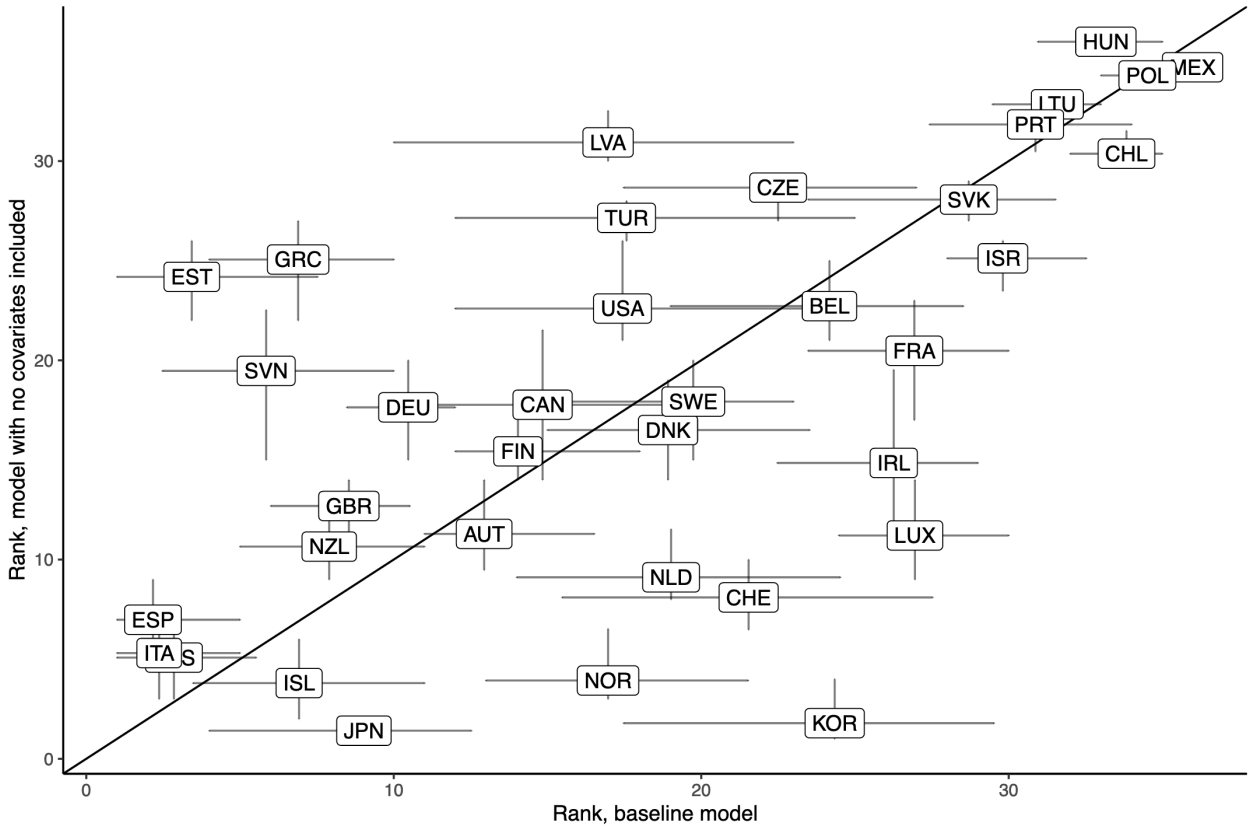


Figure 5.4. Income instead of education: *Frontier model run with income covariate instead of education covariate*

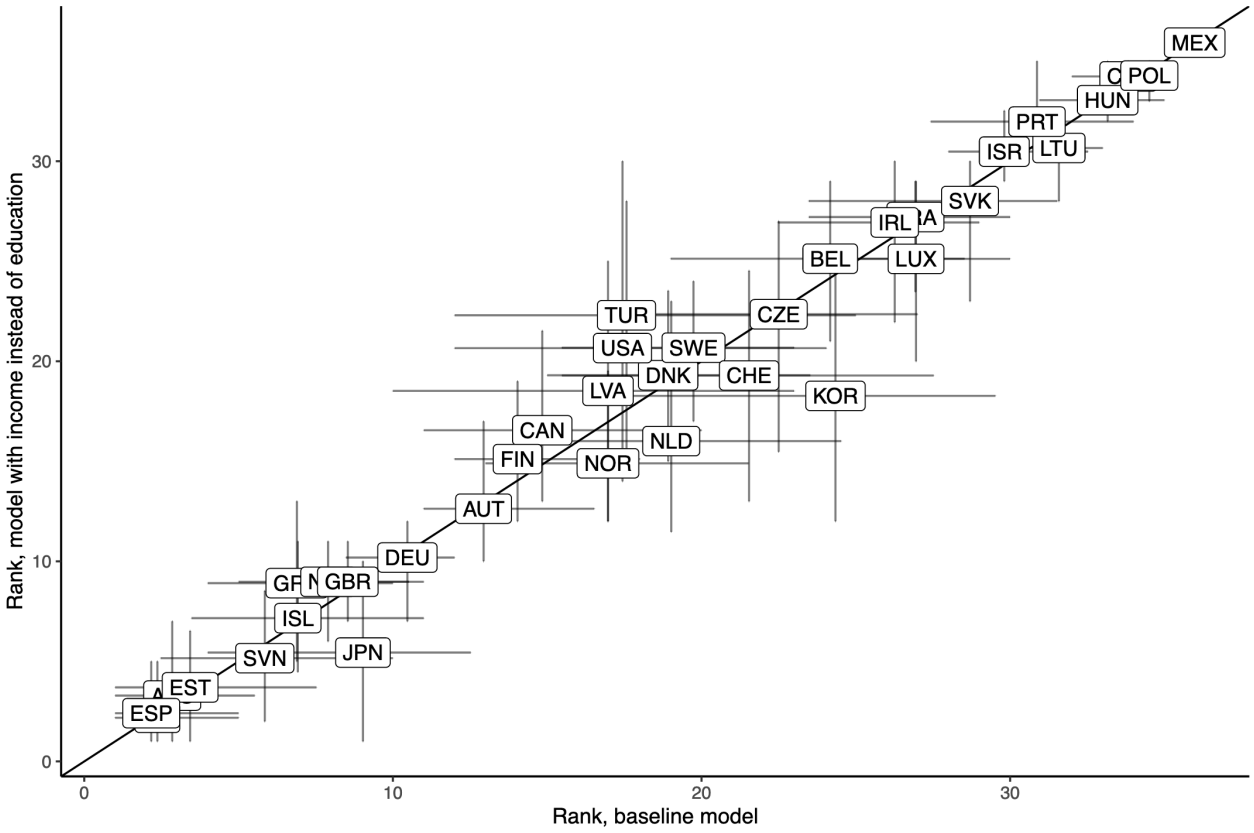


Figure 5.5. No education covariate: *Frontier model run without a covariate for educational attainment.*

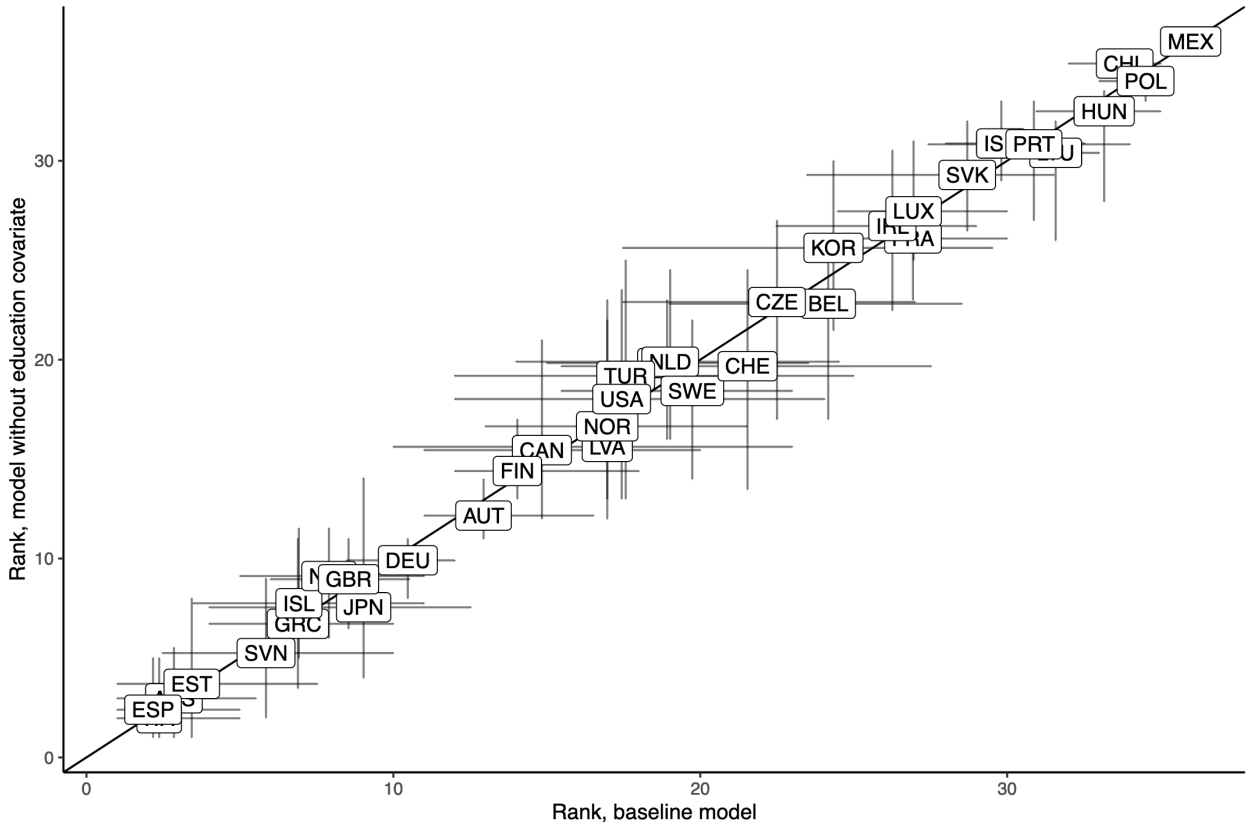


Figure 5.6. 5 knots on the spline instead of 3: *Frontier run with 5-knots on the cubic spline fit instead of the default 3-knot fit.*

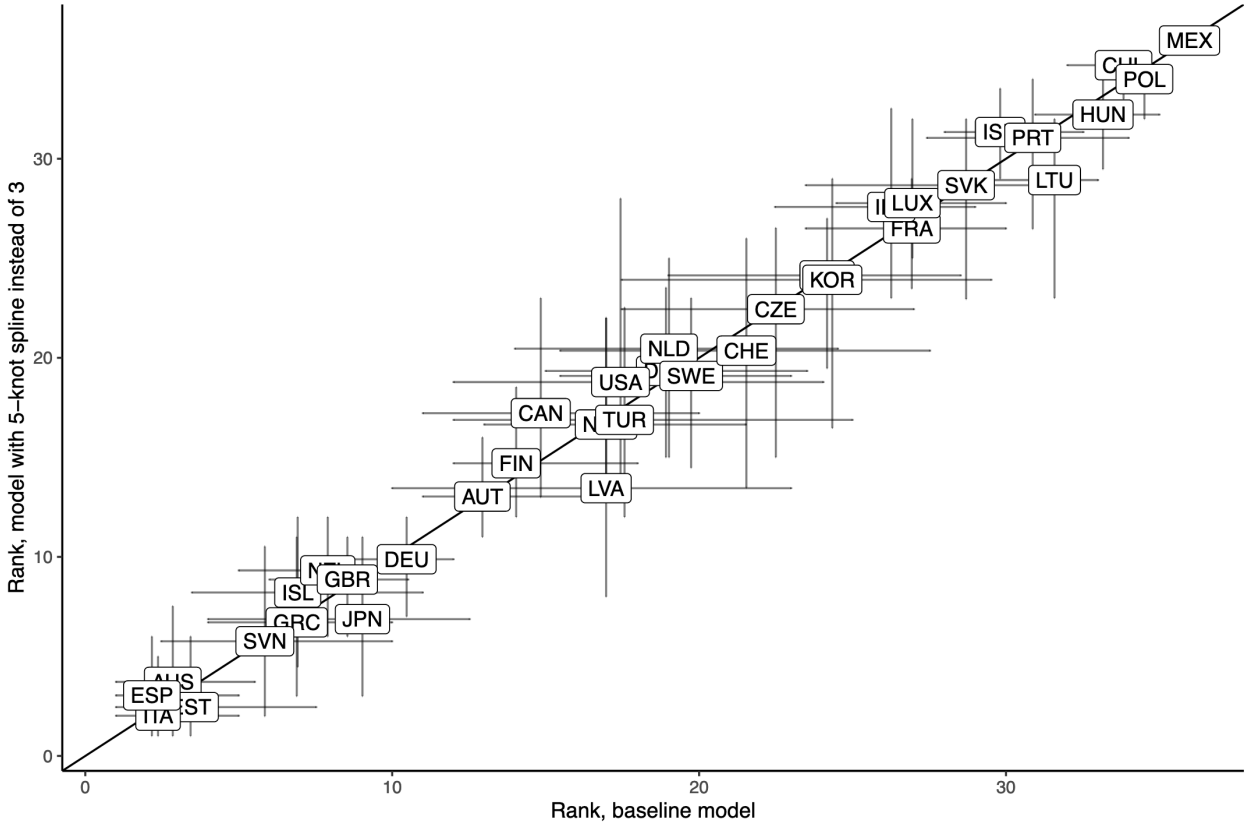


Figure 5.7: Inclusion of a population density covariate: *Frontier model run with a covariate for population density of each country.*

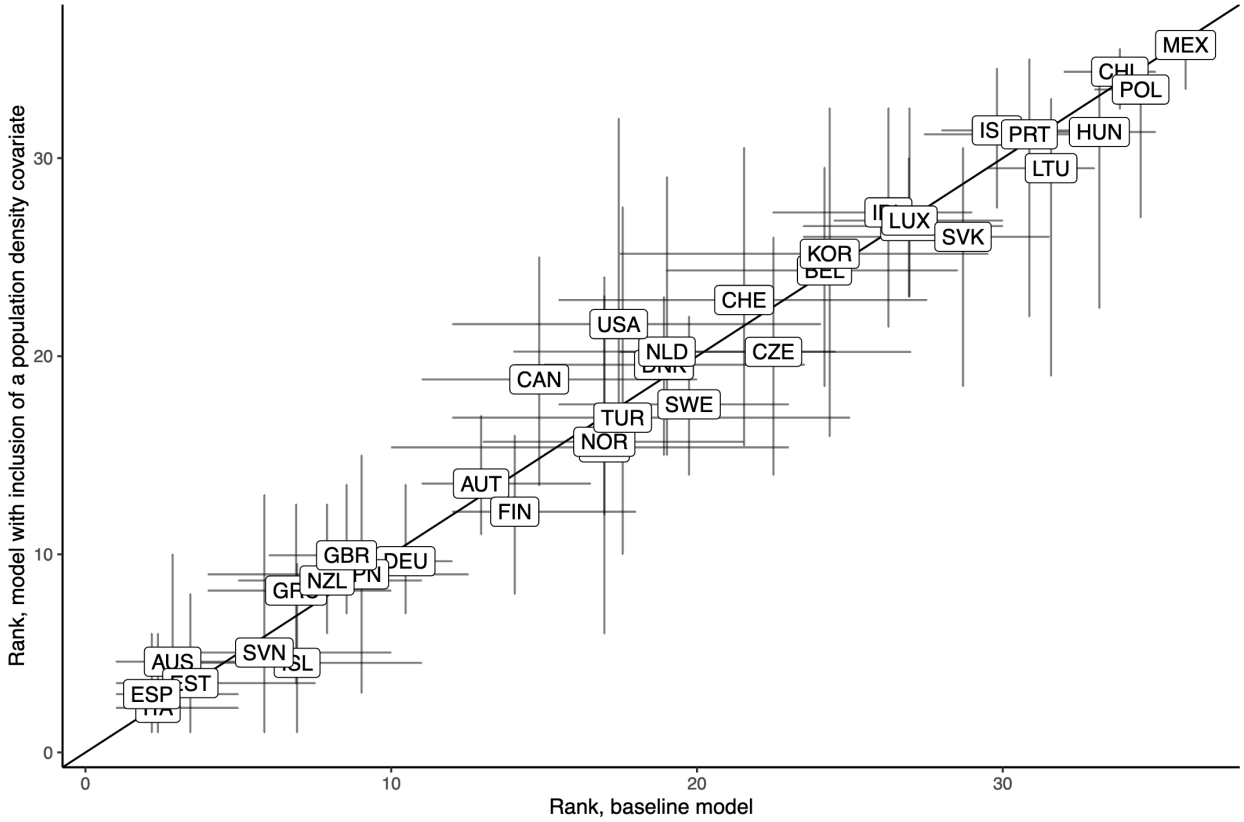
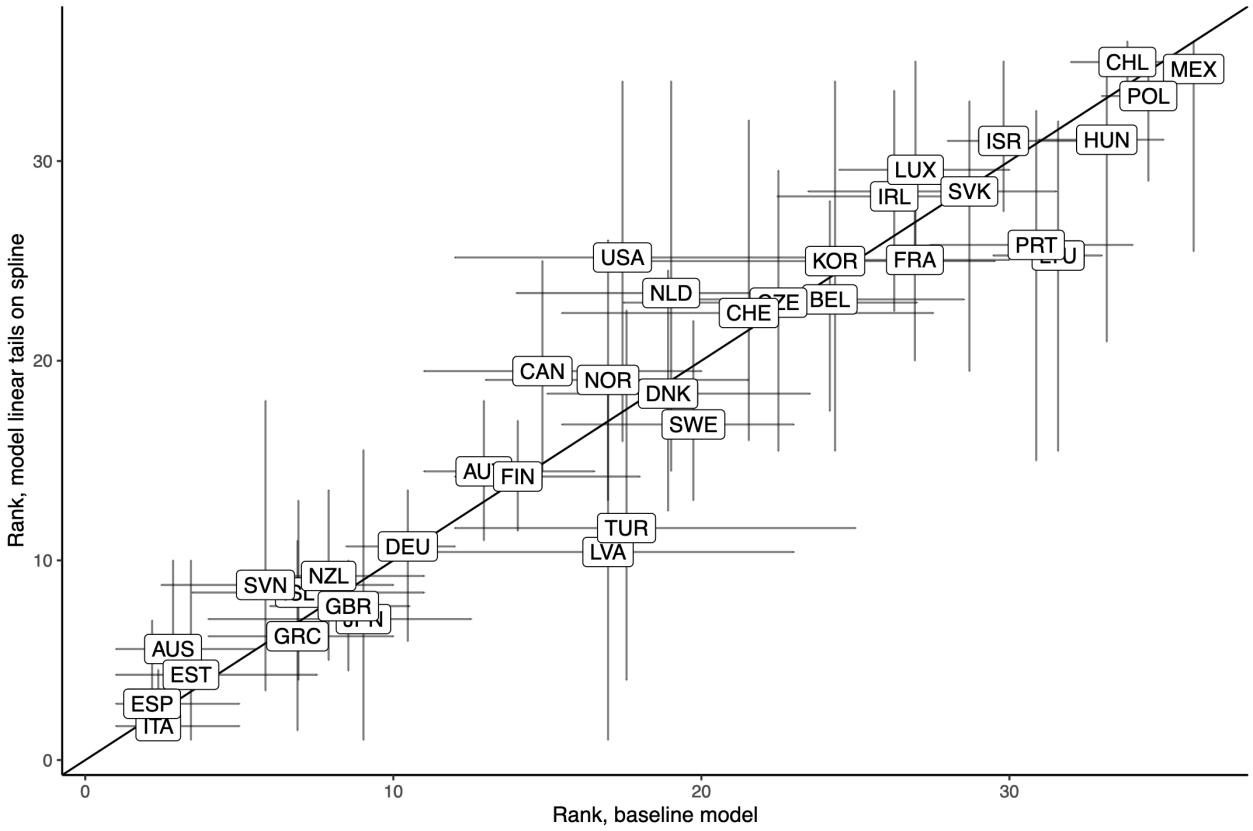


Figure 5.8: Linear tails: *Frontier model run with linear tails on the cubic spline fit.*



Section 6. Sensitivity Analysis for Policy Variable Modeling

The policy analysis was additionally assessed for robustness using sensitivity analysis specifications described in **Section 5**.

Figure 6.1. Unadjusted spending

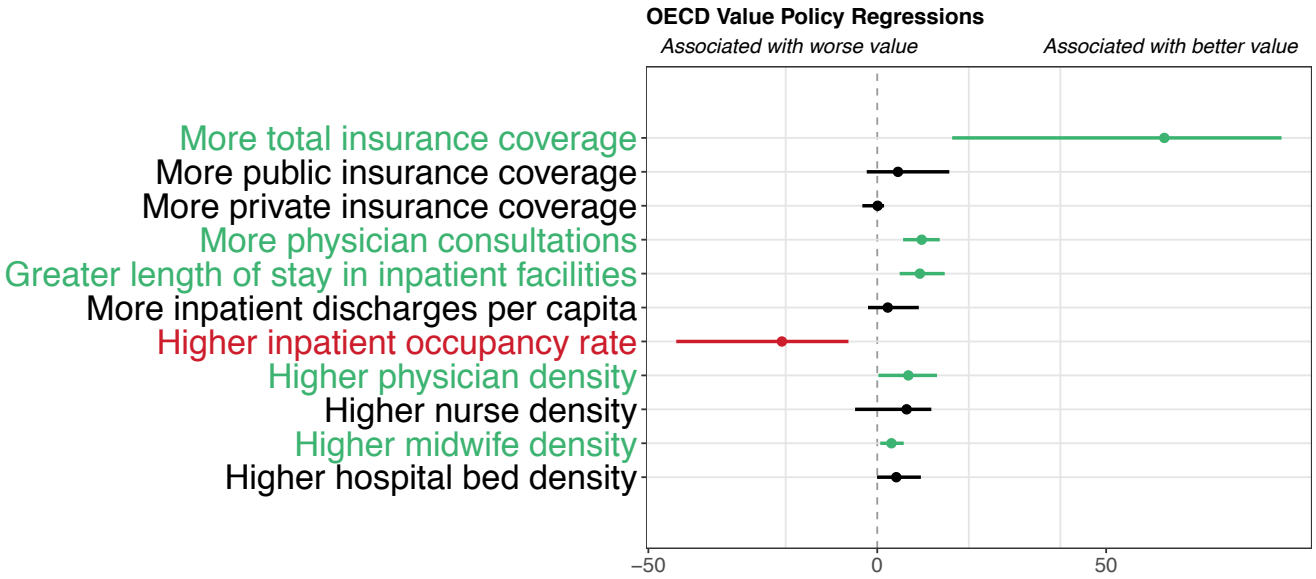


Figure 6.2. All covariates

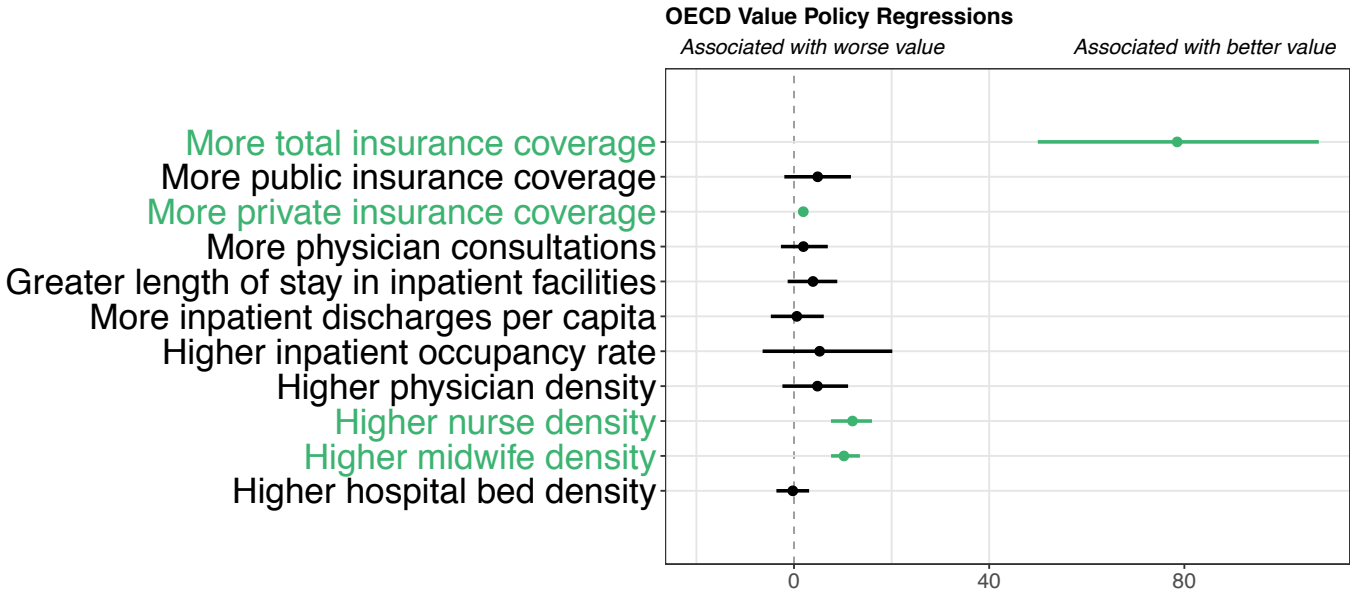


Figure 6.3. No covariates

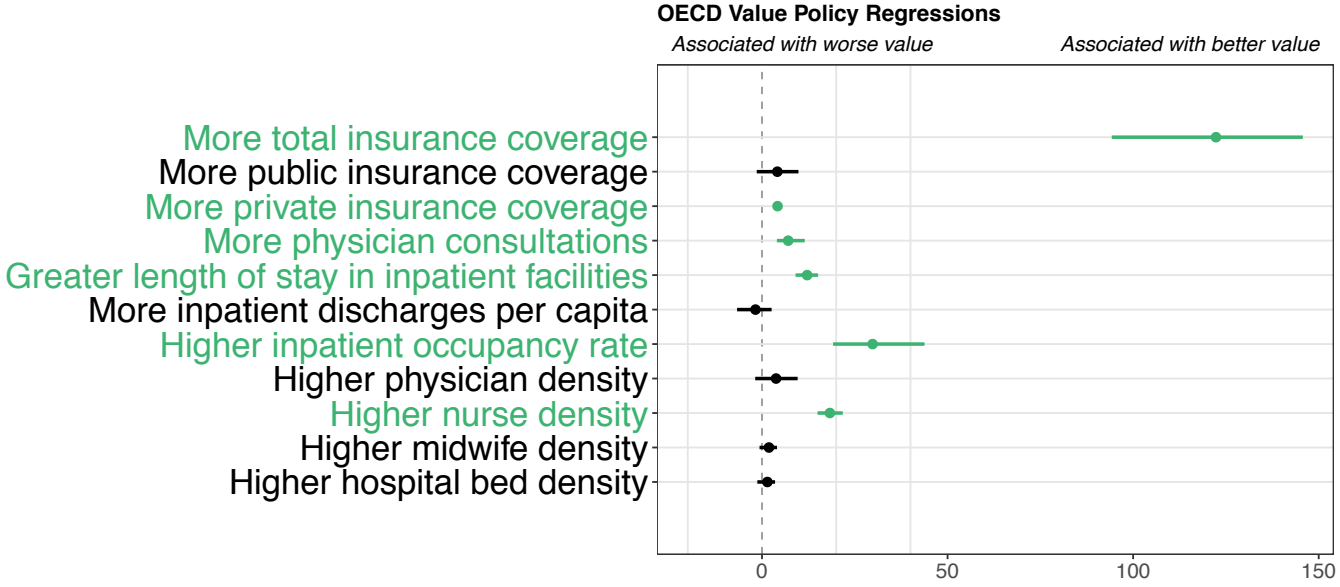


Figure 6.4. Income instead of education covariate

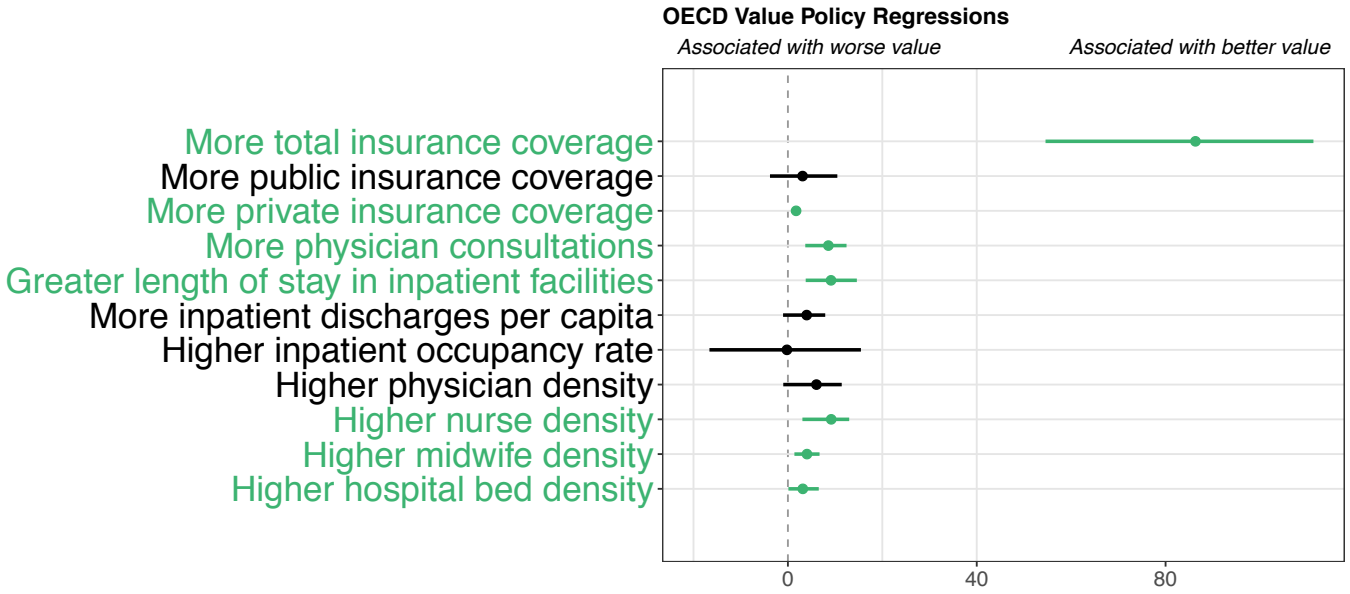


Figure 6.5. No education covariate

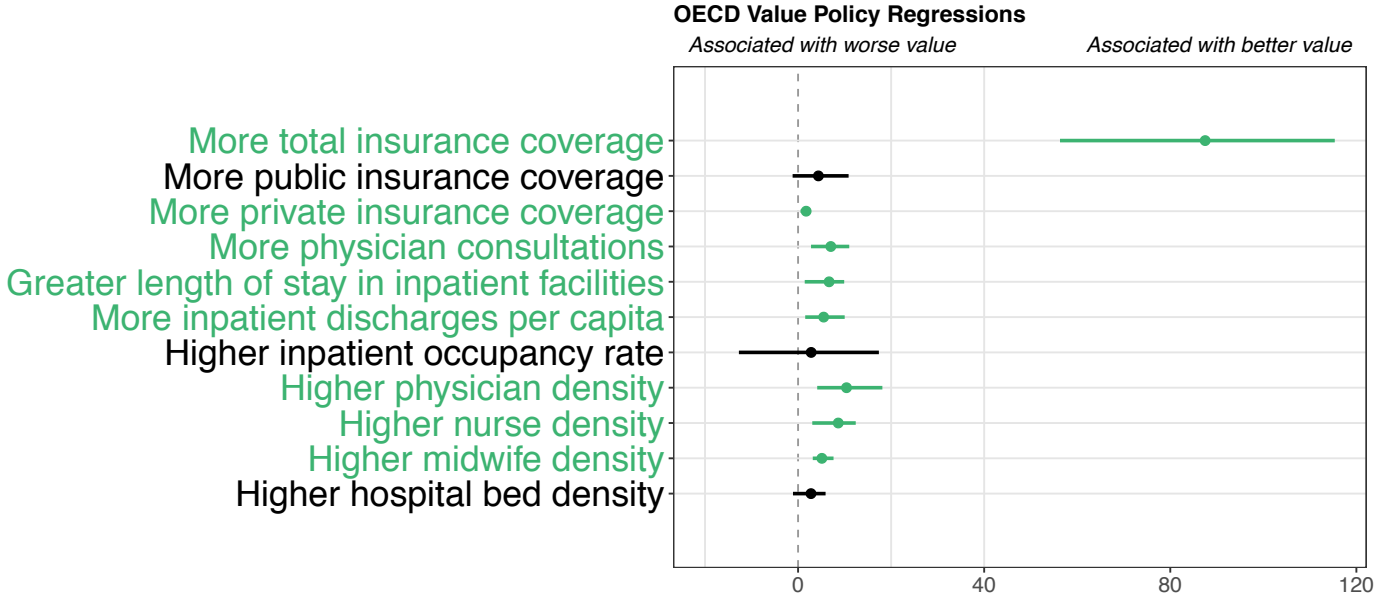


Figure 6.6. 5 knots on the spline instead of 3

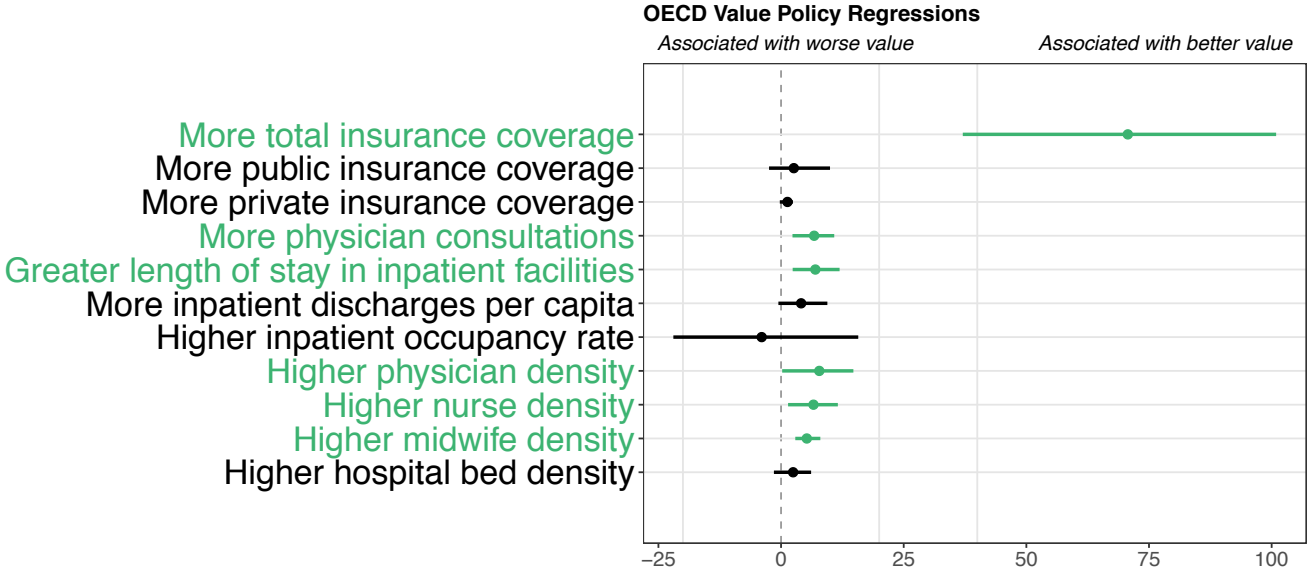


Figure 6.7: Inclusion of a population density covariate

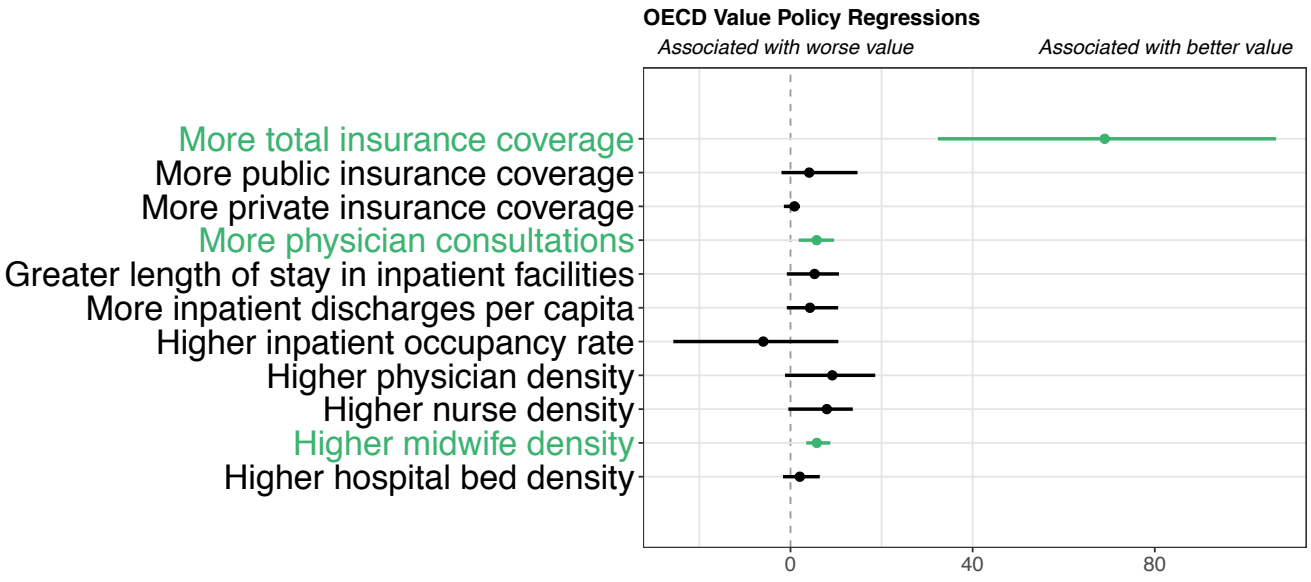
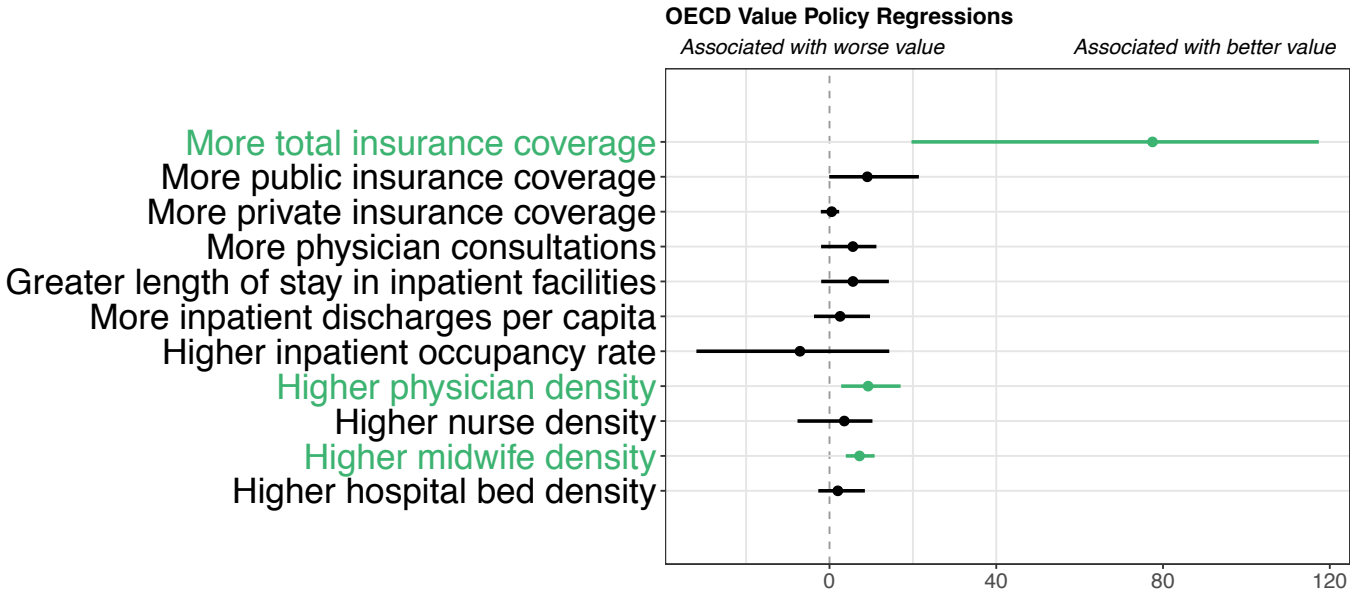


Figure 6.8: Linear tails



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