Appendices for Non-Price Competition and Risk Selection Through Hospital Networks

Appendix 1 Current risk adjustment system

Appendix Table 1: Base capitated transfer for the Contributory System during 2011

Department/city	Transfer
National (pesos)	505,627.2
Multiplier a_k	
Amazonas	$\times$ 1.10
Arauca, Arauca	$\times$ 1.10
Yopal, Casanare	$\times$ 1.10
Florencia, Caquetá	$\times$ 1.10
Chocó	$\times$ 1.10
Riohacha, Guajira	$\times$ 1.10
Guainía	$\times$ 1.10
Guaviare	$\times$ 1.10
Villavicencio, Meta	$\times$ 1.10
Putumayo	$\times$ 1.10
San Andrés y Providencia	$\times$ 1.10
Sucre, Sincelejo	$\times$ 1.10
Vaupés	$\times$ 1.10
Vichada	$\times$ 1.10
Soacha, Cundinamarca	$\times$ 1.06
Bello, Antioquia	$\times$ 1.06
Itaguí, Antioquia	$\times$ 1.06
Envigado, Antioquia	$\times$ 1.06
Sabaneta, Antioquia	$\times$ 1.06
Soledad, Antioquia	$\times$ 1.06
Bogotá	$\times$ 1.06
Medellín, Antioquia	$\times$ 1.06
Barranquilla, Atlántico	$\times$ 1.06

Appendix Table 2: Risk Adjustment Factors in the Contributory System during 2011

Age group	Sex	Multiplier a_g
<1	—	3.0000
1-4	—	0.9633
5-14	—	0.3365
15-18	M	0.3207
15-18	F	0.5068
19-44	M	0.5707
19-44	F	1.0588
45-49	—	1.0473
50-54	—	1.3358
55-59	—	1.6329
60-64	—	2.1015
65-69	—	2.6141
70-74	—	3.1369
>74	—	3.9419

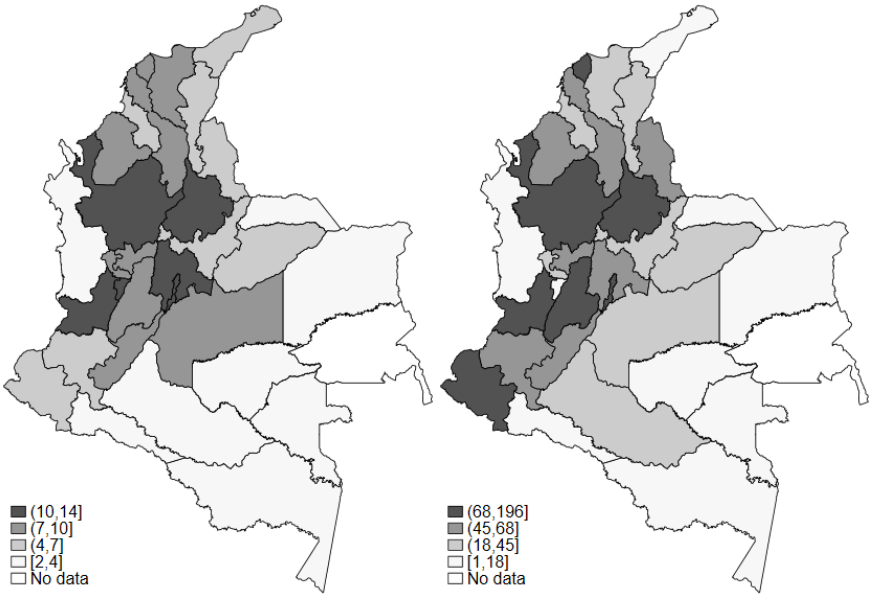
Appendix 2 Service categories

Service code	Description
01	Procedures in skull, brain, and cerebral meninges
03	Procedures in spinal cord and structures of spine
04	Procedures in peripheral and skull nerves
05	Procedures in nerves or sympathetic ganglia
06	Procedures in thyroid and parathyroid gland
08	Procedures in eyelids and lacrimal apparatus
10	Procedures in conjunctive, cornea, iris, retina, orbit
18	Procedures in ear
21	Procedures in nose and paranasal sinuses
23	Procedures in teeth, tongue, salivary glands
27	Procedures and interventions in mouth and face
28	Procedures in tonsils and adenoids
29	Procedures in pharynx, larynx, trachea
32	Procedures in lung and bronchus
34	Procedures in thoracic wall, pleura, mediastinum, diaphragm
35	Procedures in heart valves
36	Procedures in cardiac vessels
37	Procedures in heart and pericardium
38	Procedures in blood vessels
40	Procedures in lymphatic system
41	Procedures bone marrow and spleen
42	Procedures in esophagus
43	Procedures in stomach
45	Procedures in intestines
47	Procedures in appendix
48	Procedures in rectum, rectosigmoid, perirectal tissue
50	Procedures in liver
51	Procedures in gallbladder and biliary tract
52	Procedures in pancreas
53	Procedures in abdominal wall
55	Procedures in kidney
56	Procedures in ureter
57	Procedures in bladder
58	Procedures in urethra and urinary tract
60	Procedures in prostate, seminal vesicles, scrotum, testicles, penis
65	Procedures in ovaries, fallopian tubes, cervix, uterus
70	Procedures in vagina and cul-de-sac
72	Procedures and interventions in vaginal delivery
76	Procedures in bones and facial joints
79	Reduction of fracture and dislocation
80	Procedures in joint structures
81	Repair procedures and plasties in joint structures
82	Procedures in tendons, muscles, and hand fascia
83	Procedures in muscle, tendon, fascia, bursa except hand
85	Procedures in breast
86	Diagnostic procedures in skin and subcutaneous cellular tissue
87	Radiology and non-radiology imaging
89	Consultation, anatomic measures, physiology, manual tests, and pathology
90	Laboratory
91	Blood bank and transfusion medicine
92	Nuclear medicine and radiotherapy
93	Procedures and interventions in functional development and rehabilitation
94	Procedures related to mental health
95	Non-surgical procedures and interventions related to eye and ear
97	Substitution and extraction of therapeutic devices
98	Non-surgical extraction of kidney stones
99	Prophylactic and therapeutic procedures
S1	Inpatient services

Appendix 3 Description of the Colombian health care market

Appendix Table 3: National market shares in 2011

Insurer	Market share
EPS013	21.4
EPS016	15.2
EPS037	11.1
EPS002	9.3
EPS017	7.2
EPS010	7.1
EPS005	4.5
EPS018	4.4
EPS003	4.0
EPS008	3.7
EPS023	3.1
EPS009	1.8
EPS001	1.6
EPS012	1.6



(a) Insurers per market (b) Hospitals per market

Appendix Figure 1: Number of insurers and hospitals per market

Appendix Table 4: Demographic characteristics of current and new enrollees

	Current			New		
Insurer	Age	Male	Sick	Age	Male	Sick
EPS001	41.6	44.3	1.8	36.6	50.8	1.3
EPS002	36.6	44.1	7.8	31.3	59.0	8.6
EPS003	38.7	44.0	3.6	33.9	56.2	3.2
EPS005	45.4	40.9	3.3	34.9	55.9	2.8
EPS008	37.6	42.4	3.5	32.9	57.7	4.5
EPS009	38.7	42.5	1.7	32.8	56.7	2.1
EPS010	37.9	43.3	7.2	33.9	56.3	5.5
EPS012	40.5	43.7	1.6	31.7	58.0	1.5
EPS013	37.3	44.3	17.2	30.4	58.7	15.2
EPS016	37.6	43.1	15.7	32.1	55.3	16.7
EPS017	35.2	43.4	6.6	31.9	60.0	8.0
EPS018	38.1	44.6	2.9	30.5	56.2	4.1
EPS023	35.0	45.2	2.3	29.3	60.8	2.0
EPS037	52.9	39.6	24.7	42.7	50.6	24.4

Note: Average age, percentage of males, and percentage of enrollees with chronic diseases by insurer in the sample of current enrollees and new enrollees during 2011.

Appendix Table 5: Service coverage per insurer at Fundación Valle del Lili in Cali in 2011

	Insurer EPS0-													
	01	02	03	05	08	09	10	12	13	16	17	18	23	37
Adult intermediate care	1	0	0	1	1	0	0	1	0	0	0	1	0	1
Anesthesia	1	0	0	1	1	0	1	0	0	0	0	1	0	1
Cardiac vessel implant	1	0	0	0	1	0	0	0	0	0	0	1	0	0
Cardiology	1	0	0	0	1	0	1	1	0	0	0	1	0	1
Cardiovascular diagnostics	0	1	0	1	1	0	1	1	0	0	0	0	0	1
Cardiovascular surgery	1	1	0	1	1	0	0	1	0	0	0	1	0	1
Dialysis	0	1	0	0	1	0	1	0	0	0	0	0	0	1
Family medicine	0	0	0	0	1	0	1	0	0	0	0	1	0	1
Gastroenterology	0	1	0	0	1	0	1	1	0	0	0	1	0	1
Gastrointestinal surgery	0	1	0	1	1	0	0	0	0	0	0	1	0	1
General adult admission	1	0	0	1	1	0	0	1	0	1	0	1	0	1
General medicine	0	0	0	0	1	0	1	0	0	0	0	1	0	1
General pediatric admission	1	0	0	1	1	0	0	1	0	0	0	1	0	1
General surgery	0	1	0	1	1	0	0	1	0	0	0	1	0	1
ICU	1	0	0	1	1	0	0	1	0	0	0	1	0	1
Infectology	1	0	0	0	1	0	1	1	0	0	0	1	0	1
Internal medicine	1	0	0	0	1	0	1	1	0	0	0	1	0	1
Nephrology	1	0	0	0	1	0	1	1	0	0	0	1	0	1
NICU	1	0	0	0	1	0	0	1	0	0	0	1	0	1
Nuclear medicine	0	1	0	1	1	0	0	0	0	0	0	1	0	1
Oncological surgery	1	0	0	0	1	0	0	1	0	0	0	1	0	1
Oncology	1	0	0	1	1	0	1	1	0	0	0	1	0	1
Ophthalmological surgery	0	1	0	1	1	0	0	1	0	0	0	1	0	1
Ophthalmology	0	0	0	0	1	0	1	1	0	0	0	1	0	1
Pathology	1	0	0	0	1	0	1	0	0	0	0	1	0	1
Radiotherapy	1	0	0	1	1	0	1	1	0	0	0	0	0	1
Ultrasound	0	0	0	1	1	0	0	0	0	0	0	1	0	0

Note: Table presents service coverage per insurer at the largest hospital in Cali during 2011 for a sample of services. Data comes from the National Health Superintendency.

Appendix Table 6: Service coverage per insurer at Fundación Santa Fe in Bogotá in 2011

	Insurer EPS0-													
	01	02	03	05	08	09	10	12	13	16	17	18	23	37
Adult intermediate care	0	0	0	1	1	0	1	1	0	0	1	0	0	1
Anesthesia	0	0	0	0	1	0	1	0	0	0	0	0	0	1
Cardiac vessel implant	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Cardiology	0	0	0	1	1	0	1	1	0	0	0	1	0	1
Cardiovascular diagnostics	0	0	0	1	1	0	1	1	0	0	1	0	0	1
Cardiovascular surgery	0	0	0	1	1	0	1	1	0	0	0	0	0	1
Dialysis	0	0	0	1	0	0	0	0	0	0	1	0	0	0
Family medicine	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Gastroenterology	0	0	0	1	0	0	1	1	0	0	1	1	0	1
Gastrointestinal surgery	0	0	0	0	1	0	0	0	0	0	0	0	0	0
General adult admission	0	0	0	1	1	0	1	1	0	1	1	0	0	1
General medicine	0	0	0	0	0	0	1	0	0	0	1	1	0	1
General pediatric admission	0	0	0	1	1	0	1	1	0	0	0	0	0	1
General surgery	0	0	0	1	1	0	1	1	0	0	1	1	0	1
ICU	0	0	0	1	1	0	1	1	0	0	1	0	0	1
Infectology	0	0	0	1	0	0	1	1	0	0	0	0	0	1
Internal medicine	0	0	0	1	0	0	1	1	0	0	1	1	0	1
Nephrology	0	0	0	1	0	0	1	1	0	0	1	0	0	1
NICU	0	0	0	0	1	0	1	1	0	0	1	0	0	1
Nuclear medicine	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Oncological surgery	0	0	0	1	1	0	1	1	0	0	0	0	0	1
Oncology	0	0	0	1	1	0	1	1	0	0	1	0	0	1
Ophthalmological surgery	0	0	0	1	1	0	1	1	0	0	0	0	0	1
Ophthalmology	0	0	0	0	0	0	1	1	0	0	1	0	0	1
Pathology	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Radiotherapy	0	0	0	1	0	0	1	0	0	0	1	0	0	1
Ultrasound	0	0	0	0	1	0	0	0	0	0	0	0	0	0

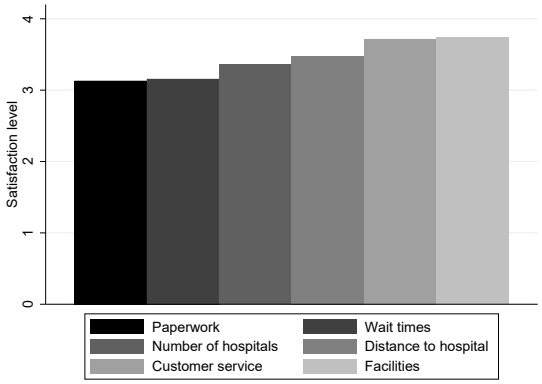
Note: Table presents service coverage per insurer at the largest hospital in Bogotá during 2011 for a sample of services. Data comes from the National Health Superintendency.

Appendix Table 7: Service coverage per insurer at Hospital Pablo Tobón in Medellín in 2011

	Insurer EPS0-													
	01	02	03	05	08	09	10	12	13	16	17	18	23	37
Adult intermediate care	0	0	0	0	0	1	0	0	0	0	0	1	0	1
Anesthesia	0	1	0	0	0	1	0	0	0	0	0	1	0	1
Cardiology	0	0	0	0	0	1	0	0	0	0	0	1	0	1
Cardiovascular diagnostics	0	1	0	0	0	1	0	0	0	0	0	0	0	1
Cardiovascular surgery	0	1	0	0	0	0	0	0	0	0	0	1	0	1
Dialysis	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Gastroenterology	0	1	0	0	0	1	0	0	0	0	0	1	0	1
Gastrointestinal surgery	0	1	0	0	0	0	0	0	0	0	0	0	0	1
General adult admission	0	1	0	0	0	0	0	0	0	1	0	1	0	1
General medicine	0	1	0	0	0	1	0	0	0	0	0	1	0	1
General pediatric admission	0	1	0	0	0	1	0	0	0	0	0	1	0	1
General surgery	0	1	0	0	0	1	0	0	0	0	0	1	0	1
ICU	0	0	0	0	0	1	0	0	0	0	0	1	0	1
Internal medicine	0	0	0	0	0	1	0	0	0	0	0	1	0	1
Nephrology	0	0	0	0	0	1	0	0	0	0	0	0	0	1
NICU	0	1	0	0	0	0	0	0	0	0	0	1	0	1
Nuclear medicine	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Oncological surgery	0	1	0	0	0	1	0	0	0	0	0	0	0	1
Oncology	0	1	0	0	0	1	0	0	0	0	0	1	0	1
Ophthalmological surgery	0	1	0	0	0	1	0	0	0	0	0	1	0	1
Ophthalmology	0	0	0	0	0	1	0	0	0	0	0	1	0	1
Radiotherapy	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Ultrasound	0	0	0	0	0	0	0	0	0	0	0	0	0	1

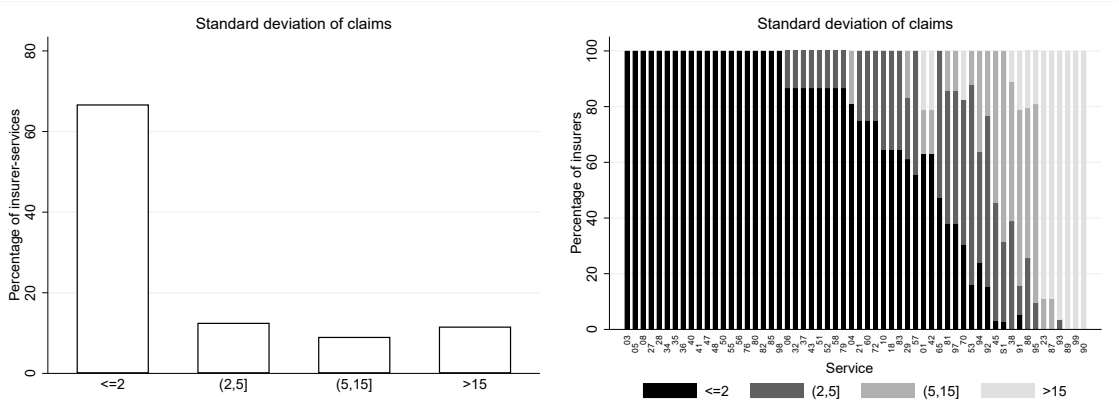
Note: Table presents service coverage per insurer at the largest hospital in Medellín during 2011 for a sample of services. Data comes from the National Health Superintendency.

Appendix 4 Variation in provider quality within service



Appendix Figure 2: Average satisfaction levels

Note: This figure shows the average enrollee satisfaction level with six measures of insurer quality: amount of paperwork, number of hospitals in-network, customer service, wait times for doctor appointments, distance to the nearest hospital, and insurer facilities. The data for this graph are the pooled enrollee satisfaction surveys from 2013 to 2016 conducted by Ministry of Health to individuals in the contributory regime.



(a) All services (b) Per service

Appendix Figure 3: Standard deviation of claims across providers

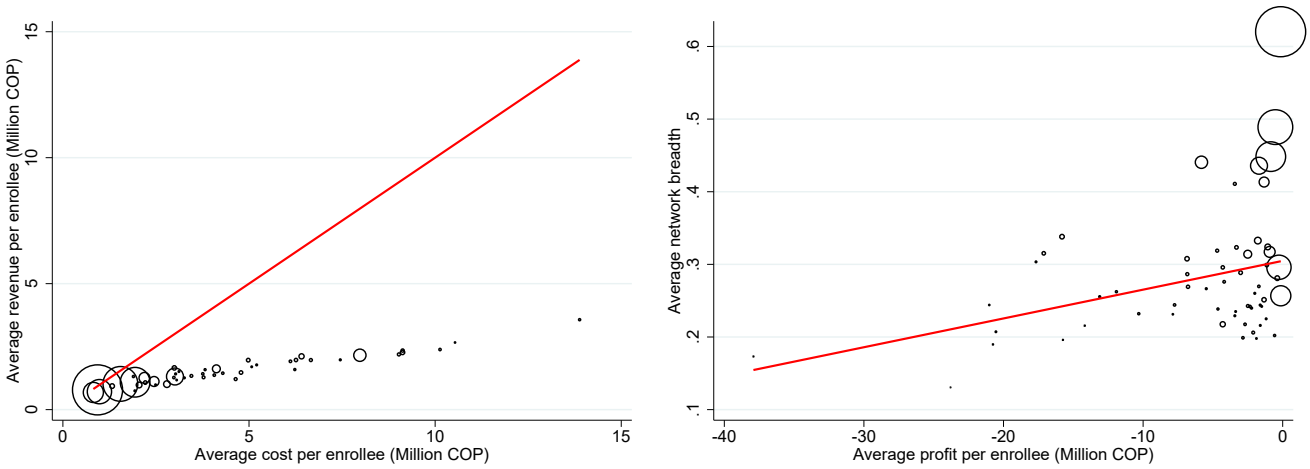
Note: Panel (a) of this figure shows distribution of the standard deviation of number of claims across insurer-service combinations. Panel (b) shows the distribution of the standard deviation of number of claims across insurers separately for every service in the x-axis.

Appendix 5 Robustness checks on correlates of network breadth

Appendix Table 8: Network breadth and service profitability

	Network breadth		
	(1)	(2)	(3)
Profit per enrollee	0.002***	0.002***	0.001***
	(0.0002)	(0.0002)	(0.0002)
Market	—	Y	Y
Insurer	—	Y	Y
Service	—	—	Y
N	11,377	11,377	11,377
R^2	0.005	0.32	0.40

Note: Table presents results of an OLS regression of network breadth per insurer, service, and market, on the average profit of enrollees who make a claim for the service. The profit per enrollee is calculated as ex-ante plus ex-post government transfers, plus revenues from copayments and coinsurance rates, minus total health care costs. Column (1) has no fixed effects, column (2) includes market and insurer fixed effects, and column (3) includes market, insurer, and service fixed effects. Robust standard errors in parenthesis. ***p<0.01, **p<0.05, *p<0.1.

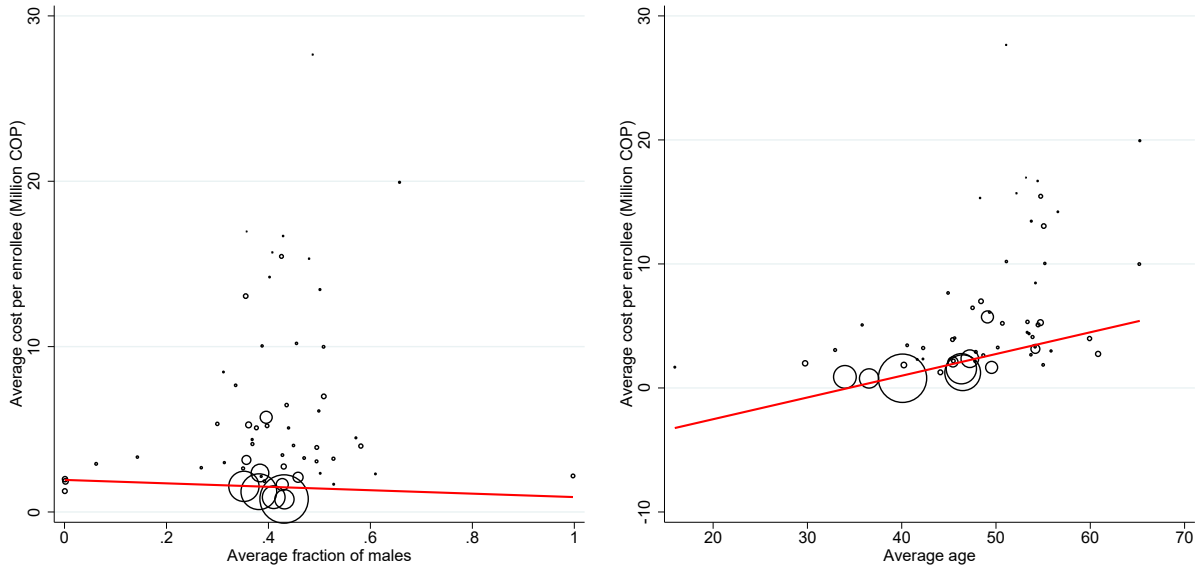


(a) Service-level selection incentives after risk adjustment

(b) Network breadth and service profitability

Appendix Figure 4: Service-level selection incentives and profitability

Note: This figure uses data from all enrollees to the contributory system without constraining enrollment to be continuous. Panel (a) presents a scatter plot of average revenue and average cost per enrollee among those who make claims for each service. Individual costs are annualized by dividing by the number of days the individual is enrolled to the system and multiplying by 360. Panel (b) presents a scatter plot of profits per enrollee among those that make claims for each service, where individual costs are annualized as before, and average network breadth per service.



Appendix Figure 5: Predictability of cost per service

Note: Scatter plot of average cost per enrollee for patients who make claims for each service against average fraction of males in panel (a) and average age in panel (b). Every dot represents a service weighted by the number of consumers that make claims for that service. The red line represents a linear fit.

Appendix Table 9: Switching probability and changes in health status

	Switching indicator		
	(1)	(2)	(3)
Change in diagnosis	0.01***	——	
	(0.003)		
Newly diagnosed	—	0.01***	—
		(0.004)	
Number of additional diagnoses	—	—	0.002
			(0.001)
log(total cost 2010+1)	-0.02***	-0.03***	-0.02***
	(0.002)	(0.003)	(0.002)
Constant	0.08***	0.08***	0.08***
	(0.007)	(0.008)	(0.007)
R^2	0.0003	0.0003	0.0003
N	6,004,069	3,999,316	6,004,069

Note: Table presents results of an OLS regression of the probability of switching insurers in 2011 on an indicator for whether the patient received a different diagnosis in 2011 relative to 2010 in column (1), on an indicator for whether the patient receives a chronic disease diagnosis in 2011 conditional on being healthy in 2010 in column (2), and on the number of additional diagnoses received in 2011 relative to 2010 conditional on being sick in 2010 in column (3). All models include sex, age group, and state of residence dummies. Coefficients are multiplied by 100 and represent percentage changes. Robust standard errors in parenthesis. ***p<0.01, **p<0.05, *p<0.1.

Appendix Table 10: Switching probability and network breadth

	Switching indicator		
	(1)	(2)	(3)
H_{jt}^{2010} hospital admissions	-0.07***	—	—
	0.001		
H_{jt}^{2010} consultations	—	-0.15***	—
		0.01	
H_{jt}^{2010} laboratory	—	—	-0.07***
			0.01
log(total cost 2010+1)	-0.02***	-0.02***	-0.02***
	0.002	0.002	0.002
Constant	0.12***	0.22***	0.12***
	0.01	0.01	0.01
R^2	0.0003	0.0003	0.0003
N	6,004,069	6,004,069	6,004,069

Note: Table presents results of an OLS regression of the probability of switching insurers on network breadth for hospital admissions at the incumbent insurer in column (1), on network breadth for consultations at the incumbent insurer in column (2), and on network breadth for laboratory at the incumbent insurer in column (3). All models include sex, age group, and state of residence dummies. Coefficients are multiplied by 100 and represent percentage changes. Robust standard errors in parenthesis. ***p<0.01, **p<0.05, *p<0.1.

Appendix Table 11: Insurer choice among switchers with changes in health status

	Insurer choice
(1) Women in childbearing ages	
$H_{jt}^{2010} - H_{j't}^{2011}$ Delivery	-2.77***
	(0.12)
N	14,958
(2) Additional diagnosis of renal disease	
$H_{jt}^{2010} - H_{j't}^{2011}$ Dialysis	-1.51*
	(0.84)
N	40
(3) Additional diagnosis of cancer	
$H_{jt}^{2010} - H_{j't}^{2011}$ Therapy	-3.23***
	(0.37)
N	1,658
(4) Additional diagnosis of arthritis	
$H_{jt}^{2010} - H_{j't}^{2011}$ Bones and joints	-1.82***
	(0.65)
N	533
(5) Newly diagnosed	
$H_{jt}^{2010} - H_{j't}^{2011}$ Hospital admissions	-1.94***
	(0.21)
N	5,787

Note: Table presents results of a conditional logit estimated by maximum likelihood on the sample of switchers. Panel (1) uses the subsample of women in childbearing ages during 2010. The main explanatory variable is the difference in network breadth for delivery services between the incumbent insurer j and all other insurers j'. Panel (2) uses the subsample of patients who develop renal disease in 2011 and the difference in network breadth for dialysis between the incumbent insurer and all other insurers. Panel (3) uses the subsample of patients who develop cancer in 2011 and the difference in network breadth for chemotherapy between the incumbent insurer and all other insurers. Panel (4) uses the subsample of patients who develop arthritis and the difference in network breadth for procedures in bones and joints between the incumbent insurer and all other insurers. Panel (5) uses the subsample of patients who were healthy in 2010 and develop a disease in 2011. The main explanatory variable is the difference in network breadth for hospital admissions between the incumbent insurer and all other insurers. Robust standard errors in parenthesis. ***p<0.01, **p<0.05, *p<0.1.

Appendix Table 12: Insurer choice among switchers diagnosed in 2010

	Insurer choice
(1) Renal disease	
$H_{jt}^{2010} - H_{j't}^{2011}$ Dialysis	-2.91***
	(1.00)
N	92
(2) Cancer	
$H_{jt}^{2010} - H_{j't}^{2011}$ Therapy	-2.77***
	(0.40)
N	1,988
(3) Arthritis	
$H_{jt}^{2010} - H_{j't}^{2011}$ Bones and joints	-0.93
	(0.58)
N	462
(4) Any disease	
$H_{jt}^{2010} - H_{j't}^{2011}$ Hospital admissions	-1.72***
	(0.16)
N	9,512

Note: Table presents results of a conditional logit estimated by maximum likelihood on the sample of switchers. Panel (1) uses the subsample of patients diagnosed with renal disease in 2010. The main explanatory variable is the difference in network breadth for dialysis between the incumbent insurer j and all other insurers j'. Panel (2) uses the subsample of patients diagnosed with cancer in 2010 and the difference in network breadth for chemotherapy between the incumbent insurer and all other insurers. Panel (3) uses the subsample of patients diagnosed with arthritis in 2010 and the difference in network breadth for prcedures in bones and joints between the incumbent insurer and all other insurers. Panel (4) uses the subsample of patients with any disease in 2010 and the difference in network breadth for hospital admissions between the incumbent insurer and all other insurers. Robust standard errors in parenthesis. ***p<0.01, **p<0.05, *p<0.1.

Appendix Table 13: Robustness on regression specification: Network breadth and health care cost per service during 2011

	$1\{\text{service cost}^{2011}>0\}$	$\log(\text{service cost}^{2011})$
Panel A: Stayers		
H_{jmk}	0.14***	0.09***
	(0.01)	(0.01)
N	622,256	
R^2	0.31	
Panel B: New enrollees		
H_{jmk}	0.26***	0.16***
	(0.02)	(0.02)
N	226,400	
R^2	0.27	
Panel C: Full sample		
H_{jmk}	0.18***	0.08***
	(0.01)	(0.01)
N	14,831,006	
R^2	0.26	

Note: Table reports coefficients from a two-part model of health care cost per service during 2011. The first stage is a logistic regression for the probability of having non-zero cost. The second-stage is a log-linear regression of cost per service conditional on having non-zero cost. The independent variable is the 2011 network breadth per service. Panel A conditions on the sample of stayers. Panel B conditions on the sample of new enrollees. Panel C uses the full sample without conditioning enrollment to be continuous. In the last panel, costs are annualized by dividing by the number of days enrolled and multiplying by 360. All the models control for consumer demographics and diagnoses, and include market, service, and insurer fixed effects. Robust standard errors in parenthesis. ***p<0.01, **p<0.05, *p<0.1.

Appendix Table 14: Robustness on regression specification: Selection on baseline costs

	$1\{\text{service cost}^{2010}>0\}$	$\log(\text{service cost}^{2010})$
$H^{2010}_{j'mk} - H^{2011}_{j'mk}$	0.34***	0.24***
	(0.02)	(0.02)
Switch	-0.36***	-0.14**
	(0.08)	(0.06)
Switch $\times$ $(H^{2010}_{j'mk} - H^{2011}_{j'mk})$	-1.74**	0.56
	(0.79)	(0.58)
N	14,457,009	
R^2	0.51	

Note: Specification uses a random sample of 250,000 current enrollees. Table presents results of a two-part model of total costs per service. Independent variables include a switching indicator and the difference between network breadth in 2010 and network breadth in 2011 for the insurer chosen in 2011 (j'). The first stage is a logistic regression for the probability of having non-zero cost. The second stage is a log-linear regression of total costs per service conditional on non-zero costs. Model includes demographics and diagnoses indicators, as well as insurer, service, and market fixed effects. Robust standard errors in parenthesis. ***p<0.01, **p<0.05, *p<0.1.

Appendix Table 15: Selection on current enrollees' baseline costs

	$\log(\text{total cost}_{ijmt}^{2010}+1)$ (1)	$\text{any claim}_{ijmt}^{2010}$ (2)
$(H_{jmk}^{2010} - H_{j'mk}^{2011})$	0.004*	-0.0001
	0.002	0.0002
Switch	-0.09***	-0.007***
	0.02	0.001
Switch $\times$ $(H_{jmk}^{2010} - H_{j'mk}^{2011})$	-0.08	-0.01
	0.06	0.006
Demog+Diag	Y	Y
Market	Y	Y
Service	Y	Y
Insurer	Y	Y
N	14,457,009	14,457,009
R^2	0.50	0.51

Note: Specifications use a random sample of 250,000 current enrollees. j denotes the choice of insurer in 2010. j' denotes the choice of insurer in 2011. Column (1) presents results of an OLS regression of the logarithm of 2010 total service-specific costs on a switching indicator and the difference between network breadth in 2010 for the insurer chosen in 2010 (j) and network breadth in 2011 for the insurer chosen in 2011 (j'). Column (2) shows results of an OLS regression for an indicator of non-zero service-specific claims on the same variables as before. Both columns include demographics and diagnoses indicators, as well as insurer, service, and market fixed effects. Robust standard errors in parenthesis. ***p<0.01, **p<0.05, *p<0.1.

Appendix Table 16: Selection on baseline costs conditional on switchers

	$\log(\text{total cost}_{ijmt}^{2010}+1)$ (1)	$\text{any claim}_{ijmt}^{2010}$ (2)
$(H_{j'mk}^{2010} - H_{j'mk}^{2011})$	-0.09	-0.01
	0.08	0.008
Demog+Diag	Y	Y
Market	Y	Y
Service	Y	Y
Insurer	Y	Y
N	8,870	8,870
R^2	0.51	0.51

Note: Results in columns (1) and (2) condition on the sample of switchers. j' denotes the choice of insurer in 2011. Column (1) presents results of an OLS regression of the logarithm of 2010 total service-specific costs on the difference between network breadth in 2010 and network breadth in 2011, for the insurer chosen in 2011 (j'). Column (2) shows results of an OLS regression for an indicator of non-zero service-specific claims on the same variables as before. Both columns include demographics and diagnoses indicators, as well as insurer, service, and market fixed effects. Robust standard errors in parenthesis. ***p<0.01, **p<0.05, *p<0.1.

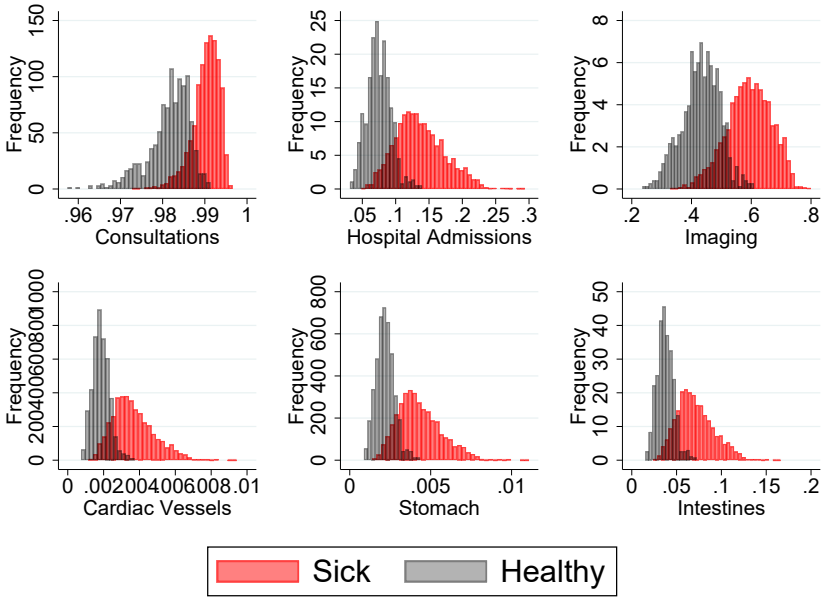
Appendix Table 17: New enrollees' risk scores and network breadth levels

	$\log(\text{risk transfer}^{2011})$
H_{jk}^{2011}	0.003
	0.005
Demog+Diag	—
Market	Y
Service	—
Insurer	Y
N	2,653,415
R^2	0.06

Note: Table presents results of an OLS regression of the logarithm of new enrollees' risk-adjusted transfers on the insurer's 2011 total network breadth level. Specification includes market and insurer fixed effects. Robust standard errors in parenthesis. ***p<0.01, **p<0.05, *p<0.1.

Appendix 6 Additional demand results

6.1 Service claim probability



Appendix Figure 6: Distribution of service claim probability

Note: This figure shows the distribution of the probability of making a claim in 6 service categories separately for sick and healthy individuals. The 6 services are consultations, hospital admissions, imaging, and procedures in cardiac vessels, stomach, and intestines.

6.2 Correlation between out-of-pocket costs and average costs per enrollee

Appendix Table 18: Pass-through of average costs to out-of-pocket costs

	Out-of-pocket cost		
	(1)	(2)	(3)
	$<$ 2 x MMW	[2,5] x MMW	$>$ 5 x MMW
$AC_{\theta ljk}$	0.083***	0.143***	0.209***
	(0.0004)	(0.0002)	(0.003)
Constant	0.036***	0.061***	0.182***
	(0.0002)	(0.0001)	(0.002)
N	162,464	334,961	2,575
R^2	0.19	0.63	0.68

Note: This table presents results of an OLS regression of out-of-pocket costs on observed average cost per enrollee conditional on observed insurer choices. Column (1) uses the sample of low-income individuals earning less than 2 times the monthly minimum wage (MMW), column (2) uses the sample of middle-income individuals earning between 2 and 5 times the MMW, and column (3) uses the sample of high-income individuals earning more than 5 times the MMW. Robust standard errors in parenthesis. ***p$<$0.01, **p$<$0.05, *p$<$0.1.

6.3 Demand with random coefficients

The model with unobserved consumer heterogeneity that is common across alternatives is as follows:

$$u_{ijk} = \beta_i^D \sum_m \gamma_{\theta lmk} H_{jmk} - \alpha_i c_{\theta lyjk} + \phi_j + \varepsilon_{ijk}$$

with

$$\begin{aligned} \beta_i^D &= x_i' \beta^D + \sigma_\beta \nu_i \\ \alpha_i &= x_i' \alpha + \sigma_\alpha \nu_i \\ \nu_i &\sim N(0,1) \end{aligned}$$

Appendix Table 19: Insurer demand with random coefficients

Variable		Coefficient	Std. Error
Network		1.94***	0.04
sigma Network		0.00	0.02
OOP spending		-6.78***	0.44
sigma OOP spending		1.63***	0.11
Interactions			
Network	Demographics		
	Male	0.30***	0.01
	Age	-0.01***	0.00
	Diagnoses		
	Cancer	-0.33***	0.02
	Cardiovascular	-0.32***	0.02
	Diabetes	-0.42***	0.05
	Renal	-0.56***	0.09
	Other	-0.52***	0.02
	>=2 diseases	-0.58***	0.02
	Healthy	(ref)	(ref)
	Location		
	Normal	-0.03***	0.01
	Special	0.64***	0.03
	Urban	(ref)	(ref)
	Income		
	Low	0.60***	0.03
	Medium	0.40***	0.03
	High	(ref)	(ref)
OOP spending	Demographics		
	Male	1.66***	0.24
	Age	-0.07***	0.01
	Diagnoses		
	Cancer	3.24***	0.50
	Cardiovascular	2.05***	0.39
	Diabetes	1.85*	1.10
	Renal	4.55***	0.62
	Other	1.97***	0.47
	>=2 diseases	3.38***	0.38
	Healthy	(ref)	(ref)
	Location		
	Normal	5.84***	0.28
	Special	-2.86***	0.86
	Urban	(ref)	(ref)
N		5,800,610	
N enrollees		500,000	

Note: This table presents results of the insurer choice model with random coefficients on network breadth and average out-of-pocket payments denoted by σ and distributed standard normal. Includes insurer fixed effects. Robust standard errors reported. ***p<0.01, **p<0.05, *p<0.1.

6.4 First stage control function

Appendix Table 20: Control function for out-of-pocket costs

	OOP spending	
	Coefficient	Std. Error
$\sum_m \gamma_{\theta l m k} A_m$	3.66***	0.01
Demographics		
Male	0.01***	0.00
Age<1	(ref)	(ref)
Age 1-4	-0.03***	0.00
Age 5-14	-0.03***	0.00
Age 15-18	-0.03***	0.00
Age 19-44	-0.04***	0.00
Age 45-49	-0.03***	0.00
Age 50-54	-0.03***	0.00
Age 55-59	-0.03***	0.00
Age 60-64	-0.03***	0.00
Age 65-69	-0.02***	0.00
Age 70-74	-0.02***	0.00
Age>=75	-0.04***	0.00
Diagnoses		
Cancer	0.02***	0.00
Cardio	0.03***	0.00
Diabetes	0.04***	0.00
Renal	0.25***	0.01
Other	0.04***	0.00
>=2 diagnoses	0.15***	0.00
Healthy	(ref)	(ref)
Location		
Normal	0.00***	0.00
Special	0.00***	0.00
Urban	(ref)	(ref)
N	5,800,610	
R^2	0.20	

Note: First stage regression of average out-of-pocket costs on service reference prices. Includes insurer fixed effects. Robust standard errors in parenthesis. ***p<0.01, **p<0.05, *p<0.1.

6.5 Endogenous out-of-pocket costs

Appendix Table 21: Insurer demand with endogenous out-of-pocket costs

Variable		Coefficient	Std. Error
Network		1.92***	0.03
OOP spending	(million COP)	-6.45***	0.21
Interactions			
Network	Demographics		
	Male	0.29***	0.01
	Age	-0.01***	0.00
	Diagnoses		
	Cancer	-0.35***	0.02
	Cardiovascular	-0.33***	0.01
	Diabetes	-0.43***	0.04
	Renal	-0.61***	0.08
	2 diseases	-0.53***	0.02
	>=3 diseases	-0.63***	0.02
	Healthy	(ref)	(ref)
	Location		
	Normal	-0.03***	0.01
	Special	0.63***	0.04
	Urban	(ref)	(ref)
	Income		
	Low	0.61	0.03
	Medium	0.42	0.03
	High	(ref)	(ref)
OOP spending	Demographics		
	Male	0.04	0.09
	Age	-0.01***	0.00
	Diagnoses		
	Cancer	5.17***	0.22
	Cardiovascular	5.69***	0.18
	Diabetes	5.60***	0.30
	Renal	6.07***	0.22
	2 diseases	5.36***	0.20
	>=3 diseases	5.68***	0.18
	Healthy	(ref)	(ref)
	Location		
	Normal	1.19***	0.11
	Special	0.68	0.43
N		5,800,610	
N enrollees		500,000	
Pseudo-R^2		0.17	

Note: This table presents results of the insurer choice model without a control function to correct for endogeneity of out-of-pocket costs. Includes insurer fixed effects. Robust standard errors reported. ***p<0.01, **p<0.05, *p<0.1.

6.6 Other robustness checks

Appendix Table 22: Insurer demand with star hospital coverage indicator

Variable		Coefficient	Std. Error
Network		1.70***	0.03
OOP spending	(million COP)	-9.32***	0.57
Star hospital		1.28***	0.02
Interactions			
Network	Demographics		
	Male	0.29***	0.01
	Age	-0.01***	0.00
	Diagnoses		
	Cancer	-0.30***	0.02
	Cardiovascular	-0.31***	0.02
	Diabetes	-0.42***	0.04
	Renal	-0.55***	0.08
	Other	-0.51***	0.02
	>=2 diseases	-0.60***	0.02
	Healthy	(ref)	(ref)
	Location		
	Normal	0.05***	0.01
	Special	0.82***	0.04
	Urban	(ref)	(ref)
	Income		
	Low	0.58***	0.03
	Medium	0.34***	0.03
	High	(ref)	(ref)
OOP spending	Demographics		
	Male	1.71***	0.26
	Age	-0.03***	0.01
	Diagnoses		
	Cancer	4.68***	0.52
	Cardiovascular	4.37***	0.52
	Diabetes	3.01***	1.03
	Renal	4.37***	0.78
	Other	4.06***	0.51
	>=2 diseases	3.71***	0.48
	Healthy	(ref)	(ref)
	Location		
	Normal	5.54***	0.44
	Special	-0.86	1.94
	Urban	(ref)	(ref)
N		5,800,610	
N enrollees		500,000	
Pseudo-R^2		0.17	

Note: This table presents results of the insurer choice model including a measure of star hospital coverage equal to $\sum_m \gamma_{\theta lmk} Star_{jmk}$, where $Star_{jk}$ is an indicator for insurer j covering a star hospital in market k for service m. Includes insurer fixed effects. Robust standard errors reported. ***p<0.01, **p<0.05, *p<0.1.

Appendix Table 23: Insurer demand with additional quality measures

Variable		Coefficient	Std. Error
Network		2.03***	0.03
OOP spending	(million COP)	-7.00***	0.56
Likert quality		0.001***	0.00
Wait time		-0.002***	0.00
Interactions			
Network	Demographics		
	Male	0.30***	0.01
	Age	-0.01***	0.00
	Diagnoses		
	Cancer	-0.36***	0.02
	Cardiovascular	-0.34***	0.01
	Diabetes	-0.44***	0.04
	Renal	-0.62***	0.08
	Other	-0.55***	0.02
	>=2 diseases	-0.64***	0.02
	Healthy	(ref)	(ref)
	Location		
	Normal	-0.02**	0.01
	Special	0.55***	0.03
	Urban	(ref)	(ref)
	Income		
	Low	0.50***	0.03
	Medium	0.31***	0.03
	High	(ref)	(ref)
OOP spending	Demographics		
	Male	1.46***	0.23
	Age	-0.03***	0.01
	Diagnoses		
	Cancer	2.38***	0.50
	Cardiovascular	2.03***	0.46
	Diabetes	1.16	0.88
	Renal	2.27***	0.61
	Other	2.07***	0.48
	>=2 diseases	1.83***	0.45
	Healthy	(ref)	(ref)
	Location		
	Normal	5.18***	0.45
	Special	-2.83	2.11
	Urban	(ref)	(ref)
N		5,800,610	
N enrollees		500,000	
Pseudo-R^2		0.17	

Note: This table presents results of the insurer choice model with additional quality measures obtained from enrollment surveys conducted by the Colombian Ministry of Health during 2013 to 2016. These measures include average quality from a likert scale and average waiting time for an appointment with the primary care doctor or specialist. Both variables are measured at the insurer-market level. I interact each of them with the probability of making claims for a service $\gamma_{\theta lmk}$, then summing across services. The model includes insurer fixed effects. Robust standard errors reported. ***p<0.01, **p<0.05, *p<0.1.

Appendix Table 24: Insurer demand with alternative network measures

		Largest hospitals		All providers	
Variable		Coef.	SE	Coef.	SE
Network		2.03***	0.06	2.39***	0.05
OOP spending	(million COP)	-10.79***	0.61	-4.03***	0.46
Interactions					
Network	Demographics				
	Male	0.31***	0.01	0.14***	0.01
	Age	-0.01***	0.00	0.00***	0.00
	Diagnoses				
	Cancer	-0.28***	0.03	-0.72***	0.02
	Cardiovascular	-0.38***	0.02	-0.51***	0.02
	Diabetes	-0.44***	0.05	-0.64***	0.06
	Renal	-0.65***	0.10	-0.59***	0.11
	Other	-0.56***	0.02	-0.70***	0.03
	>=2 diseases	-0.67***	0.02	-0.90***	0.02
	Healthy	(ref)	(ref)	(ref)	(ref)
	Location				
	Normal	-0.06***	0.01	-0.39***	0.01
	Special	0.75***	0.05	-0.74***	0.02
	Urban	(ref)	(ref)	(ref)	(ref)
	Income				
	Low	0.39***	0.06	0.45***	0.05
	Medium	0.27***	0.06	0.11**	0.05
	High	(ref)	(ref)	(ref)	(ref)
OOP spending	Demographics				
	Male	2.00***	0.25	0.50***	0.17
	Age	-0.04***	0.01	-0.02***	0.00
	Diagnoses				
	Cancer	5.24***	0.52	-0.87**	0.34
	Cardiovascular	5.49***	0.48	-0.94***	0.33
	Diabetes	4.20***	1.05	-1.85***	0.62
	Renal	5.94***	0.60	-0.35	0.43
	Other	5.23***	0.51	-1.59***	0.35
	>=2 diseases	4.71***	0.47	-0.94***	0.33
	Healthy	(ref)	(ref)	(ref)	(ref)
	Location				
	Normal	6.09***	0.48	5.68***	0.37
	Special	4.91***	1.24	5.61***	0.46
	Urban	(ref)	(ref)	(ref)	(ref)
N		5,800,610		5,800,610	
N enrollees		500,000		500,000	
Pseudo-R^2		0.17		0.12	

Note: This table presents results of the insurer choice model under alternative specifications of network breadth. Column (1) reports coefficients and standard errors of a model where network breadth is constructed from a sample of the largest hospitals in each market. Large hospitals are defined as having number of beds above the 70th percentile of the distribution of beds in each market. There are 314 hospitals under this definition. Column (2) presents coefficients and standard errors of a model where network breadth is constructed from the sample of all institutional providers of which there are 16,609. All models include insurer fixed effects. Robust standard errors reported. ***p<0.01, **p<0.05, *p<0.1.

Appendix Table 25: Insurer demand on adults aged 19 or older

Variable		Coef.	SE
Network		1.59***	0.04
OOP spending	(million COP)	-7.14***	0.44
Interactions			
Network	Demographics		
	Male	0.30***	0.01
	Age	-0.01***	0.00
	Diagnoses		
	Cancer	-0.31***	0.02
	Cardiovascular	-0.33***	0.01
	Diabetes	-0.34***	0.03
	Renal	-0.63***	0.06
	Other	-0.48***	0.02
	>=2 diseases	-0.59***	0.01
	Healthy	(ref)	(ref)
	Location		
	Normal	-0.05***	0.01
	Special	0.46***	0.03
	Urban	(ref)	(ref)
	Income		
	Low	0.81***	0.04
	Medium	0.63***	0.04
	High	(ref)	(ref)
OOP spending	Demographics		
	Male	0.91***	0.16
	Age	-0.02***	0.00
	Diagnoses		
	Cancer	2.10***	0.41
	Cardiovascular	1.19***	0.33
	Diabetes	1.70**	0.74
	Renal	2.91***	0.66
	Other	1.90***	0.33
	>=2 diseases	1.23***	0.32
	Healthy	(ref)	(ref)
	Location		
	Normal	6.22***	0.32
	Special	0.00	1.20
	Urban	(ref)	(ref)
N		5,849,583	
N enrollees		500,000	
Pseudo-R^2		0.17	

Note: This table presents results of the insurer choice model estimated on a sample of adults aged > 18. All models include insurer fixed effects. Robust standard errors reported. ***p<0.01, **p<0.05, *p<0.1.

Appendix 7 Note on primitives of average cost function

Suppose there is a second stage in the demand model where consumers choose a hospital to receive service m. The cost of consumer i enrolled to insurer j can be written as:

$$c_{ij}(H_j) = \sum_m \gamma_{\theta(i)l(i)m} \sum_{h \in H_{jm}} p_{jhm} s_{ihm}(H_{jm})$$

where p_{jhm} is the negotiated price for service m between insurer j and hospital h, s_{ihm} is the probability that consumer i chooses hospital h for service m, and γ is the probability that consumer i of type (θ, l) makes a claim for service m.

With this specification of individual costs, the insurer profit function is:

$$\pi_j = \sum_i (R_{ij} - c_{ij}(H_j)) s_{ij}(H_j)$$

where s_{ij} is the probability that consumer i enrolls insurer j. We can rewrite the previous equation as:

$$\pi_j = (R_j - AC_j(H_j)) D_j$$

where $R_j = \sum_i R_{ij}$, $D_j = \sum_i s_{ij}$, and

$$AC_j(H_j) = \frac{1}{D_j} \sum_i c_{ij}(H_j) s_{ij}(H_j)$$

Suppose s_{ihm} and s_{ij} are obtained from discrete choice models with preference shocks that are distributed T1EV. Also, for exposition, assume there are two hospitals and two insurers. Then, the insurer's average cost is:

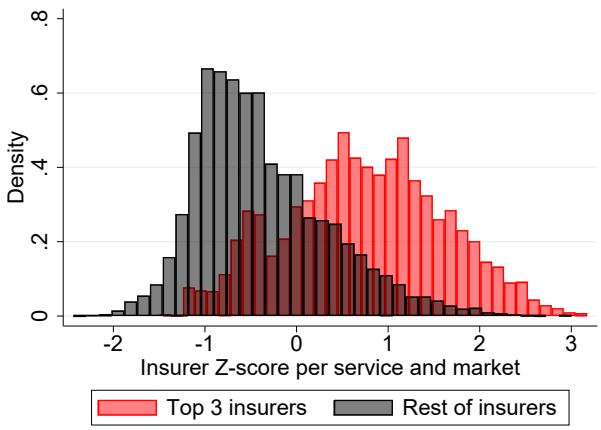
$$AC_j(H_j) = \sum_i \left(\sum_m \gamma_{\theta(i)l(i)m} \underbrace{\sum_{h \in H_{jm}} p_{jhm} \frac{exp(\delta_{ihm})}{1 + exp(\delta_{ihm})} \left(\frac{1 + exp(\eta(H_j))}{exp(\eta(H_j))} \right)}_{A_m} \right) \frac{exp(\eta_i(H_j))}{1 + exp(\eta_i(H_j))}$$

where $\eta(H_j)$ is the average utility of choosing insurer j and δ_{ihm} is the average utility of choosing hospital h for service m. Take one consumer and apply logs to the equation above, which yields:

$$\log(AC_{ij}(H_j)) = \log\Big(\sum_m \gamma_{\theta(i)l(i)m} A_m \Big) + \underbrace{\eta_i(H_j)}_{\sum_m \gamma_{\theta(i)l(i)m} H_{jm}} - \log(1 + exp(\eta_i(H_j)))$$

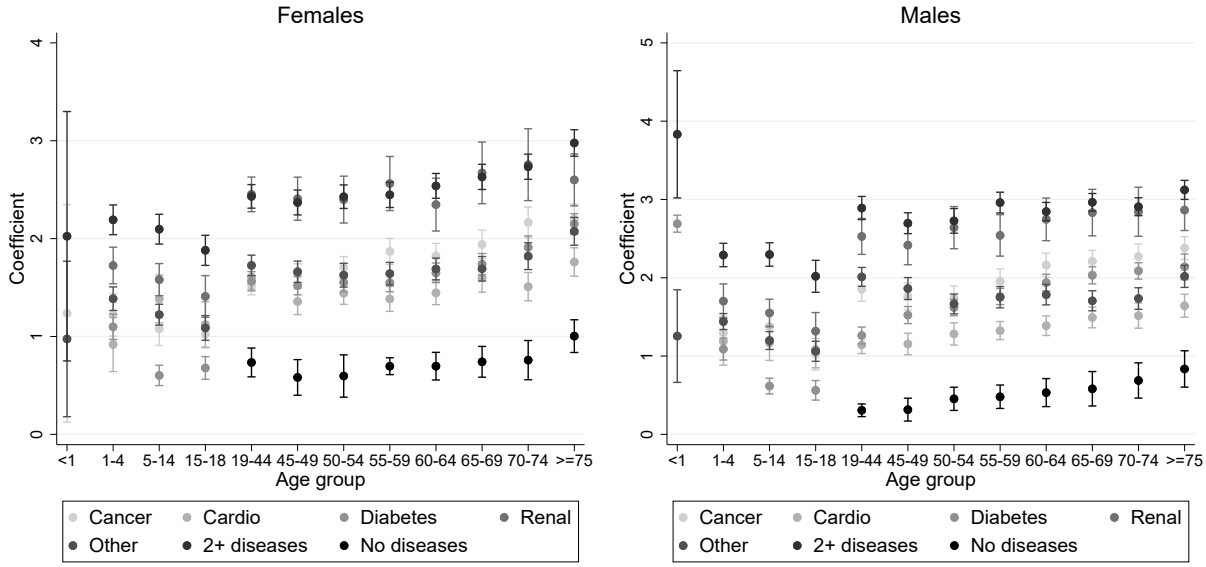
This resulting equation resembles the average cost function per enrollee in my main specification. Thus, the average cost function can be derived from a more involved model of hospital choice under certain conditions.

Appendix 8 Additional average cost results



Appendix Figure 7: Standardized network breadth per service and market

Note: Figure shows the distribution of network breadth standardized within service and market, separately for the top 3 insurers (EPS013, EPS016, and EPS037) and the rest of insurers. Standardized values of network breadth are obtained by subtracting the service-market level mean and dividing by the service-market level standard deviation. The top 3 insurers have consistently broad networks across services, while the rest tend to have narrow networks across services.



Appendix Figure 8: Consumer type fixed effects

Note: This figure shows the point estimate and 95% confidence interval of the consumer type fixed effects in the average cost function. The left panel shows the fixed effects for females separately by disease category and age group. The right panel shows the fixed effects for males separately by disease category and age group.

Appendix Table 26: Average cost over more granular consumer types

Variable	Coefficient	Std. Error
Network	0.22***	0.01
Scope economies	-4.24***	0.35
Avg. ref. price	5.94***	0.03
Insurer		
EPS001	-0.11***	0.01
EPS002	-0.28***	0.01
EPS003	0.01	0.01
EPS005	0.30***	0.01
EPS008	0.16***	0.01
EPS009	0.15***	0.01
EPS010	-0.01	0.01
EPS012	-0.01	0.01
EPS013	0.15***	0.01
EPS016	0.04***	0.01
EPS017	-0.14***	0.01
EPS018	0.11***	0.01
EPS023	-0.05***	0.01
EPS037	(ref)	(ref)
N	653,902	
R^2	0.25	

Note: OLS regression of logarithm of average costs per insurer, market, and consumer type on network breadth, economies of scope, and service reference price. Consumer type is defined as combinations of sex, age, and diagnosis from a list of 30 exhaustive and mutually exclusive diagnoses in appendix table 36. Includes insurer, market, and consumer type fixed effects. Robust standard errors reported.

Appendix Table 27: Patient-level estimates of average cost

	log(total cost + 1)	
Variable	Coefficient	Std. Error
Network	0.39***	0.01
Scope economies	-9.53***	0.31
Avg. ref. price	-6.65***	0.19
Insurer		
EPS001	-0.57***	0.01
EPS002	0.51***	0.01
EPS003	0.45***	0.01
EPS005	1.98***	0.01
EPS008	1.86***	0.01
EPS009	0.51***	0.01
EPS010	0.77***	0.01
EPS012	1.02***	0.01
EPS013	1.00***	0.01
EPS016	0.12***	0.01
EPS017	1.19***	0.01
EPS018	1.06***	0.01
EPS023	1.19***	0.01
EPS037	(ref)	(ref)
N	8,655,617	
R^2	0.25	

Note: OLS regression of logarithm of patient-level total healthcare cost (plus 1) on network breadth, economies of scope, and service reference price. Consumer type is defined as combinations of sex, age, and diagnosis. Includes insurer, market, and consumer type fixed effects. Robust standard errors reported.

Appendix Table 28: Predicted change in females' average cost by type of carrier and diagnosis

	F, 19-44, Healthy		F, 19-44, Cancer	
Service	Narrow	Broad	Narrow	Broad
Cardiac vessels	455	1,588	787	6,784
Stomach	457	1,592	799	6,802
Intestines	659	1,784	1,638	7,559
Imaging	3,399	4,071	9,841	14,105
Consultations	8,236	6,893	17,764	18,175
Laboratory	5,413	5,847	14,711	17,086
Nuclear medicine	1,296	2,724	3,189	8,816
Hospital admissions	1,755	3,035	4,949	9,967

Note: This table shows the average change in the average cost of a healthy female aged 19-44 and a female aged 19-44 with cancer following a 10% increase in network breadth for the service in the row, separately for broad and narrow network carriers. Broad network carriers are defined as insurers with average network breadth across all other services above 70% and narrow network carriers as the complement. Units are in Colombian pesos.

Appendix Table 29: Predicted change in males' average cost by type of carrier and diagnosis

	M, 19-44, Healthy		M, 19-44, Diabetes	
Service	Narrow	Broad	Narrow	Broad
Cardiac vessels	210	757	772	3,365
Stomach	211	759	779	3,374
Intestines	317	860	1,180	3,782
Imaging	1,902	2,213	6,302	8,209
Consultations	5,305	4,252	13,752	12,302
Laboratory	3,248	3,639	9,951	11,182
Nuclear medicine	804	1,733	2,331	5,312
Hospital admissions	1,047	1,904	3,277	5,969

Note: This table shows the average change in the average cost of a healthy male aged 19-44 and a male aged 19-44 with diabetes following a 10% increase in network breadth for the service in the row, separately for broad and narrow network carriers. Broad network carriers are defined as insurers with average network breadth across all other services above 70% and narrow network carriers as the complement. Units are in Colombian pesos.

Appendix 9 Dropout and transition probabilities

To estimate the marginal cost of network formation in the third step of my model, I first need to compute the probability that consumer type (θ, l) drops out of the contributory system and the probability that consumer type (θ, l) in period t transitions into diagnosis l' in period $t+1$. Both of these probabilities weight future per-enrollee profits in the insurer's total profit function.

I use the data from *all* enrollees to the contributory system in 2010 and 2011, regardless of their enrollment spell length, to compute dropout probabilities. For each consumer type (θ, l), I calculate the probability that she drops out of the system non-parametrically as the number of individuals of type (θ, l) observed only in 2010 but not 2011, divided by the total number of type (θ, l) individuals in 2010. Table 30 presents the mean and standard deviation of the dropout probability overall, and conditional on health status, sex, and age. Healthy individuals are on average 10 percentage points more likely to dropout of the system compared to sick patients, and consumers aged less than 44 are on average 3.8 percentage points more likely to dropout compared to individuals aged 45 or older. The table also shows that males are more likely to dropout of the contributory system relative to females, with the difference in means equal to 3.6 percentage points.

I use a non-parametric approach to compute transition probabilities as well, using data from continuously enrolled new *and* current enrollees in 2010 and 2011. Given that the transition from θ to θ' is deterministic, I only need to compute transition probabilities across diagnoses. The probability that type (θ, l) transitions into $(theta', l')$ equals the number of type (θ, l) in 2010 that end up with diagnosis l' in 2011, divided by the number of type (θ, l) individuals in 2010. Table 31 presents the mean and standard deviation in parenthesis of transition probabilities from having cancer, cardiovascular disease, diabetes, renal disease, other diseases, 2 or more diseases, and no diseases in period t to having each of these 7 diagnoses in period $t+1$. Because my list of diagnoses is mutually exclusive, the table shows that the probability of transitioning from a particular diagnosis in t to a single different diagnosis in $t+1$ is zero, but the probability for the transition into the same diagnosis or to an added diagnosis (≥ 2 diseases) in $t+1$ is non-zero. For patients without diseases in period t, remaining healthy in period $t+1$ has the higher likelihood, followed by receiving a diagnosis for cardiovascular disease and other diseases like long-term pulmonary disease. The fact that the diagnosis list is mutually exclusive simplifies the computation of future profits and future marginal variable profits per enrollee that are needed to recover the marginal cost of network formation. I move to the estimation of this marginal cost next.

Appendix Table 30: Summary statistics of dropout probability

	Mean	SD
Overall	0.111	0.114
Sick	0.094	0.110
Healthy	0.201	0.092
Age>44	0.094	0.100
Age<=44	0.135	0.129
Male	0.129	0.124
Female	0.093	0.101

Appendix Table 31: Summary statistics of transition probabilities across diagnoses

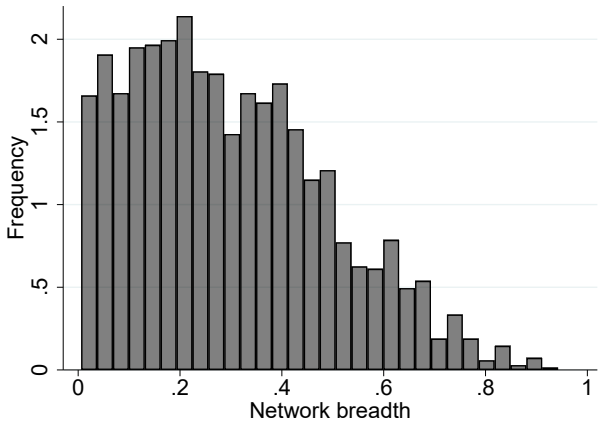
Diagnosis t/t+1	Cancer	Cardio	Diabetes	Renal	Other	≥2 disea.	No disea.
Cancer	0.789	0.000	0.000	0.000	0.000	0.211	0.000
	(0.136)	(0.000)	(0.000)	(0.000)	(0.000)	(0.136)	(0.000)
Cardio	0.000	0.774	0.000	0.000	0.000	0.226	0.000
	(0.000)	(0.148)	(0.000)	(0.000)	(0.000)	(0.148)	(0.000)
Diabetes	0.000	0.000	0.654	0.000	0.000	0.346	0.000
	(0.000)	(0.000)	(0.209)	(0.000)	(0.000)	(0.209)	(0.000)
Renal	0.000	0.000	0.000	0.643	0.000	0.357	0.000
	(0.000)	(0.000)	(0.000)	(0.167)	(0.000)	(0.167)	(0.000)
Other	0.000	0.000	0.000	0.000	0.711	0.289	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.171)	(0.171)	(0.000)
>=2 diseases	0.000	0.000	0.000	0.000	0.000	1.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
No diseases	0.034	0.087	0.007	0.004	0.044	0.054	0.770
	(0.038)	(0.086)	(0.015)	(0.016)	(0.028)	(0.084)	(0.148)

Note: This table shows the mean and standard deviation in parenthesis of transition probabilities from cancer, cardiovascular disease, diabetes, renal disease, other diseases, 2 or more diseases, and no diseases in period t to each of these 7 diagnoses in period $t+1$. Summary statistics are calculated across sex-age combinations in each cell.

Appendix Table 32: Summary statistics of marginal variable profits per insurer

Insurer	MVP
EPS001	272 (1,143)
EPS002	829 (3,095)
EPS003	400 (1,551)
EPS005	222 (864)
EPS010	894 (3,067)
EPS013	717 (2,331)
EPS016	1,276 (4,166)
EPS017	619 (3,339)
EPS018	571 (2,224)
EPS037	1,103 (3,533)

Note: Mean and standard deviation in parenthesis of marginal marginal variable profits in the left-hand side of equation (5). Measured in millions of Colombian pesos per service per market.



Appendix Figure 9: Distribution of network breadth for FOC

Note: This figure shows the distribution of network breadth in the fourlargest markets and top 10 insurance companies, where no one chooses a corner solution.

Appendix Table 33: First stage regression of network breadth

H_{jmk}	Coefficient	Std. Error
H_{jmk}^{t-1}	0.76***	0.01
$\overline{\gamma}_{female,m,k}$	33.93***	8.45
$\overline{\gamma}_{healthy,m,k}$	14.30***	4.21
$\overline{\gamma}_{age\ 19-44,m,k}$	-55.33***	13.63
$H_{jmk}^{t-1} \times \overline{\gamma}_{age\ 19-44,m,k}$	0.16***	0.05
Insurer FEs		
EPS001	-0.02***	0.01
EPS002	0.02*	0.01
EPS003	-0.03***	0.01
EPS005	0.02*	0.01
EPS010	-0.01	0.01
EPS013	0.00	0.01
EPS016	0.14***	0.01
EPS017	0.00	0.01
EPS018	-0.01	0.01
EPS037	(ref)	(ref)
Market FEs		
Market 05	1.14***	0.25
Market 08	1.14***	0.25
Market 76	1.14***	0.25
Market 11	1.12***	0.24
N	2,262	
F-stat	774.45	

Note: This table presents the first stage of the GMM estimation of equation (6). H_{jmk}^{t-1} is the network breadth in 2010. $\overline{\gamma}_{i,m,k}$ is the average probability that a consumer with characteristic i makes a claim for service m in market k. The specification includes insurer, market, and service fixed effects. Robust standard errors and first-stage F-statistic reported. ***p<0.01, **p<0.05, *p<0.1.

Appendix Table 34: Predicted average total network formation cost per market

Insurer	(1) Total	(2) %
EPS001	2,428	57
EPS002	9,738	92
EPS003	4,430	85
EPS005	2,557	82
EPS010	7,807	61
EPS013	8,457	84
EPS016	15,139	82
EPS017	7,330	69
EPS018	6,288	61
EPS037	13,399	74

Note: Column (1) presents the predicted average total cost of network formation in millions of pesos across markets and column (2) presents this cost as a percentage of total variable profits.

Appendix Table 35: Decomposition of profit changes after network breadth increase by diagnosis

	Healthy		Renal		Other disease	
Service	$\%\Delta s_{ijk}$	$\%\Delta AC_{\theta ljk}$	$\%\Delta s_{ijk}$	$\%\Delta AC_{\theta ljk}$	$\%\Delta s_{ijk}$	$\%\Delta AC_{\theta ljk}$
Cardiac vessels	0.01	0.00	0.01	0.00	0.01	0.00
Stomach	0.01	0.00	0.02	0.00	0.02	0.00
Intestines	0.22	0.02	0.31	0.02	0.29	0.02
Imaging	3.57	0.29	3.27	0.31	3.45	0.33
Consultations	11.89	1.24	6.53	0.95	7.99	1.01
Laboratory	4.90	0.43	3.86	0.41	4.29	0.43
Nuclear medicine	0.06	0.01	0.09	0.01	0.09	0.01
Hospital admissions	0.60	0.05	0.83	0.07	0.77	0.06

Note: This table shows the average percentage change in demand ($\%\Delta s_{ijk}$) and average costs per enrollee ($\%\Delta AC_{\theta ljk}$) for healthy individuals, patients with renal disease, and patients with other chronic conditions, after a 10% unilateral increase in network breadth for the service in the row by insurer j, while holding its competitors' choices fixed.

Appendix 10 Concavity of the profit function

The second partial derivative of the short-run insurer profit function with respect to network breadth for service m, all else equal, is:

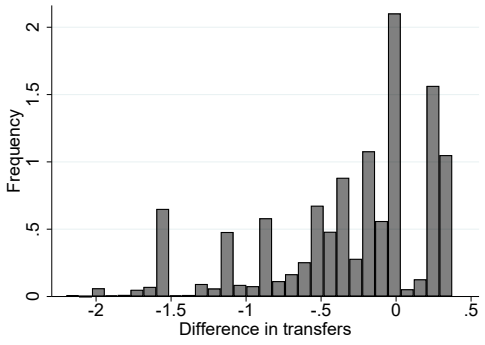
$$\frac{\partial^2 \Pi_{jk}}{\partial H_{jmk}^2} = \sum_i \left((R_{\theta k} - (1 - r_i) AC_{\theta l j k}) \frac{\partial^2 s_{ijk}}{\partial H_{jmk}^2} - 2(1 - r_i) \frac{\partial s_{ijk}}{\partial H_{jmk}} \frac{\partial AC_{\theta l j k}}{\partial H_{jmk}} - (1 - r) s_{ijk} \frac{\partial^2 AC_{\theta l j k}}{\partial H_{jmk}^2} \right) - 2\omega$$

Given the functional form for demand and average costs and the estimated parameters, we have that

$$\begin{aligned}
\frac{\partial AC_{\theta l j k}}{\partial H_{jmk}} &> 0 \\
\frac{\partial s_{ijk}}{\partial H_{jmk}} &> 0 \\
\frac{\partial^2 AC_{\theta l j k}}{\partial H_{jmk}^2} &= \left(\frac{\partial AC_{\theta l j k}}{\partial H_{jmk}} \right)^2 \frac{1}{AC_{\theta l j k}} > 0 \\
\frac{\partial^2 s_{ijk}}{\partial H_{jmk}^2} &= \left(\frac{\partial s_{ijk}}{\partial H_{jmk}} \right)^2 \frac{1 - 2 s_{ijk}}{s_{ijk}(1 - s_{ijk})} + s_{ijk}(1 - s_{ijk}) \mu_y \left(\frac{\partial AC_{\theta l j k}}{\partial H_{jmk}} \right)^2 \frac{1}{AC_{\theta l j k}}
\end{aligned}$$

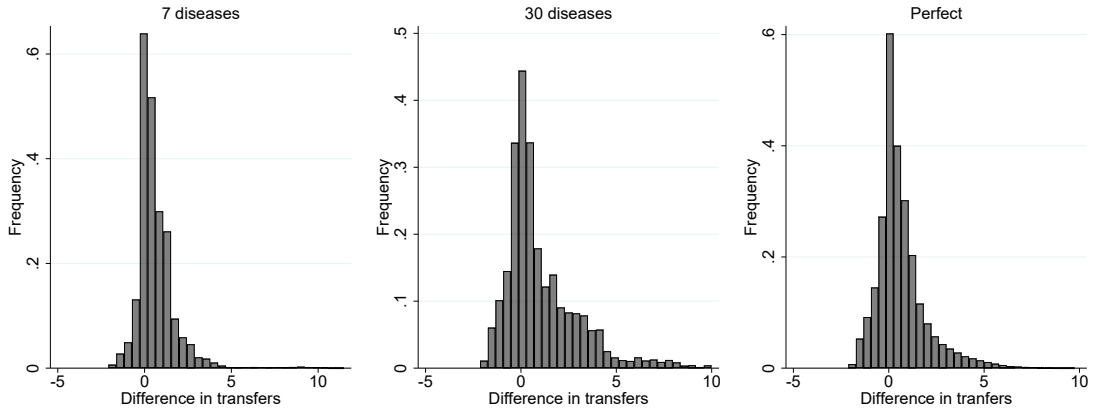
The last expression above is positive whenever $s_{ijk} < 1/2$. This condition likely does not hold in markets with a few competitors. But my counterfactual analyses are conducted on data from the largest market in the country which has 14 insurance companies. From counterfactual results, I confirm that no insurer ends up with a market share above 50%, which suggests that $\sum_i (1 - r_i) AC_{\theta l j k} \frac{\partial^2 s_{ijk}}{\partial H_{jmk}^2} > 0$. So as long as $\sum_i R_{\theta k} \frac{\partial^2 s_{ijk}}{\partial H_{jmk}^2}$

Appendix 11 Additional counterfactual results



Appendix Figure 10: Distribution of counterfactual minus observed transfer under no risk adjustment

Note: This figure shows the distribution of the difference between the observed risk-adjusted transfer and the counterfactual under no risk adjustment across consumer types.

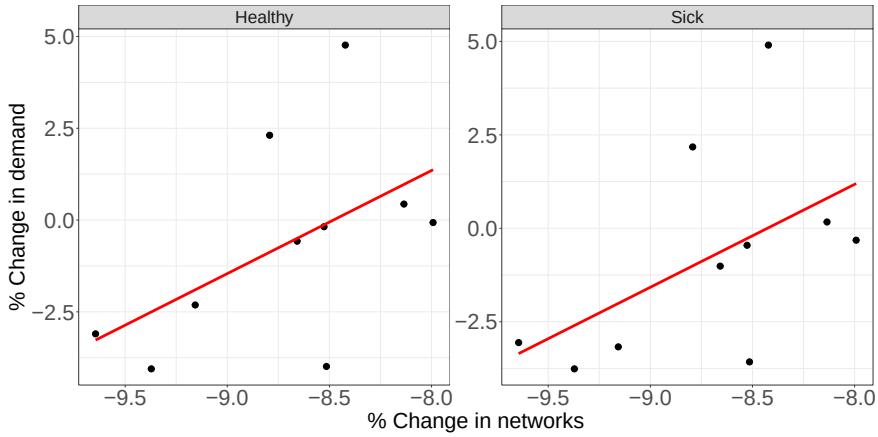


Appendix Figure 11: Distribution of counterfactual minus observed transfer under improved risk adjustment

Note: This figure shows the distribution of the difference between the observed risk-adjusted transfer and the counterfactual transfer under a improved risk adjustment formula across consumer types. In the left panel, the counterfactual transfer compensates insurers for the list of 7 diseases included in the model in addition to sex, age group, and municipality. In the middle panel, the counterfactual transfer compensates insurers for a list of 30 exhaustive and mutually exclusive disease categories (presented in appendix table 36), in addition to sex, age group, and municipality. The right panel corresponds to "perfect" risk adjustment, where the transfer equals the individual's average cost.

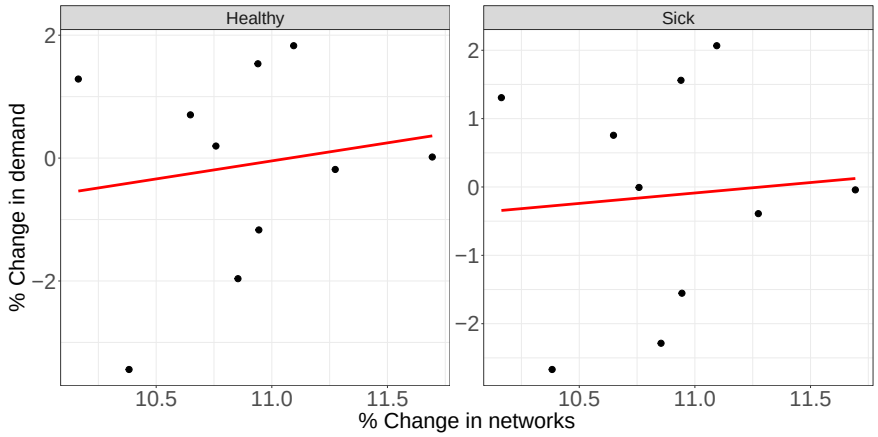
Appendix Table 36: Disease categories

Arthritis
Arthrosis
Asthma
Autoimmune disease
Breast cancer
Cancer in digestive organs
Cancer in female genitalia
Cancer in male genitalia
Cancer therapy
Invasive cervical cancer
Local cervical cancer
Diabetes
Epilepsy
Genetic anomalies
HIV-AIDS
Hypertension
Cancer in respiratory organs
Lymphatic cancer
Melanoma or skin cancer
Other types of cancer
Other types of cardiovascular disease
Long-term pulmonary disease
Renal disease
Chronic kidney disease
End-stage renal disease
Long-term renal disease
Transplant
Tuberculosis
More than 2 diseases
No diseases



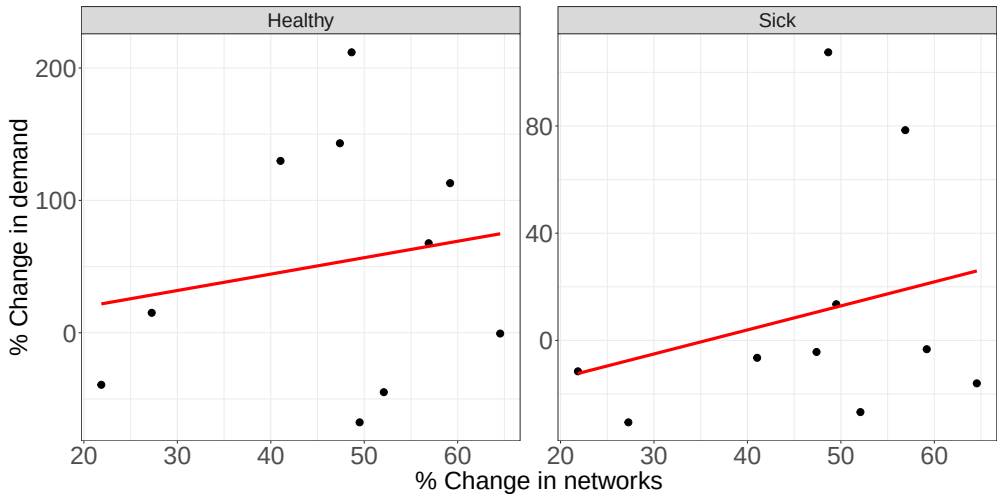
Appendix Figure 12: Correlation between network changes and changes in demand under no risk adjustment

Note: This figure shows the correlation between changes in network breadth and changes in demand at the insurer level in the counterfactual of no risk adjustment relative to the observed scenario. Every black dot is an insurer and the red line corresponds to a linear fit. The left panel focuses on changes in demand from healthy individuals and the right panel focuses on changes in demand from sick individuals.



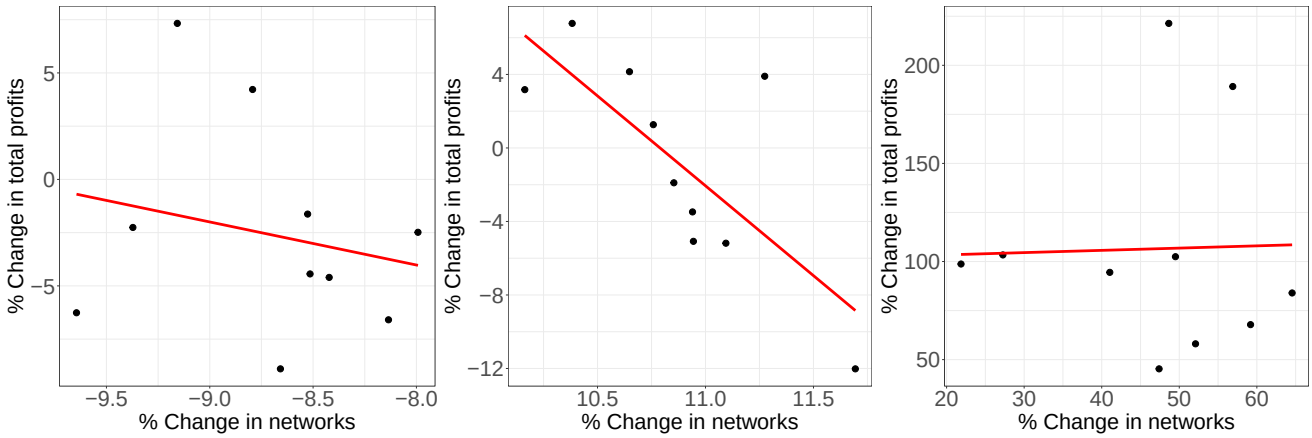
Appendix Figure 13: Correlation between network changes and changes in demand under improved adjustment

Note: This figure shows the correlation between changes in network breadth and changes in demand at the insurer level in the counterfactual of improved risk adjustment with compensations for 30 disease categories relative to the observed scenario. Every black dot is an insurer and the red line corresponds to a linear fit. The left panel focuses on changes in demand from healthy individuals and the right panel focuses on changes in demand from sick individuals.



Appendix Figure 14: Correlation between network changes and changes in demand under premium deregulation

Note: This figure shows the correlation between changes in network breadth and changes in demand at the insurer level in the counterfactual of premium setting relative to the observed scenario. Every black dot is an insurer and the red line corresponds to a linear fit. The left panel focuses on changes in demand from healthy individuals and the right panel focuses on changes in demand from sick individuals.



(a) No risk adjustment (b) Improved risk adjustment (c) Premium deregulation

Appendix Figure 15: Correlation between profit and network changes in counterfactual

Note: This figure shows the correlation between changes in network breadth and changes in total profits at the insurer level in the counterfactual of no risk adjustment in panel (a), improved risk adjustment with 30 disease categories in panel (b), and premium setting in panel (c), all relative to the observed scenario. Every black dot is an insurer and the red line corresponds to a linear fit.