Supply-Side Variation in the Use of Emergency Departments

On-Line Appendix

Weighted Difference Calculation

This section details the calculation of weighted mean differences and standard errors of outcomes from before and after the move.

Let n_t be the number of movers that are observed at event time t (years relative to their move), and let $\hat{\delta}$ be the vector of estimated coefficients from equation (1). The estimated mean difference between post- and pre-move periods is the dot product:

$$\widehat{\Delta Y} = w'\delta, \tag{A1}$$

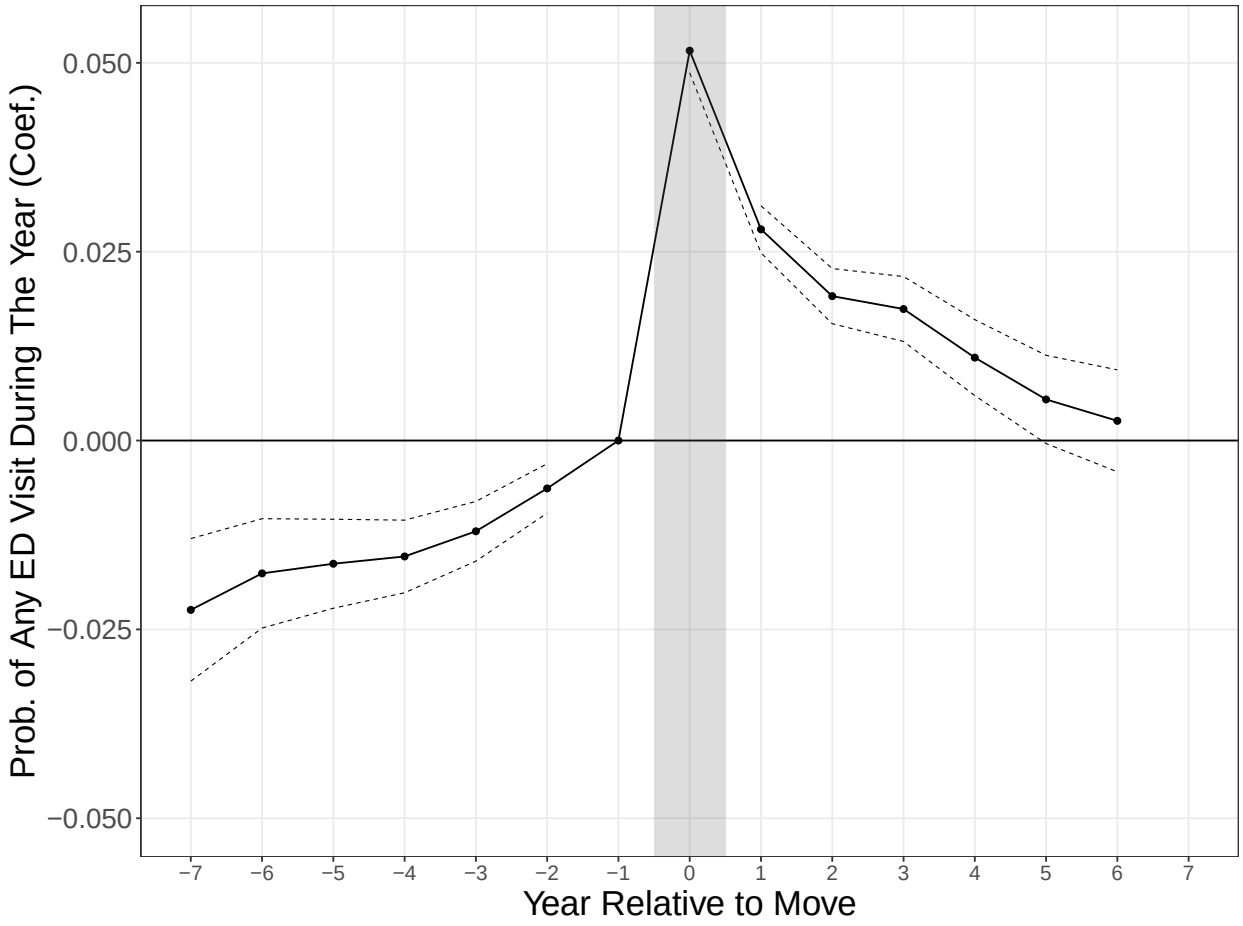
where w_t equals $-n_t/\sum_{s<0} n_s$ for $t < 0$, $n_t/\sum_{s>0} n_s$ for $t > 0$, and zero for the year of the move. Because the total number of observations in the pre and post periods are not exactly equal, $w_t \neq -w_{-t}$, but by construction, $\sum_{t>0} w_t = -\sum_{t<0} w_t = 1$. Standard errors are obtained by weighting the estimated covariance matrix $\hat{\Sigma}$ accordingly, $w'\hat{\Sigma}w$.

The resulting weighted average reflects the effect of a change from no one using the ED to everyone using the ED each year. To scale the effect, we calculate the average absolute destination-origin difference in ED use:

$$\overline{\Delta ED} = \sum_i |\overline{ED}_{d(i)} - \overline{ED}_{o(i)}|, \tag{A2}$$

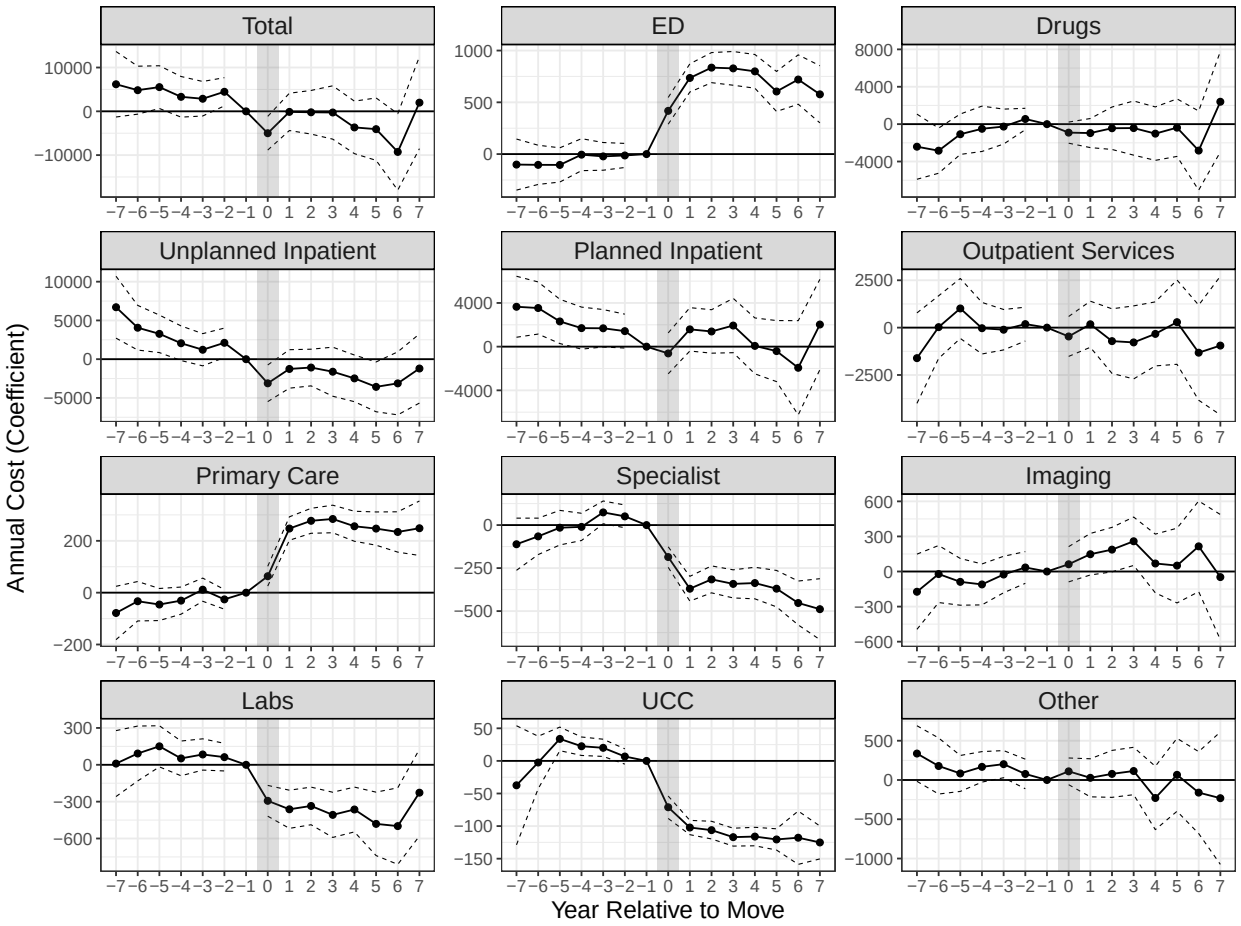
and multiply both to obtain the effect of an average move: $\widehat{\Delta Y} \cdot \overline{\Delta ED}$.

Appendix Figure A1: Change in Movers' ED Use Following a Move



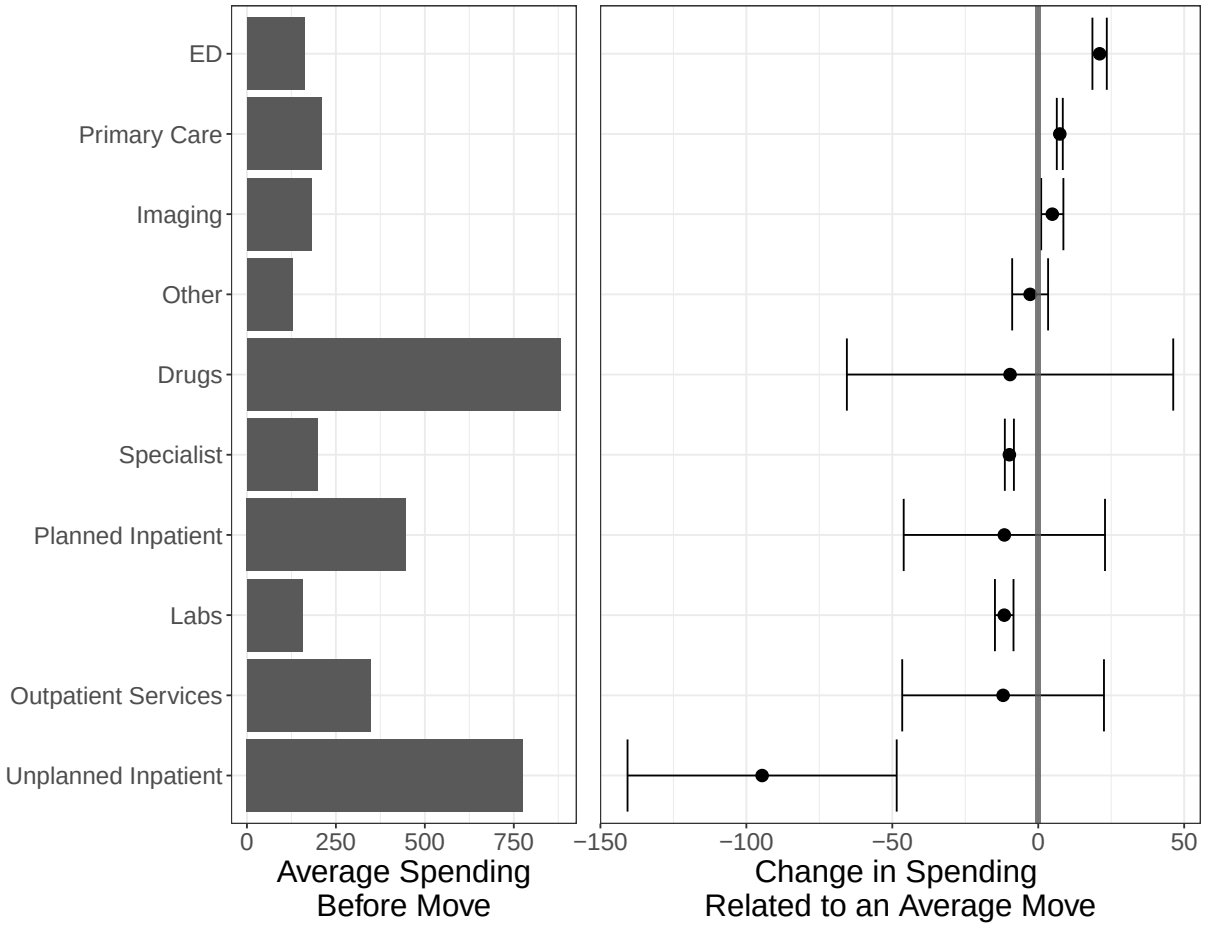
Notes: The figure shows event-study estimates of the change in movers' ED use following a move, namely, θ_t from equation (1). Year 0 is the year of the move. The coefficient of the year before the move is normalized to 0. The sample is all movers (N = 1,274,445 patient-years).

Appendix Figure A2: Change in Movers' Spending and Utilization Related to Destination-Origin Difference in ED Visit Rates



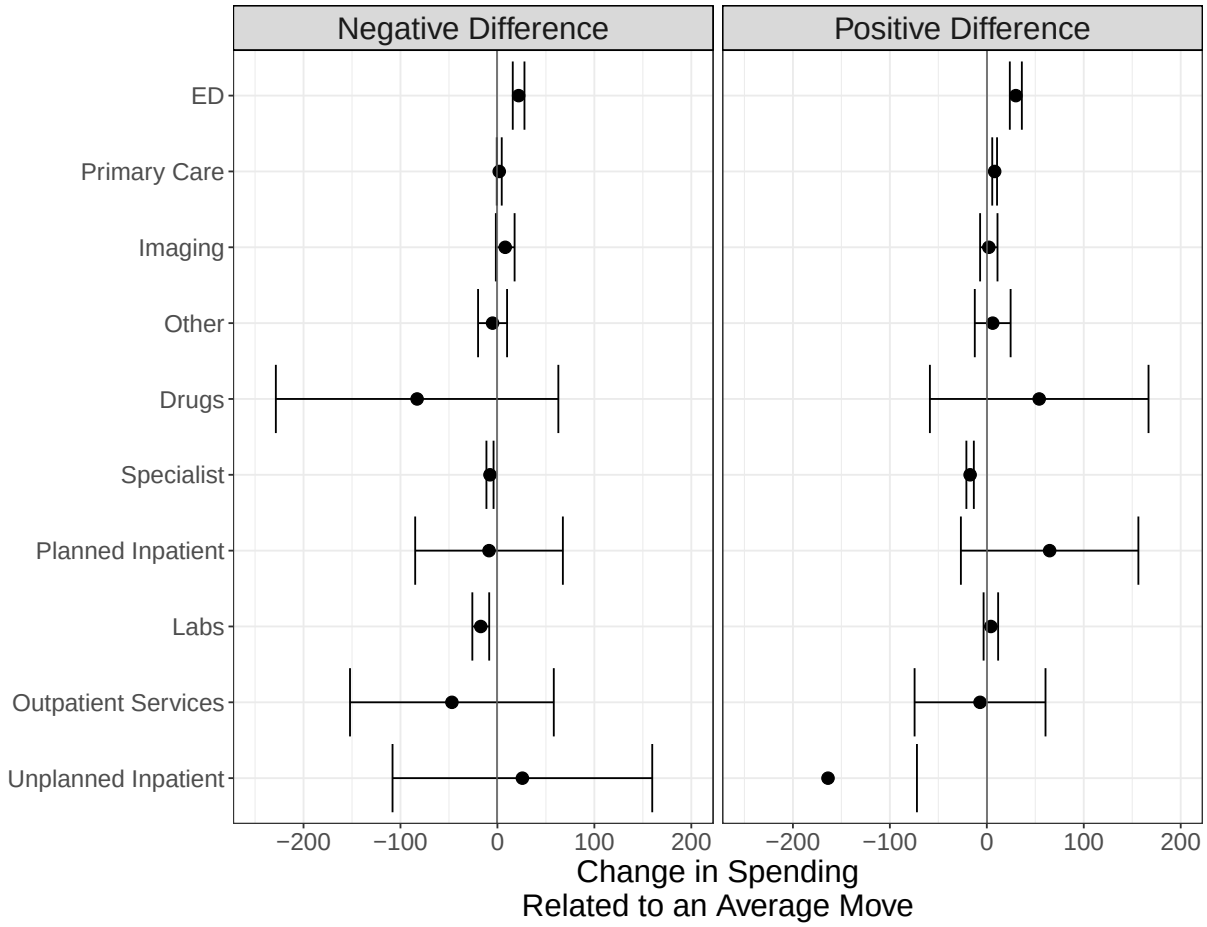
Notes: Estimates of equation (1) for different spending measures. Estimates reflect the change in annual healthcare spending associated with destination-origin difference in ED utilization rate. Year 0 is the year of the move. The coefficient of the year before the move is normalized to 0. Spending is denominated in NIS (except for UCC, where the y-axis scale is percentage point). Total is the total annual spending on all service types. Standard errors are clustered by patient. The sample is all movers (N = 1,274,445 patient-years).

Appendix Figure A3: Baseline Spending and Changes in Movers' Spending Related to Destination-Origin Difference in ED Visit Rates



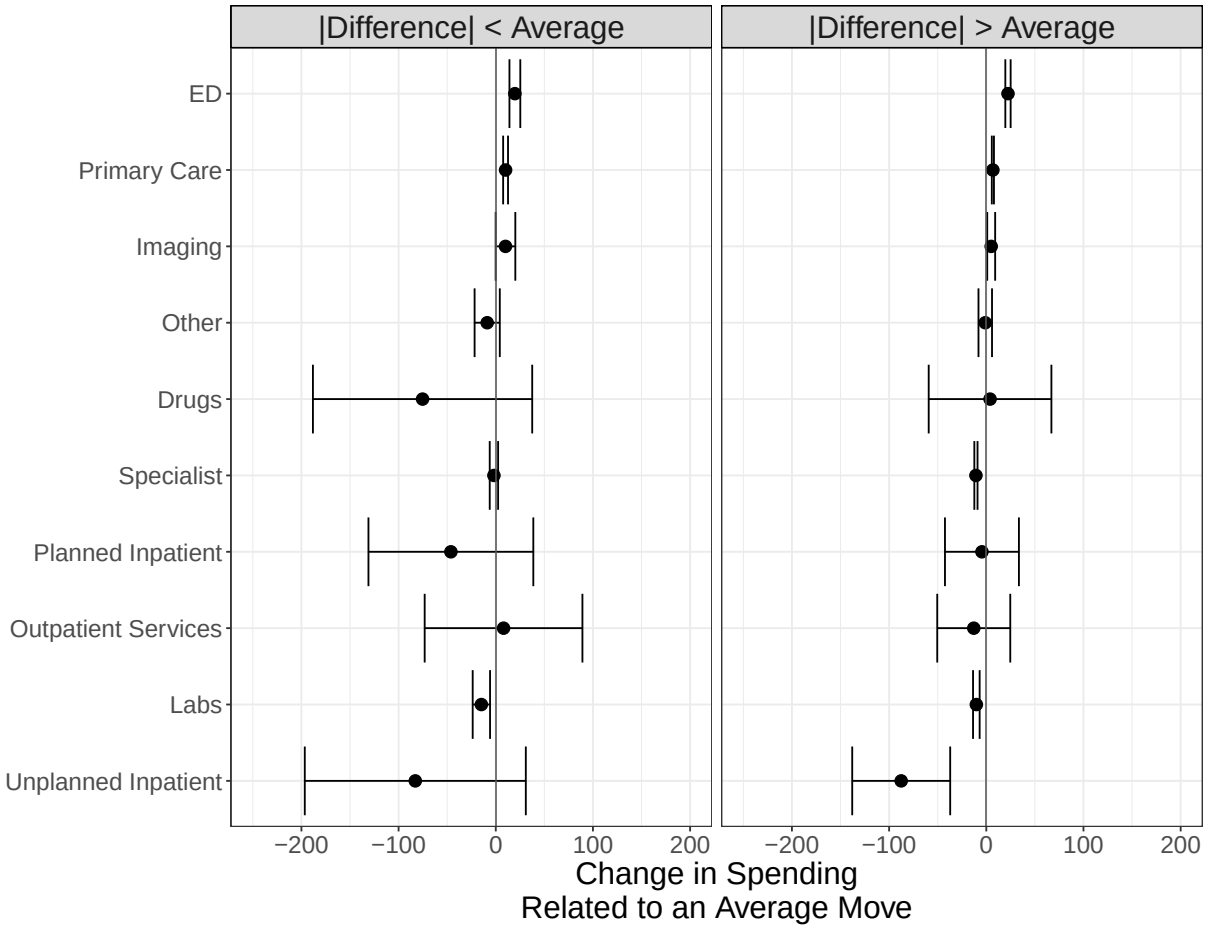
Notes: The figure shows average pre-move annual spending and estimates of the change in spending following a move that is related to each mover's destination-origin difference in ED utilization rate, by type of service. For each service category, the left bar plot shows the average spending among movers, pre-move. The right panel shows for each service category, the average change in individual spending related to the origin−destination difference, estimated using equation (1) and collapsed to the difference between all post- and pre-periods, weighted by sample size. This effect is scaled to show the effect on spending associated with the average absolute origin-destination difference in ED utilization in our sample, which is 2.6 percentage points. The details of these calculations are discussed in the Appendix. Spending is denominated in New Israeli Shekels (NIS). The error bars reflect 95 percent confidence intervals based on standard errors clustered by patient. The sample is all movers (N=1,274,445 patient-years).

Appendix Figure A4: Change in Movers' Spending and Utilization Related to Positive Versus Negative Destination-Origin Differences in ED Visit Rates



Notes: The figure shows an analysis of heterogeneity of estimates of the model in equation (1) for the relationship between destination-origin difference in ED use and mover spending. The figure shows moves that involve a negative (right panel, $N = 620,613$ patient-years) and positive (left panel, $N = 653,832$ patient-years) destination-origin difference in average ED use. Each panel shows for each service category, the average change in individual spending related to the origin−destination difference, estimated using equation (1) and collapsed to the difference between all post- and pre-periods, weighted by sample size. This effect is scaled to show the effect on spending associated with the average absolute origin-destination difference in ED utilization in our sample, which is 2.6 percentage points. The details of these calculations are discussed in the Appendix. Spending is denominated in New Israeli Shekels (NIS). The error bars reflect 95 percent confidence intervals based on standard errors clustered by patient.

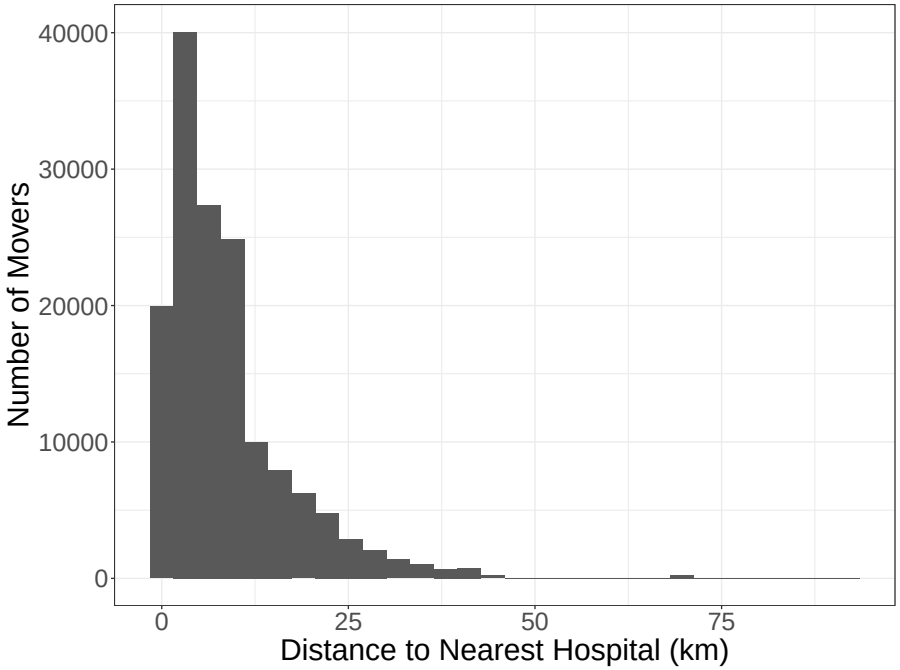
Appendix Figure A5: Change in Movers' Spending and Utilization Related to Large Versus Small Destination-Origin Differences in ED Visit Rates



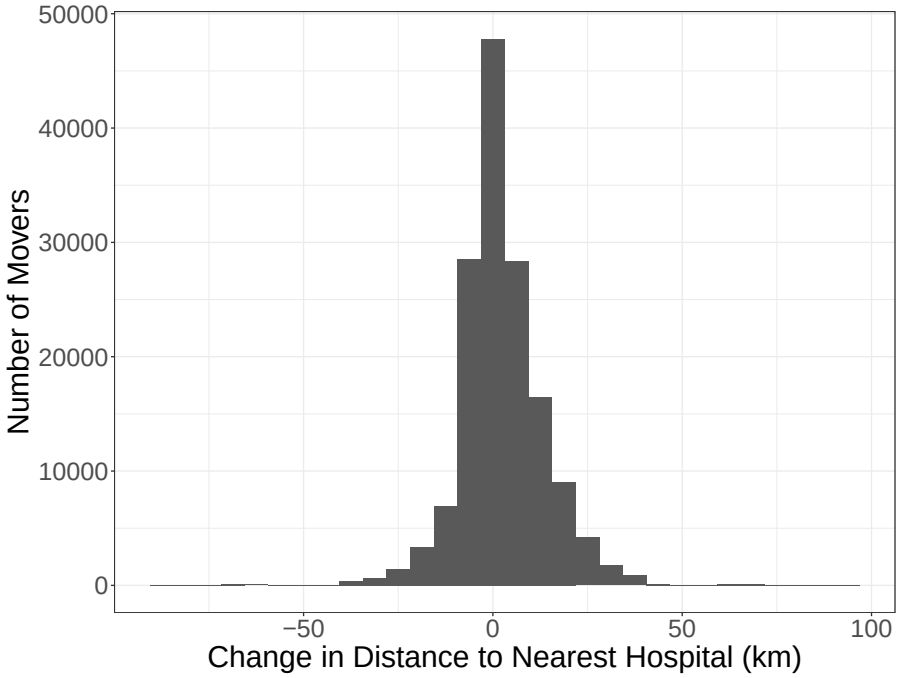
Notes: The figure shows an analysis of heterogeneity of estimates of the model in equation (1) for the relationship between destination-origin difference in ED use and mover spending, for moves with a smaller-than-average (left panel, $N = 506,024$ patient-years) and greater-than-average (right panel, $N = 768,421$ patient-years) absolute destination-origin difference in average ED use. Each panel shows for each service category, the average change in individual spending related to the origin−destination difference, estimated using equation (1) and collapsed to the difference between all post- and pre-periods, weighted by sample size. This effect is scaled to show the effect on spending associated with the average absolute origin-destination difference in ED utilization in our sample, which is 2.6 percentage points. The details of these calculations are discussed in the Appendix. Spending is denominated in New Israeli Shekels (NIS). The error bars reflect 95 percent confidence intervals based on standard errors clustered by patient.

Appendix Figure A6: Level and Change in Movers' Distance to the Nearest Hospital

(A) Before the Move



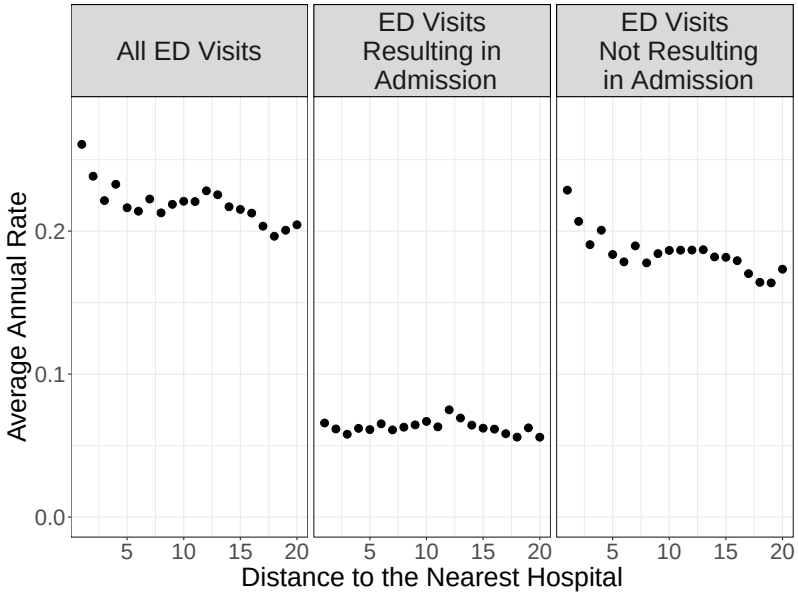
(B) Change During a Move



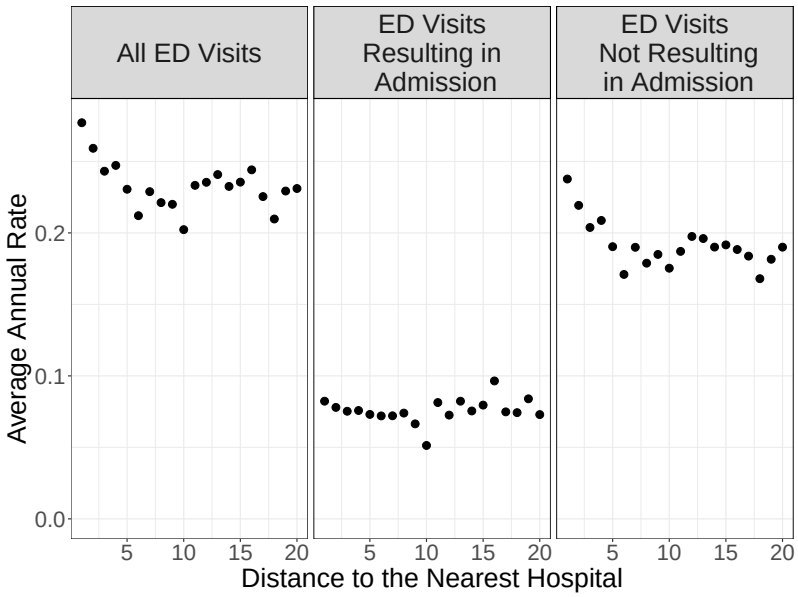
Notes: The figure shows, for the sample of 150,676 movers, the distribution of the patients' distance to the nearest hospital. Panel A shows the distribution of this distance before the move. Panel B shows the distribution of the change in this distance following a move. Section 5 discusses in detail the definition of our distance measure.

Appendix Figure A7: ED Utilization and Distance to the Nearest Hospital

(A) Pre Move



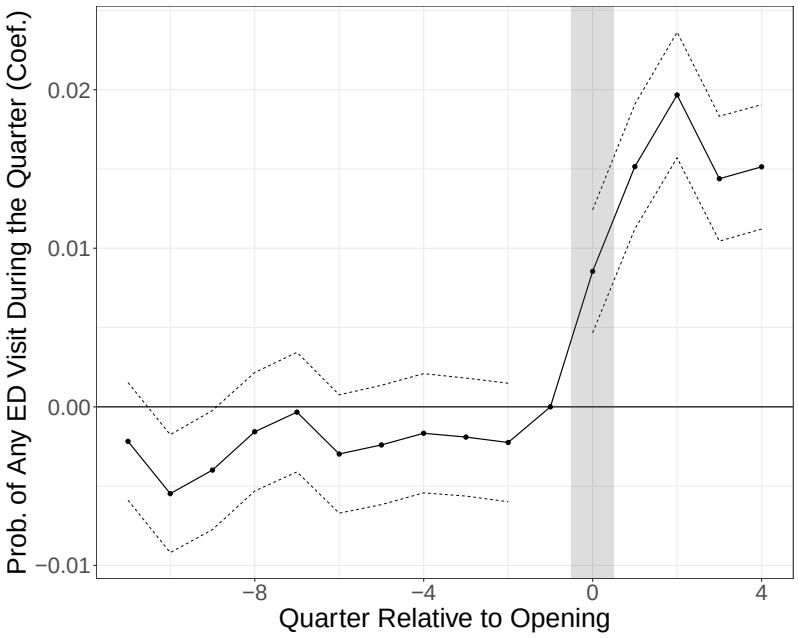
(B) Post Move



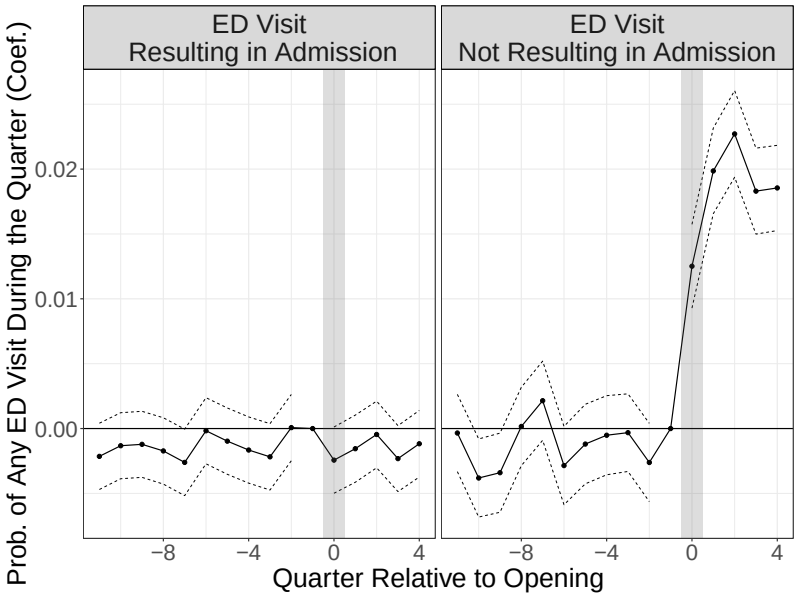
Notes: The figure shows the average annual ED visit rates by the patients' distance to the nearest hospital. For each mover, we calculated the distance to the nearest hospital before and after the move (see Section 5 for details) and binned these distances into twenty ventiles. The x-axis shows the patient distance ventile. The y-axis shows the average annual ED use rates for patient in each ventile. Panels (A) and (B) show results from before (N= 706,800 mover-years) and after the move (N = 562,406 mover years). The different facets show results for all ED visits, and separately by discharge status.

Appendix Figure A8: The Impact of Hospital Opening on ED Use

(A)

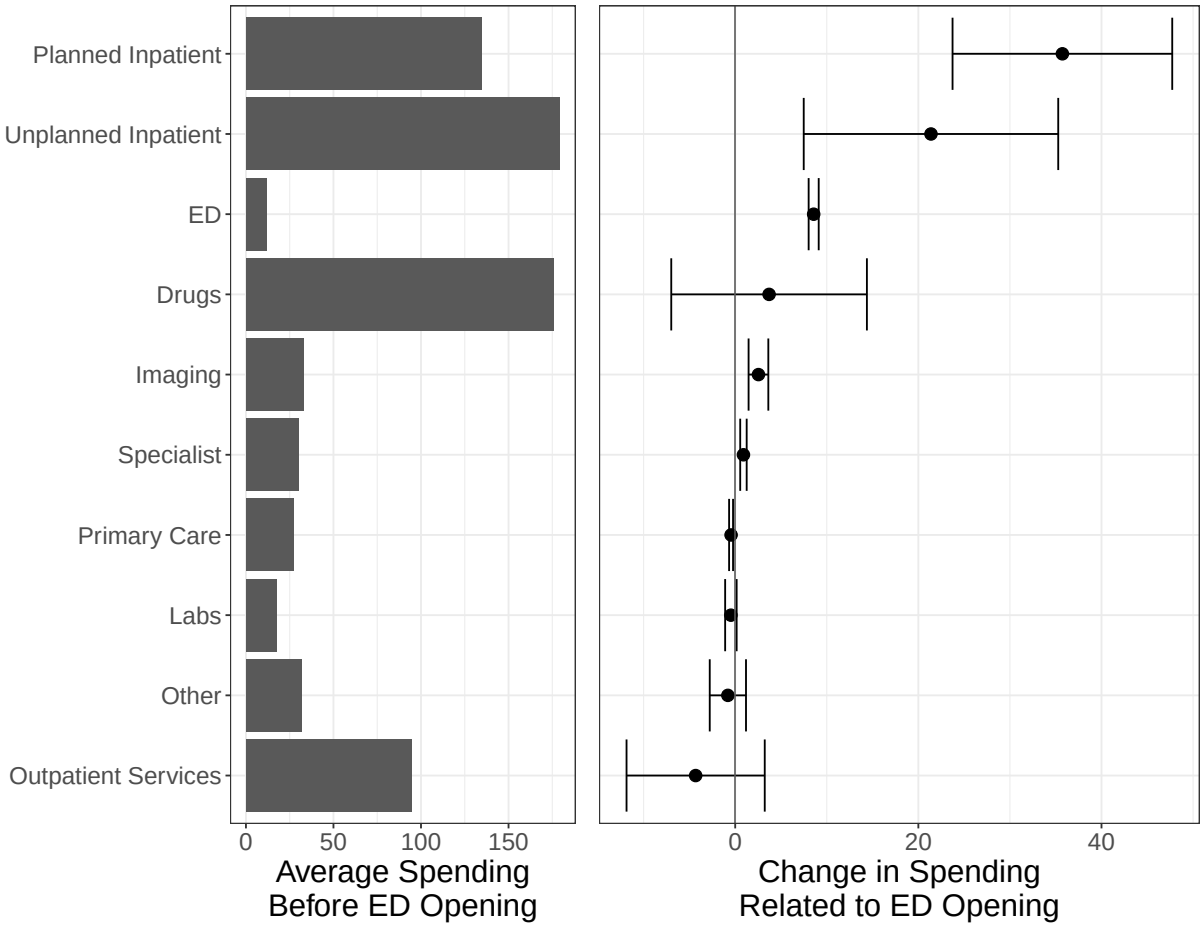


(B)



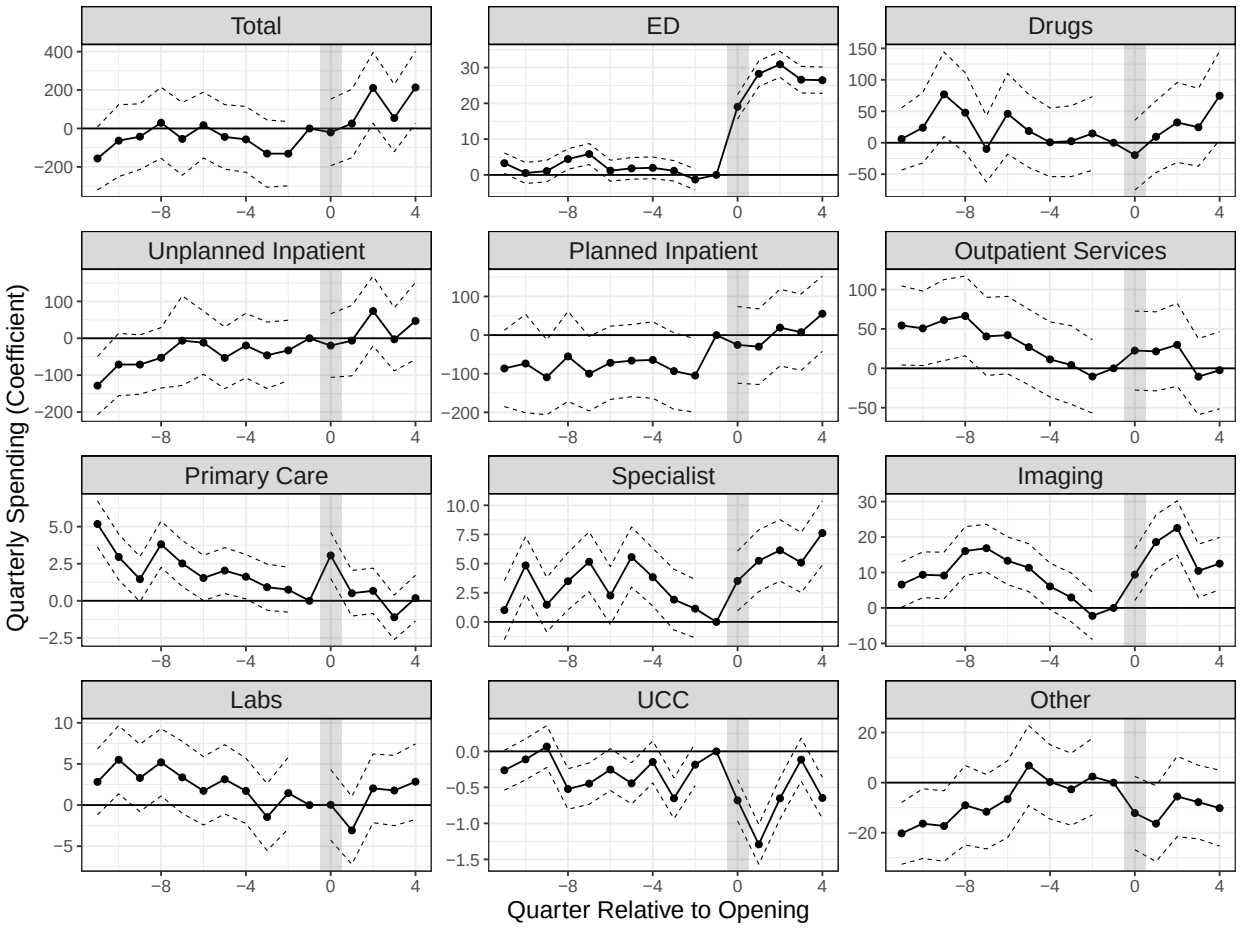
Notes: The figure shows estimates of equation (6) of the impact of hospital entry on local ED use relative to ED use in cities without entry. Quarter number 0 is the quarter of the ED opening. The coefficient of quarter −1 is normalized to 0. Panel (A) shows results for any ED visit; Panel (B) shows results separately by ED visit outcome: admission (left) and discharge home (right). The comparison group consists of cities similar in size to the treated cities that did not have a hospital opening throughout the period. The sample consists of 41,031 treated and 343,332 untreated patients (N=5,964,797 patient-quarters).

Appendix Figure A9: Difference-in-Differences Estimates of the Overall Change in Spending Related to Hospital Opening



Notes: The figure shows average pre-treatment annual spending and estimates of equation (6) for the change in spending associated with hospital entry, by type of service. For each service category, the left panel shows the pre-treatment average monthly spending in Ashdod—the treated city. The right panel shows estimates of equation (6) for the impact of hospital entry on healthcare spending of treated residents, relative to residents of comparison cities that did not have hospital entry. The sample consists of 41,031 treated and 343,332 untreated patients (N=17,870139 patient-months).

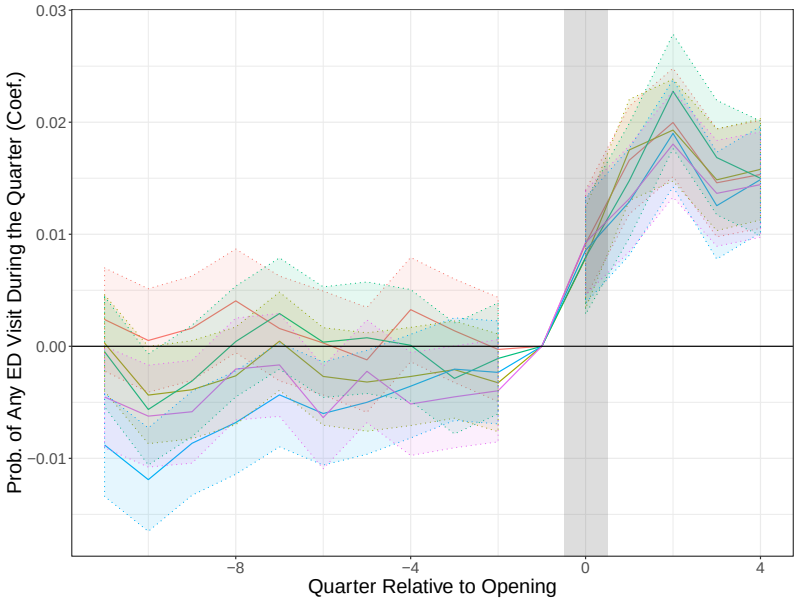
Appendix Figure A10: Change in Spending Related to ED Opening



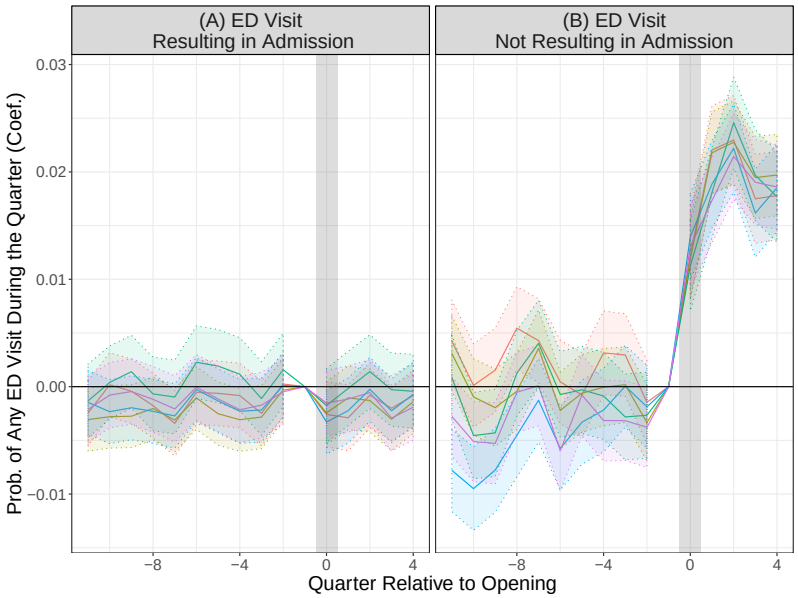
Notes: Table shows estimates of equation (6) for the impact of hospital opening on average individual spending by nearby ("treated") residents on different types of healthcare services relative to spending by untreated residents residing in cities that did not have a hospital entry during the study period. Spending is denominated in NIS (except for UCC, where the outcome is a dummy for a visit, and the y-axis scale shows percentage points). Total is the total annual spending on all service types. ED denotes spending on emergency department visits. Standard errors are clustered by patient. The sample consists of 41,031 treated and 343,332 untreated patients (N=17,870139 patient-months).

Appendix Figure A11: Impact of Hospital Entry on ED Use, Estimated Separately Relative to Each Comparison City

(A) All ED Visits

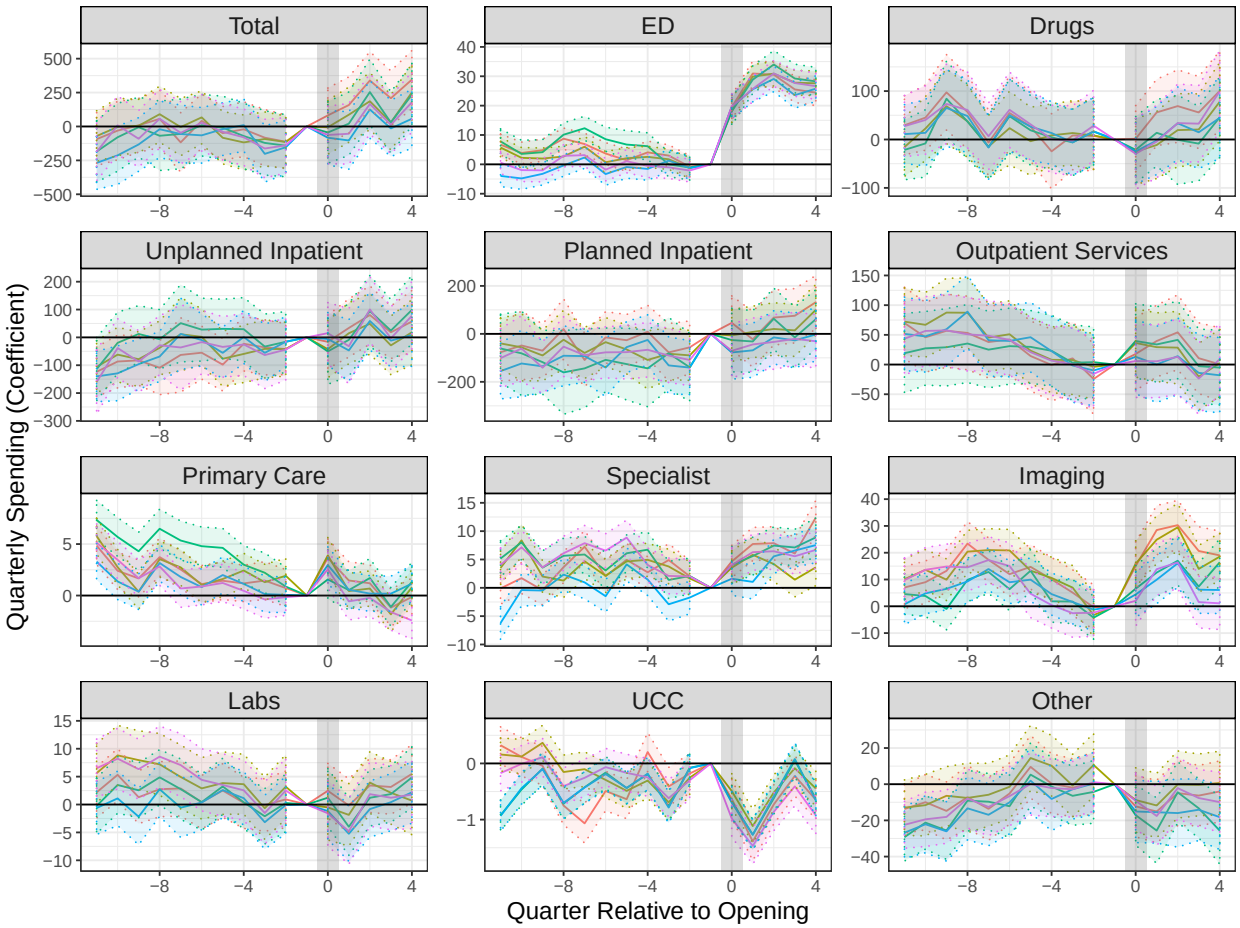


(B) ED Visits by Discharge Status



Notes: For the treated city and each one of the five comparison cities, the figure shows the fraction of residents with one or more ED visit during each month. The gray vertical shade highlights November 2017, the month in which the index city opened its first ED. Before that time, it had been served only by emergency departments in adjacent cities. Comparison cities were served by at least one local emergency department throughout the study period.

Appendix Figure A12: The Impact of Hospital Entry on Spending, Estimated Relative to Each Comparison City Separately



Notes: Table shows estimates of equation (6) for the impact of hospital opening on average individual spending by nearby ("treated") residents on different types of healthcare services, relative to spending by untreated residents of each of the comparison cities, which did not have a hospital entry during the study period. Spending is denominated in NIS (except for UCC, where the outcome is a dummy for a visit, and the y-axis scale shows percentage points). Total is the total annual spending on all service types. ED denotes spending on emergency department visits. Standard errors are clustered by patient.

Appendix Table A1: District-Level ED Utilization and Spending

	District									
	1	2	3	4	5	6	7	8	9	All
A. Annual Emergency Department Use										
Percent with Any ED Visit	20.1	22.4	23.4	24.1	24.5	24.9	26.4	27.8	30.8	24.2
Discharged Home	15.0	16.3	18.3	17.6	18.9	19.8	21.5	23.2	28.1	18.8
Admitted	8.2	9.7	8.6	10.5	9.5	8.8	8.9	8.8	7.2	9.1
Died	0.067	0.054	0.041	0.060	0.046	0.056	0.049	0.070	0.091	0.055
Fraction of ED Visits Resulting in Admission	37.3	38.9	32.3	39.1	34.8	31.7	29.5	27.5	17.6	33.6
Percent with Any UCC Visit	13.2	4.3	9.3	2.9	0.9	10.8	1.9	2.0	0.8	5.4
B. Annual Spending, By Category (mean, NIS)										
Total (All Categories)	6,490	6,249	6,768	7,968	6,334	5,697	6,774	5,950	6,622	6,470
Emergency Department	159	165	193	193	189	191	220	240	371	193
Prescription Drugs	1,308	1,294	1,452	1,826	1,392	1,205	1,565	1,289	1,007	1,395
Inpatient - Unplanned	1,770	1,854	1,704	2,512	1,622	1,411	1,615	1,444	1,246	1,722
Inpatient - Planned	1,073	983	1,171	1,150	1,109	875	1,118	1,013	1,956	1,063
Outpatient Services	931	718	918	827	815	808	922	775	807	830
Primary Care Visits	285	291	279	252	280	309	257	327	241	286
Specialist Visits	235	271	282	351	269	222	292	197	203	263
Laboratory Services	274	267	322	340	282	310	345	274	395	299
Imaging Services	182	179	178	246	161	145	193	154	152	177
Other	246	220	257	268	214	208	243	234	245	234
C. Additional Statistics										
Average Distance to Hospital (km)	6.4	13.3	9.1	6.6	9.4	18.0	3.1	12.4	3.9	10.2
Average Share of PCP visits with ED Referral (Percent)	2.2	1.9	2.1	2.3	1.9	3.4	2.9	3.2	3.9	2.5
Number of Observations (Patient-Year, thousands)	2,172	3,929	2,892	1,994	3,254	2,455	2,365	2,570	159	21,791
Number of Patients (thousands)	326	556	424	313	469	362	356	368	27	3,005

Notes: Districts are ordered from lowest (1) to highest (9) ED use. The district names are: 1. Jerusalem, 2. Haifa, 3. Center, 4. Tel-Aviv Jaffa, 5. Sharon-Shomron, 6. South, 7. Dan, Petach-Tikva, 8. North, 9. Eilat. Distance to the hospital and share of PCP ED referrals are defined in Section 5.

Appendix Table A2: Distribution of Year of Move

Calender Year of Move	Number of Movers (1)	Share of Sample (2)
2011	21,354	0.142
2012	21,097	0.140
2013	21,561	0.143
2014	21,599	0.143
2015	21,428	0.142
2016	21,649	0.144
2017	21,988	0.146
All	150,676	1.000

Notes: Table shows the number of patients who moved in each calendar year during our study period of 2011–2017. Column 1 shows the number of movers. Column 2 shows their share of the total sample.

Appendix Table A3: Move Origin and Destination

Origin District	Number of Patients	Number of Movers	Destination District (Fraction)								
			1	2	3	4	5	6	7	8	9
1	333,119	14,247		0.08	0.28	0.19	0.11	0.11	0.15	0.08	0.02
2	563,751	17,642	0.07		0.09	0.18	0.22	0.05	0.12	0.24	0.02
3	432,948	20,390	0.09	0.05		0.24	0.13	0.21	0.21	0.05	0.02
4	324,144	25,666	0.04	0.06	0.28		0.20	0.06	0.31	0.04	0.01
5	477,350	18,574	0.07	0.12	0.11	0.26		0.06	0.27	0.09	0.01
6	369,676	14,078	0.10	0.08	0.30	0.18	0.12		0.15	0.04	0.03
7	366,106	21,204	0.07	0.06	0.22	0.27	0.26	0.06		0.05	0.01
8	376,048	16,270	0.08	0.36	0.08	0.13	0.16	0.06	0.11		0.02
9	29,170	2,605	0.07	0.14	0.15	0.13	0.12	0.22	0.09	0.08	
Total	3,004,676	150,676	0.06	0.10	0.17	0.17	0.16	0.08	0.17	0.07	0.02

Notes: For each origin district, the matrix shows the fraction of patients that moved to each destination district, with each row adding up to one. Also shown are the overall number of patients (including non-movers) and the number of movers in each district. See Section 3 for sample definitions.

Appendix Table A4: Characteristics of Cases Used in Estimating Physician Propensity to Refer to the ED

ED Referral Rate	0.0247
ACG (mean)	3.63
Number of Chronic Conditions (Mean)	0.574
Distance to Hospital (km)	10.4
Female (Percent)	58.8
Age (Mean)	53.6
Number of Visits	19,519,925
Number of Doctors	4,205

Notes: The table shows descriptive statistics for the auxiliary sample of all visits in 2018 to physicians in our sample. ED referral rate is the fraction of visits that ended with the physician referring the patient to the ED. Distance to the hospital is the distance between the patient's assigned primary care clinic and the nearest hospital. See Section 5 for detailed definitions.

Appendix Table A5: The Change in ED Use Associated with PCP Referral Propensity

	Dependent variable:			
	Change in ED Visits	Change in ED Visits Not Resulting in Admission	Change in ED Visits Resulting in Admission	Change in UCC Visits
	(1)	(2)	(3)	(4)
Change in PCP Referral Propensity	0.0020^{***}	0.0022^{***}	0.0002^{**}	-0.0019^{***}
	(0.0002)	(0.0002)	(0.0001)	(0.0001)
Change in Distance to the Nearest Hospital	-0.0069^{***}	-0.0076^{***}	-0.0008	0.0099^{***}
	(0.0009)	(0.0008)	(0.0005)	(0.0005)
ACG Resource Utilization Band	Yes	Yes	Yes	Yes
Number of Chronic Conditions	Yes	Yes	Yes	Yes
Age Group	Yes	Yes	Yes	Yes
Gender	Yes	Yes	Yes	Yes

Notes: The figure shows estimates of equation (4) for the relationship between a mover's change in utilization and the change in their PCP propensity to refer to the ED. For each mover in each year, we calculate the primary care physician's referral propensity, based on estimates of equation (3). We then averaged these measures, separately for the years before and the years after the move and calculated the change in this propensity, defined as the average propensity in all years after a move minus the average propensity in all years before a move. Change in PCP Referral Propensity is the ventile of these changes, scaled between 1 and 20. Change in Distance to the Nearest Hospital is the difference in the mover's distance to the nearest hospital before the move minus their distance to the nearest hospital after the move (see Section 5 for details) in multiples of 10 kilometers. The different columns show estimates of equation (4) separately for different utilization measures. The sample includes all movers, excluding a small number of movers whose physicians had fewer than 100 visits in 2018. Standard errors in parentheses. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.