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עמותה רשומה

## Supply-Side Variation in the Use of Emergency Departments

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# Supply-Side Variation in the Use of Emergency Departments

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## Abstract

We investigate the role of person-specific and place-specific factors in explaining geographic variation in emergency department (ED) utilization using detailed data on 150,000 patients who moved regions within Israel. We observe a sharp change in the probability of an ED visit following a move that is equal to half of the destination-origin difference in the average ED utilization rate. In contrast, we find no change in the probability of having an unplanned hospital admission (that is, via the ED), implying that the entire change is driven by ED visits that do not lead to hospital admission. Similar results are obtained in our complementary event-study analysis, which uses hospital entry as a source of variation. The results from both approaches suggest that supply-side variation in ED access affects only the less severe cases—for which close substitutes likely exist—and that variation across ED physicians in their propensity to admit patients is not explained by place-specific factors, such as differences in incentives, capacity, or diagnostic quality.

Keywords: regional variation, emergency department utilization

JEL Classification: I11

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# 1 Introduction

Admitting a patient to the hospital from the emergency department (ED) is one of the more expensive routine healthcare decisions (Sabbatini, Nallamotheu and Kocher, 2014). It directly influences the probability of hospital stays, which account for a large share of total healthcare spending.

Both ED utilization and admissions through the ED exhibit large variation over time and across space, and the sources of that variation remain unclear. To better understand this variation, it is important to acknowledge the interrelated nature of patients' decisions to visit the ED and emergency physicians' decisions as to which ED patients to admit. Variation in each of these margins may be driven by place-specific factors. The decision to visit the ED for urgent care may be influenced by place-specific factors such as distance to the nearest ED and the presence of other urgent care services, such as urgent care centers or retail clinics (Alexander, Currie and Schnell, 2019; Allen, Cummings and Hockenberry, 2019). The decision to admit patients from the ED may be influenced by place-specific factors such as the distribution of cases arriving at the ED and hospital diagnostic quality, capacity, and incentives for filling beds. Both decisions may also be driven by patient-specific factors, such as preferences for walk-in care over scheduled care and population morbidity that affects the need for urgent and emergent care. Patient-specific factors generally correspond to what we think of as "demand" and place-specific factors to what we think of as "supply."

In this paper, we analyze the relative importance of supply- and demand-side factors in driving ED use and ED admission decisions. Separating demand and supply factors is an important first step for both understanding the nature of the variation in such use and for assessing the need for and potential impact of policies aimed at changing the variation.

To implement this exercise, we study the response to changes in ED access using two complementary empirical approaches. Our primary approach uses the variation in ED utilization across space. To separate the variation in ED utilization that is due to place-specific factors from variation due to patient-specific factors, we use within-patient variation in ED utilization as patients move, arguably for non-healthcare reasons, across regions that vary in their access to EDs.<sup>1</sup> In a secondary approach, we use an event-study design, which takes advantage of the entry of a new hospital (and thus a new ED) into a large market, thus increasing ED access sharply over time.

We implement our empirical strategy using detailed and comprehensive longitudinal medical data from about half of the Israeli population. The data come from Clalit Health Ser-

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<sup>1</sup>Our approach is similar to that used by Finkelstein, Gentzkow and Williams (2016), Finkelstein, Gentzkow and Williams (2018), Finkelstein, Gentzkow and Williams (2019), Cutler et al. (2019), and Agha, Frandsen and Rebitzer (2019), among others.

vices, the largest of four Health Maintenance Organizations (HMOs) in Israel that provide universal, standardized, tax-funded health insurance to all residents. Coverage broadly resembles that of Medicare in the United States, and it does not change when a patient moves. We study migration across Israel’s nine districts, which are geographic units comparable to US counties, with an average population of about one million residents per district and a fairly wide range of annual ED use rates (the share of covered individuals who visit the ED in a given year), which varies from 20.1 percent to 30.8 percent. Our main sample consists of all 150,000 adult beneficiaries (aged 25 and older) who moved across districts between 2011 and 2017. Movers in our sample are relatively young, thus mitigating concerns that moves might be driven by changes in health status.

We observe a sharp change in the probability of an ED visit around the year of a move; it is equal to about half of the difference in the average ED utilization rates of the origin and destination districts. There is no trend pre-move or systematic adjustment post-move. Remarkably, all of the correlation between an individual ED use rate and the origin-destination difference in average ED use rates is concentrated in ED visits that did not result in admission to the hospital. For visits that resulted in an admission, we find no correlation between individual rates and the destination-origin difference in ED utilization rate.

Taken together, the results suggest that at least half of the geographic variation in ED use is attributable to supply-side factors, but that such factors influence only cases that are discharged home, which are likely less severe. Conversely, the entire variation in ED visits that result in a subsequent hospital admission is attributable to demand-side factors. Using data on non-ED healthcare utilization, we present additional evidence consistent with the fact that these incremental low-severity ED visits are associated with a reduction in the utilization of other, presumably substitutable, healthcare services.

In a complementary approach, we also exploit a distinctly different source of variation in ED access: the impact on ED use and admissions that results from the opening of a new general hospital in a previously under-served city. Like patient migration, hospital entry also leads to a sharp change in supply-side factors because it significantly reduces the distance and travel time to the nearest ED for the “treated” population of nearby residents (while also improving access to other inpatient services). We use a difference-in-differences framework to account for potential time trends by comparing outcomes of the treated population against outcomes of “untreated” patients residing in similar cities that did not experience a change in ED availability. Our two empirical approaches—analyzing patient migration and hospital entry—complement each other in that the first focuses on those patients who choose to migrate, while the second focuses on those who do not.

Conforming with our earlier results, we find that an ED opening that occurs when a

general hospital enters a local market results in a sharp increase in the monthly probability of an ED visit of nearby residents compared to residents of comparable cities. Furthermore, once again, the increase in ED use following the supply-side change is entirely concentrated in visits that result in discharge to home, with no impact on unplanned admissions (that is, via the ED). Results are robust to the choice of comparison city and to including patient fixed effects as well as to adding controls for time-varying patient characteristics.

The results from both approaches suggest that supply-side variation in ED access affects only the less severe ED cases—for which alternative settings might be a good substitute—but not the more severe cases that result in an admission.<sup>2</sup> In contrast, our finding that the entire effect is driven by ED visits that are less severe suggests that prior evidence of large variations in ED admissions may reflect mostly demand-side, not supply-side, factors. Specifically, our evidence militates against explanations of variation in ED admissions in terms of factors that vary locally. In particular, the findings do not fit with the idea that the mere decision to visit the ED being a source of increase, all else being equal, in inpatient hospital utilization rates and the findings do not lend support to the idea that admission decisions (from the ED) depend on hospital differences in available capacity, diagnostic quality, or financial incentives.

A large body of existing work has documented substantial variation in ED use and admissions, both across and within countries. For example, Shoff, Caines and Pines (2018) find that the ED admission rate of Medicare beneficiaries in 2012 varied tremendously across US counties; Abualenain et al. (2013) and Sabbatini, Nallamotheu and Kocher (2014) document large variation in hospital-level admission rates; Dawson, Weerasooriya and Webster (2008) document variation across Canadian provinces; Van Parys (2016) documents variation in admission rates among ED physicians in Florida. By separating supply- and demand-side factors, our analysis extends our understanding of the potential nature of this variation.

The rest of this paper proceeds as follows. Section 2 presents our data source and setting. Section 3 presents our main sample and empirical strategy using patient migration. Section 4 presents our main results decomposing ED utilization rates to place versus person effects. Section 5 presents additional results analyzing the impact of hospital entry on ED use. Section 6 concludes.

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<sup>2</sup>The finding that supply-side variation explains a substantial share of ED utilization is consistent with prior evidence that suggests a scope for substituting ED with other types of urgent care providers in low severity cases, using research designs that are based on the variation in entry and opening hours of retail clinic entry and urgent-care centers (Alexander, Currie and Schnell, 2019; Allen, Cummings and Hockenberry, 2019; Llovera et al., 2019). Although our results do not directly reveal the extent to which patient can efficiently self-select.

## 2 Setting and Data

### 2.1 Institutional Background

Our data come from Clalit Health Services, one of Israel’s four non-profit HMOs that provide universal tax-funded healthcare coverage from birth onward to all Israeli residents, in accordance with the National Health Insurance Law (1995). Coverage broadly resembles that of Medicare parts A, B, and D, and includes hospital admissions, outpatient services, physician consults, drugs, and durable medical equipment. The set of services covered under the universal coverage tier is reviewed and expanded every year by a professional committee that ranks new technologies to match a predetermined budget increase. The universal coverage tier is fully subsidized (HMOs receive risk-adjusted capitated payments from the government for each individual they enroll), but includes copay rates that are updated annually by the Ministry of Health.<sup>3</sup> ED visits, which are the focus of our analysis, require a copay, with certain exemptions.<sup>4</sup> At the time of our observation period, the copay was NIS 900 (about \$240) during the day and NIS 200 (about \$55) between 1:00 a.m. and 6:00 a.m.<sup>5</sup>

All four HMOs offer identical universal coverage but use distinct provider networks to do so, with the exception of hospitals, which are predominantly government-operated and are used by all four HMOs. All four HMOs also offer optional supplemental coverage for items not covered by the universal tier, such as second-opinion specialist consults and additional paramedical treatments for children. The supplemental coverage requires subscribers to pay an additional, regulated, age-rated premium. In principle, enrollees can switch HMOs every other month and maintain their universal coverage, but the annual switching rate is extremely low at less than 1 percent, so each HMO covers a very stable population of enrollees.

Clalit is the largest of these four HMOs, covering approximately 4.5 million enrollees of all ages, or just over one-half of the entire Israeli population. It is an integrated provider and insurer, providing most of the services it finances, and reimbursing preauthorized services purchased from external providers. Its enrollees are admitted to all of Israel’s thirty general hospitals, eight of which Clalit directly owns and operates.<sup>6</sup> Clalit employs over 11,000

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<sup>3</sup>Copay rates differ by service, with a service-specific quarterly out-of-pocket maximum. There are no copays for inpatient services.

<sup>4</sup>ED visits that result in admission are exempt. In addition, copay exemption applies for patients who were referred to the ED by a physician or visits for one of several specific emergent conditions, such as traffic accidents, work- or school-related injuries, new bone fractures, and injuries that require stitches.

<sup>5</sup>Prices and payments are denoted in current New Israeli Shekels (which had an average exchange rate of 3.7 NIS per USD during the observation period).

<sup>6</sup>Hospitals are reimbursed per diem, except for a set of procedures (such as surgeries), for which hospital reimbursement is based on a procedure-related grouping of services. Patients can also utilize services from

physicians and 10,000 nurses, and operates over 1,500 clinics across the country, and provides multiple outpatient services. Most of Clalit’s physicians are salaried. Members also have access to urgent care centers (UCCs) that provide after-hours walk-in care for urgent but non-emergent conditions. Most UCCs are operated by external providers, charge a copay of about NIS 90, and close before midnight. Clalit is organized around nine districts, which follow geographic boundaries and are all subject to general operational guidelines from Clalit management.

## 2.2 Data

Clalit maintains detailed and comprehensive claim-level data associated with all the services it provides to its universe of enrollees. The data contain demographic information about enrollees, information that is typical of billing data in the United States, as well as additional information about tests and test results, sometimes referred to as electronic medical records. The data we use for this study are based on Clalit’s claims data from 2010–2018.

For our analysis, we construct health utilization variables at the patient-year level. Our primary variable of interest is the propensity of ED visits, and whether the visit resulted in the patient’s being discharged or admitted to the hospital. We exclude a small number of cases that resulted in death during the ED visit; this is not common (accounting for 0.016 percent of patient-year observations among movers), so grouping them with ED visits that result in admission does not change any of the results. We refer to ED visits in which the patient was discharged without being admitted to the hospital as *outpatient* ED visits. We construct additional health utilization variables including healthcare spending for different categories of services and UCC utilization.<sup>7</sup> The main spending categories are prescription drugs and inpatient services, which together account for two-thirds of total spending.

## 2.3 Cross Sectional Variation Across Districts

The focus of our study is the extent of geographic variation in ED use and how it may be related to healthcare outcomes. In this section, we describe this variation, which will then be used as a key input in our analysis in the next section. The geographic unit for this analysis is a district, which is the administrative unit around which Clalit’s healthcare services are organized. There are nine such districts that cover the entire country of Israel, with an

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external providers, which in non-emergent cases require preauthorization. Our data include detailed claims information for all these services.

<sup>7</sup>Because we do not reliably observe negotiated prices for UCC visits, we only measure their utilization. UCC visits account for less than 1 percent of total spending.

average population of one million residents per district. All districts are roughly similar in size, with the exception of the Eilat district, which is much smaller.<sup>8</sup>

Similar to patterns documented in other countries, Israel’s healthcare spending in general and ED use in particular exhibit marked geographic variation. Appendix Table 1 reports summary statistics that illustrate the variation in healthcare utilization across these districts. For each district, Panel A summarizes annual ED use. For the population aged 25 and above, the probability of an ED visit ranges between 20.1 percent and 30.8 percent across Israel’s districts. The fraction of ED visits resulting in an admission also exhibits cross-sectional variation, ranging between 17.6 percent to 39.1 percent of ED visits across districts. Panel B summarizes spending by service category and shows a similar variation in spending across districts.

Figure 1 summarizes the regional variation of different measures of ED use and spending. For each such measure, the figure shows its loading on each of two principal components of the regional variation in all measures shown. There are two noteworthy observations. First, there seems to be a clear distinction between districts with more unplanned admissions (through the ED), drugs, specialist visits, and labs on the one hand, and districts with heavier hospital use through planned inpatient visits and outpatient ED visits. Second, primary care and UCC visits vary across districts and are unrelated to most services but are negatively correlated with outpatient ED use. These services load almost entirely on the second principal component.

Of course, it is difficult to draw sharp conclusions from descriptive evidence for variation in ED use and its correlation with other services, partly because it is unknown whether this variation reflects regional differences in the patient population’s morbidity or preferences, or in provider access or choices. We next turn to decompose this variation along these lines.

### 3 Empirical Strategy and Baseline Sample

Our primary analysis relies on a “movers” research design (in the spirit of Finkelstein, Gentzkow and Williams, 2016), which analyzes within-individual changes in healthcare utilization and outcomes before and after a move from one geographic unit (district in our context) to another. In this section we describe the empirical strategy and the baseline sample we assemble to take advantage of this research design.

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<sup>8</sup>Eilat is an Israeli port and resort town located in the very south of the country and is quite isolated from other population centers.



### 3.1 Research Design and Empirical Specification

To decompose the variation in average ED utilization across districts into a demand-side component that reflects regional differences in patient health or preferences and a supply-side component that reflects differences across places, we use patient migration. To the extent that migration is not driven by health status, studying patients who move locations provides an opportunity to study the ED utilization of the same patients in different regions.

**Patient Migration** Our main focus is an event-study analysis of changes in patient ED use associated with the timing and direction of moves. Consider a patient  $i$  who moved from origin district  $o(i)$  to destination district  $d(i)$ . Let  $\overline{ED}_{o(i)}$ ,  $\overline{ED}_{d(i)}$  denote the average ED utilization at each district, which we estimate using the full population across all periods.<sup>9</sup> We define the *destination-origin difference* in ED utilization for patient  $i$  to be

$$\Delta ED_i = \overline{ED}_{d(i)} - \overline{ED}_{o(i)}.$$

We then estimate the following event-study equation:

$$Y_{it} = \alpha_i + \tau_y + \theta_t + \delta_t \Delta ED_i + X_{it}\beta + \varepsilon_{it}, \quad (1)$$

where  $Y_{it}$  is one of several measures of utilization of ED and other healthcare services for patient  $i$  in year  $t$  measured relative to  $t = 0$ , the year when  $i$  moved;  $\alpha_i$  and  $X_{it}$  are patient fixed-effects and controls for patient age, sex, and number of chronic conditions;  $\tau_y$  are calendar year fixed effects; and dummies  $\theta_t$  for the number of years relative to the move allow for post-move utilization adjustment to the new place to be gradual.

The parameter of interest is  $\delta_t$ , which captures, for each period relative to the move, the relationship between mover  $i$ 's utilization to the difference in average ED visit rates between patient  $i$ 's destination and origin districts. If all of the regional variation in the outcome (e.g., ED use) is driven by patient-related factors, the estimated coefficients would be zero. If regional variation is fully driven by supply-side factors, the estimated coefficients would be one. An intermediate coefficient of between zero and one measures the extent to which regional variation can be attributed to patient- versus location-related factors.

The key to separate identification of person and place effects is the observed change in utilization when patients move. Our model permits movers to differ from non-movers in both their level of ED utilization (as fixed effects  $\alpha_i$  are included) and in the trends of ED utilization around the move (as both  $\delta_t$  and  $\theta_t$  are allowed to vary with  $t$ ). The

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<sup>9</sup>For movers, we exclude the year of the move to avoid the need to partially attribute spending or utilization to the origin and destination districts.

identification assumption is that any shocks to healthcare utilization do not exactly coincide with the timing of the move *and* are correlated with the origin and destination differences in utilization. The assumption might be violated if patients who receive adverse health shocks move to high ED-utilization areas. The fact that movers are younger and healthier than the (relatively young) general population suggests that is not commonly the case. To the extent that such violations occur, it would cause us to overstate the role of place relative to patients.

To estimate the total effect of a move on the mover utilization, we aggregate the estimated period-by-period effects obtained using Equation (1) to obtain the mean difference between post- and pre-move outcomes, weighted by sample size to account for the fact that our panel is imbalanced. We scale this estimated total difference in mover utilization by the mean absolute destination-origin difference in utilization. The details of this calculation are discussed in the Appendix.

### 3.2 Baseline Sample of Movers

The Clalit data include the residential address of each enrollee, which is regularly updated by Israel’s Population and Immigration Authority. We map each address to one of Clalit’s nine districts and construct our baseline sample by including all adult patients aged 25 and above who moved across districts exactly once during the period 2011–2017. We study moves across—not within—districts, to exclude local moves in which access to ED and other healthcare services does not substantially change.

During the study period, out of the entire population of three million adult Clalit enrollees, 150,676 enrollees moved exactly once. These enrollees constitute our baseline “movers” sample. We exclude 78,932 individuals who moved twice or more during the study period as well as the majority of individuals who did not move across districts during the observation period. To guarantee that we observe utilization at least one year before and one year after each move, we include in this sample only enrollees with continuous coverage for at least one calendar year prior to the year of the move and for the year following the year of the move, as long as the individuals are alive. To satisfy this requirement for patients who moved in 2011 or 2017, we extract data from 2010 and 2018 as well. Given the low churn rate of enrollees, nearly all patients are observed throughout our nine-year study period (2010–2018), with the average patient being observed for more than eight years. The resulting (unbalanced) baseline sample has a total of 1.27 million enrollee-year observations. The rate of migration is stable over the study period (Appendix Table 2).

Movers are on average younger and slightly healthier than the overall adult population.

Table 1 compares the average characteristics of movers in our sample and the population of non-movers, calculated over the entire study period. Panel A of this table compares demographic and health status. The average mover is 40 years old at the time of the move—ten years younger than the average adult Clalit enrollee who did not move. Movers have a higher socioeconomic status than non-movers, a lower number of chronic conditions, and a lower annual mortality rate. The fact that movers are younger and healthier suggests that health is less likely to be the main reason for the move.<sup>10</sup>

Consistent with their being slightly younger and healthier, movers’ annual probability of ED use is lower than non-movers’. Panel B of Table 1 compares the average ED utilization during the study period between the sample of movers and the non-mover population. Movers had a lower probability of any ED visit during the year (22.5 percent versus 24.3 percent for non-movers) and a lower rate of admission from the ED, conditional on visiting (25.8 percent versus 34.4 percent for non-movers). However, average ED utilization rates of movers prior to migration is highly correlated with ED use of non-movers in the origin district: the correlation coefficient is 0.95; it is 0.90 when weighting by district size.

Movers also spend less, on average, than non-movers. Panel C of Table 1 shows average annual healthcare spending per patient by type of service for movers and for non-movers. The average annual healthcare spending of a patient in our sample of movers is NIS 4,900, which is lower than the average adult enrollee of Clalit who did not move (NIS 6,700 per year). The breakdown of spending is fairly similar between movers and non-movers, with movers devoting a slightly higher fraction of their total spending to drugs (24 percent versus 22 percent by non-movers) and a slightly lower fraction to inpatient services (38 percent versus 43 percent). Movers and non-movers spend a similar amount on ED services, which reflects a slightly higher share of movers’ overall lower spending (4 percent versus 3 percent).

## 4 Results

### 4.1 Decomposing ED Utilization Using Patient Migration

Figure 2 shows the distribution of the destination-origin differences in ED utilization rates for movers—the key right-hand-side variable in the event-study analysis. This distribution is centered at zero and is approximately symmetric, suggesting that moves from low to high

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<sup>10</sup>In a survey conducted in 2008 among a representative sample of the adult Israeli population, the top reported reasons for moving to a new apartment were to improve housing or school quality (27 percent); family reasons, including family expansion, marriage, and divorce (27 percent), switching from renting to owning a house or an apartment (19 percent), changes in personal economic circumstances (6 percent), and changes in employment (4 percent). Source: Central Bureau of Statistics, 2008 Social Survey. [https://www.cbs.gov.il/he/publications/DocLib/2010/seker\\_hevrat08/pdf/h\\_print.pdf](https://www.cbs.gov.il/he/publications/DocLib/2010/seker_hevrat08/pdf/h_print.pdf). Accessed February 2020.

ED-utilization districts are as common as moves from high to low. This is also confirmed by the matrix of the origin and destination of migrations (shown in Appendix Table 3).

Figure 3 shows our main event-study results, plotting the estimates of the coefficient  $\delta_t$  from estimating Equation (1) with the probability of an ED visit during a given year as a dependent variable. Results for all ED visits are shown in Panel A. It shows that there is a sharp discontinuous jump at the time of the move in the probability of any ED visit, from 0 to approximately 0.5.<sup>11</sup> Under the identification assumptions discussed in Section 3, this jump implies that half of all ED utilization is attributable to supply-side factors associated with the place of residence, with the remaining half attributable to demand-side factors associated with the patient.

Panel B of Figure 3 shows results separately by discharge status. Remarkably, supply-side factors that impact patient ED utilization only affect outpatient ED visits. We find no relationship at all between the rate of patients' ED visits that result in an admission and the place of residence; the probability of such visits is entirely attributable to patient factors. This finding further supports the identification assumption that migration is not driven by health status because if it were, as discussed in Section 3, we would expect coefficients to be upward biased. Furthermore, this evidence suggests that hospitals do not indiscriminately admit patients who visit the ED but rather that the decision to admit patients is made consistently across regions. In sum, all of the supply-side driven variation in ED utilization is concentrated within outpatient ED cases.

Table 2 scales our estimates and standard errors from Equation (1) to show the change in movers' ED use that is related to an "average move"—a move across two hypothetical regions with a destination-origin difference in ED use equal to the sample average of the absolute value of such difference—and compare that change to the pre-move mean of each outcome. Column 1 shows the pre-move means among movers.<sup>12</sup> Columns (2) and (3) show summary of the weighted post- minus pre-move difference in ED use related to the average move. Panel A shows estimates for ED use. The average move is related to a change of 1.5 percentage points in the annual probability of any ED visit (which is approximately 7 percent of the pre-move baseline). The increase is concentrated in outpatient ED visits. We estimate a very small change in the probability of an ED visit resulting in admission (a  $-0.1$  percentage point change with a standard error of 0.048; the pre-move baseline probability is

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<sup>11</sup>While there is a small pre-trend, it is only statistically significant several years before the move, where we have fewer observations per year (because of our unbalanced panel). It is small and insignificant in years where we can more precisely estimate it.

<sup>12</sup>Note that pre-move mean outcomes for movers are lower than their mean outcomes over the entire study period due to both aging and time trends in utilization. For example, movers' average annual spending is NIS 3,500 pre-move (Panel B of Table 2) and NIS 4,900 over the entire study period (Panel C of Table 1). Our empirical specification flexibly accommodates such trends.

5.8 percent). Increased outpatient ED use is mirrored by a 1.95 percentage point decrease in the probability of any UCC visit (approximately a third of the pre-move baseline probability of 5.2 percent).

## 4.2 Other Outcomes

Appendix Figure 1 and Appendix Figure 2 show additional event-study results relating patient spending—overall and by type of services—to destination-origin differences in ED use. Appendix Figure 1 shows estimates of Equation (1) with spending in each service category on the left-hand side using the same destination-origin difference in ED visit rates,  $\Delta ED_i$ , on the right-hand side. Consistent with our main result, following a move, a patient’s spending on ED becomes more similar to the average spending in the destination area. In addition, we find that moving to an area with a higher (lower) average ED use rate is positively correlated with spending on primary care services and negatively correlated with spending on urgent care centers, specialist visits, and outpatient laboratory services.

Panel B of Table 2 shows the estimated change in utilization associated with the average place-related change in the ED utilization rate. Column 1 shows the average pre-move spending in each category. Column 2 shows the estimated weighted mean difference between post- and pre-move estimates shown in Appendix Figure 1, scaled by the average absolute destination-origin difference in ED use, and column 3 shows standard errors (details of this calculation are discussed in the Appendix). Appendix Figure 2 summarizes these same results visually. For each category, the left panel of Appendix Figure 2 shows the average annual pre-move spending among movers, and the right panel shows the estimated change in utilization associated with an average move.

Place-related differences in ED use are most strongly—and negatively—associated with spending on unplanned admissions. They are positively associated with spending on primary care and imaging. These findings are consistent with ED visits that complement primary care visits and substitute for office-based consults and diagnostics. Overall, moving to an area with higher (lower) ED use is associated with a decrease (increase) in spending overall, as lower spending on unplanned hospital admission offsets the increased spending on ED and complementary services.

We perform additional heterogeneity analyses whereby we re-estimate the event-study model specified in Equation (1) separately for moves from low to high ED-use districts and from high to low ED-use districts (Appendix Figure 3). We also separately estimate the same model for moves associated with above-median and below-median change in the absolute destination-origin difference in ED use (Appendix Figure 4). In both cases, we find

that results hold similarly across subsamples.

## 5 Decomposing ED Utilization via Hospital Entry

In this section we complement the previous analysis with an event-study design, in which we estimate the contribution of supply- versus demand-side factors to ED utilization using an alternative supply-side shock, or “treatment”: an opening of a new general hospital, which sharply improved ED access for nearby residents.

### 5.1 Data Sample and Empirical Specification

In 2017, a new general hospital was opened in Ashdod—the sixth largest city in Israel, with a population of 220,000 in 2017—introducing to the city its first emergency department. Prior to its opening, the closest emergency departments serving the Ashdod population (which we refer to as “the treated population”) were located in general hospitals in nearby cities, each located 32 km (20 miles) away. Therefore, the opening of a new general hospital resulted in a sharp change in local availability of emergency services.

As a comparison group, we pick the five Israeli cities most similar in their total population size to the treated city.<sup>13</sup> Throughout the study period, each of these cities had been served by at least one local hospital and had not experienced hospital entry or exit. We sample the entire Clalit patient population aged 25 and older in these cities.

Table 3 shows summary statistics for this sample. Residents of both the treated and comparison cities have similar mortality rates, ages, and gender composition. Compared to Ashdod, other cities have higher average socioeconomic statuses and lower morbidity burdens (measured by the Johns Hopkins Adjusted Clinical (ACG) Group commercial risk classifier).<sup>14</sup> Nonetheless, both the treated and comparison populations have similar average total annual healthcare spending (NIS 9,200 versus NIS 8,950; the breakdown by category is also similar). In line with Ashdod’s relatively limited access to ED services throughout the beginning of the sample period, its residents visit the ED less and visit urgent care centers more than residents of comparison cities.

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<sup>13</sup>We chose the Israeli cities ranked third to eighth in Israel by 2017 total population size (ranging between 200,000 and 280,000 residents). These cities are: Haifa, Rishon LeZion, Petah Tikva, Netanya, and Be’er Sheva. We did not include in the comparison group Jerusalem and Tel Aviv (ranked first and second), which are substantially bigger, and the cities ranked ninth through eleventh (with populations of between 150,000 and 200,000 residents), which are all part of the Tel Aviv metropolitan area.

<sup>14</sup>The ACG system is used by both commercial insurers and non-commercial healthcare organizations worldwide (as well as by Clalit) to describe or predict a population’s past or future healthcare utilization and costs. For more information, see the Johns Hopkins ACG System Version 11.0 Technical Reference Guide (2014).

Using individual-level claims data on the sample of treated and comparison cities from 2015–2018 aggregated at a quarterly or monthly frequency, we estimate a difference-in-differences specification:

$$Y_{it} = \alpha_i + \beta X_{it} + \gamma T_i + \delta_t + \eta_t T_i + \varepsilon_{it}, \quad (2)$$

where  $i$  and  $t$  index individuals and the number of periods since hospital opening;  $Y_{it}$  is one of the same outcomes as in Equation (1), including ED use and cost by category;  $\alpha_i$  and  $X_{it}$  are individual fixed effects and controls for time-varying individual characteristics (including age and ACG resource utilization band); and  $T_i$  is a “treatment” dummy for whether the individual lives in an area where a hospital opened.

The parameter of interest is  $\eta_t$ , the impact of a positive shock to ED access on ED use by nearby residents, relative to residents of other cities that did not experience such a shock. To the extent that an increased availability of ED induces greater ED use, we expect an increase in ED use in the treated city post-treatment. In addition to this specification, which we use to produce event-study plots, we also estimate another variant substituting the monthly dummies with one dummy for all periods  $t$  after the hospital opening for reporting the overall effects in a more succinct tabulated form. The identification assumption is that trends in the treated and other cities would have been common if not for the shock we observe. Given that planning and constructing a hospital is a multi-year process, it seems plausible that the exact opening day is determined by factors such as construction and licensing, and not in exact anticipation of local healthcare utilization (even if it is correlated with long-run healthcare needs of the local population).<sup>15</sup>

## 5.2 Results

As may be expected, the hospital opening led to a sharp increase in the treated city’s ED use, moving it from the bottom to the middle of the range of ED use across all comparison cities. This change is evident in Figure 4, which shows the average monthly probability of ED use in each of the comparison cities in our sample (the treated city in black; comparison cities in gray).

Panel A of Table 4 summarizes the estimated impact of hospital entry on ED use, from estimates of Equation (2) at a quarterly frequency; disaggregated estimates are shown in Appendix Figure 5. The improved access brought by the opening of a local ED was associated with a sharp increase in the probability of ED visits by nearby residents. Post-

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<sup>15</sup>The planned hospital construction was announced in 2002, and the bidding for its construction closed in 2011, six years before its inauguration.

treatment, treated residents were 27.5 percent more likely to visit the ED in a given month (a 0.7 percentage-point increase in the probability of a treated patient’s visiting the ED each month, over the pre-period baseline of 2.5 percent).

Remarkably, consistent with our earlier findings from patient moves described in Section 4, the increased ED use associated with hospital entry is entirely concentrated in outpatient ED cases, the probability of which has increased by almost 50 percent following the event. The use of urgent care centers—an ED substitute for less severe cases—decreased by more than 10 percent. In contrast, there was virtually no change in the share of patients with ED visits resulting in an admission (a 0.01 percentage point increase over the pre-treatment baseline of 1.17 percent, with a standard error of 0.02 percentage points).

Panel B of Table 4 shows estimates of Equation (2) with spending on each category and in total as the outcome (Appendix Figure 6 shows the same data as the table in a visual form; Appendix Figure 7 shows disaggregated estimates.) Average spending on ED services sharply increased among the treated population immediately after the opening (by 72 percent) and remained high throughout our sample period, which includes four quarters after the opening. Other spending categories that saw large increases were planned and unplanned inpatient services, which increased by 27 and 12 percent, respectively. Such increase is consistent with increased availability of inpatient services as a result of the hospital’s opening. Overall, the hospital’s opening was associated with a 9.1 percent increase in total average spending.

It is important to highlight that, naturally, hospital opening reflects a different type of shock to access than a patient move, which we analyzed in the previous section. While a move is associated with a change in the composition (and distance to) multiple health services available to movers, a hospital opening is primarily associated with a sharp change in access to emergency and inpatient services to nearby residents. Therefore, there is no reason the two changes should have the same association with spending. Indeed, our findings suggest that they differ in this regard.

All results are robust to the definition of the comparison group, as shown in Appendix Figure 8 and Appendix Figure 9, which show estimates of Equation (2) using five different samples obtained by separately pairing the treated city with each one of the comparison cities.

## 6 Conclusion

We document large geographic variation in ED use in Israel in 2011–2017, similar to that observed in other countries. We study the role of supply- and demand-side factors in explaining this variation using two approaches that exploit two distinct supply-side shocks to



ED access—patients who moved to an area with a different ED use rate and residents who had a nearby hospital opening. Overall, we find that about half of this variation can be attributed to supply-side factors and the rest to demand-side factors. Namely, we estimate that the probability of visiting the ED changed sharply after a move and following a hospital (and ED) opening.

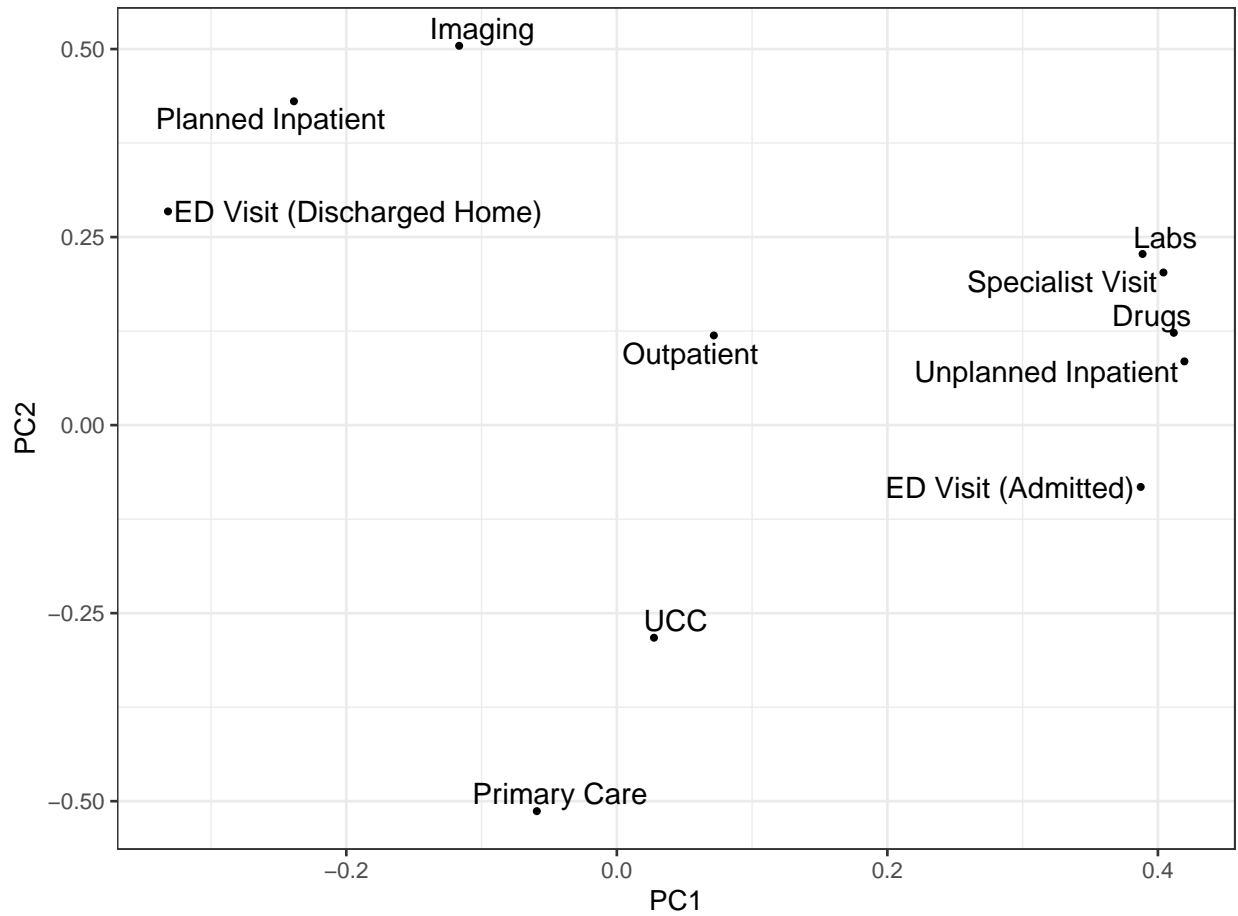
In contrast, the variation in unscheduled admissions through the ED is entirely explained by person-specific demand factors. In particular, the (unconditional) probability of a patient’s being urgently admitted through the ED in a given year did not change upon a move or following hospital entry. The fact that the marginal cases—those most affected by supply-side factors—are of low severity is unsurprising because there are many reasons for less severe cases to be the most responsive to variation in ED access. What is, perhaps, more surprising is that even though a patient’s probability of utilizing the ED is affected by supply-side factors, the admission threshold is not. That is, if unplanned admissions are driven by demand-side factors alone, as we find, it does not appear that ED physicians in low versus high ED-access locations have different criteria associated with admitting patients. This finding militates against a host of explanations that attribute the observed variation in ED admissions to place- or hospital-specific factors. For example, unless the following forces exactly offset each other in our sample, our main finding is inconsistent with different hospitals having different admission thresholds due to varying capacity, quality of on-site diagnostic, or financial incentives.

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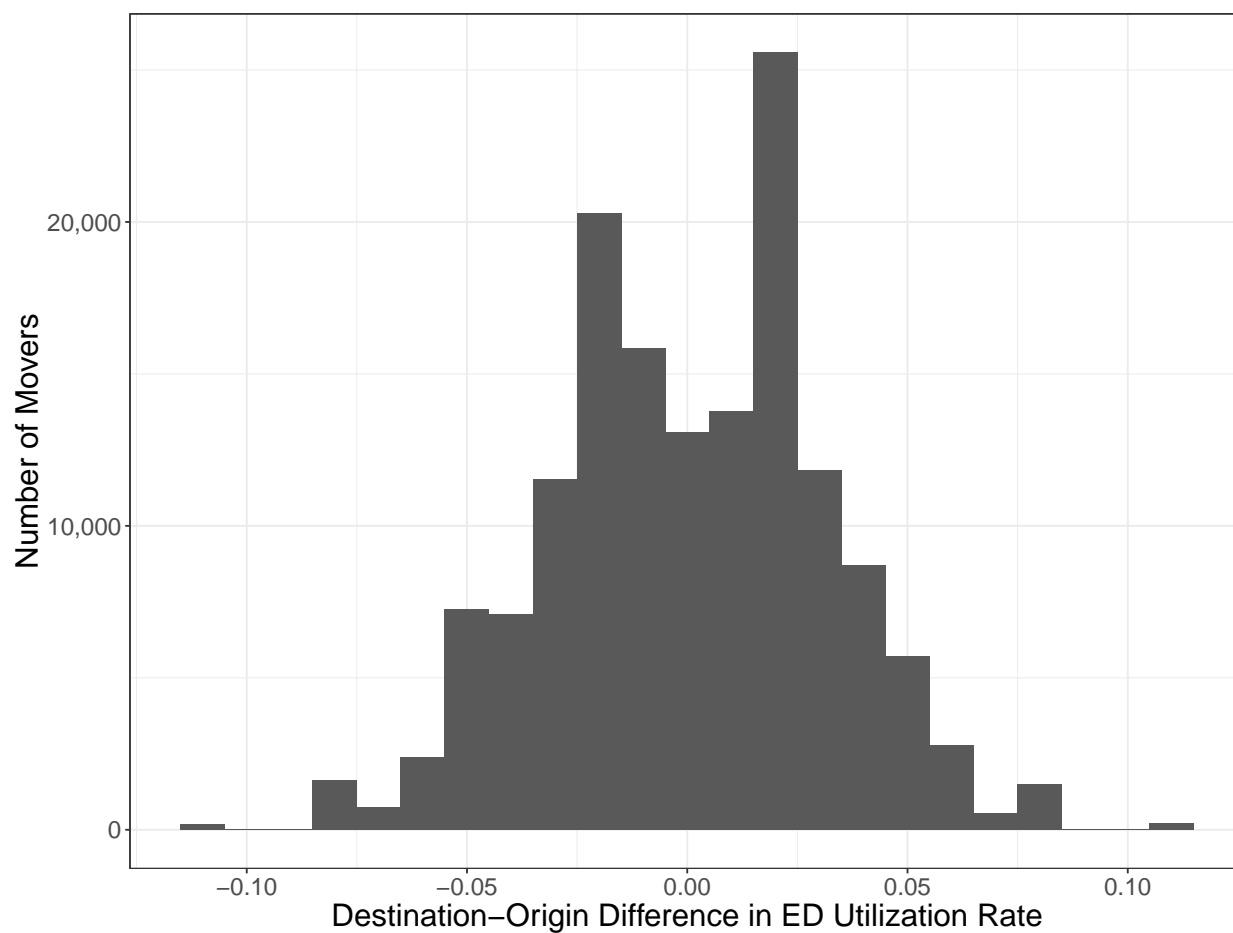
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Figure 1: Main Principal Components of Cross-District ED Use and Spending



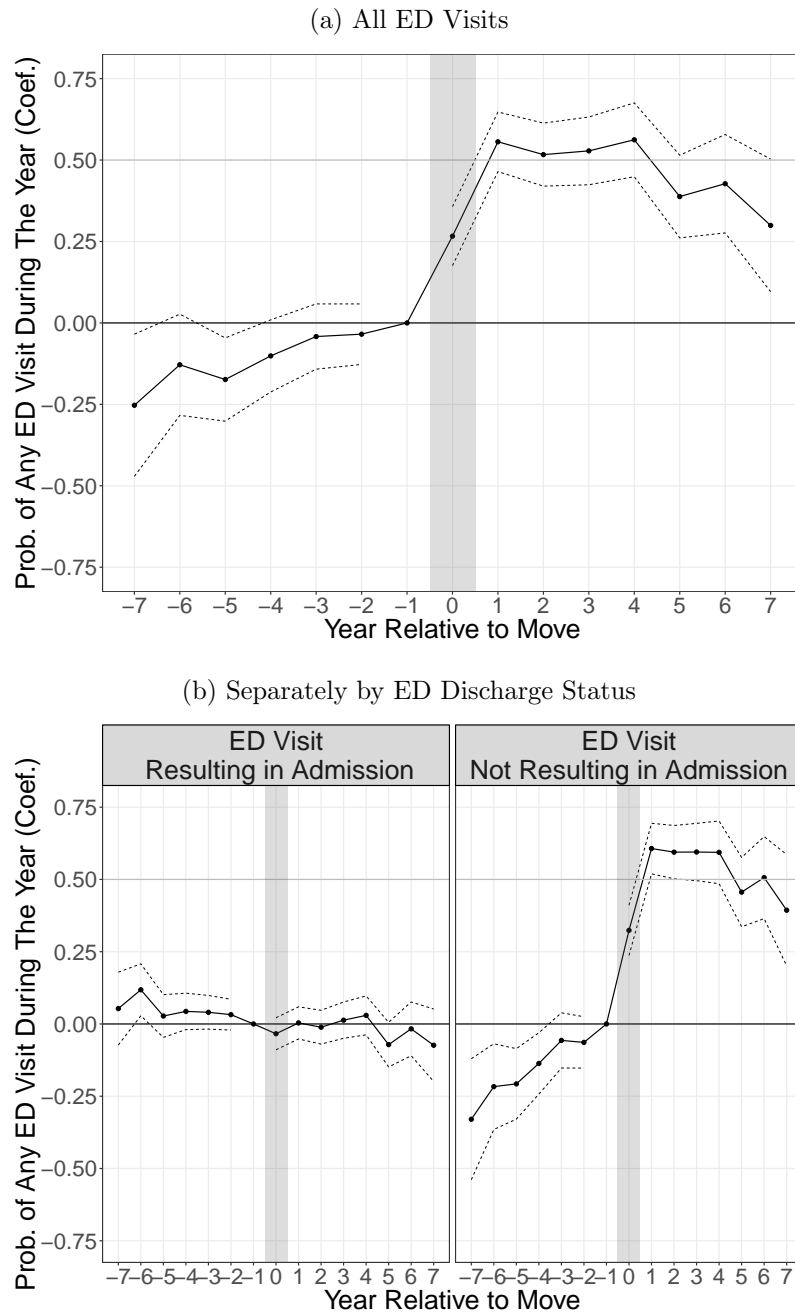
*Notes:* Figure shows, for the sample of three million covered adults, the loading of different ED use and spending categories on the two main principal components of between-district variation in ED use and spending on different service categories. The figure is based on the data on district means shown in Appendix Table 1 with variables standardized prior to the analysis. The two main principal components explain 75.1 percent of the total variation in shown measures. UCC stands for the fraction of residents with any urgent care center visit. ED Visit stands for the fraction of all residents with at least one emergency department visit, by visit outcome (home or hospital).

Figure 2: Destination-Origin Differences in ED Utilization Rates



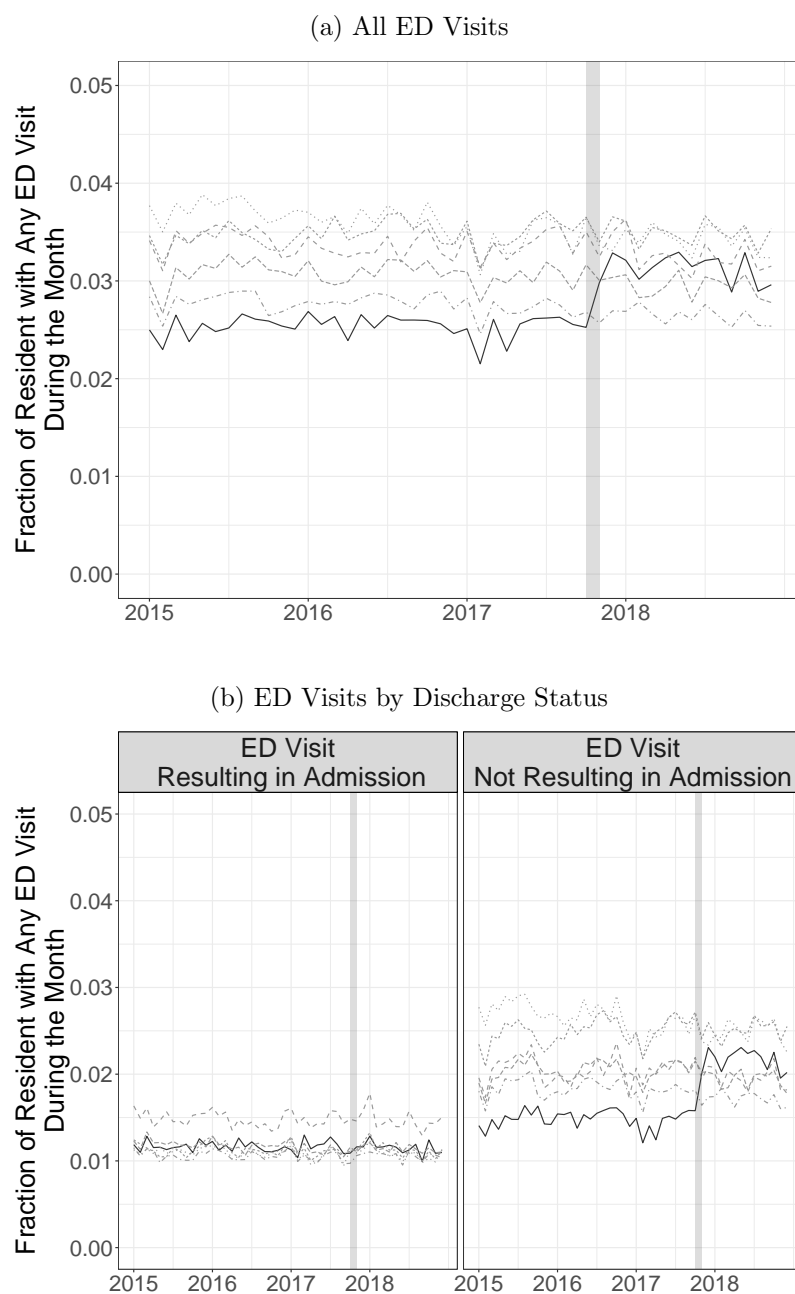
*Notes:* The figure shows, for the sample of 150,676 movers, the distribution of the difference between each mover's origin and destination districts' average ED visit rate. Averages for each district are calculated for the entire population over the entire study period (excluding the year of the move for movers). An average move involves an absolute origin-destination difference in the ED use rate of 2.6 percentage points. See Appendix Table 1 for additional information on the distribution of ED visit rates across districts. See Appendix Table 3 for additional information on the distribution of origin and destination of moves.

Figure 3: Change in Movers' ED Use Related to the Destination-Origin Difference in ED Visit Rates



*Notes:* The figure shows event-study estimates of the fraction of movers' ED use that is associated with the destination-origin difference in ED visit rates, namely,  $\delta_t$  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).

Figure 4: Monthly ED Utilization Before and After Hospital Opening



*Notes:* For the treated city (solid black) and five comparison cities (gray), 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 had opened its first ED. Before that time, it had been served only by the emergency departments in adjacent cities. Comparison cities were served by at least one local emergency department throughout the study period. The sample consists of 41,031 treated and 343,332 untreated patients ( $N=17,870,139$  patient-months)

Table 1: Characteristics of Movers and Non-Movers

	Movers (1)	Non-Movers (2)
<b>A. Demographics and Health Status</b>		
Age (mean)	40.6	50.8
Female (percent)	49.5	52.4
High SES (percent)	52.1	32.7
Number of Chronic Conditions (mean)	2.28	3.41
ACG High Resource (percent)	6.8	12.4
Annual Mortality Rate (percent)	0.42	1.22
<b>B. Annual Emergency Department Use</b>		
Percent with ED Visit, by Visit Outcome		
Any Outcome	22.5	24.3
Discharged Home (Outpatient ED)	18.8	18.8
Admitted (Inpatient ED)	6.9	9.3
Died	0.016	0.057
Fraction of ED Visits Resulting in Admission	25.8	34.3
Percent with UCC Visit	5.5	5.4
<b>C. Annual Spending, By Category (mean, NIS)</b>		
Total (All Categories)	4,946	6,689
Emergency Department	200	190
Prescription Drugs	1,173	1,441
Inpatient - Unplanned	1,222	1,796
Inpatient - Planned	670	1,113
Outpatient Services	564	862
Primary Care Visits	221	293
Specialist Visits	243	266
Imaging Services	275	302
Laboratory Services	196	175
Other	175	243
Number of Observations (Patient-Year)	1,274,445	20,085,457
Number of Patients	150,676	2,723,196

*Notes:* Descriptive statistics comparing our main sample of patients who moved and patients who did not move during 2011–2017. Panel A shows demographic and health status information. High SES is the top tercile of zipcode-based socioeconomic status scores. ACG High Resource is a dummy for high predicted utilization. Panel B shows ED use—having any visits during the year and the number of visits conditional on any visits, by discharge status. Panel C shows healthcare utilization by service category. Non-mover spending was calculated using a random subsample of 100,000 patients. See Section 2.2 for detailed sample and variable definitions.

Table 2: The Change in ED Use and in Spending Related to Destination-Origin Difference in ED Use

	Pre-Move Mean	Change Related to Average Absolute Origin–Destination Difference in ED Use	S.E.
	(1)	(2)	(3)
<b>A. Annual Emergency Department Use</b>			
Any ED Visit	0.207	0.0152	0.00080
Any ED Visit Not Resulting in Admission	0.175	0.0175	0.00075
Any ED Visit Resulting in Admission	0.058	-0.0010	0.00048
Any UCC Visit	0.052	-0.0195	0.00049
<b>B. Annual Spending (by Category)</b>			
Emergency Department	162.5	21.9	1.3
Primary Care Visits	209.3	7.2	0.5
Imaging Services	180.9	5.6	1.9
Other	128.1	-2.2	3.2
Prescription Drugs	882.2	-7.2	28.7
Specialist Visits	199.4	-9.4	0.8
Inpatient - Planned	447.1	-10.3	17.6
Outpatient Services	347.4	-10.5	17.6
Laboratory Services	155.4	-10.9	1.6
Inpatient - Unplanned	775.8	-85.9	23.5
Total (All Categories)	3494.5	-105.0	54.5

*Notes:* Table shows estimates of the change in movers' ED use, following a move. Column 1 shows the average pre-move mean of each outcome. Column 2 shows estimates of the change in ED use that is related to an “average move”—a move across two hypothetical regions with a destination-origin difference in ED use equal to the sample average of the absolute value of such difference. These estimates were obtained using Equation (1), collapsed to the difference between all post- and pre-periods (weighted by sample size) and 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. Details of these calculations are discussed in the Appendix. Column 3 shows estimated standard errors, clustered by patient. Panel A shows estimates for the probability of ED and UCC use. Panel B shows estimates for spending on different types of services. Spending is denominated in New Israeli Shekels (NIS). The sample is all movers (N=1,274,445 patient-years).



Table 3: Summary Statistics: Treated and Comparison Cities

	Treated City (1)	Comparison Cities (2)
<b>A. Demographics and Health Status</b>		
Age (mean)	54.8	54.8
Female (percent)	53.7	53.9
High SES (percent)	25.8	43.4
Number of Chronic Conditions (mean)	4.48	4.05
ACG High Resource (percent)	19.4	16.0
Annual Mortality Rate (percent)	1.62	1.60
<b>B. Annual Emergency Department Use</b>		
Percent with ED Visit, by Visit Outcome		
Any Outcome	21.6	25.4
Discharged Home (Outpatient ED)	15.6	19.6
Admitted (Inpatient ED)	9.7	9.9
Died	0.058	0.070
Fraction of ED Visits Resulting in Admission	40.5	34.0
Percent with UCC Visit	13.6	5.9
<b>C. Annual Spending, By Category (mean, NIS)</b>		
Total (All Categories)	9,193	8,956
Emergency Department	171	212
Prescription Drugs	2,165	2,185
Inpatient - Unplanned	2,249	2,219
Inpatient - Planned	1,729	1,421
Outpatient Services	1,149	1,284
Primary Care Visits	319	278
Specialist Visits	366	357
Imaging Services	420	438
Laboratory Services	215	226
Other	387	328
Number of Observations (Patient-Year)	160,116	1,340,494
Number of Patients	41,013	343,332

*Notes:* Descriptive statistics for the sample of patients who resided in treated (experiencing hospital entry) and comparison cities (with no hospital entry) during 2015–2019. See Section 5 for sample definitions. Panel A shows demographic and health status information. High SES is the top tercile of zipcode-based socioeconomic status scores. ACG High Resource is a dummy for high predicted utilization. Panel B shows ED use—having any visits during the year and the number of visits conditional on any visits, by discharge status. Panel C shows healthcare utilization by service category. For comparability with Table 1, the numbers shown are annual, aggregated at the patient-year level. To better reveal time trends, our analysis below aggregates the same data at the patient-month level.

Table 4: Change in ED Use and in Spending Related to ED Opening

	Estimated Impact of Hospital Entry	S.E.	Pre-Treatment Mean Dep. Var (for Treated)	Estimated Impact of Entry as Percent of Pre-Treatment Mean Dep. Var
	(1)	(2)	(3)	(4)
<b>A. Monthly Emergency Department Use</b>				
Any ED Visit	0.0070	0.0003	0.0255	27.5
ED Visit Not Resulting in Admission	0.0075	0.0003	0.0150	49.8
ED Visit Resulting in Admission	0.0002	0.0002	0.0117	1.3
Any UCC Visit	-0.0015	0.0002	0.0141	-10.4
<b>B. Monthly Spending (by Category)</b>				
Emergency Department	8.6	0.3	11.9	71.9
Prescription Drugs	3.7	5.4	175.5	2.1
Imaging Services	2.5	0.5	33.1	7.7
Laboratory Services	-0.5	0.3	17.7	-2.6
Other	-0.8	1.0	31.5	-2.5
Outpatient Services	-4.3	3.8	94.6	-4.6
Inpatient - Planned	35.7	6.1	134.6	26.5
Primary Care Visits	-0.5	0.1	27.1	-1.7
Specialist Visits	0.9	0.2	29.9	3.0
Inpatient - Unplanned	21.4	7.1	179.3	11.9
Total (All Categories)	66.7	13.5	737.2	9.0

*Notes:* Table shows estimates of the change in ED use due to ED opening. Column 1 shows estimates of Equation (2) for the impact of hospital opening on ED use and healthcare spending of (“treated”) nearby residents relative to residents of comparison cities that did not have any new hospital open during the study period. Column 2 shows standard errors for these estimates, clustered by patient. Column 3 shows the average pre-treatment outcome for residents of the treated city. Column 4 shows the magnitude of the impact (from column 1) as percent of the pre-move baseline (from column 3). The sample consists of 41,031 treated and 343,332 untreated patients (N=17,870139 patient-months).

# 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:

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

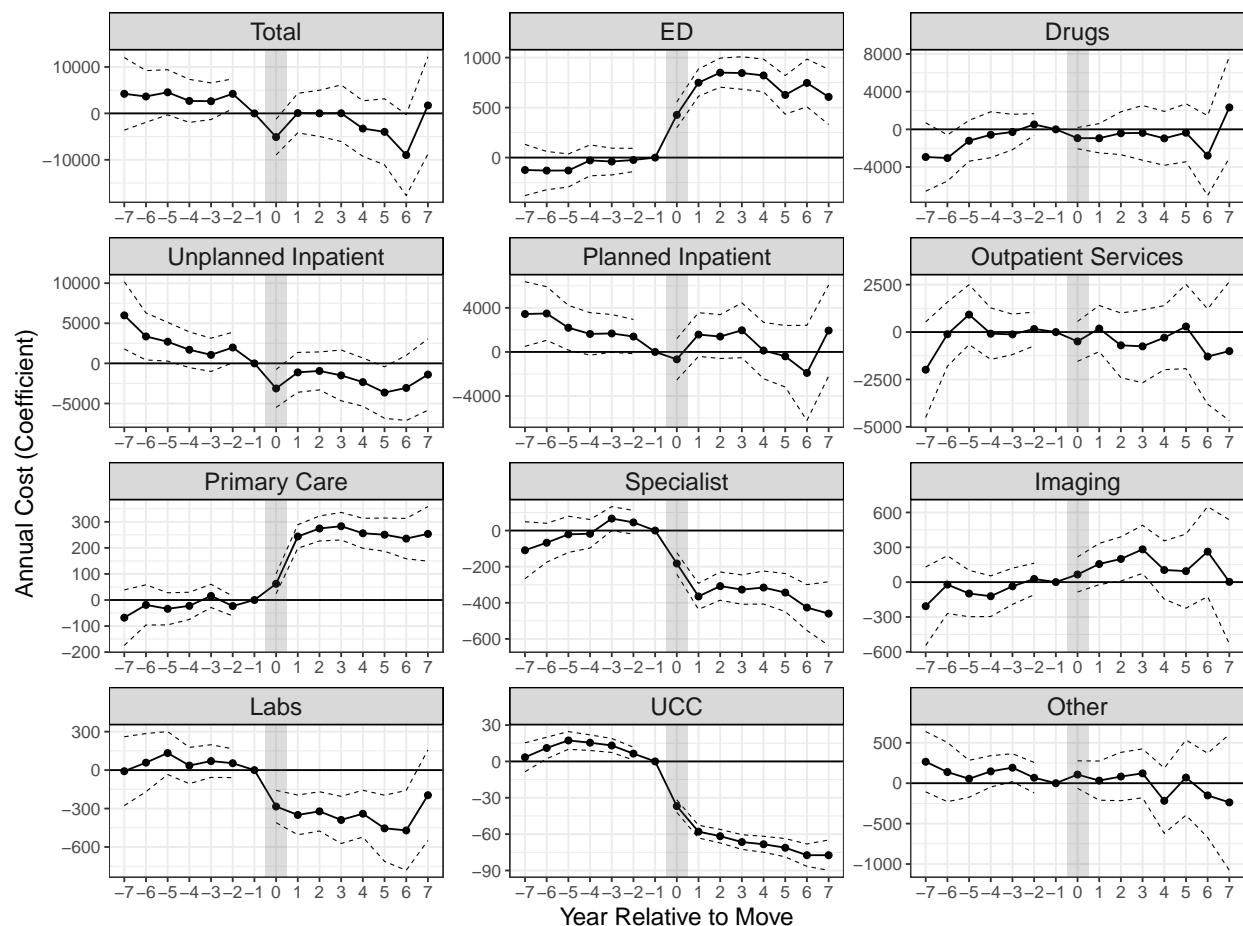
where  $w_t$  equals  $-n_t / \sum_{s < 0} n_s$  for  $t < 0$ ,  $n_t / \sum_{s > 0} n_s$  for  $t > 0$ , and zero for the year of the move. Because the total number of observations in the pre and post period are not exactly equal,  $w_t \neq -w_{-t}$ , but by construction,  $\sum_{t > 0} w_t = -\sum_{t < 0} w_t = 1$ . 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:

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

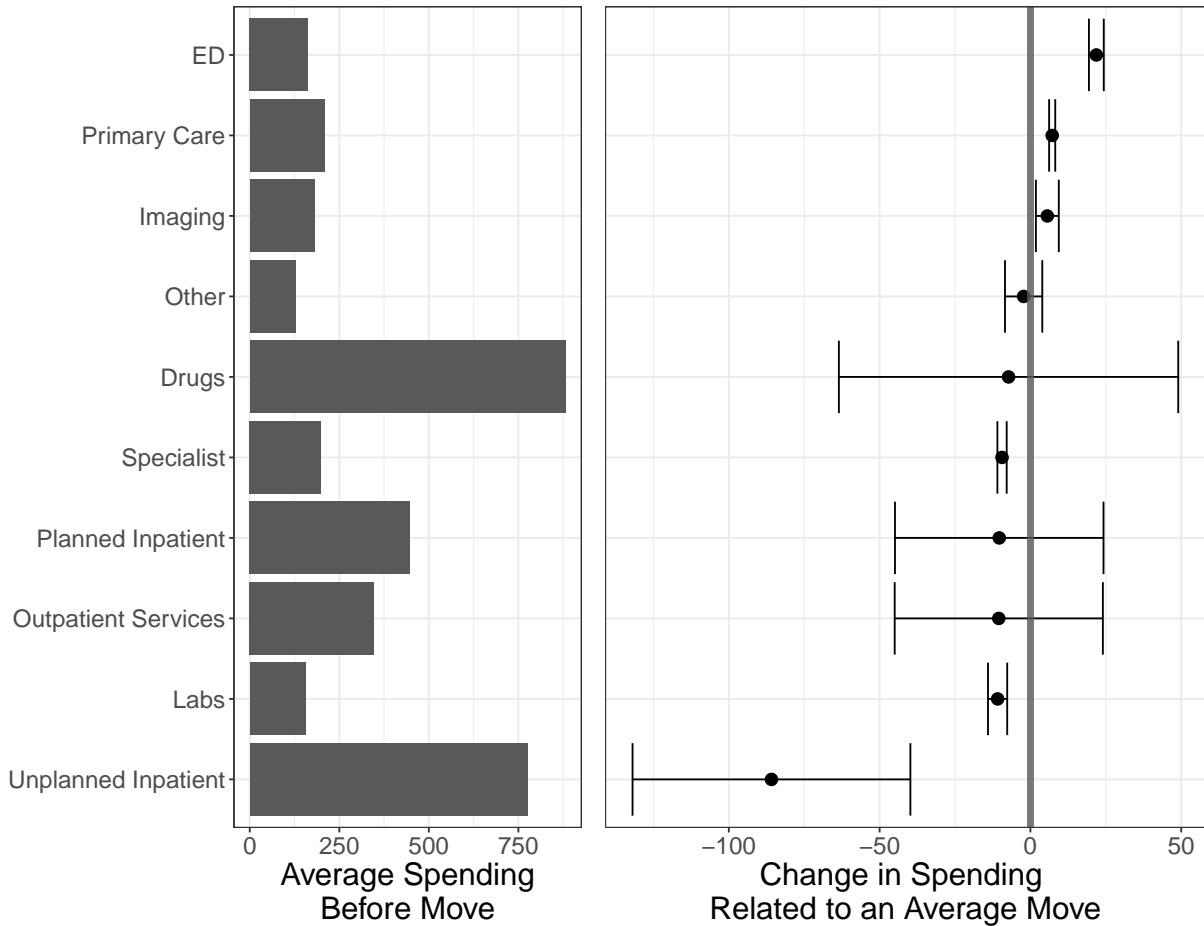
and multiply both to obtain the effect of an average move:  $\widehat{\Delta Y} \cdot \overline{\Delta ED}$ .

Appendix Figure 1: Change in Movers' Spending and Utilization Related to Destination-Origin Difference in ED Visit Rates



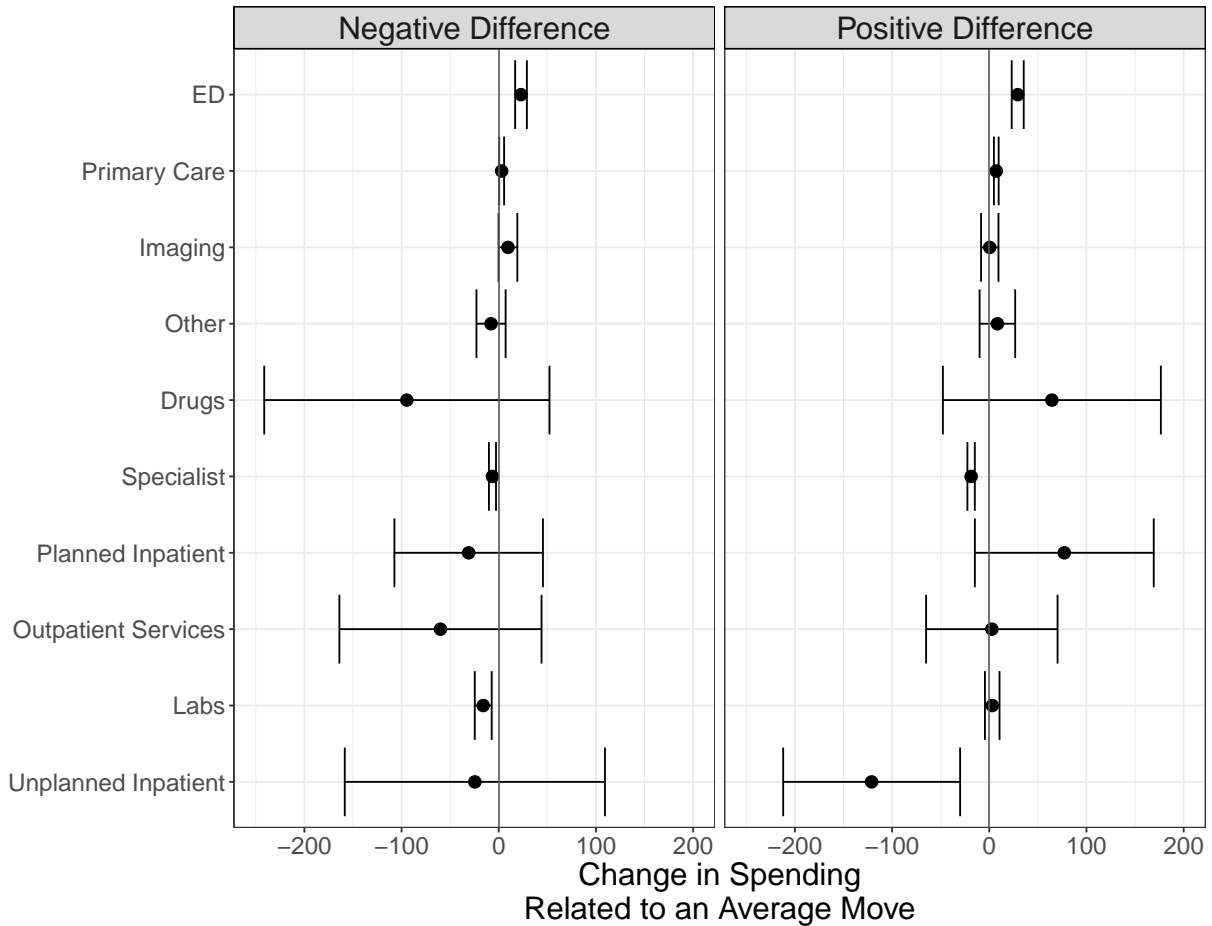
*Notes:* Estimates of Equation (1) for different spending measures. Estimates reflect the change in annual healthcare spending associated with destination-origin difference in ED utilization rate. Year 0 is the year of the move. The coefficient of the year before the move is normalized to 0. Spending 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 2: Baseline Spending and Changes in Movers' Spending Related to Destination-Origin Difference in ED Visit Rates



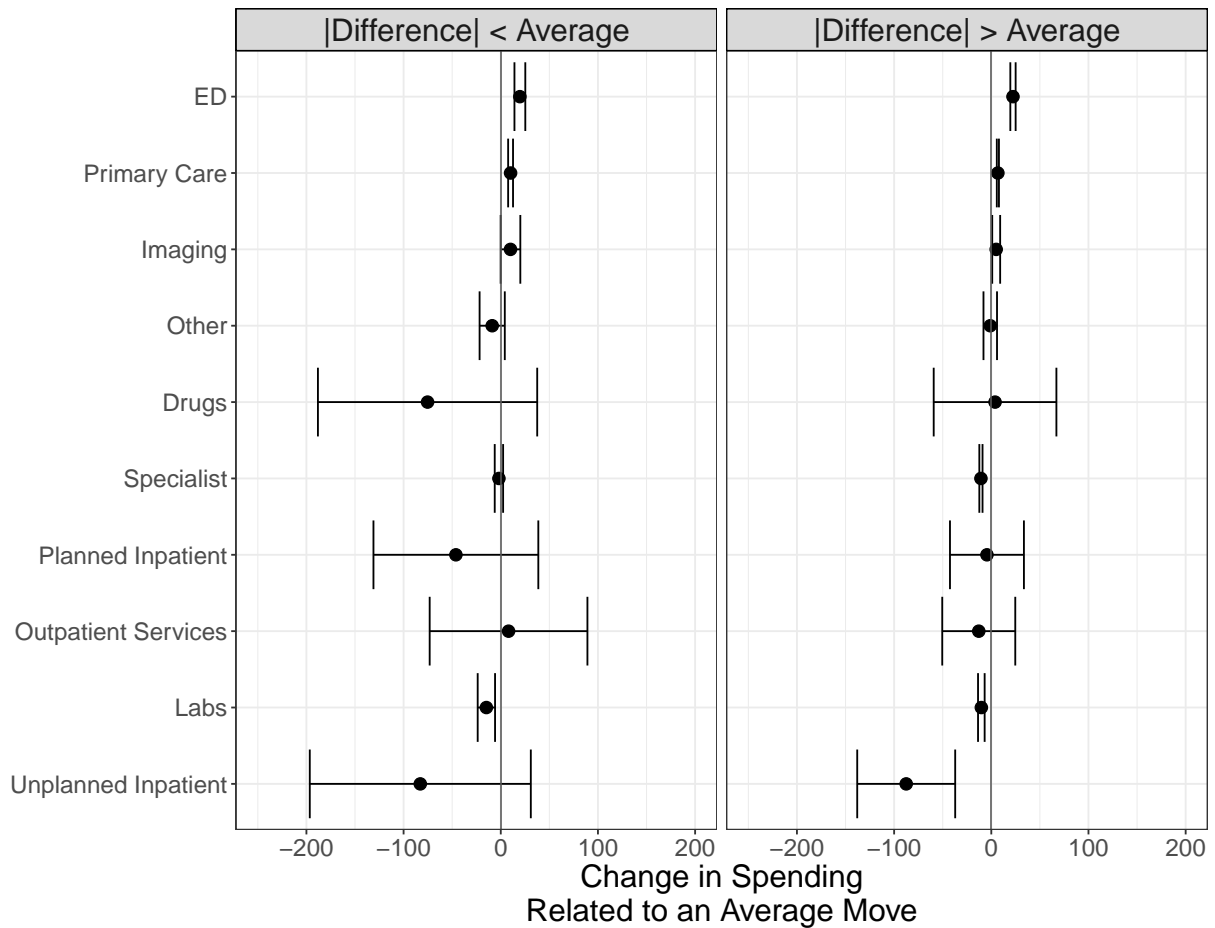
*Notes:* The figure shows average pre-move annual spending and estimates of the change in spending following a move that is related to each mover's destination-origin difference in ER, by type of service. For each service category, the left bar plot shows the average spending among movers, pre-move. The right panel shows for each service category, the average change in individual spending related to a 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 3: Change in Movers' Spending and Utilization Related to Positive Versus Negative Destination-Origin Differences in ED Visit Rates



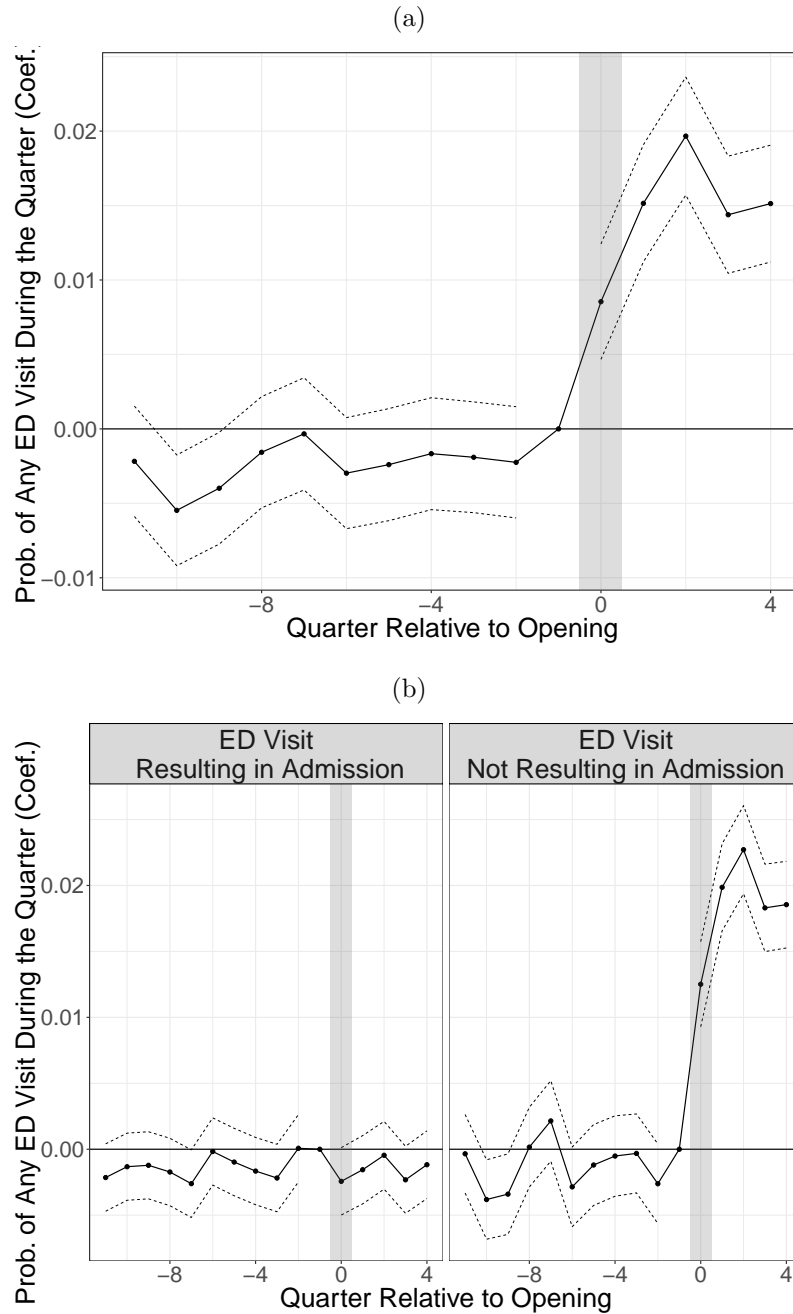
*Notes:* The figure shows an analysis of heterogeneity of estimates of the model in Equation (1) for the relationship between destination-origin difference in ED use and mover spending. The figure shows moves that involve a negative (right panel,  $N = 620,613$  patient-years) and positive (left panel,  $N = 653,832$  patient-years) destination-origin difference in average ED use. Each panel shows for each service category, the average change in individual spending related to a 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 4: 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 a 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.

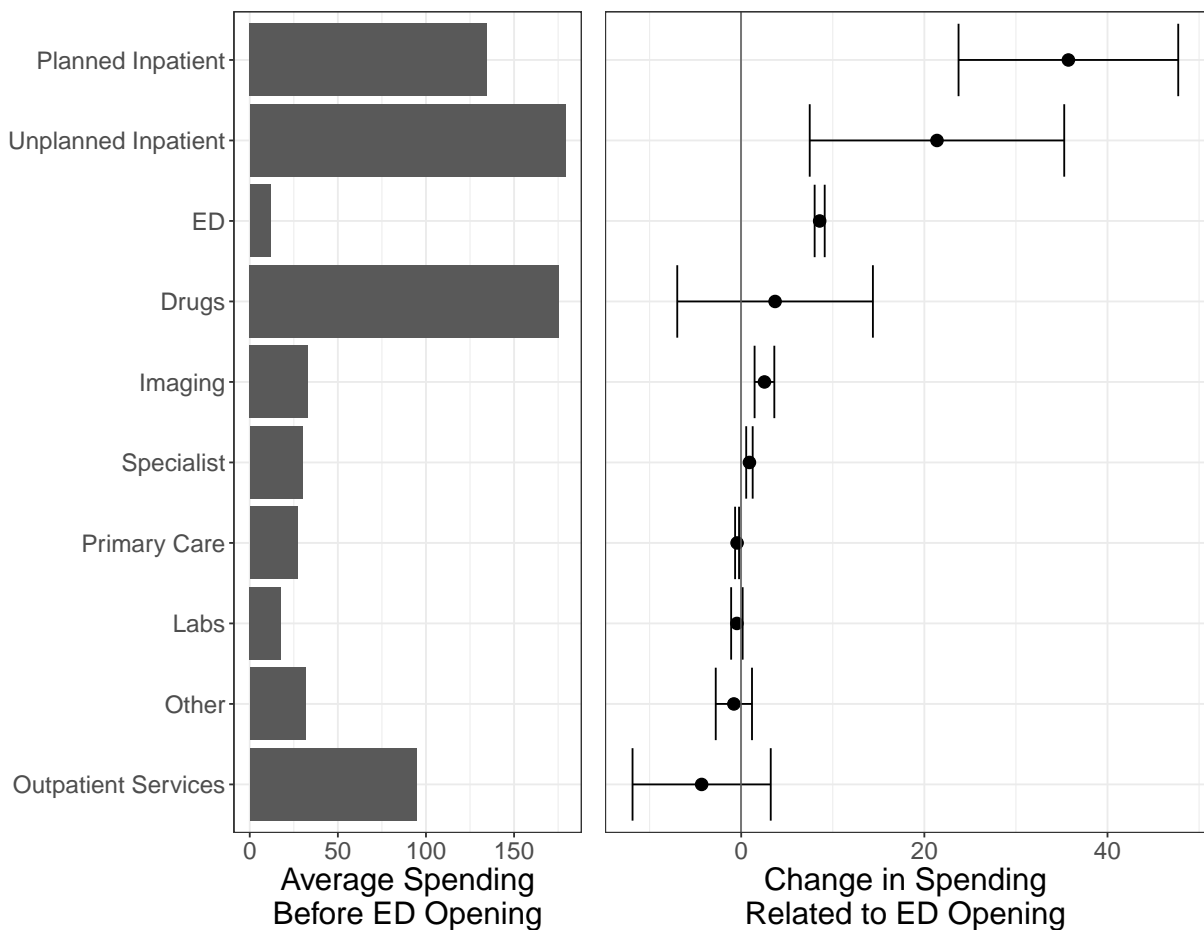
Appendix Figure 5: The Impact of Hospital Opening on ED Use



*Notes:* The figure shows estimates of Equation (2) 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).

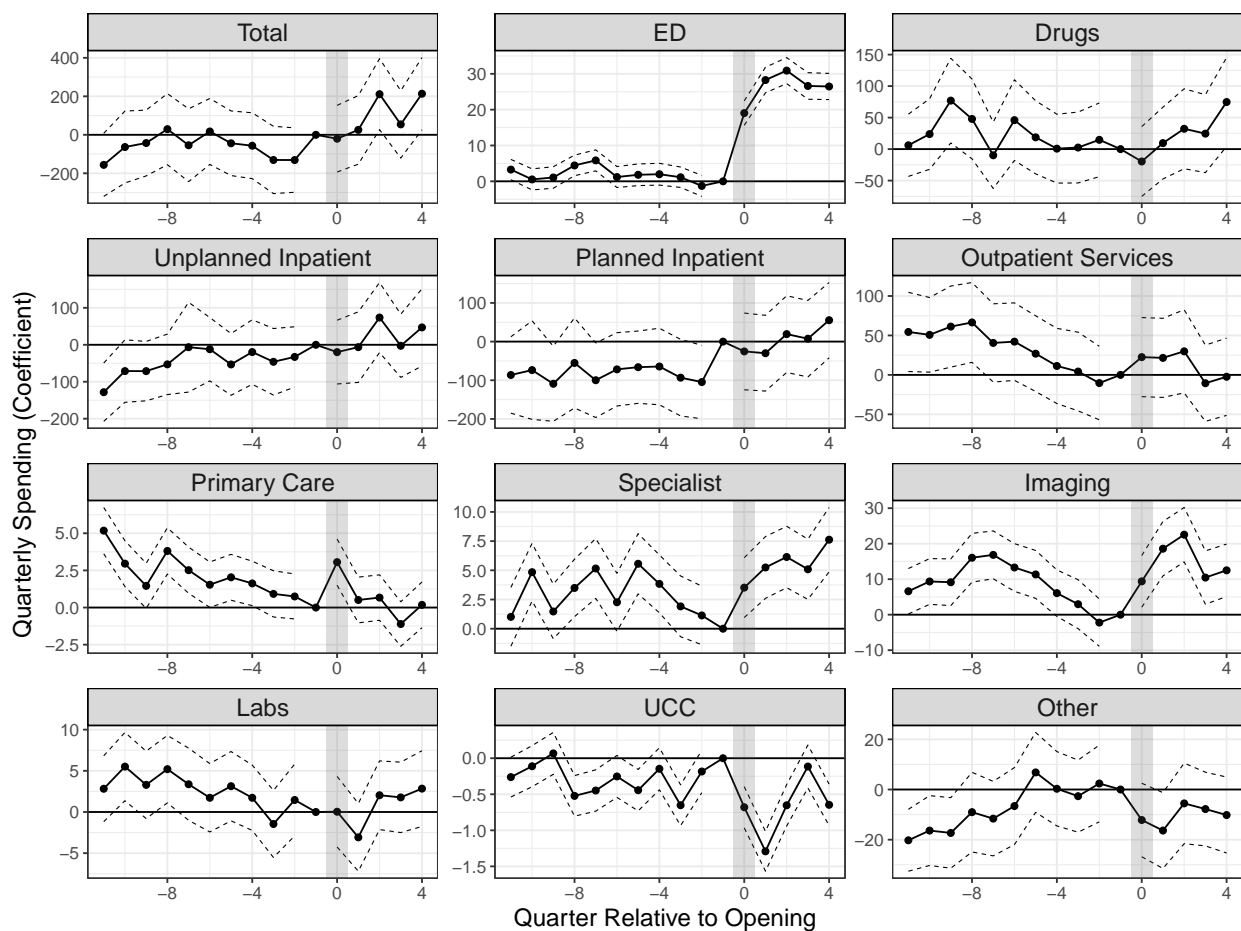


Appendix Figure 6: Difference-in-Differences Estimates of the Overall Change in Spending Related to Hospital Opening



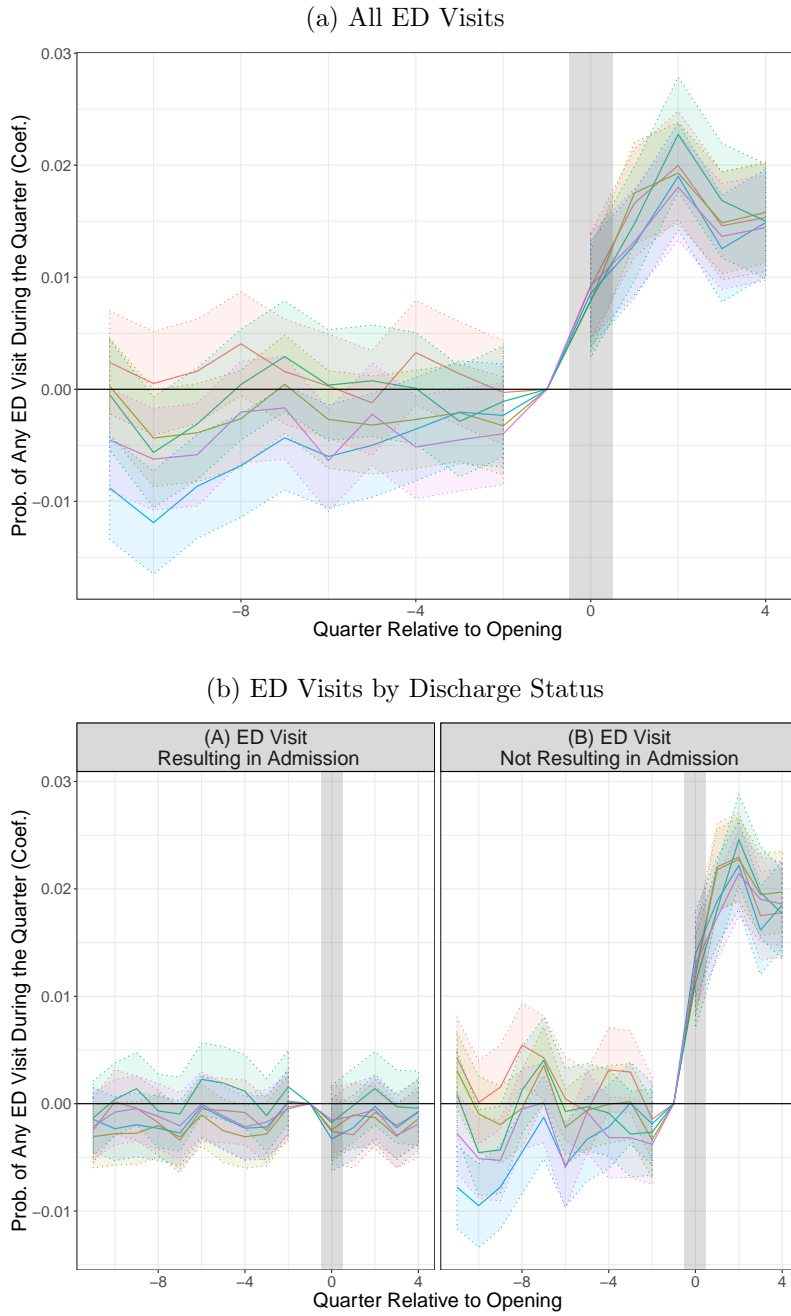
*Notes:* The figure shows average pre-treatment annual spending and estimates of Equation (2) for the change in spending associated with hospital entry, by type of service. For each service category, the left panel shows the pre-treatment average monthly spending in Ashdod—the treated city. The right panel shows estimates of Equation (2) 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=17,870,139 patient-months).

Appendix Figure 7: Change in Spending Related to ED Opening



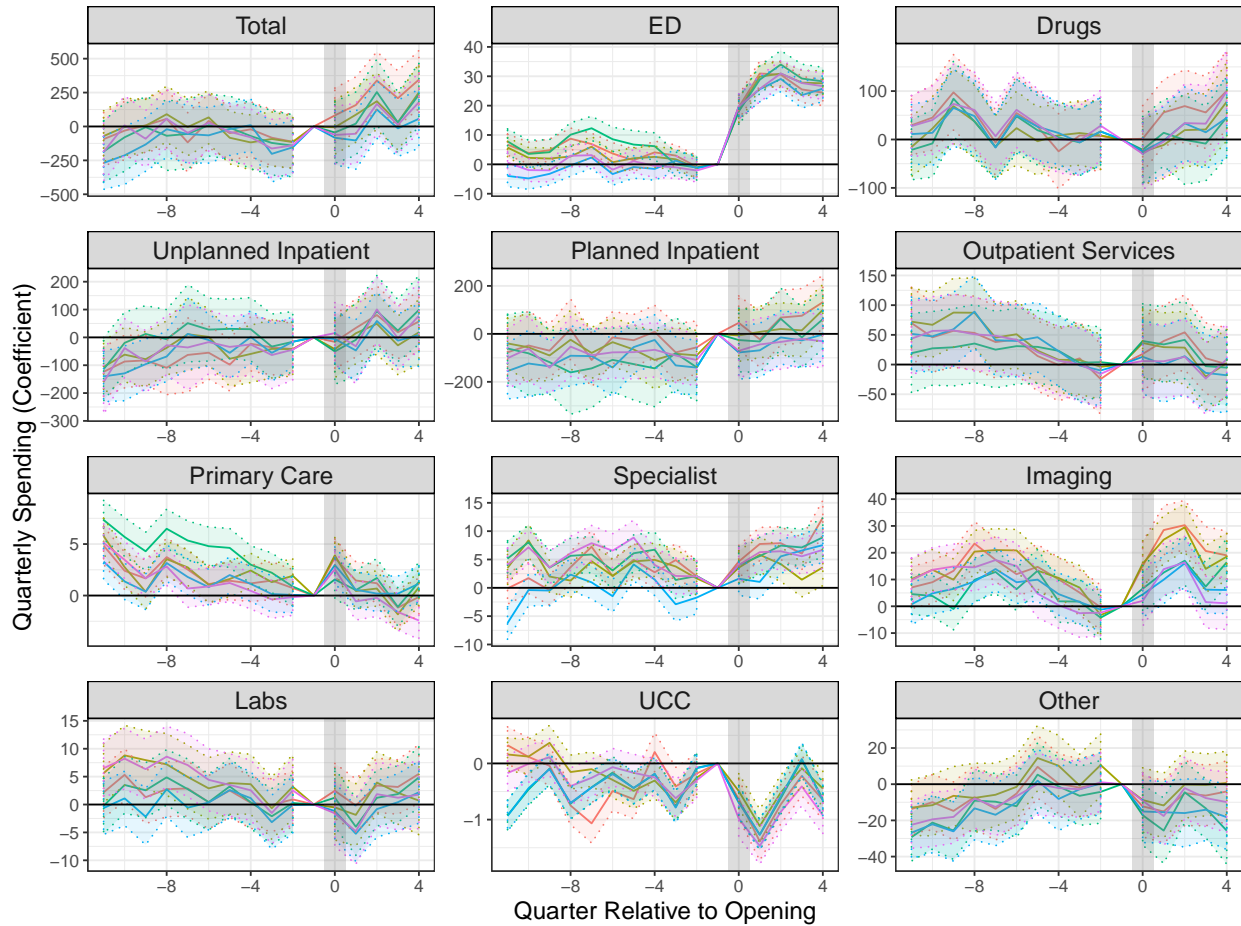
*Notes:* Table shows estimates of Equation (2) for the impact of hospital opening on average individual spending by nearby (“treated”) residents on different types of healthcare services relative to spending by untreated residents residing in cities that did not have a hospital entry during the study 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 8: Impact of Hospital Entry on ED Use, Estimated Separately Relative to Each Comparison City



*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 9: The Impact of Hospital Entry on Spending, Estimated Relative to Each Comparison City Separately



*Notes:* Table shows estimates of Equation (2) 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 1: District-Level ED Utilization and Spending

	District									All
	1	2	3	4	5	6	7	8	9	
<b>A. Annual Emergency Department Use</b>										
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>B. Annual Spending, By Category (mean, NIS)</b>										
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
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.

Appendix Table 2: Distribution of Year of Move

Calendar 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 3: 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.