For-Profit Entry and Market Expansion in the Hospice Industry

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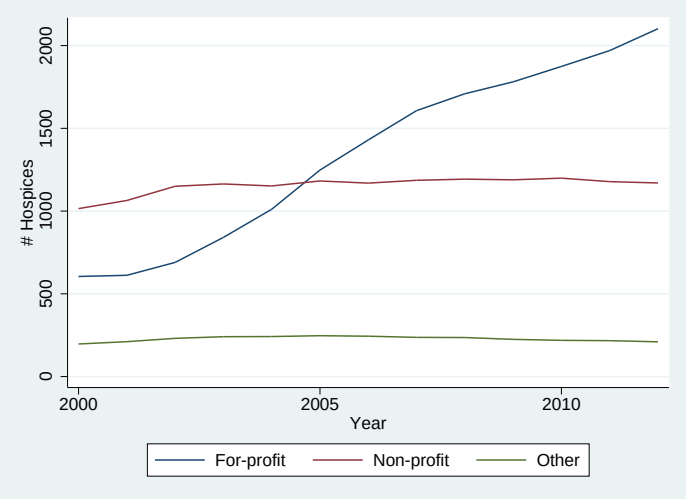
Abstract

Between 2000 and 2012, the number of hospices operating in the United States nearly doubled. We estimate the extent to which this entry wave resulted in market expansion, meaning an increase in overall hospice utilization, rather than simply stealing patients from incumbent hospices. Using data on annual hospice enrollments from Medicare cost reports, we estimate a nested logit model of patient demand for hospices. Our results indicate a high degree of substitutability between hospices, implying that entry primarily results in business-stealing rather than market expansion. We also find that the market expansion effects of entry are larger in states with Certificate of Need laws, and larger for dementia patients than for cancer patients.

1 Introduction

Between the years of 2000-2012, the number of hospices operating in the United States nearly doubled, from 1,817 to 3,482. As shown in Figure 1, this growth was primarily due to entry of for-profit (FP) hospices, whose numbers more than tripled (from 605 to 2,102). The number of not-for-profit (NP) hospices remained relatively stable. Combined, the 3,482 hospices operating in 2012 served over 1 million patients, and were paid approximately $15 billion by Medicare.

Figure 1: Number of hospices in the U.S., 2000-2012



In this paper we analyze the extent to which this wave of entry was market-expanding—that is, to what extent did the entry of new hospices lead to an increase in overall hospice utilization, as opposed to merely reallocating patients and profits from incumbent hospices to entering hospices? While hospice utilization clearly increased over the same period (from 22.9% of Medicare deaths in 2000 to 46.7% in 2012),[1] it is not *a priori* clear whether this increase was the result of entry. Growth in utilization could have been driven by an increase in demand, for example, which in principle could have been accommodated by incumbents.

Understanding the rise in hospice utilization—and the role of for-profit entry in particular—is important because the Medicare program spends nearly $200 billion per year on end-of-life care, with roughly 28% of Medicare expenditures in a given year being spent on the 6% of beneficiaries who

[1] See Medicare Payment Advisory Commission (MedPAC) (2014)

die in that year.[2] The fact that medical costs are concentrated at the end of life is unsurprising, since dying patients are naturally sicker and costlier to treat. But concerns about the overuse of expensive (and minimally effective) procedures have made end-of-life care a priority in policymakers' efforts to curb the rising cost of health care. Since hospice patients choose to forego expensive curative treatments,[3] increased utilization of hospice could in principle lead to substantial reductions in Medicare spending. Studies of the cost savings from hospice, which we review in more detail below, have estimated savings in the thousands of dollars per patient—so the $15 billion that Medicare spent on hospice in 2012 could have been a bargain relative to the alternative.

To empirically measure the market expansion effects of hospice entry, we adopt the methodology used by Berry and Waldfogel (1999) to analyze analogous questions in the broadcast radio industry. We estimate a nested logit model of hospice choice, in which a single parameter summarizes the substitutability of different hospices in the same market. At one extreme, hospices in the same market could be perfect substitutes for one another, in which case entry would have no effect on overall hospice utilization. If, on the other hand, hospices are differentiated—e.g. due to geographic location or types of services offered—then newly entering hospices will attract new patients, increasing overall hospice utilization. Our results indicate that the market expansion effects of the entry wave between 2000-2012 were modest. In a typical market with one hospice, we estimate that the entry of a second hospice increased utilization (i.e., the fraction of patients who choose hospice) by less than 3 percentage points. Put differently, we estimate that of every 100 patients served by the entering hospice, fewer than 25 of them would be new patients who would not otherwise have elected hospice.

Our data come from Medicare cost reports, which include hospices' reports of the total number of patients they cared for each year. We calculate a hospice's market share by dividing its reported number of patients by the total number of non-injury related deaths in the market, as reported by the Centers of Disease Control (CDC).[4] This measure is imperfect, for two reasons. One is that not all hospice patients die while in hospice. Some are discharged because their health improves, and some leave hospice because they choose to pursue treatments not covered under the hospice benefit. Since the Medicare cost reports count hospice patients rather than hospice deaths, we also analyze more detailed data from the California Office of Statewide Health Planning and Development

[2] See Calfo et al. (2008).

[3] Readers unfamiliar with hospice will get a more thorough introduction in Section 2. In a nutshell, hospices provide palliative care—such as pain management and emotional counseling—in lieu of aggressive medical intervention.

[4] We use the CDC's Health Service Areas (HSA) as our definition of hospice markets; we discuss our reasons for this market definition in Section 2.2.

(OSHPD), which provides more specific information about hospice deaths, to both estimate the rate of live discharges at a typical hospice and to cross-check our results from the nationwide sample. We also use the OSHPD data to explore the ways in which entering for-profit hospices differ from existing hospices, and in particular whether they tend to enroll different types of patients.

2 Background and Data

2.1 Industry background

The idea of hospice care originated in Europe in the 1800s, but was not imported to the U.S. until the 1960s. The first U.S. hospice opened in Connecticut in 1973, and it was not until the late 1970s and early 1980s that the U.S. Department of Health, Education, and Welfare began to seriously evaluate hospice as an alternative form of medical care for the dying. Medicare began coverage of hospice services in 1983, and since then there has been an increasing acceptance of hospice as a viable mode of care for the terminally ill.

In order to be eligible for Medicare's hospice benefit, the patient's physician and the hospice medical director must certify that the patient has a terminal disease with a life expectancy of 6 months or less (Medicare Payment Advisory Commission (MedPAC) (2014)). After 90 days, the patient needs to be re-certified. After a second 90-day period, patients can be re-certified for additional 60-day periods as long as they remain eligible for hospice care—i.e., as long as the doctors' prognosis is still a life expectancy of less than 6 months. Patients usually enroll in hospices through referrals from physicians and long-term care facilities.

Hospice services are typically provided in the home. A family member usually serves as the primary caregiver, while hospice staff members—including physicians, nurses, home health aides, social workers, clergy and other volunteers—make regular visits to the patient and provide other support services for the family. Typical hospice services include pain management, emotional/psychosocial counseling, drugs and medical equipment, and bereavement care for family and friends.

Medicare reimbursement for hospice services is on a per diem basis, with four tiers of reimbursement rates corresponding to different intensities of care. The payment rates were set based on data from a Medicare demonstration project done in the early 1980s, and are adjusted annually

to reflect inflation.[5] The most common level of care is Routine Home Care, for which the 2014 reimbursement rate was $156.06 per day. During brief periods of crisis (e.g., to manage acute medical symptoms), the reimbursement level can be escalated to Continuous Home Care ($910.78 per day). When patients need pain control or other symptom management that cannot be managed at the patient's home, they can be hospitalized on a short-term basis in a hospice inpatient facility, or a hospital with which the hospice has contracted, and the hospice is reimbursed for General Inpatient Care ($694.19 per day). Finally, when inpatient care is needed on a short-term basis in order to relieve the beneficiary's primary caregiver, the hospice can be reimbursed for Inpatient Respite Care ($161.42 per day). In addition to the annual inflation updates, these reimbursement rates are also adjusted locally using area wage indexes to reflect differential labor costs in different markets. The per-diem rates include payment for drugs used for pain control and symptom management.[6]

The costs of providing hospice care are generally believed to be U-shaped over time: there are high setup costs in the first week of a patient's hospice care, and high costs in the last days before death, mainly due to an increased frequency of nurse and physician visits. The costs in between are typically lower, since maintenance care is less resource-intensive.

Studies on the hospice industry have argued that hospice can lead to substantial cost savings for the Medicare program. Taylor et al. (2007) found that hospice patients had Medicare expenditures that were on average $2,309 lower than non-hospice patients. Similarly, Kelley et al. (2013) report lower expenditures for hospice patients vs. non-hospice patients—between $2,500 and $6,500 per patient—as well as fewer hospital admissions.

While historically hospice care was provided primarily in the home, over the past decade there has been an increase in the use of hospice services in assisted living facilities. The OIG reports a 119% increase in Medicare hospice spending for care provided in these types of assisted living facilities (Office of Inspector General (OIG) (2015)). For Medicare patients on hospice while in a nursing home, the nursing home typically provides care that is not related to the terminal diagnosis, as well as room and board. The hospice takes care of issues directly related to the patient's terminal illness. Medicare reimburses hospices for whatever care is provided under the hospice benefit, and the patient and/or insurer (Medicare or other insurer) pays the nursing home for the relevant costs associated with room and board and other care. Recent research has looked at whether or not there are cost savings for these nursing home hospice patients. In particular, Gozalo et al. (2015)

[5] Perhaps surprisingly, the payment system has not been reevaluated since the 1980s, in spite of probable changes in hospice costs and patterns of usage.

[6] Drugs prescribed for conditions unrelated to the patient's terminal illness must be reimbursed separately.

found that hospice patients in nursing homes actually had higher Medicare expenditures. They find that the expansion of hospice enrollment of nursing home patients between 2004 and 2009 was associated with a mean net increase in Medicare expenditures of $6,761, as greater spending on hospice care more than offset the reductions in spending on hospital and other care.

2.2 Data

Our primary data come from annual Medicare Cost Reports, which are filed by all organizations that run a hospice and contract with Medicare.[7] The reports include information on hospice characteristics such as ownership type, location, and the date on which the hospice first began operations. The reports also provide cost information and utilization statistics, such as total volume of patients and total patient-days. The data span the years 2000-2012 and include hospices that are free-standing (71% of our sample in 2012), associated with a home health agency (13%), or associated with a hospital (16%).[8]

Table 1 reports basic summary statistics for the 1,817 Medicare certified hospices operating in 2000 (top panel) and the 3,482 hospices operating in 2012 (bottom panel). From 2000 to 2012, the composition of hospices changed dramatically. The percentage of hospices that were operating as a for-profit increased from 33.3% to 60.4%. Overall, the average size of hospices increased only slightly over this time period, from an average of 316 patients to 443 patients. However, non-profit hospices increased significantly in size, from an average of 340 patients to 644 patients. The sizes of for-profit hospices largely remained the same: an average of 338 patients in 2000 and 354 patients in 2012. Table 1 also shows that the median number of rivals faced by a hospice tripled between 2000 and 2012.

To assign hospices to separate geographic markets (e.g., for the purpose of counting the number of rivals they face), we use Health Service Areas (HSA) as defined by the Centers for Disease Control and Prevention (CDC). The CDC constructs HSAs from one or more counties that are relatively self-contained with respect to the provision of routine hospital care. In total, there are 805 HSAs in the U.S. The fact that HSAs are combinations of counties is convenient because it allows us to link other county-level demographic information, such as deaths, to the hospice data. Using

[7] We could not determine what fraction of hospices contract with Medicare, but we suspect it is very close to 100%.

[8] Due to difficulties collecting data, our analysis excludes hospices that are operated within a skilled nursing facility. According to the National Hospice and Palliative Care Organization, only about 5% of hospices are based in skilled nursing facilities.

Table 1: Summary statistics by hospice: 2000 vs. 2012

2000 ($N = 1,817$)

			Percentiles		
	mean	sd	0.10	0.50	0.90
FP (0/1)	0.333	0.471	0	0	1
NP (0/1)	0.559	0.497	0	1	1
Total patients	316	531	17	159	709
# rival hospices	5.13	7.60	0	3	13

2012 ($N = 3,482$)

			Percentiles		
	mean	sd	0.10	0.50	0.90
FP (0/1)	0.604	0.489	0	1	1
NP (0/1)	0.336	0.472	0	0	1
Total patients	443	878	34	206	1,001
# rival hospices	16.96	26.25	1	8	43

Total patients is the total number of patients treated by the hospice in the year. Number of rival hospices is calculated as the number of other hospices in the same HSA.

counties as the market definition would be problematic, since it is typical for hospices to operate in multiple counties, and our conversations with hospice managers suggested they consider their relevant markets to be broader than single counties.

Death data come from the CDC's National Center for Health Statistics, which reports death counts by place of death (county), cause of death, and age. Since we are interested in the choices of individuals for whom hospice was a viable option, our measure of deaths excludes accidental deaths, homicides, and deaths from other acute injuries. By counting only deaths of individuals who plausibly could have been on hospice, we aim to capture a reasonable measure of the potential market for hospice—i.e., the number of individuals who died and could have chosen hospice. We use this measure of market size to calculate hospice utilization rates and individual hospices' market shares (i.e. the share of potentially hospice-eligible deaths occurring at a specific hospice).

For some analyses, we complement the Medicare Cost Reports with data from California's Office of Statewide Health Planning and Development (OSHPD). These data provide facility-specific data for California hospices only, taken from reports submitted by home health agencies and hospices at the end of each calendar year. The data contain information on visits, services provided, and revenue and cost data for each hospice. The main advantage of using the OSHPD data is that they contain more detailed information than the Medicare Cost Reports about patients and visits. In particular, the OSHPD data report the number of patient discharges that were due to death (as opposed to live discharges), whereas the cost reports only indicate the total number of patients treated. In the OSHPD data, patient discharges are also broken down by diagnosis (e.g. cancer, dementia). We also examine some information reported in the OSHPD data about the number and types of patient visits (e.g. visits by physicians, nurses, social workers, chaplains), since these numbers are potentially indicative of differences in the quality of service provided by different hospices.

In the OSHPD data from California, we calculate that 79.3% of hospice discharges over the sample period are discharges due to death. We use this number in our calculations of hospice utilization in the descriptive tables and figures below, as well as in the empirical analysis of Section 3. That is, instead of simply computing hospice patients divided by deaths, which would overstate utilization, we compute hospice *deaths* as 79.3% of hospice patients and divide by total deaths. This scaled estimate yields utilization rates that are more closely aligned with rates reported by Medicare.

Finally, to control for relevant market characteristics in our analyses, we obtained data on Medicare-

Table 2: Summary statistics by HSA: 2000 vs. 2012

2000

			Percentiles		
	mean	sd	0.10	0.50	0.90
# of hospices	2.41	3.12	0	2	5
# of FP hospices	0.97	1.97	0	0	3
# of NP hospices	1.62	1.84	0	1	3
# hospices per 100,000	7.57	6.7.83	0	5.73	17.09
Medicare-eligible pop. (000)	53.55	101.04	6.09	24.66	114.49
Hospice usage rate	0.192	0.146	0.053	0.173	0.341

2012

			Percentiles		
	mean	sd	0.10	0.50	0.90
# of hospices	4.64	8.00	0	2	10
# of FP hospices	3.14	7.27	0	1	8
# of NP hospices	1.73	1.92	0	1	4
# hospices per 100,000	9.23	7.96	0	7.50	19.75
Medicare-eligible pop. (000)	72.14	131.92	7.31	33.84	156.42
Hospice usage rate	0.452	0.286	0.140	0.415	0.793

Statistics calculated across HSAs with 4,000 or more Medicare eligibles in 2012 ($N = 746$). Hospice usage rate is calculated as (0.793$\times$patients)/(total deaths). (See text for more explanation.)

eligible population from Medicare Enrollment Reports. This dataset is publicly available from CMS.

Table 2 reports summary statistics for HSAs, again comparing 2000 to 2012. The average number of hospices per HSA increased from 2.41 to 4.64, and most of the increase came from for-profit entry. On average the number of FP hospices more than tripled, while the number of NP hospices stayed roughly the same. The average number of Medicare eligibles per HSA increased by almost 20,000 people between 2000 and 2012, and the hospice utilization rate increased from 19.2% to 45.2%.

Some hospices have branches in multiple locations but still file under a single provider number. As such, these hospices appear as a single hospice in our data, while in reality one or more satellite branches may be operating nearby. CMS must approve multiple-location arrangements and has a strict set of guidelines regarding the lines of authority that must be established between branch and parent hospices. These regulations restrict the amount of control that branch locations have. For our purposes, the primary concern is that a hospice that opens a satellite location will likely show an increase in patient volume (as the satellite location's patient volume will be incorporated into the parent's cost report numbers), but in the data we do not see the entry of a new location. Thus, while we are properly counting the number of entrants that are new firms, we are slightly understating the number of "entrants" in terms of new locations.[9]

2.3 Entry patterns

Based on the Medicare cost report data, there were 2,406 new hospices that entered between 2000 and 2012. There were 722 hospices that exited. Of 805 HSAs, 349 (43%) had positive net entry; 388 (48%) had zero net entry; and 68 (8%) had negative net entry. Of the HSAs with zero net entry, most (53%) were rural HSAs that had either no hospices or one hospice in both 2000 and 2012.

Figure 2 displays maps of the number of total hospices by HSA in 2000 and 2012. The maps suggest some regional differences in hospice penetration. Much of the entry appears to have been concentrated in the South. Comparing the 2000 and 2012 maps carefully, one can see that entry tended to occur in HSAs that already had hospices. Of the 171 HSAs that had no hospices in 2000, 75 (44%) had one or more hospices by 2012. By contrast, positive net entry occurred in 354 of the 637 markets (56%) that had one or more hospices in 2000.

Some of the geographic differences in hospice penetration are due to certificate of need (CON) laws, which regulate the supply of hospices. Seventeen states[10] that regulate hospice facilities and services by CON. Florida is special because in addition to having CON regulations, it also forbids

[9] While the Medicare Cost Reports do not distinguish between these parent and branch hospices, the OSHPD data have more information on these branch locations. We hand-matched hospices from the OSHPD to the cost reports (based on name and address) to measure the prevalence of branch-parent arrangements. Based on this matching, we estimate that approximately 10% of the hospices present in the OHSPD are branches.

[10] As of 2015, CON states included: Alaska, Arkansas, Arizona, Connecticut, Florida, Illinois, Kentucky, Maryland, Mississippi, Nevada, New York, North Carolina, Ohio, Tennessee, Vermont, Washington, and West Virginia. Washington DC also had CON regulations in place.

Figure 2: Hospice penetration, 2000 vs. 2012

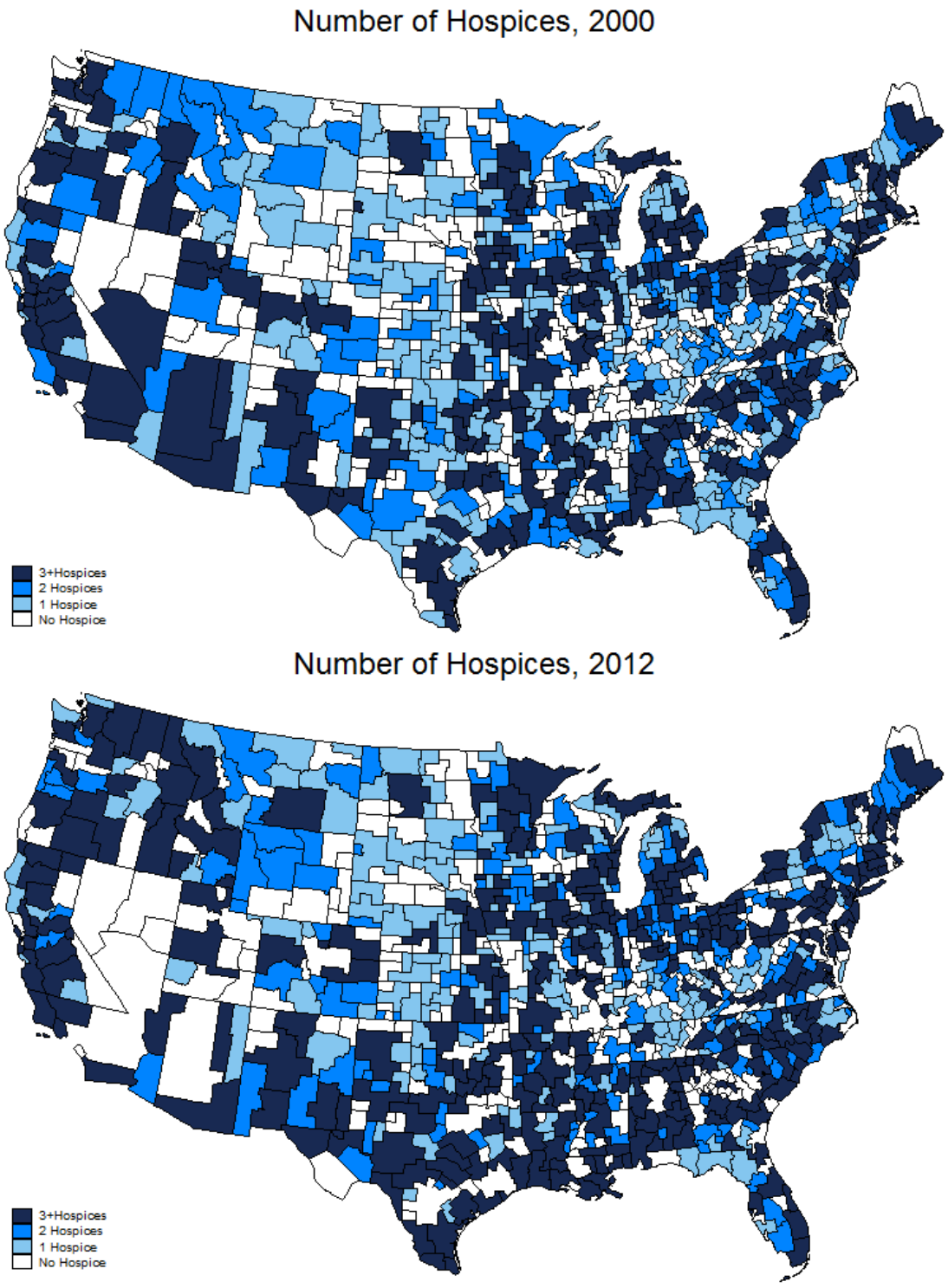
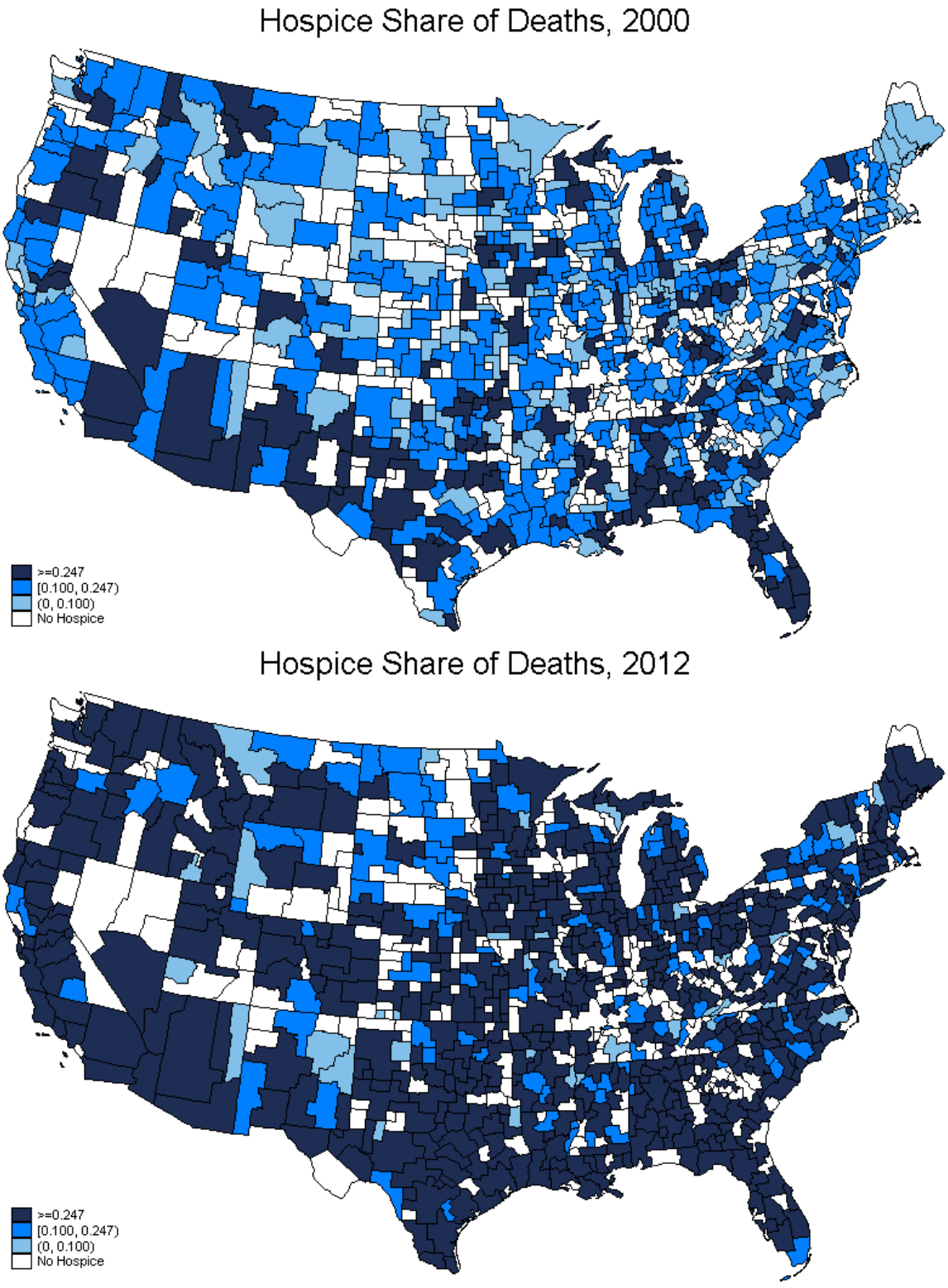


Figure 3: Hospice utilization rates, 2000 vs. 2012



for-profit entry: new hospices are required to operate as not-for-profit organizations.

The maps in Figure 3 show geographic differences in how hospice *utilization* changed between 2000 and 2012. For the figure we measure hospice utilization as 0.793 times the number of hospice patients in the HSA, divided by the number of reported deaths in the HSA.[11] The increases in utilization appear to have been roughly uniform across the country.

Table 3 reports changes in hospice utilization depending on how the number of hospices in the market changed. For example, there were 41 markets that went from 0 hospices to 1 hospice between 2000 to 2012, and on average these markets saw a 23.8 percentage point increase in hospice utilization. By definition, the increase in utilization in these markets must be due to market expansion effects. Note that markets with no change in the number of hospices still had increases in hospice utilization. For example, one-hospice markets that had no entry between 2000 and 2012 had on average a 14.4 percentage point increase in utilization (from a base utilization rate of 16.3%); one-hospice markets that gained a second hospice had an average increase in utilization of 21.7 percentage points.

While Table 3 shows some basic evidence of market expansion effects—markets with more entry had larger increases in hospice utilization—we can also look for basic evidence of business stealing by examining how incumbent hospices were affected by entry. Table 4 reports the average change in incumbents' market shares in years with and without entry, with incumbents defined as hospices that were already operating in 2000. In market-years with entry, the incumbent hospices' shares increased by 0.001 on average, compared to an increase of 0.006 in market-years without entry. In other words, while all of these hospices experienced a growth in their market shares over the sample period (as more patients opted for hospice in general), this growth was significantly slowed in markets/years with entry. The second panel of the table reports similar numbers at the market level—i.e., aggregating all incumbents' shares. Incumbents' combined market shares increased by 0.003 in market-years with entry, and by 0.014 in market-years without entry.

The last panel of Table 4 describes changes in incumbents' shares in California separately for cancer and dementia patients, showing that entry's impact on incumbents was more pronounced for cancer patients than for dementia patients. We explore this comparison in more depth in Section 3.3 below.

[11] As discussed above, not all hospice patients are discharged due to death. From the OSHPD data, we estimate that hospice deaths are 79.3% percent of hospice patients.

Table 3: Changes in hospice utilization by change in number of hospices

	# of Hospices, 2012				
# Hospices, 2000	0	1	2	3	4
0	0	0.238	0.302	0.381	0.337
	(93)	(41)	(22)	(6)	(3)
	0	*0*	*0*	*0*	*0*
1	-0.074	0.144	0.217	0.300	0.291
	(21)	(110)	(64)	(25)	(10)
	0.179	*0.163*	*0.154*	*0.170*	*0.152*
2	-0.230	-0.041	0.166	0.283	0.249
	(2)	(22)	(56)	(28)	(15)
	0.230	*0.173*	*0.179*	*0.198*	*0.220*
3	-	0.027	0.189	0.172	0.233
	(0)	(4)	(10)	(26)	(14)
	-	*0.277*	*0.198*	*0.265*	*0.186*
4	-	-	0.308	0.147	0.249
	(0)	(0)	(1)	(7)	(7)
	-	-	*0.266*	*0.195*	*0.236*

Each cell reports the average change in the hospice utilization rate, the number of markets represented in parentheses, and the baseline utilization rate in 2000 in italics.

Table 4: Changes in incumbents' shares in years with and without market entry

Hospice Level	Incumbent Δ Shares
Years with Market Entry	0.001
Years without Market Entry	0.006
Years with Market Entry, Cancer (CA only)	-0.001
Years without Market Entry, Cancer (CA only)	0.002
Years with Market Entry, Dementia (CA only)	-0.0002
Years without Market Entry, Dementia (CA only)	0.004
Market Level	
Years with Market Entry	0.003
Years without Market Entry	0.014
Years with Market Entry, Cancer (CA only)	-0.013
Years without Market Entry, Cancer (CA only)	0.002
Years with Market Entry, Dementia (CA only)	0.006
Years without Market Entry, Dementia (CA only)	0.010

Table 5: Poisson Regression: Predictors of Total Entrants

	Total Hospice Entrants (2000-2012)	
Hospices per 100,000 eligibles in 2000	-0.370***	-0.504***
	(0.0374)	(0.0468)
Hospice utilization in 2000	1.757***	2.187***
	(0.0898)	(0.121)
Medicare-eligible pop. (000)	0.00302***	0.00384***
	(5.91e-05)	(0.000110)
State FE	N	Y
Observations	805	805

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5 shows some descriptive evidence of the predictors of hospice entry in our data. We report results from Poisson regressions using the total number of entrants in an HSA over the time span of 2000 to 2012 as the dependent variable. The explanatory variables are the total number of hospices per 100,000 Medicare eligibles in 2000, the hospice utilization rate in 2000, and the Medicare-eligible population. We report results with and without state fixed-effects. The results indicate that entry was most likely in areas with few existing hospices per capita, higher hospice utilization rates (as measured in 2000), and larger Medicare-eligible populations. The predictive relevance of the Medicare-eligible population is important, since we use it as an instrument in our main empirical analysis below.

3 Empirical Analysis

3.1 Empirical model

To measure the extent to which entering hospices expand the market—i.e., increase overall hospice utilization—we adopt an approach similar to Berry and Waldfogel (1999). We model an individual's choice of hospice in a nested logit framework, where one nest consists of all hospices operating in the individual's HSA, and the other nest consists of the outside good (i.e., traditional

medical care). Individual i's utility from choosing hospice j in year t is

$$u_{ijt} = \delta_{jt} + \nu_{it}(\sigma) + (1-\sigma)\varepsilon_{ijt} \ ,$$

where δ_{jt} represents the mean utility of hospice j in year t (common across individuals), ε_{ijt} is a type-1 extreme value error, and ν_{it} is an individual-specific error term whose distribution depends on σ. The parameter σ summarizes the substitutability of hospices within the "inside" nest. If $\sigma = 1$, then hospices are perfect substitutes for one another, and entry of an additional hospice results only in business stealing. If $\sigma = 0$, then the model is equivalent to an ordinary logit model, in which hospices are imperfect substitutes and entry results in market expansion.

We also follow the convention of decomposing mean utility into an observable and unobservable component, letting $\delta_{jt} \equiv x'_{jt}\beta + \xi_{jt}$. Observable characteristics of hospice j in year t are represented in the vector x_{jt}, and ξ_{jt} is an unobserved utility shock or quality shock.

As explained in Berry (1994), the nested logit setup permits a convenient estimation approach. Hospice j's market share in year t is

$$s_{jt} = \frac{exp(\frac{\delta_{jt}}{1-\sigma})}{D} \frac{D^{1-\sigma}}{1+D^{1-\sigma}}$$

where $D \equiv \sum_j exp(\frac{\delta}{1-\sigma})$. We can estimate the β and σ parameters by running a linear regression of the form:

$$ln(s_{jt}) - ln(s_{0t}) = x'_{jt}\beta + \sigma ln(s^{in}_{jt}) + \xi_{jt} \ \ , \tag{1}$$

where s^{in}_{jt} is hospice j's "inside share" in year t—i.e., its share of patients who chose hospice.

Unlike Berry and Waldfogel (1999), who estimate this model using a single cross-section of markets, we have a relatively long panel. An important advantage of the panel data is the ability to directly observe entry in many markets, along with the responses of incumbent hospices' market shares. Intuitively, the estimate of σ from the regression in (1) will be near 1 if entrants' patients are mostly stolen from incumbent hospices, since in that case the reductions in hospices' inside shares will also imply reductions in their overall shares. If, on the other hand, entrants' patients consist entirely of people who would not have otherwise chosen hospice, then incumbent hospices' inside shares will fall without any change in their overall shares, leading to an estimate of σ near

0.

The appropriate method for estimating the regression in (1) depends on how ξ_{jt} evolves over time. Unobserved hospice characteristics almost surely exhibit persistence, and we consider alternative ways of incorporating this. One possibility is that unobserved hospice utility follows a random walk: $\xi_{jt} = \xi_{jt-1} + \eta_{jt}$, where η_{jt} is a random shock. An alternative assumption is that the unobserved hospice characteristic is primarily time invariant: $\xi_{jt} = \xi_j + \eta_{jt}$. Estimating the regression in first differences should deliver consistent estimates in either case; estimating a fixed-effects model is appropriate in the latter case. We report results from both methods, and we adjust the standard errors in both models to account for serial correlation in the η_{jt} shocks.[12]

Another econometric issue is the endogeneity of the hospice "inside share," s_{jt}^{in}. Because Berry's inversion yields a linear regression, standard instrumental variables methods such as two-stage least squares can be used; the question is what to use as instruments. An ideal instrument is one that affects hospice j's inside share but is orthogonal to its unobserved quality, ξ_{jt}. Typical instruments are ones that describe j's rivals. In our data, the most obvious shifter of a single hospice's demand is entry by rival hospices. However, using direct measures of entry (such as changes in the number of rivals faced by hospice j between years $t-1$ and t) may be inappropriate, since unobserved market characteristics that attract entry may also be related to demand for hospice j. A better alternative is to use instruments that are predictors of entry but plausibly exogenous with respect to a single hospice's demand. With this in mind, we use the size of the Medicare eligible population as our instrument. Based on our results in Table 5, an HSA's Medicare-eligible population is a strong predictor of entry: there were significantly more entrants in areas with more Medicare-eligibles. Furthermore, we expect a market's Medicare-eligible population to be orthogonal to any unobserved quality or demand shocks specific to a hospice j.

While addressing the endogeneity of s_{jt}^{in} is in principle important, as a practical matter we expect the endogeneity bias to be small. We expect unobserved differences in hospice quality to be primarily time-invariant, so first-differencing the ξ_{jt}'s or estimating fixed effects (ξ_j's) will eliminate most of the unobserved heterogeneity that would otherwise induce bias.

[12] We tested for serial correlation using the procedure outlined in Wooldridge (2002), where the residuals from the first differenced model are regressed on the one-period lagged residuals, and found clear evidence of serial correlation.

3.2 Results

Table 6 reports our estimates using first differences and fixed effects.[13] Columns 1 and 3 of the table report OLS results for the nationwide sample using first differences and fixed effects, respectively. Columns 2 and 4 report results from instrumental variables regressions in which we instrument for the hospice's "inside share" using the Medicare-eligible population in the market.[14] The estimated coefficients in the fixed effects model are quite similar to those in the first-differences model. To control for the possibility that new hospices might start small and then grow, we include indicators for whether the hospice has been in operation for 1-3 years or 4-6 years (Age_{1-3} and Age_{4-6}, respectively).

The estimated values of σ indicate that entry is market-expanding (the estimates of σ are statistically different from 1), but the magnitude of the implied market expansion effect is small. For example, the estimate of σ=0.89 from the nationwide IV first differences regression in Table 6 implies that if a second hospice enters an HSA that previously had only one hospice, the overall hospice utilization rate in that market would increase by only 2.8 percentage points. Put differently, for every 100 patients served by the entering hospice, roughly 92 of those patients would have been stolen from the incumbent, and 8 would be new patients who otherwise would not have chosen hospice.[15] Entry into more saturated markets was even less expansionary: based on the IV-FD estimates, entry of a fifth hospice into a market that previously had four would increase hospice utilization by only 1.0 percentage point.

One potential concern about these estimates is that the nested logit functional form is too restrictive, in particular because it does not allow for horizontal differentiation between hospices in a market. Berry et al. (2016) noted that this can bias the estimate of σ upward, and in their application (to broadcast radio markets) argued that richer nesting structures should alleviate this bias. In our context, a natural alternative is to divide hospices into for-profit and non-profit nests. Table 7 shows results from this specification. Most of the estimates of σ decrease slightly, which suggests not much of an upward bias in our case. Furthermore, the implied market expansion effects are still small. For example, the IV fixed-effects estimate of σ (0.723) implies that only 22 of every 100

[13] The estimates in Table 6 are based on a sample that excludes the Los Angeles HSA. Los Angeles is an extreme outlier in our data in that it has over 130 hospices in 2012, and including it in the analysis yields implausibly large estimates of the σ parameter. (The next largest number of hospices is around 50, in the Dallas HSA, and dropping this HSA doesn't meaningfully change the estimates.)

[14] The first-stage F-statistic is over 1,000 (p-value$<$0.0001).

[15] These numbers are calculated by computing the changes in predicted market shares for a lone incumbent with the mean δ vs. an incumbent facing a new entrant (also with the mean δ).

Table 6: Nested Logit Regressions: First-difference and Fixed-effects Estimates

	(OLS US, FD)	(IV US, FD)	(OLS US, FE)	(IV US, FE)
σ	0.658***	0.890***	0.648***	0.803***
	(0.00694)	(0.0623)	(0.00718)	(0.0387)
NP	-0.00711	-0.0108**	-0.0213	-0.0404*
	(0.0227)	(0.00510)	(0.0228)	(0.0224)
Age_{1-3}	0.106***	0.0642***	0.0188	-0.0998***
	(0.0161)	(0.0155)	(0.0187)	(0.0166)
Age_{4-6}	0.00593	0.00730	-0.00476	0.000547
	(0.0130)	(0.00819)	(0.0139)	(0.0127)
Constant	0.118***	0.0865***	-0.165***	
	(0.0203)	(0.0114)	(0.0432)	
Year FE	Y	Y	Y	Y
Hospice FE	N	N	Y	Y
Observations	27,683	27,683	28,200	31,908
R-squared	0.391	0.309	0.558	0.621

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 7: Nested Logit Regressions with For-Profit/Non-Profit Nests

	(OLS US, FD)	(IV US, FD)	(OLS US, FE)	(IV US, FE)
σ	0.525***	0.894***	0.508***	0.723***
	(0.0069)	(0.0721)	(0.0070)	(0.0288)
Age_{1-3}	0.146***	0.108***	0.013	-0.201***
	(0.0161)	(0.0154)	(0.0198)	(0.0156)
Age_{4-6}	0.004	0.025***	-0.017	-0.024*
	(0.0137)	(0.0086)	(0.0146)	(0.0130)
Constant	0.062***	0.084***	-0.142***	-2.080***
	(0.0113)	(0.0113)	(0.0442)	(0.0485)
Year FE	Y	Y	Y	Y
Hospice FE	N	N	Y	Y
Observations	27,683	27,683	28,200	32,195
R-squared	0.327	0.166	0.456	0.540

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

patients served by an entering hospice would be patients who otherwise would not have chosen hospice.

The models represented in Tables 6 and 7 assume a common σ parameter across markets, but the effects of entry could possibly be heterogeneous. One reason to expect such heterogeneity is the existence of certificate of need (CON) laws, as mentioned above. If CON laws serve their stated purpose, requiring potential entrants to justify their entry based on an unmet need, then we should expect the market expansion effects of entry to be larger in states with CON laws. Table 8 reports results from our nested logit specification estimated separately for states with vs. without CON regulations. The results are consistent with the hypothesized influence of CON laws. The estimate of σ is significantly smaller in CON states, implying a larger market expansion effect. For example, the IV-FD estimates imply that in markets with CON regulations, entry of a second hospice increases utilization by 8.9 percentage points. Interestingly, the IV-FD estimate of σ for states without CON laws is not statistically different from 1, meaning we cannot rule out the idea that entry resulted in pure business stealing in those states.

Table 8: Nested Logit Regressions: CON vs. Non-CON markets

	(IV-FD CON)	(IV-FD Non-CON)	(IV-FE CON)	(IV-FE Non-CON)
σ	0.515***	0.955***	0.473***	0.859***
	(0.0819)	(0.0642)	(0.0969)	(0.0426)
NP	-0.0212**	-0.00757	-0.0398	-0.0407
	(0.0103)	(0.00594)	(0.0385)	(0.0277)
Age_{1-3}	0.0485***	-0.183***	-0.0669***	
	(0.0231)	(0.0172)	(0.0327)	(0.0194)
Age_{4-6}	0.00609	0.00293	0.00859	0.00764
	(0.0193)	(0.00905)	(0.0290)	(0.0143)
Constant	0.0426**	0.102***		
	(0.0217)	(0.0132)		
Year FE	Y	Y	Y	Y
Hospice FE	N	N	Y	Y
Observations	7,092	20,591	8,130	23,774
R-squared	0.287	0.296	0.450	0.530

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

3.3 Do for-profit entrants pursue different kinds of patients?

The fact that the entry wave of 2000-2012 was mainly driven by for-profit hospices suggests that perhaps these hospices pursue different strategies than incumbent non-profits. One common claim in press reports is that FP hospices target different kinds of patients. Under Medicare's per diem payment system, some types of patients are meaningfully more profitable than others: to a first approximation, the most profitable patients are "long-stay" patients who require minimal care. Cancer patients generally do not fit this description: they have shorter stays on average, and the care they require is relatively intensive. By contrast, dementia patients tend to stay on hospice for longer, under maintenance care that requires fewer resources. According to CMS, for example, in 2009 hospice patients with lung cancer had an average length of hospice stay of 45 days, while Alzheimer's patients had an average length of stay of 106 days.[16]

The OSHPD data, which contain more detailed information about patient and facility characteristics than the Medicare cost reports, allow us to examine differences in hospices' patient mixes for the subset of hospices that are located in California. Table 9 describes some of the differences between incumbents (as of 2002) and FP entrants over the period 2002-2012. Compared with incumbent hospices, a smaller fraction of entrants' patients had a cancer diagnosis (37.6% versus 45.4%), and a larger fraction had a dementia diagnosis (18.1% versus 11.1%). FP entrants had fewer short-stay and more long-stay patients relative to incumbents, and their patients' routine home care days were more likely to be at a skilled nursing facility. For entrants, 27.8% of discharges were for causes other than death, compared to 16.4% for incumbents, suggesting that entrants may have been enrolling healthier patients on average.

The OSHPD data provide total discharges by ICD-9 code. Those ICD-9 codes are grouped into larger categories, such as cancer and dementia and cerebral degeneration. (These categories of cancer and dementia are what we report in Table 9.) The CDC data also allow us to count deaths by cause in each county, where causes of death are indicated by an ICD-10 code. We matched the ICD-9 codes to ICD-10 codes to get comparable estimates of hospice deaths and total deaths in each disease category, and used these to compute the shares of cancer and dementia deaths that occurred on hospice. The disease-specific market shares allow us to apply our nested logit framework to analyze whether the business stealing and market expansion effects differed across disease categories.

[16]These numbers are based on Medicare data; see https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/Hospice/Medicare_Hospice_Data.html.

Table 9: Incumbents vs Entrants in California

	Incumbent (2002)	Entrant
% Discharged patients admitted with cancer	45.4	37.6
% Discharged patients admitted with dementia	11.1	18.1
% Days of RHC at SNF	15.0	17.1
ALOS	45.0	50.4
% Short stays (0-7days)	28.4	26.2
% Long stays (180+days)	7.9	8.6
% Non-death discharge	16.4	27.8
Nursing visits per patient day	0.359	0.470
Physician visits per patient day	0.008	0.027
IP Facility	0.141	0.075

Table 10: Nested Logit Regressions: OSHPD, by Cancer or Dementia Diagnosis

	(IV-FD CA)	(IV-FD, Cancer)	(IV-FD, Dementia)
σ	0.980***	0.956***	0.574***
	(0.0545)	(0.0657)	(0.175)
NP	-0.0152	-0.0285***	-0.0653**
	(0.0105)	(0.0108)	(0.0291)
Age_{1-3}	0.00522	0.0245	0.179*
	(0.0301)	(0.0400)	(0.0935)
Age_{4-6}	-0.0126	-0.0401	0.0337
	(0.0167)	(0.0265)	(0.0672)
Constant	0.0607***	0.00613	0.216***
	(0.0111)	(0.0127)	(0.0420)
Year FE	Y	Y	Y
Observations	1,414	1,393	1,239
R-squared	0.894	0.776	0.432

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 10 reports estimates from regressions that mirror those in section 3.2 using first differences. Column 1 reports results from an instrumental variables regression for the state of California using the OSHPD data, with Medicare-eligible population as the instrument for the hospice's inside share. Column 2 reports the estimates for cancer patients and column 3 reports estimates for dementia patients. California is a non-CON state, so the estimate of σ in column 1 is consistent with the relevant nationwide estimates from Tables 6 and 8. The market expansion effects of entry appear to have been much smaller among cancer patients ($\hat{\sigma}$=0.956) than among dementia patients ($\hat{\sigma}$=0.574). This is consistent with the notion that incumbents were already serving the cancer segment of the market—cancer has historically been the most common diagnosis among Medicare hospice patients—but there was room for growth in treating dementia patients.

4 Conclusion

The entry wave of hospices between 2000-2012 was evidently quite profitable. But our results imply that it was profitable primarily because entrants were able to steal business from incumbent hospices, not because entrants were attracting previously unserved hospice patients.

If, as suggested by our analysis, little of the increase in hospice utilization can be attributed to the increased number of hospices, what were the real drivers of the increased utilization? One possibility is that patients became more informed about hospice as an alternative to conventional treatments. During the time period we study, there were national media campaigns that were aimed at increasing awareness of hospice care. For instance, starting in 2000, the National Hospice Foundation launched a series of public service announcements that were reported to have received more than 75 million viewer impressions[17].

In addition to broader awareness of hospice among patients, there was also an increasing acceptance of hospice by the medical community. From 1996 to 2006, over 2,100 physicians obtained board certification from the American Board of Hospice and Palliative Medicine[18], and in 2006 the American Board of Medical Specialties formally recognized hospice and palliative medicine as an official medical subspecialty. Between 1994 and 2004, 7 new palliative care nursing certifications were also established (Institute of Medicine (IOM) (2015)). Nurses trained in palliative

[17] See http://www.nhpco.org/publications/psa-information

[18] See http://www.nhpco.org/sites/default/files/public/quality/physician-board-certification-fact-sheet.pdf

care might have played a role in advocating for the use of hospice, particularly in nursing homes where nurses often serve as primary caretakers. More generally, the growing number of specialists in hospice and palliative care likely reflected a growing propensity of physicians to refer terminally ill patients to hospice. Another reason for increased utilization of hospice is the trend toward value-based payments in CMS. These payments bundle episodes of care and essentially make providers financially responsible for keeping costs down for their patients. While wide-spread value-based payment initiatives were limited to the end of the time period we study, we expect that these types of incentives may further increase utilization of hospice services for certain types of patients.

Regardless of the causes of the growth in utilization, it is important to note that incumbent hospices were likely capable of accommodating the growth. Our data indicate that patient volumes at NP hospices doubled from 2000 to 2012, and Thompson et al. (2012) report that the number of employees at hospices also increased. If hospices faced diseconomies of scale, then we would expect growth in demand to induce entry of small hospices—but this does not appear to be the case.

Given how much Medicare spends on end-of-life care, a natural question is whether the increased utilization of hospice has reduced Medicare's costs. Previous studies have suggested that hospice care is meaningfully cheaper than the alternative, but there has been little research examining how changes in the patient mix would affect the cost savings[19], and Section 3.3 suggests that the disease-composition of hospice patients has changed considerably. With CMS beginning to act on the mandate to reform the hospice payment system,[20] it seems especially important to understand how patient characteristics and underlying health status affect a person's decision of whether and when to enroll in hospice, and by extension affect the subsequent costs. As the industry expands and more patients choose hospice, it is not obvious that the marginal patients choosing to enroll in hospice are those for whom hospice is a lower-cost alternative.

[19]Gozalo et al. (2015) get closest to answering this question by looking at nursing home hospice patients only.

[20]The Patient Protection and Affordable Care Act of 2010 (ACA) requires the Secretary of Health and Human Services (HHS) to revise Medicare's payment system for hospice care.

References

Berry, S. (1994). Estimating discrete choice models of product differentiation. *RAND Journal of Economics*, 25:242–262.

Berry, S., Eizenberg, A., and Waldfogel, J. (2016). Optimal product variety in radio markets. *RAND Journal of Economics*, 47:463–497.

Berry, S. and Waldfogel, J. (1999). Free entry and social inefficiency in radio broadcasting. *RAND Journal of Economics*, 30:397–420.

Calfo, S., Smith, J., and Zezza, M. (2008). Last year of life study. *Centers for Medicare and Medicaid Services, Office of the Actuary*.

Gozalo, P., Plotzke, M., Mor, V., Miller, S. C., and Teno, J. (2015). Changes in medicare costs with the growth of hospice care in nursing homes. *The New England Journal of Medicine*, 372:1823–1831.

Institute of Medicine (IOM) (2015). *Dying in America: Improving Quality and Honoring Individual Preferences Near the End of Life.* The National Academies Press.

Kelley, A., Deb, P., Qingling, D., Aldridge Carlson, M., and Morrison, R. S. (2013). Hospice enrollment saves money for medicare and improves care quality across a number of different lengths-of-stay. *Health Affairs*, 32:552–561.

Medicare Payment Advisory Commission (MedPAC) (2014). Hospice services. Report to Congress: Medicare Payment Policy.

Office of Inspector General (OIG) (2015). Medicare hospices have financial incentives to provide care in assisted living facilities. Department of Health and Human Services.

Taylor, D., Ostermann, J., Van Houtven, C., Tulsky, J., and Steinhauser, K. (2007). What length of hospice use maximizes reduction in medical expenditures near death in the us medicare program? *Social Science and Medicine*, 65:1466–1478.

Thompson, J., Carlson, M., and Bradley, E. (2012). Us hospice industry experienced considerable turbulence from changes in ownership, growth, and shift to for-profit status. *Health Affairs*, 31:1286–1293.

Wooldridge, J. M. (2002). *Econometric Analysis of Cross Section and Panel Data*. MIT Press.