Hospital Safety, Endogenous Entry and Competition by Ambulatory Surgery Centers

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Abstract

Ambulatory surgery centers (ASCs) are emerging as a preferred setting, in lieu of traditional hospitals, for many types of surgical care. The ASC's ability to attract patients depends on covariates related to patient and facility match, as when the ASC offers the convenience of close distance to the patient residence. This study examines how hospital safety and other facility-choice determinants drive the entry of new ASC facilities.

Hospital safety affects market outcomes in different ways. First, patient referrals to hospitals may be directly affected by perceptions of hospital safety. Second, physicians may move referrals to an ASC in order to avoid practicing at a local hospital with poor safety ratings. Finally, new ASC entry may get attracted due to poor levels of safety in the service area hospitals.

Using a twelve year panel of data from the state of Florida, we model discrete ASC entry episodes, controlling for the expected post-entry volume (profitability), to examine how hospital safety records foster the growth of ambulatory surgeries. The results find that patient safety indicators are informative and have significant effects on allocation of outpatients across available facilities. Moreover, in addition to the patient allocation effects, indicators of low hospital safety are clearly shown to be significant in the probability of ASC entry.

Key words: Ambulatory Surgical Centers, Hospital Quality, Physician groups
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1. Introduction

Dissatisfaction over the problem of improving quality of care in US hospitals continues today. The recent national health care quality report by AHRQ to the Congress finds the problems of adverse events and patient safety in hospitals have not gotten much better in recent years (AHRQ, 2010). The report found that one out of seven inpatient Medicare patients experienced an adverse event during hospitalization, and particular concerns remain about the rate of hospital acquired infections (HAIs) which have also worsened compared to earlier years.

Along with the challenge of maintaining and improving patient safety, over the last few years, hospitals have also faced increased competition from specialty care providers called ambulatory surgery centers (ASCs). These providers operate on a small scale, involve physician ownership and focus on specific procedures that can be performed on a single day basis. Their presence in the market increases patient choices, reduces scheduling difficulties for doctors and provides convenience to patients in the form of greater individual attention and shorter travel distances. Incumbent, acute care hospitals, on the other hand, recognize the effects of ASC competition in siphoning off outpatient surgical cases and reducing revenue. The next two sections provide an overview of these developments and the literature.

The focus of this study is on two distinct, but related empirical aspects of the market for surgical care. First, we empirically examine patient demand for surgical procedures in the framework of a multinomial choice model including hospital outpatient departments, and ASCs. The nature of our problem easily lends itself to a nested logit framework and we estimate demand for specific surgeries that can be done both at hospital outpatient departments and ASCs. We assume patients and their referring physicians first decide between a hospital setting or an ambulatory surgery center and then choose among different acute care hospitals within the hospital nest or among different choices in the ASC nest.

A key question addressed in this study is the direct effect of patient safety measures on patient choice of surgical setting. We measure safety with indexes derived from the set of AHRQ patient safety measures including post-surgical infection and complication rates. If primary physicians base their patient referrals upon knowledge of the relative safety/quality of local hospitals, and if the available measures of these dimensions are informative, they should have explanatory power in how patients get allocated across available options. For this study, surgeries are defined in narrow categories of close substitutes, based on clinical classification software's (CCS) multi-level classification, including operations on the digestive system, on the eyes, on the nervous system and on the musculoskeletal system. We use a twelve year panel data set including a census of surgeries performed in hospitals and ASCs in Florida. The empirical strategy is explained in section 5, and the results are given in the section following it.

Next, we estimate an empirical model of new ASC firm-level entry by locality and year, as a function of its expected profitability and other determinants, including the quality of care available at local hospitals. This sequence of estimation is similar to Chernew (2002) where authors study the entry of hospitals in CABG market based on payer type returns. However much the safety/quality indexes are informative in the previous model about the patient choice of hospital, it is hypothesized that an indirect effect on ASC entry may also occur. With 221 entry episodes in the 1997-2008 panel across Florida, we ask whether the safety of care provided by local hospitals has any explanatory power in the decision to open an ASC. The hypothesis is that high quality surgeons operating in an incumbent hospital can profitably disassociate from quality or safety problems by establishing a separate ASC to achieve better control. We imagine a model of profit maximizing firms who enter the market once the threshold predicted volume of surgeries is reached, but their ability to profitably enter depends further on the safety of existing care in the market.

In the conclusion, we discuss potential implications and further directions of this research. We also lay down a foundation for further research on hospital response to ASC entry and the encroachment by ASC market shares.

2. Developments in competition between hospitals and surgical centers

In the recent past there has been a surge in the number of small stand alone units that provide outpatient health care. These providers exist in a multitude of health care areas and are known as freestanding ambulatory surgery centers (ASCs). Type of ASCs vary between those that provide focused outpatient care for selected services and those that perform multiple services under one roof.[1] Services are limited to planned surgical episodes requiring less than a 24 hour hospital stay. These facilities are different from hospital based outpatient departments as they are not located on hospital premises and are often not affiliated with a general acute care hospital. Most of these facilities are owned by individual physicians or group of physicians but there is also an increasing trend towards consolidation with national investor-owned hospital and outpatient chains

[1] In 1997, half of the ASCs in Florida could be considered specialty facilities exclusively performing surgeries related to specific body organs or systems. By 2008, the proportion of ASCs that were specialty care providers grew up to 60%.

(Lynk and Longley (2002), Casalino et al. (2003), Mechanic et al. (2005)). Nationwide, the number of freestanding ASCs rose from 2,314 in 1996 to 3,400 in 2002 (Mechanic et al. (2005)) while, in Florida itself their numbers increased from 218 in 1997 to 365 in 2008 (Table 1).

Technological developments in the fields of minimal invasive surgery and anesthesia, better architectural designs for operating rooms and supporting facilities, more convenient suburban locations and an entrepreneurial zeal among the physicians combined with their desire for a higher degree of control over procedure scheduling and other facility level operations are some of the reasons for ASC growth (Poole (1999), Mechanic et al. (2005)). It is also argued that these facilities benefit from efficiencies due to a narrow focus on fewer disease groups/surgeries. However, the research evaluating various aspects of their role in health care is limited.

The state of Florida has witnessed its own share of growth in competition from ASCs. We use data supplied by Agency for Health Care Administration (AHCA) in Florida to analyze some of the trends in ASC evolution and in empirical estimation. The agency collects a census of patient visits for both inpatient and outpatient care as well as infrastructural data on health care facilities operating in the state. Those data reveal that the number of ASCs has increased by 67% over the period of 1997 to 2008. Growth in the number of hospital based outpatient departments, in comparison, has been stagnant.

[Table 1 here.]

As shown in figure 2 growth of ASCs is also associated with a gradual change in physician preferences for outpatient surgery at ASCs. This change reflects the fact that less than half of all outpatient surgeries are now done in a hospital setting (Haugh, 2006) as compared to mid 80's when more than 90% outpatient surgeries were performed at a hospital. The sample selected in the figure includes only those surgeons whose work involves outpatient procedures done at hospitals and ASCs, and who at any point during 1997-2008 performed surgeries at both settings. The figure shows the dramatic change in the relative share of ASCs for elective surgeries.[2]

[Figure 2 here.]

ASCs in Florida have also gained substantial market share in several specific procedures. For instance, using single level Clinical Classification of Services (CCS) codes and data from quarter 2

[2]The sample omits other specialists doing major interventions like heart surgeries strictly on inpatient basis. In addition, this share was calculated for only those physicians who on average served at least 300 elective surgery patients every year and at least in one year during 1997-2008 were working both at ASCs and hospitals. There are 2247 such physicians in the state of Florida.

of selected years, Table 2 depicts trends (and ASC share of total Medicare outpatient market, in parenthesis) for some of the outpatient procedures. These are major types of procedures that have witnessed substantial increases in share and are also the ones that affect a large number of patients. Besides the procedures shown in the table, there are some others that have witnessed major growth in shares of around 15 to 25 percentage points over the period of 6 years. For instance, 70-90% of eye care related procedures like Glaucoma, Lasik surgery and therapeutic procedures on eyelids, cornea etc were performed at ASCs in 2006. Similarly, more than 60% of 'Esophageal dilatation'[3] and 'Upper gastrointestinal endoscopy'[4] Medicare cases were also performed at these centers (a 15 percentage point increase from 2001).

[Table 2 here.]

As pointed out earlier, ASCs have quite a few advantages over acute care hospitals in the provision of outpatient services. Advocates for the hospitals, however, argue against the establishment of ASCs, as outpatient services are a profitable area of their operations and thus help them cover their costs for other socially relevant but unprofitable services (Casalino et al., 2003). Not surprisingly, hospitals themselves are getting more involved as participants in the ASC business model, probably due to the efficiency advantages gained from a dedicated outpatient care environment (Smallet (2008),Mechanic et al. (2005)).

Another noteworthy feature of the changes in the outpatient care market is the effect on hospital behavior. Data records as well as independent reports indicate that certain inpatient procedures that earlier were a part of the basket of services primarily provided at acute care hospitals are now increasingly being performed at ASCs (Russo et al. (2007)). ASC entry has not only reduced the cost of services for the patient by reducing length of stay but has also made certain surgeries/procedures much more convenient than previously and may have lead to a shift in patient preferences of surgery setting. Thus, drawing of patients away from inpatient and outpatient departments at hospitals is likely to affect the decision making process, whether led by the physician or the patient, about the setting of the surgery; that is, whether the surgery should be performed at hospital outpatient department or at an ASC, after accounting for all important medical aspects of the surgery.

Table 3, using the Florida data from second quarter, presents some trends over the period of 1997-2006 in the number of surgeries/procedures done at inpatient hospitals, ASCs and hospital

[3]This technique is used to stretch or open the blocked portion of the food tube.

[4]Visual examination of the upper intestinal tract using a fiber optic or video endoscope.

outpatient departments in Florida. The table illustrates the shift of major surgeries from inpatient to outpatient arena. Shown are some important health care procedures traditionally carried out as both inpatient and outpatient. For instance, in the procedure of 'Laminectomy', the total number of patients over time (incidence) has not changed much but inpatient hospitals have lost a fourth of their share by 2006, compared to 1997, while, ASCs and hospitals outpatient both share almost one third of the Florida market in 2006. We also witness visits more than doubling at hospital outpatient for 'Tracheoscopy' over the given period. Most of this growth seems to have come at the expense of hospital inpatient departments given that the total number of visits have not changed much. For the growth areas like 'Insertion of Catheter' and 'Colonoscopy & Biopsy' we find that while the number of overall visits have more than doubled in the first case and almost tripled for the second, the hospital inpatient and outpatient departments have either lost share ('Insertion of Catheter') or gained very little relatively ('Colonoscopy & Biopsy'). ASCs on the other hand, have seen almost quadrupling of total visits and an increase in their share to almost three fourths of the market in both cases.

[Table 3 here.]

Growth of ASCs has wide reaching impact on the health care sector. It has increased patient choice and has provided patients with an element of convenience as the surgery centers are likely to locate close to the patient's residence and due to their small size provide a feeling of individual attention that is difficult for big hospitals to offer. ASCs have a capability to impact not only the patient welfare but also the financial goals of policy makers. Promoting competition and supporting technological developments in the mode of health care delivery are important alternatives that policy makers can pursue to control the costs and increase efficiency of the system. To do so, policy makers must have access to good and actionable information about the nature of competition from ASCs and their effects on hospital market outcomes.

3. Relevant Literature

Empirical literature that addresses the ASC entry impact on patient welfare is scarce but, there is substantial work done in the area of hospital quality as well as entry and competition.

Plotzke and Courtemanche (2010) and Courtemanche and Plotzke (2010) studied the effects of ASC entry on hospital surgical output and the relationship between profitability of a surgery and its likelihood of being carried out in an ASC, respectively. In the first case, the authors used a linear probability model to predict the probability that the setting of a surgery will be an ASC while controlling for profit rate and time fixed effects besides other patient level controls. The paper not only found a higher probability of profitable surgeries, after controlling for surgery type, to be performed at an ASC but also that the patient health and procedure complexity may be even more important drivers of surgery location choice. It is important to note, however, and the authors observe it too, that ASC growth may also have market expansion effects or that lower prices at ASCs may be leading to an increase in quantity demanded. Also, procedures done at ASCs can inherently be profitable given that the risk profile of the patient at an ASC is likely to be lower.

Courtemanche and Plotzke (2010), evaluated the ASC entry effect on hospital output. The authors found a 2-4% decline in a hospitals annual outpatient surgeries but no significant change in inpatient surgeries after ASC entry. Also, they found that the impact on hospital output was stronger due to the first ASC entry than the later entries. Definition of hospital geographic market is a very important element of competition analysis and their paper used two different approaches of fixed radius (11.5 miles) and variable radius market definition. Both of these methods have a problem that they do not account for possible substitutions between providers that can take place if one evaluates the geographic market by patient's perspective. The radius approach especially does not account for patients who are residing at the boundary of the defined market and are thus, likely to cross county or go outside the fixed radius. Another issue with Plotzke's approach is the homogeneous treatment of ASCs i.e. the scope and service attributes are not treated differently in terms of their effect on hospital volumes.

A recent research by Weber (2010) comes close to our study in terms of some empirical techniques and the data set used. However, the author is interested in estimating a demand curve, as a function of travel time, for health care facilities (hospitals and ASCs) providing outpatient care by using Agency for Health Care Administration data for Florida from 2003-2004 (we use the same data set covering the time period of 1997 to 2008). The author uses a multinomial logit choice model with random parameters to estimate patient choice for outpatient surgery and uses an effective method for computing the welfare impact of ASCs on patients. Since there is a high estimation cost of mixed logit specifications in the form of increased convergence times for big data sets, the author restricts estimation to choice models for individual procedures based on CPT codes. This is not a problem when the researcher's interest is in estimating specific demand functions, but for studying competitive effects of entry it is important to define markets broadly enough to cover all procedures that are generally provided under one roof. Therefore, in our paper we define markets by grouping procedures that are either carried out on same body parts or on the same body system. For example, all operations on eye form one self contained market. While Weber (2010) uses fixed effects in her paper, we use actual measures for hospital safety that allows us to study it's exact impact on patient choice as well as ASC entry.

The motivation for modeling patient choice directly emerges from the need to recognize the value that ASCs may provide from the patient point of view. Due to technological changes, many surgeries, including for example, hernia repair, bariatric surgery and removal of gall bladder, that were previously handled with an inpatient hospital stay can now be done in an outpatient setting (Russo et al., 2007). This evolution and the structural benefits like small size of the facility, likely small distances from home, focused nursing staff and less administrative delays accompanied with the same day outpatient surgery aspect, overall provide a convenience factor for the patients that make ASCs very attractive. On the flip side, however, patients need to consider characteristics like lack of emergency departments and potential risk of other complications that an ASC may not be equipped to take care of. For example, surgeries like 'Mastectomy' that were typically performed on inpatient basis, faced controversy and legal action in different states when performed in an outpatient setting (Russo et al., 2007). Agency for Health Care Administration (AHCA) data, from 2001-06, show a fall in the share of outpatient Mastectomy surgeries performed at ASCs, from 11.4% in 2001 to 3.5% in 2006 reflecting this risk element and the regulatory crackdown.

Unlike the case of ASCs, association between competition and quality of care has been studied extensively in health literature, in the context of increased competition between acute care hospitals. Kessler and Geppert (2005) used the competition measure first suggested by Kessler and McClellan (2000) and evaluated the effect of competition on patients with different levels of health severity. They found that in an increasingly competitive market patients with higher levels of illness severity also get more intensive treatment while patients with lower levels of severity receive less intensive treatment. Their results support the notion that there are efficiency enhancing effects of competition, but it is unclear whether similar conclusions can be applied to the competitive effects due to ASCs.

Barro et al. (2006), on the other hand, studied hospital competition in the light of new entry. They examine the impact of entry by cardiac specialty hospitals on the overall cardiac care quality in the market. They found that markets with specialty hospital entry have lower spending for cardiac care but, these hospitals tend to attract healthier patients and provide higher level of intensive procedures. Specialty Hospitals as well as ASCs can have diverse effects on the health care market. If their entry promotes competition and leads to better allocation of patients among providers, by the patient severity status, then policy makers should facilitate their growth, while if their entry has social costs in the form of undue and unnecessary increase in services - a medical arms race, then these negative external affects need to be accounted in policy making. Barro et al study the effect on costs and outcomes at the hospitals due to specialty hospital entry. We will extend our analysis by evaluating both sides of the competition by modeling the entry decision as well as the hospital reaction to entry in the form of quality adjustment. This paper in its present form, however, estimates the impact of existing quality in the market on the entry decision itself.

The entry model proposed by us is similar to the two step analysis carried out by Chernew et al. (2002). Their work aimed to infer payer type returns in bypass surgery based on hospital entry behavior. Authors used patient flows from choice model as input to their entry model and tried to estimate the likelihood of hospital entry as a function of the payer type returns. Like them, we also rely on predicted volumes along with market level safety measures but, instead of predicting ASC entry, we model the probability of a county witnessing ASC entry in any given year and use county level predicted volumes at the best zip code location (as explained in section 5).

Evidence that poor hospital quality may drive the entry of new ASCs would help substantiate the hypothesis that these facilities are welfare-enhancing. We examine the issue from the standpoint of problems in the safety standards of care in a local community. As described earlier, we use software provided by Agency for Healthcare Research and Quality (AHRQ) to compute patient safety indicators based on inpatient discharge data. How we use the set of indicators in our analysis is described in the next section.

When local hospital care is subject to poor safety performance, such as excessive post-operative and other hospital-acquired infections or poor nursing quality, surgeons operating in the incumbent hospitals can profitably disassociate from these safety problems by establishing a separate ASC to achieve better control. We imagine a model of profit maximizing firms who only choose to enter the market if the predicted volume of patients is greater than the threshold volume that gives zero profit. Once a market attains a size adequate to provide the threshold patient volume and cover fixed costs, entry depends further on the safety level of existing care in the market. If, furthermore, ASC growth induces quality improvement by hospitals seeking to regain market share, then the likelihood of a positive welfare effect is strengthened. These are questions that this study is directed at.

4. Patient Data and Hospital Safety Measures

4.1. **Patient Data.** For this study, inpatient discharge data, outpatient visit data involving surgical procedures and hospital financial data from 1997 to 2008 are collected from Florida Agency for Health Care Administration (AHCA). Patient characteristics in the data include detailed clinical and demographic information. Patients' procedures, coded in Clinical Classification System (CCS) codes were used to select the set of surgery types affected by ASC competition. Multi-level CCS classification system is used for the choice model. It groups procedures by body systems or condition categories (AHRQ (2007)) and allows us to analyze different health care markets as defined by the CCS type. We estimate different choice models for those CCS types that form the majority of ASC services. These are operations on the nervous system and musculoskeletal system (CCS 1 & 14), operations on the eye (CCS 3), and operations on the digestive system (CCS 9). Upon observing the actual combination of CCS types performed at the same facility, we grouped CCS 1 & 14 to define a self contained market. These three CCS categories account for approximately 90% of the total outpatient procedures done at ASCs.

Table 4 provides the exact details of variables used in our choice model specification. Included are the patient's payer category (Medicare, Medicaid, Commercial Insurance, and Other), demographics (age, race, gender), and distance measures derived from patient residential zip code centroid (Mileage distances to each hospital are derived using an html program that extracts actual distances from Google maps). Attributes of each acute care hospital include its control type (for profit, not for profit, or government), teaching status, nursing intensity, capital intensity, and the total number of beds available. Two hospital safety safety measures based on the Agency for Healthcare Research and Quality (AHRQ) safety indexes are used. Our methods for constructing these safety indexes are detailed next.

4.2. **Hospital Safety Measures.** Of great interest to our estimation are the facility characteristics relating to safety - the nursing safety and surgery safety indexes. Following closely the methods detailed in Encinosa and Bernard (2005) and Bazzoli et al. (2008), we compute risk-adjusted Patient Safety Indexes[5] (PSIs). The Florida hospital inpatient data file includes all patient discharges with a major surgery diagnosis-related group (DRG). The AHRQ-provided algorithm uses this data for computing the safety indexes. These indexes track the occurrence of adverse events and focus on

[5]Risk adjustment is based on computed hospital fixed effects. First, using logistic model predicted value of complications is calculated for each discharge and then subtracted from the actual outcome. Then, this difference is averaged over each hospital to get the risk adjusted rate.

conditions and complications experienced by patients during their hospital stay. Using the PSIs, we construct, by year and by hospital, two aggregate measures of patient safety over all major surgery discharges. The first measure, surgery safety index, consists of nine PSIs that are most closely related to the actual surgery, while largely independent of post-operative nursing care. These include complications in anesthesia, postoperative hemorrhage or hematoma, postoperative hip fracture, postoperative physiologic and metabolic derangements, postoperative pulmonary embolism or DVT, postoperative respiratory failure, postoperative sepsis, postoperative wound dehiscence and finally, accidental puncture or laceration. The second measure, nursing safety index, is constructed from three PSI indicators previously recognized as related to the nursing activity - post operative hip fracture, decubitus ulcer, and selected infections due to medical care.[6]

These two measures distinguish nursing and surgery as sources of adverse events in hospital, and may produce different effects in the model. Further, as in Bazzoli et al. (2008) we construct aggregate nursing and surgery complication rates. After computing the individual PSIs we subtract from each hospital's rate the overall average rate, for the same PSI, of hospitals in the Florida data set.[7] This gives us a measure of excess number of incidents that took place in the hospital. Finally, we weight each of these excess measures (as mentioned above, 9 for surgery and 3 for nursing) by the proportion of patients at risk for the indicator. To illustrate for the case of the nursing indexes, first, the excess measure for each of the three nursing PSIs is weighted by the number of patients at risk at the hospital. These weighted excess measures are then summed up and divided by the total number of patients at risk for all 3 nursing related PSIs.

5. Empirical Strategy

5.1. **Patient Choice Model.** The empirical analysis is divided into two parts. First, a choice model is used to study characteristics and drivers of patient choice of location for surgery, i.e. patient choice[8] among ASCs and acute care hospitals' outpatient departments. Using the choice model, we examine the first order effect of safety i.e. how does the market share of a hospital gets affected due to lower safety performance. Patient choices from the model are then used to predict volumes for an hypothetical entrant in the next part. The choice predictions feed into a model that predicts probability of entry as a function of expected profits (as measured by expected volumes)

[6]As explained in Bazzoli et al. (2008), postoperative hip fracture is used in both type of indicators as it can occur because of either nursing or surgery errors.

[7]Only those individual PSIs are used for which the population at risk was at least equal to 30 patients at the hospital.

[8]Patient choice here actually implies the choice of location made by the patient and her physician together. This choice is likely to be guided by the insurance plan restrictions, especially in the case of Non-Medicare plans. However, keeping with the traditional use of the term in case of choice models and for ease of description we will call it the patient choice.

and existing market conditions, including surgery and nursing safety rates of each hospital in the market.

We choose to model the patient choice decision for surgery within a nested logit framework. The patient decision is considered as a nested choice as it is reasonable to believe that the patients who choose a hospital over an ASC may be less healthy and more worried about the potential complications that may arise during a surgery and that can be much more easily handled at a hospital due to the presence of an emergency department and the availability of combined medical experience from different fields. On the other hand, certain procedures, like lasik surgery or endoscopy, involve much less risk and conceivable complications than, for example, spine surgery and consequently the patient or physician may be predisposed to the idea of getting the surgery done in a smaller and convenient ASC facility. Nesting hospitals and ASCs in different branches further helps us by allowing different substitution patterns in both nests. This is an important benefit of the methodology as it not only weakens the IIA assumption but also strengthens the market share predictions by taking into account that new ASC entry will take away business from both hospitals and ASCs but certainly in different magnitudes. Finally, nesting also allows us to account for information that is specific to hospitals or ASC nests. For instance, for-profit/ non-profit status of the hospital along with the safety measures for hospital nest and distance to the closest emergency center in case of ASCs.

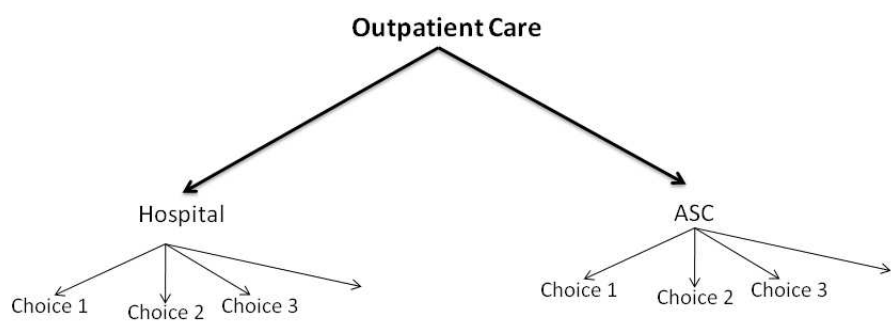

FIGURE 1. Patient Choice of Surgery Setting

Since there are a number of procedures that can only be treated at hospital outpatient departments, procedures selected for the study are the ones that are amenable to be done in both hospital and ASC outpatient environments. The patient is assumed to choose between all the facilities that can provide the surgery within the expanse of a defined geographical market. This choice problem is then expressed within the class of nested logit random utility models where an individual maximizes utility over available nests, and conditional on a nest, maximizes utility over available choices within the nest. Each patient i (*where i=1 to I*) makes a choice among alternative health care facilities j (*where j=1 to J*) in nest B_k (k = *hospital* or *ASC*) that can provide the required procedure. Thus, with utility expression U_{ij}, where $j \in B_k$, patient's utility function, given knowledge of clinical condition and facility choices, can be written, using the terminology by Train (2003), in the following form:

$$U_{ij} = W_{ik} + Y_{ij} + \varepsilon_{ij},\ j \in B_k \tag{1}$$

Here, W_{ik} represents set of variables that vary by nests but are constant over alternatives within nest k. In our model, these are individual specific regressors like, age, gender, race, payer type etc. (see Table 4) that affect patient's choice of nest. The second set of variables, Y_{ij}, vary across different choices within the nest and include choice characteristics as well as interaction terms between patient demographics and choice characteristics. In particular, Y_{ij} can be summarized as:

$$Y_{ij} = \beta R_j + \eta X_i\, R_j + \nu Dist_{ij} + \delta Dist_{ij}\, X_i + \theta Dist_{ij}\, R_j \tag{2}$$

The term X_i represents the patient characteristics, for example, demographics and a set of dummies for payer types. $Dist_{ij}$ is the mileage from patients $i's$ home to the provider $j's$ location and R_j is facility characteristics including its size (number of beds), the measures of safety at the hospital and ownership type. Table 4 provides details on the facility characteristics, R_j, which are defined similarly in both the nests but with some differences in specific regressors by nest. Certain features like teaching status and profit status are not relevant to the ASC nest, while others (such as specialty status and distance to the emergency center) are not relevant to the hospital nest.

The nested logit model assumes that an individual can compare utility derived from each choice and choose the alternative that gives the maximum utility, so choices are based on net utilities (Jones, 2000). The stochastic error term is given by ε_{ij} and is assumed to follow Generalized Extreme Value (GEV) distribution. The error terms ε_{ij} are correlated within a nest and the probability of facility $j's$ selection by patient i in nest k, for a given procedure, can be written as:

$$P_{ij} = P_{ij|B_k}\, P_{iB_k} \tag{3}$$

Here, $P_{ij|B_k}$ is the conditional probability that the alternative j is chosen given an alternative in nest k is chosen, and P_{iB_k} is the marginal probability of choosing an alternative in nest B_k. The product of marginal and conditional probability then gives us the joint probability of a specific choice. This can be further written as:

$$P_{ij} = \frac{e^{W_{ik}+\lambda_k I_{ik}}}{\sum_{l=1}^{K} e^{W_{il}+\lambda_l I_{il}}} \frac{e^{Y_{ij}/\lambda_k}}{\sum_{j\in B_k} e^{Y_{ij}/\lambda_k}} \tag{4}$$

where,

$$I_{ik} = ln \sum_{j\in B_k} e^{Y_{ij}/\lambda_k}$$

Here, I_{ik} is the inclusive value and λ_k is the dissimilarity coefficient, for nest k, indicating the degree of independence among choices in the nest.

5.2. **Geographic Market and Model Estimation.** It must be noted that the sampling design is subject to certain considerations. We use the choice based sampling strategies to select relevant hospitals, ASCs and patients and to construct zip code specific choice sets. Consistent with multinomial choice analysis, the choice set for a patient in any zip code area should be self-contained and include every facility available for the procedures sampled. This means, first, that the analysis should not overlook any other "outside" facilities where evidence reveals that patients in the local area are able to choose, and sometimes actually choose, for surgical care. These outside hospitals and ASCs are competing for local patients. In short, we construct diverse zip code level choice sets. Varying the hospital choices by areas as small as a zip code allows for considerable heterogeneity across the total service areas of any given hospital or ASC. Further, since we estimate separate models by type of procedures (CCS type - 1 & 14, 3 and 9), the choice sets from the same zip code may also be different for different procedure types.[9]

Kessler and McClellan (2000) and Gowrisankaran and Town (2003) point out the problem of endogeneity that can arise if competition is defined on the basis of actual patient choices. In cases where the interest lies in understanding competitive effects, the estimates can get biased if the market is calculated from actual patient choices because these choice decisions may become increasingly affected by unobservable quality aspects of the health care facilities. Kessler and McClellan (2000) also cite other problems associated with measuring market sizes based on patient choices and introduce the method of using probabilistic patient choices based on the estimates of multinomial logit models that account for both patient and facility characteristics and help build competition measures at patient zip code residence level. This method is also adopted here to identify the likely potential patient volume of a new entrant from predictions.

[9]To reduce the sample to a manageable size, we drop choices made by less than 2% of the patients from a zip code. Zip codes with less than 10 patients are also excluded. In Fournier and Gai (2007), sampling issues are discussed at length and authors also explored the sensitivity of the model's predictions to changes in the sampling design.

The patient choice model is estimated separately for each year from 1997 to 2008 to account for any changes in patient choice parameters caused due to a changing health care environment and the resulting payer response. Separate estimation also allows us to account for patient choice set changes over time as the set of facilities continuously expands. To facilitate the numerical convergence, we estimate the parameters on a random sample of zip code choice sets, including 40,000 patients[10] for each CCS type, i.e. nervous and musculoskeletal system, eye care and digestive system surgeries, to obtain converged parameters.[11] We use these estimates to get choice predictions over the 12 year period.

Previous literature in health has shown in detail the importance of distance and travel time for patient choice and the preference for the closest hospital. In our data set, the distance to the closest hospital or closest ASC can vary across different regions. To account for this effect we include ordinal constants for each choice in both the nests. The order of choices is coded for each nest and is decided based on the closeness of each facility choice to the centroid of the patient zip code. In nested logit models, even with variable choice sets across individuals, the estimation software still constructs a universal choice set with all the choices in it and therefore, leads to heavy costs in terms of estimation times. There are other estimation problems too that result when random samples from the data are taken as there may not be enough observations left for each of the specific choices, resulting in dropping of the choice from the model altogether. Including ordinal constants allows us to limit the universal choice set as each choice is now identified by its order, as the closest choice to the patient, the second closest and so on. The model then gives the effect of varying characteristics of the choices without taking into account the actual identity of the choice. This helps in reducing convergence time for the nested logit models and also to account for all possible choice characteristics in estimation.

Hospital level measures for nursing and surgery safety, used in the nested logit model, are also relevant to the choice set definition. We find that there is substantial variation in aggregate nursing and surgery complication rates across hospitals statewide, especially in the case of excess nursing complications. However, within localized zip code choice sets we often find that the hospital complication rates are clustered close to each other. Therefore, in the nested logit specification we use a discretized version of both nursing and surgery safety rates. We define high-risk hospitals in

[10] We also experimented with bigger sample sizes that form 25% and 50% of the overall CCS wise data and found little or no change in the parameter estimates

[11] This results in a total of 36 choice models (12 years x 3 CCS types) collectively accounting for 120,000 patients each estimated year or approximately 10% of CCS type patient population depending on the year.

a choice set as the ones that have a complication rate one standard deviation[12] greater than the average complication rate of the choice set. This implies that the same hospital may be considered a high-risk hospital in some of its markets and a low-risk in some others. This conforms with the notion that patients choose from the facilities that are relevant to their geographic choice set. By this definition, more than 35% of the hospitals, on average across the years, can be considered high risk hospitals.

Table 5 presents a comparison of the hospitals that have nursing complication rates and/or surgery complication rates one standard deviation higher than the average (High-Risk) in their choice set with those that do not (Low-Risk). On average, across the 12 year period, there does not seem to be substantial differences in covariates, other than safety itself, between hospitals categorized as high-risk and those categorized as low-risk. Size measures like number of beds and inpatient volumes are quite similar for both nursing and surgery cases. Compared to the hospitals that are high-risk due to nursing safety, high-risk hospitals by surgery safety standards are more likely to be non-profit or government hospitals. Hospitals that have higher complications in nursing safety are also likely to have higher surgery complications while, the same is not true for hospitals that are high-risk for surgery safety.

[Table 4 and 5 about here.]

5.3. **Entry Model.** We assume that the entry decision depends on the volume that an ASC expects to serve upon entry and the area level safety records. We approximate the expected volumes to be served by computing the volume predictions post-entry, using previous year's predictions and after assuming an hypothetical entrant in the market. In this way, our methodology is similar to Chernew et al. (2002). except that for this study we focus on the entry events by CCS type at the county level. There are a total of 221 entry events that took place in Florida during 1998 to 2008, out of which 212 were in 34 urban counties. This makes sense as ASC entrants are mostly for-profit facilities that would tend to locate in well populated markets. We accordingly restrict our sample to these counties as potential entry locations.

To simplify the dynamic structure we assume that the entry decision for time t is made at time $t-1$ and entrants use the existing market structure to predict the share of patients they will

[12]Measures based on more than 1 standard deviation reduce the number of hospitals that can qualify as a high-risk hospital to a relatively small group.

get. A potential entrant will evaluate the expected volume of patients to be served by locating in each zip code in a county and then choose the one that yields the maximum number of patients.

ASC facilities can be divided according to two major business models - entrants that operate as multi-specialty facilities and provide almost all types of multi-level CCS treatments under one roof. These are also more likely to be partly owned by corporate chains like Symbion Healthcare, HCA etc. The second type are specialty facilities that focus on one or two related CCS categories, for example, orthopedic specialties, eye care specialists, urology centers etc. Likewise, different types of ASCs (by model and by service type and locality) are likely to face different prospects in terms of number of competitors, set up costs and predicted patient volumes in each market; accordingly, we model entry by type. We focus on four type of entrants that form the majority of entry events over the 11 year period - Multi-Specialty, Nervous System & Musculoskeletal, Eye Surgery, and Digestive System. These types account for 90% of all urban area entries (193 out of 212). In 17 cases, two entrants serving the same CCS type enter at the same location. We treat these ties as single entry events which further brings the entry events down to 176.

The estimated parameters from the choice model provide a basis for predicting the aggregate patient volume that a new entrant would achieve, across every zip code in its potential service area. Estimated choice probabilities for new ASC entrants, as well as all other facilities in the market, are estimated from the model, accounting for various patient and facility level control variables and their interactions. These predicted probabilities are interpreted as predicted market share. Combined with the size of the overall patient population, the choice model thus provides a specific measure of the expected patient volume an entrant would achieve at every possible location. The prediction for the multi-specialty entrants is computed differently by switching the specialty status variable from 1 to 0, for the entrant, and then aggregating the volumes from each estimated procedure type to get the predicted volumes. The advantage of the prediction for the analysis of entry is that predicted measures are derived from patients' estimated probabilities of visiting a facility rather than being based on the actual visits.

The first step is to create weighted zip code level market shares for each potential new facility-location as a prediction from the patient choice model. Expected volume by entering in zip code j can be summarized as:

$$\widehat{Vol_j} = \sum_{z \in I_j} \widehat{p_z} * N_z \tag{5}$$

Here, p_z is the choice probability of a potential entrant in zip code z and N_z is the number of patients in the zip code.[13] Summing up the expected volume over each zip code z that an entrant will serve by entering zip code j provides us the total expected volume. The set of zip codes $z \in I_j$ are referred to as the market service area of the entrant in zip code j. Maximum volume from the entry zip codes in a particular county is chosen as the predictor of entry at a county level.

Next, consistent with the measures of nursing and surgery safety used in the nested logit choice model, variables for safety included in the entry model are also relevant to the potential market service area of the entrant. Since the hypothesis is that the entry decision, after accounting for the expected profitability, depends on the area level safety, we use two different area level measures in the model - number of high-risk hospitals and the volume of patients treated at the outpatient departments of high-risk hospitals. These measures, like the predicted volumes, are defined by the market service area of the entrant.

The probability of an urban county witnessing a type a (where $a = 1$ to 4 for 4 different types of entrants) ASC entry during any time period from 1998 to 2008, conditional on the predicted volume, and county level hospital safety measures is modeled with a standard probit:

$$P(Entry^a_{c,t}) = \Phi(\beta_1 \, a * \widehat{Vol}^a_{c,t} + \beta_2 Safety_{c,t-1} + \beta_3 time) \tag{6}$$

We compute the probability of entry by different types by using dummies for each type in the model interacted with the type specific variables. Here, a represents the entrant type, while, $\widehat{Vol}$ is the predicted volume by type. $Safety$ stands for alternative area level hospital risk measures from previous year and $time$ represents time dummies.

Our main interest in the entry model is interpreting how hospital safety measures may drive physician groups to invest in setting up ASCs. Moreover, the effect of safety on entry probability can be broken into two parts - direct and indirect. The direct effect is what we model with the help of the entry probit, i.e. entry is a function of the overall safety in the area, after controlling for the predicted patient volumes. The prevalence of high-risk hospitals in the locality improves the prospects of a new ASC entrant indirectly by raising the entrant's predicted profitability. In addition, an indirect effect occurs because low prevailing safety in the area may increase the the attractiveness of a new non-hospital facility. When safety risks are relatively stronger and recognized

[13] Since we have access to the universe of patients treated in Florida hospitals and ASCs, we use the actual patient numbers to create the zip code level population measure. This is better than using Census numbers coinciding with our data period, as they are rough extrapolations based on the 2000 census.

at local hospitals, the choice model predicts larger shares for new entrant ASC facilities, and this in turn raises the entrants predicted patient volume.

$$\frac{dP_{entry}}{dSafety} = \frac{\partial P_{entry}}{\partial Safety} + \frac{\partial P_{entry}}{\partial \widehat{Vol}} \frac{\partial \widehat{Vol}}{\partial Safety} \tag{7}$$

According to the above equation, we expect to find the total derivative of entry probability, with respect to safety measures, significant and positive. We expect to find all three terms on the right hand side of the equation positive. The first term on the right hand side is the effect of the increase in number of high-risk hospitals in the entrant's market service area on the entry decision given the predicted volume (i.e. marginal effects coefficient on safety measure in the probit model). The second partial is the effect of predicted volume on entry (i.e. coefficient on predicted volumes in the probit) which should be positive if volume drives entry; finally, the last partial is the increase in expected ASC share (volume) due to a hospital being high-risk (its marginal effect in the patient choice model), that again we expect to find positive. It is possible that any one of these effects stand-alone is not strong enough but the overall impact, we expect, should increase the probability of ASC entry.

6. Results

6.1. **Nested Logit.** In the first stage of the estimation, nested logit choice models are estimated using a random sample from entire state for each year. This sample includes observations for three CCS types with 40000 cases each (approximately 10% of all cases). Separate estimation is done for nervous system and musculoskeletal procedures (CCS 1), eye care procedures (CCS 3) and digestive system procedures (CCS 9). Tables 6, 7, and 8 present these results. The models have been estimated using all twelve years of Florida data but for presentation purposes we have included results from selected years of 1998, 2002 and 2006.

[Table 6, 7, and 8 about here.]

The primary coefficients of interest associated with the choice specific variables like, safety rate measures, distance, specialty status of ASCs as well as the nest specific variables like, age, race, severity (measured by number of diagnosis and procedures) are always significant. Coefficients from the nest choice equation suggest that older people are more likely to choose ASCs while, males are more likely to choose hospitals over ASCs. Patients with severe health status are also understandably more likely to choose hospitals. The LR test on the dissimilarity coefficients for hospital and ASC nest shows that the coefficients are significantly different from each other for all the estimated models and therefore this test supports the decision to nest hospitals and ASCs separately. For consistency with stochastic utility maximization, the dissimilarity coefficients are required to lie within the unit interval (Daly-Zachary-McFadden conditions). In the early years of 1997 and 1998 these coefficients take a value much greater than 1 in some of our CCS type estimations. We reconcile these estimates with utility maximization in the appendix to this paper.

To get a clear understanding of the impact of important variables, it is important to look at the marginal effects. The marginal effects of the covariates, expressed as % change in choice probability, for selected regressors are presented in Table 9, separated by the CCS type as well as the nest. For the hospital nest we examine distance, nursing safety, and surgery safety[14] while, for the ASC nest we look at the impact of specialty status, distance from the patient, and distance to the emergency center. These are basically average marginal effects as we first compute an analytical derivative and then average it over all observations.[15] The average marginal effects suggest that distance always has a negative impact on choice probabilities (see figure 4), but the impact is stronger for musculoskeletal patients and digestive system patients, a fall in market share of 0.4 to 0.5%, than for eye care where choice probability falls by 0.2%. This result makes sense as eye care surgeries are more specialized in nature and patients may be more likely to travel far for the treatment. Distance to the emergency center is also not important in case of eye surgeries, perhaps because these surgeries are less riskier than the other ASC procedures. Patients are also highly likely to visit a specialty ASC for eye and digestive system procedures but not for the nervous and musculoskeletal system procedures.

[Table 9 here.]

Turning to the effect of the main variables of nursing safety and surgery safety, we find that being a high-risk hospital (rate one standard deviation above the choice set average) has a strong negative impact on choice probabilities and therefore, hospital market share. The impact is stronger if the hospital is high-risk due to low nursing safety than surgery safety and is also stronger for nervous system and digestive system procedures. Choice probability for a hospital that is high-risk for nursing safety can be lower by anywhere between 1 to 4% while, for a hospital that is high-risk due to surgery complications, probability is lower by 0.5 to 2%. Even when the impact is of the opposite sign, in a few cases for surgery measure, than expected (positive), average effect for

[14] As mentioned before safety rates in the Nested logit Model enter as dummy for a high-risk hospital.

[15] Since, coefficients from the nested logit are in general all significant at 1% or 5%, it is safe to assume that the marginal impact is significant too.

Medicare patients is still negative, highlighting the fact that freedom of choice available to Medicare patients allows them to pick the best hospital.

These results further suggest that if a hospital is high-risk by both nursing and surgery safety standards then the overall impact on patient choice will be consistently negative. Also, since patients overwhelmingly prefer the closest facility to their residence (see figure 4), it is of interest to examine the negative effect on the market share of the closest hospital to the patient if it is high-risk in both nursing and surgery safety. To analyze this effect, we simulate the marginal impact on the closest hospital if it was the only hospital in the choice set that was high-risk due to both high nursing and surgery related complications. We do this by looking at the change in choice probability of the closest hospital when it goes from being a low-risk hospital to a high-risk hospital in terms of safety performance, while holding all other characteristics of the facility and the patient constant. We analyze this marginal impact for choice set sizes that vary by the number of hospitals and ASCs in them. This impact is presented in Table 10 for all three CCS types and on average it ranges between 3-6% loss in share for the closest hospital, for the musculoskeletal procedures, 2-4% for eye care procedures and between 1-8% for digestive system procedures. These results point out the significant threat of ASCs to hospitals. When the closest hospital becomes a high-risk hospital, its market share loss can translate into a loss for the entire hospital nest with ASCs gaining a significant proportion. The closest ASC also stands to gain more than the second closest hospital. This effect seems to be stronger during the period of 1997 to 2004. For instance, in 1998 an approximate loss of 9% by the closest hospital in the eye surgery market translated into a 3% average gain for the closest ASC and almost 8% for all ASCs i.e. almost the entire share lost by the closest hospital went to the ASCs. The significance of this impact is also clear from figure 5 that plots the loss in share for all three CCS types, for the closest hospital, when it becomes a high-risk hospital (high nursing and surgery complications) from a low-risk hospital, for selected years.

[Figures 4 and 5 about here.]

6.2. **Entry Model.** In the second stage, we utilized results from the nested logit estimation to construct out of sample choice predictions, by the CCS type, for a hypothetical entrant with average characteristics in each of the potential entry zip codes. Potential entry zip codes themselves were chosen based on the location decisions of existing health care facilities in Florida. These facilities are restricted to eligible areas set by the local level zoning laws. Using these predictions we constructed an estimate of expected volume measure by CCS type, county and year to include as regressors in the entry model.

The entry event is modeled for four types of entrants - specialty entrants in three of the CCS types discussed above and a multi-specialty entrant providing all three of the CCS procedures at one facility. Specialty status of an ASC was controlled for in the nested logit estimation and allows for simulating an entry event by a specialty or a multi-specialty facility. To model multi-specialty ASC entry decision, we sum up the predicted volumes in each of the three CCS type predictions to get an overall estimate of volume that the entrants expect to serve. Predicted volume by type is entered in the model by interacting it with type dummies.

The entry model results are presented in Table 12. We include results from selected specifications of the Probit model. These specifications differ by the safety measure used. While models (2) and (3) use nursing related complications to define high-risk hospitals, models (4) and (5) use surgery complications. For ease of interpretation and to provide an understanding of the magnitude of the results, variables are entered as standardized scores (z-scores) and coefficients represent the impact of one standard deviation change in dependent variable on the entry probability. Descriptive statistics for the entry model variables are given in Table 11. Time fixed effects were also included in the specifications, but the results did not change qualitatively. Hence, those results are not included here.

[Table 11 and 12 here.]

The first Probit, model (1), presents baseline results including only the predicted volumes. Predicted volume measures are significant drivers of entry for all four types with a positive impact on the entry decision that is stronger for entrants in orthopedic (nervous and musculoskeletal) and digestive system specialties. However, in the standardized measures, presented here, predicted volume for the eye surgery entrants is not significant. In model (2), variable measuring the number of high-risk hospitals (based on nursing safety) is included and found to have a significant impact on the entry probability. The marginal effect (change in probability) for the variable suggests that a one standard deviation increase in the number of high-risk hospitals located in the potential market service area of an entrant leads to a 2.4% increase in the probability of entry by an ASC. The alternative measure of safety based on the surgery complications, shown in model (4), suggests a 3.5% increase in the entry probability. Predicted volume measures are also significant with the exception of eye surgery entrants. The magnitude of the safety impact based on surgery measure is stronger than in the case of nursing measure and is significant with 0.01 p-value. Given the mean number of high-risk hospitals in the market service area (see Table 11), a one standard deviation change implies on average 5 more hospitals in the area becoming high-risk by surgery safety standards.

Models (3) and (5) account for an alternative variable that measures the direct impact of potential market that an entrant stands to gain and that is being treated at high-risk hospitals. The measure is based on the number of patients treated in the outpatient departments of high-risk hospitals with their actual residence under the service area of a potential entrant. Marginal effects in both the specifications suggest a strong and significant impact of a change in this volume on the probability of entry. The predicted entry probability increases by 2.8% when more patients get treated at hospitals that are high-risk due to surgery complications. Based on the average number of patients treated (Table 11) , this translates into a 2.8% increase in entry probability when an additional 8000 patients get treated at high-risk hospitals (for surgery safety). Given that on average there is a 11% probability of an ASC entry across the years, the marginal effect of a change in safety measures on entry probability, ranging between 2 to 3.5%, is quite substantial.

Overall, the results in this study provide strong evidence for the impact of both nursing and surgery safety at hospitals on ASC entry growth. However, this impact seems to vary by the perspective of the agents involved i.e. patients and ASC entrants. In the patient choice model, evidence for the impact of high-risk for nursing safety hospitals is stronger than the impact of high-risk for surgery safety hospitals. As shown in Table 5, hospitals need not be high-risk in both nursing and surgery safety at the same time and quite likely they may be compensating for deficiency in one measure, say surgery safety, by doing better on the other measure of nursing safety. The marginal effects from the estimation suggest a very strong impact of being a high-risk nursing safety hospital on patient choice (Table 9) that can go up to as large as 7% lower likelihood of being chosen (when the patient is covered by a commercial insurance provider). Further, the simulated marginal effects on hospital shares (Table 10) suggest a strong threat to hospitals based on their geographical location and safety performance, especially in the early years of ASC growth. For instance, if all the other characteristics of the hospital choices faced by a patient were same, then upon turning into a high-risk hospital by both nursing and surgery safety standards, in some areas the closest hospital could lose up to 12% of it's market share (in bigger markets, in year 2002, see figure 5).

The entry model provides alternative evidence about the importance of the relationship between low safety and the potential market for an entrant. ASCs are profit driven ventures and areas with low safety will be viewed by entrants as attractive, potential markets only when a substantial volume of patients is being treated at the high-risk hospitals. The results from the entry model seem to suggest that both nursing and surgery safety at the area level are significant predictors of ASC entry decision, however, the number of high-risk surgery safety hospitals has a relatively stronger impact.

7. Conclusions

For insured patients, characteristics of health care other than charges play a more important role in the decision of having the surgery performed at a particular location. Attributes such as distance of the patient from the provider are a major factor affecting the patient decision to visit the provider. Moreover, with an increase in hospital acquired infections (e.g., MRSA) patients and their doctors' concerns about safety and quality of care in hospitals play an increasingly important part in affecting the decision on surgery setting. The relative role and importance of such factors is an indicator of patient welfare and needs to be evaluated thoroughly to gain a better understanding of competitive effects of ASCs.

Our empirical findings reveal that hospital quality and safety record is inherently a factor in the emergence of ASCs. First, poor safety performance makes the traditional hospital less attractive to patients and their doctors, opening up opportunities for ambulatory surgery centers to attain market share. This impact is strongest when the closest hospital to the patient is a high-risk hospital. In such a scenario, all ASCs located close to the patient stand to gain. Second, the results further suggest that when poor safety records are recorded for hospitals in the market service area of the entrant, there is a significant positive effect on the rate of new entry of ASCs. This effect is higher in magnitude and consistent in significance when the hospitals are low performers on surgery safety. These results capture a previously unexplored, but key parameter of the rivalry that goes on between these diverse facilities which is the measurable role of safety. Opponents of ASCs have argued that the entry is driven solely by profit motives. We find that even though profits play an important role, given that predicted volumes have a significant effect on entry, it is also important to account for the fact that the entry decision is dependent on the area level safety and therefore has positive implications for patient welfare due to increased convenience and likely better quality because of specialized ASCs.

The results support the hypothesis that physicians practicing at high-risk hospitals can disassociate themselves from safety problems by moving practice to ASCs. Specifically, when surgery complications at the hospitals reflect poorly on the practicing physicians/surgeons reputation, they may be more inclined to invest in their own ASCs.

A possible limitation to our model exists in case hospitals react to ASC entry by adjusting safety covariates. Although the safety measures used in the entry model are from previous year, there could still be endogeneity due to possible correlation between safety measures over the years. This problem is likely if hospitals can adjust their risk status by making strategic investments that have a direct impact on safety and that take effect gradually over years. Barro et al. (2006) studied the effects of competition on costs and quality of medical care, in the context of specialty hospitals and they assumed that there are exogenous changes in hospital quality as a result of entry instead of endogenous, strategic reactions to entry or the threat of entry by incumbent hospitals. To the hospital, deliberate improvements in the quality or safety of care may enhance reputation, boost patient share in the market, and mitigate the threat posed by this new competition. As extension to this paper, we will address this issue with a joint model that incorporates the hospital response.

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8. Tables and Figures

Table 1. Outpatient facilities in Florida, 1997-2008

Outpatient Care	1997	2001	2004	2008
ASCs	218	244	302	365
Hospital Outpatient	199	197	200	208

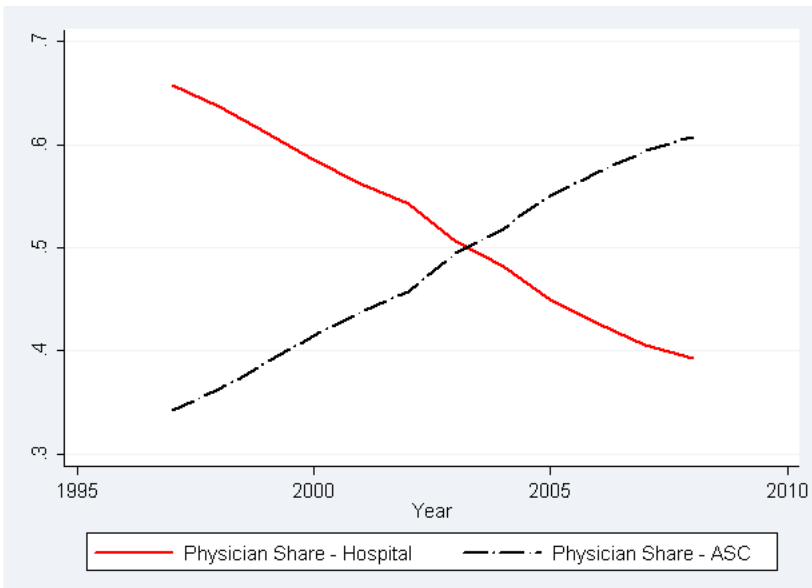


Figure 2. Changes in Physician Practice Setting, Florida 1997-2008

Table 2. Single level CCS procedures and ASC Share (%) among Medicare, Florida

CCS Procedure	2001	2003	2006
Colonoscopy and Biopsy(76)	21670	30151	37485
	(50)	(60)	(71)
Insertion of catheter/spinal stimulator(5)	9741	12730	16254
	(55)	(63)	(77)
Decompression peripheral nerve(6)	976	1139	1420
	(48)	(49)	(60)
Other OR therapeutic nervous system procedure(9)	454	599	1224
	(31)	(33)	(57)
Plastic procedures on nose(28)	90	113	130
	(42)	(50)	(56)

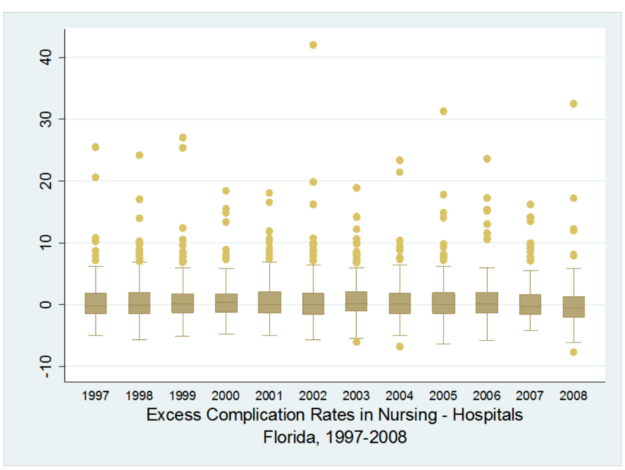
Table 3. Patient choice of provider, Florida 1997-2006

Procedure(CCS code)& Facility type	**1997**	**2000**	**2003**	**2006**	**Growth**
Laminectomy, excision intervertebral disc(3)					
Inpatient	5129	4619	4352	3903	**(-24%)**
ASC	228	385	488	904	**(296%)**
Hospital Outpatient	373	576	825	1049	**(181%)**
Total	*5730*	*5580*	*5665*	*5856*	**(2%)**
Insertion of catheter/spinal stimulator(5)					
Inpatient	979	977	1013	679	**(-31%)**
ASC	10684	22494	31176	39922	**(274%)**
Hospital Outpatient	12982	19057	16141	10308	**(-21%)**
Total	*24645*	*42528*	*48330*	*50909*	**(107%)**
Tracheoscopy and laryngoscopy with biopsy(35)					
Inpatient	628	469	400	328	**(-48%)**
ASC	207	256	222	244	**(18%)**
Hospital Outpatient	877	1283	1965	1761	**(101%)**
Total	*1712*	*2008*	*2587*	*2333*	**(36%)**
Colonoscopy and biopsy(76)					
Inpatient	3997	4751	5219	5044	**(26%)**
ASC	19821	41173	71914	103083	**(420%)**
Hospital Outpatient	27979	46963	50212	41189	**(47%)**
Total	*51797*	*92887*	*127345*	*149316*	**(188%)**
Endoscopy/endoscopic biopsy, urinary tract(100)					
Inpatient	654	554	548	452	**(-31%)**
ASC	2007	3001	3791	4512	**(125%)**
Hospital Outpatient	2324	2491	2274	2273	**(-2%)**
Total	*4985*	*6046*	*6613*	*7237*	**(45%)**

TABLE 4. Variables Used in the Nested Logit Estimation

Variable	Definition
W_{ik}, X_i	Male: dummy indicating gender White: dummy indicating race Age: patient age at admission Number of diagnoses: number of other procedures Number of procedures: number of other diagnoses Payer- Medicare: patient insured by Medicare or Medicare-HMO Payer- Medicaid: patient insured by Medicaid or Medicaid-HMO Payer-Commercial: patient insured by Commercial insurance, Commercial HMO or PPO Payer-Other/Self: patient insured by other State/Local Govt insurance or Self pay
R_j, $k = hospital$	For Profit, Not for Profit, Government: dummy indicating hospital control type Teaching: dummy for teaching hospital Beds: total number of beds available at the facility Nursing intensity: nursing hours divided by patient days Capital intensity: dollar value of capital asset divided by inpatient days, (include land, land improvement, buildings, fixed equipment, leasehold improvement, movable equipment, construction in progress) Nursing Safety Index: dummy for patient safety indexes relating to nursing care, (enters as an indicator for a high-risk nursing safety hospital) Surgery Safety Index: dummy for patient Safety indexes relating to surgical care, (enters as an indicator for a high-risk surgery safety hospital)
R_j, $k = ASC$	Distance to emergency center: distance in miles to the closest emergency center Beds: total number of beds available at the facility Specialty: dummy indicating if ASC specializes in the CCS type
$Dist_{ij}$	Distance: travel distance between patient zip code centroid and facilities in choice set

Note: Distance is interacted with all patient demographics and facility characteristics other than safety.
Surgery and Nursing rates are interacted only with payer type and control type of hospital.



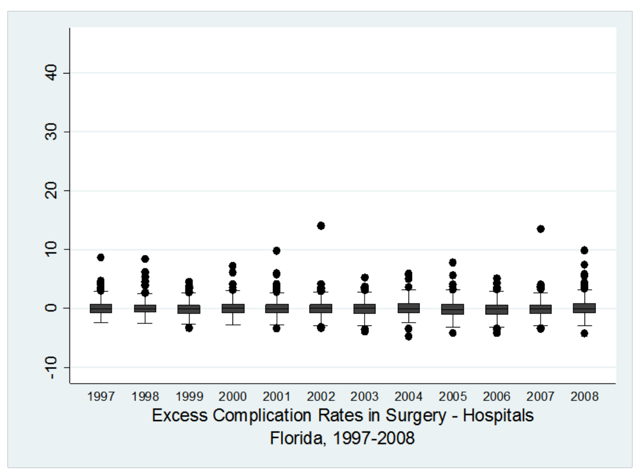


FIGURE 3. Excess Nursing and Surgery Complications, Florida Hospitals 1997-2008

Table 5. Average Summary Statistics - High-Risk and Low-Risk Hospitals, 1997-2008

	Nursing Complications				**Surgery Complications**			
	High-Risk[1]		**Low-Risk**[2]		**High-Risk**		**Low-Risk**	
Variables	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Excess Nursing Complications Rate[3]	2.78	*3.83*	0.12	*2.73*	0.44	*3.22*	0.42	*3.13*
Excess Surgery Complications Rate[3]	0.32	*1.49*	0.16	*1.48*	1.30	*1.42*	0.04	*1.22*
Beds	330	*242*	286	*213*	330	*260*	283	*205*
Inpatient Volume	14665	*12315*	13278	*11103*	14080	*11135*	12056	*9035*
For Profit (%)	0.42	*0.49*	0.42	*0.49*	0.35	*0.48*	0.43	*0.50*
Non Profit (%)	0.47	*0.50*	0.48	*0.50*	0.53	*0.50*	0.48	*0.50*
Government (%)	0.11	*0.31*	0.09	*0.29*	0.12	*0.32*	0.09	*0.29*
Teaching (%)	0.11	*0.31*	0.06	*0.24*	0.09	*0.28*	0.06	*0.24*
Nursing Intensity[4]	0.04	*0.05*	0.05	*0.08*	0.05	*0.06*	0.05	*0.07*
Capital Intensity[5]	1.39	*3.49*	1.42	*2.47*	1.61	*4.07*	1.39	*2.44*
Average N[6]	**81**		**183**		**70**		**187**	

Notes:
[1] High-Risk hospital - Hospital with a safety rate greater than one standard deviation above the average safety rate in the patient choice set.
[2] Low-Risk hospital - Hospital with a safety rate less than one standard deviation above the average safety rate in the patient choice set.
[3] Excess rate of complications per 1000 patients.
[4] Nursing hours divided by patient days.
[5] Dollar value of capital asset divided by inpatient days.
[6] Average number of High Risk and Low Risk hospitals across 1997 to 2008.

Table 6. Nested Logit Results - Nervous System and Musculoskeletal Patients

	1998		2002		2006	
Explanatory Variable	**Coeff.**	**S.E.**	**Coeff.**	**S.E.**	**Coeff.**	**S.E.**
			Bottom Level Equation			
Hospital Specific						
Nursing Safety	0.955^a	0.165	-0.800^a	0.161	0.568^a	0.114
Nursing Safety interacted with:						
Medicare	-1.078^a	0.136	0.045	0.128	-0.371^a	0.099
Medicaid	-0.44^b	0.199	0.248	0.162	-0.224^c	0.137
Commercial	-1.609^a	0.139	-0.237^c	0.127	-0.597^a	0.100
For Profit Hospital	-0.225^c	0.131	0.946^a	0.125	-0.338^a	0.082
Not For Profit Hospital	-0.518^a	0.129	0.516^a	0.118	-0.204^a	0.078
Surgery Safety	0.160	0.152	0.164	0.131	0.655^a	0.103
Surgery Safety interacted with:						
Medicare	-0.360^a	0.127	-0.86^a	0.117	-1.004^a	0.098
Medicaid	-0.200	0.200	-0.248^c	0.148	-0.233^c	0.125
Commercial	-0.322^a	0.126	-0.593^a	0.113	-0.974^a	0.096
For Profit Hospital	0.080	0.121	0.865^a	0.103	0.020	0.084
Not For Profit Hospital	0.308^a	0.110	0.321^a	0.093	0.282^a	0.067
Teaching Hospital	-0.651^a	0.064	-0.366^a	0.039	-0.289^a	0.037
Nursing Intensity	-2.056^a	0.741	-0.465^a	0.143	-1.455	2.425
Distance * Nursing Intensity	-0.038	0.034	0.039^a	0.005	0.222	0.147
Capital Intensity	-0.093^a	0.026	0.019^b	0.009	0.022^a	0.008
Distance * Capital Intensity	2.25E-04	0.002	-0.002^a	4.06E-04	-0.001^c	0.001
For Profit Hospital	0.229^a	0.052	-0.697^a	0.047	-0.225^a	0.039
Not For Profit Hospital	0.736^a	0.051	-0.147^a	0.035	0.024	0.036
ASC specific						
Specialty ASC	-1.09^a	0.054	-0.391^a	0.035	-0.021	0.026
Distance to Emergency Center	-0.17^a	0.008	-0.032^a	0.006	0.007	0.005
Distance * ASC Specialty	0.02^a	0.002	0.016^a	0.002	0.001	0.002
Common						
Beds	0.003^a	9.45E-05	0.001^a	6.27E-05	0.001^a	5.92E-05
Distance	-0.007	0.006	0.003	0.006	0.015^a	0.004
Distance interacted with:						
Beds	$-2.3\text{E-}05^a$	3.87E-06	$-5.70\text{E-}06^b$	2.40E-06	$-9.00\text{E-}06^a$	2.24E-06
Age	-0.001^a	8.38E-05	-0.001^a	7.26E-05	-0.001^a	6.23E-05
Male	0.003	0.003	0.003	0.002	0.01^a	0.002
White	-0.002	0.003	-0.001	0.003	-0.01^a	0.002
Number of procedures	-0.003^a	0.001	3.83E-05	3.88E-04	1.11E-04	3.25E-04
Number of diagnosis	0.001	0.001	-0.004^a	0.001	-0.001^a	3.07E-04
Medicare	-0.019^a	0.005	-0.017^a	0.005	-0.020^a	0.004
Medicaid	-0.018^a	0.007	-0.009^c	0.006	-0.015^a	0.005
Commercial	-0.010^a	0.004	-0.011^a	0.004	-0.011^a	0.003
			Top Level Equation (Base - ASC)			
Age	-0.013^a	0.001	-0.008^a	0.001	-0.008^a	0.001
Male	0.109^a	0.028	0.096^a	0.023	0.062^a	0.022
White	2.208^a	0.033	0.243^a	0.032	0.100^a	0.03
Medicare	2.385^a	0.063	-0.072	0.074	0.085	0.069
Medicaid	3.027^a	0.109	0.072	0.091	0.289^a	0.093
Commercial	2.621^a	0.058	-0.523^a	0.068	-0.37^a	0.064
Number of procedures	0.281^a	0.009	0.038^a	0.004	0.015^a	0.004
Number of diagnosis	0.509^a	0.013	0.267^a	0.007	-0.021^a	0.004
Dissimilarity parameters						
Hospital	1.869^a	0.054	1.300^a	0.040	1.073^a	0.035
ASC	1.235^a	0.034	1.131^a	0.031	1.055^a	0.029
p value from LR test for IIA ()	0.000		0.000		0.000	

Upper limits on the dissimilarity coefficients, for hospital nest, implied by Börsch-Supan conditions are are 2.31, 1.66 and 1.39 for years 1998, 2002 and 2006, respectively.
Upper limits on the dissimilarity coefficients, for ASC nest, implied by Börsch-Supan conditions are are 1.53, 1.31 and 1.43 for years 1998, 2002 and 2006, respectively.
[a] p-value < 0.01
[b] p-value < 0.05
[c] p-value < 0.10

Table 7. Nested Logit Results - Eye Surgery Patients

	1998		2002		2006	
Explanatory Variable	**Coeff.**	**S.E.**	**Coeff.**	**S.E.**	**Coeff.**	**S.E.**
			Bottom Level Equation			
Hospital Specific						
Nursing Safety	-0.250	0.274	-1.954^{a}	0.309	-0.253	0.177
Nursing Safety interacted with:						
Medicare	-1.139^{a}	0.207	0.805^{a}	0.221	0.336^{a}	0.130
Medicaid	-1.122^{a}	0.365	0.862^{a}	0.302	0.881^{a}	0.193
Commercial	-1.691^{a}	0.235	0.431^{c}	0.237	0.328^{b}	0.140
For Profit Hospital	0.712^{a}	0.225	1.362^{a}	0.245	-0.007	0.153
Not For Profit Hospital	1.058^{a}	0.218	0.581^{a}	0.231	-0.286^{b}	0.145
Surgery Safety	-2.794^{a}	0.299	-1.667^{a}	0.277	0.752^{a}	0.125
Surgery Safety interacted with:						
Medicare	0.436^{c}	0.233	-0.504^{a}	0.199	-0.030	0.102
Medicaid	-0.154	0.384	-0.125	0.289	-0.667^{a}	0.188
Commercial	0.955^{a}	0.242	-0.208	0.213	-0.306^{a}	0.116
For Profit Hospital	1.426^{a}	0.223	1.15^{a}	0.256	-1.01^{a}	0.146
Not For Profit Hospital	2.51^{a}	0.214	2.027^{a}	0.240	-0.59^{a}	0.102
Teaching Hospital	-1.979^{a}	0.111	-0.548^{a}	0.068	0.357^{a}	0.047
Nursing Intensity	9.841^{a}	0.992	2.75^{a}	0.202	0.315	2.799
Distance * Nursing Intensity	0.072	0.046	-0.015^{a}	0.006	0.213	0.158
Capital Intensity	0.032	0.023	0.013^{c}	0.007	0.066^{a}	0.010
Distance * Capital Intensity	-1.5E-05	0.001	0.001^{a}	2.71E-04	-1.55E-04	0.001
For Profit Hospital	-0.554^{a}	0.073	-0.577^{a}	0.067	0.100	0.077
Not For Profit Hospital	-0.071	0.065	-0.097^{c}	0.055	0.692^{a}	0.076
ASC specific						
Specialty ASC	0.625^{a}	0.025	1.002^{a}	0.031	1.058^{a}	0.032
Distance to Emergency Center	0.027^{a}	0.004	-0.008^{c}	0.005	0.015^{a}	0.004
Distance * ASC Specialty	0.021^{a}	0.001	0.032^{a}	0.002	0.022^{a}	0.001
Common						
Beds	0.003^{a}	1.06E-04	0.001^{a}	8.54E-05	8.28E-05	7.17E-05
Distance	-0.009^{c}	0.006	0.015^{b}	0.006	0.005	0.005
Distance interacted with:						
Beds	$-3.5\text{E-}05^{a}$	4.77E-06	$8.34\text{E-}06^{b}$	3.51E-06	$9.97\text{E-}06^{a}$	3.19E-06
Age	$-4.89\text{E-}04^{a}$	6.98E-05	$-4.06\text{E-}04^{a}$	7.97E-05	$-2.34\text{E-}04^{a}$	6.65E-05
Male	0.004^{a}	0.001	0.006^{a}	0.002	0.001	0.002
White	-0.039^{a}	0.002	0.007^{b}	0.003	0.001	0.002
Number of procedures	-0.008^{a}	0.001	0.001^{a}	4.32E-04	0.003^{a}	3.67E-04
Number of diagnosis	-0.003^{a}	0.001	-0.004^{a}	0.001	-0.003^{a}	3.82E-04
Medicare	0.028^{a}	0.003	-0.051^{a}	0.004	-0.037^{a}	0.003
Medicaid	0.013^{b}	0.006	-0.02^{a}	0.006	-0.012^{b}	0.005
Commercial	0.044^{a}	0.004	-0.032^{a}	0.004	-0.034^{a}	0.003
			Top Level Equation (Base - ASC)			
Age	-0.022^{a}	0.001	-0.027^{a}	0.001	-0.035^{a}	0.001
Male	-3.74E-04	0.032	0.091^{a}	0.032	0.116^{a}	0.033
White	1.846^{a}	0.039	-0.142^{a}	0.045	-0.162^{a}	0.042
Medicare	1.386^{a}	0.075	-0.378^{a}	0.083	-0.266^{a}	0.072
Medicaid	2.169^{a}	0.124	-0.058	0.122	-0.151	0.112
Commercial	1.678^{a}	0.080	-0.634^{a}	0.084	-0.631^{a}	0.073
Number of procedures	0.516^{a}	0.015	0.133^{a}	0.007	0.089^{a}	0.007
Number of diagnosis	1.008^{a}	0.019	0.478^{a}	0.011	0.064^{a}	0.007
Dissimilarity parameters						
Hospital	1.841^{a}	0.059	1.253^{a}	0.045	0.790^{a}	0.027
ASC	1.011^{a}	0.03	1.285^{a}	0.028	1.110^{a}	0.026
p value from LR test for IIA ()	0.000		0.000		0.000	

Upper limits on the dissimilarity coefficients, for hospital nest, implied by Börsch-Supan conditions are are 1.55, 1.35 and 1.23 for years 1998, 2002 and 2006, respectively.
Upper limits on the dissimilarity coefficients, for ASC nest, implied by Börsch-Supan conditions are are 2.81, 3.03 and 3.16 for years 1998, 2002 and 2006, respectively.
[a] p-value < 0.01
[b] p-value < 0.05
[c] p-value < 0.10

Table 8. Nested Logit Results - Digestive System Patients

	1998		2002		2006	
Explanatory Variable	**Coeff.**	**S.E.**	**Coeff.**	**S.E.**	**Coeff.**	**S.E.**
			Bottom Level Equation			
Hospital Specific						
Nursing Safety	0.381^a	0.120	-0.83^a	0.142	0.047	0.102
Nursing Safety interacted with:						
Medicare	-0.631^a	0.104	0.225^c	0.119	-0.004	0.091
Medicaid	-0.479^a	0.149	0.525^a	0.147	-0.172	0.122
Commercial	-1.128^a	0.110	-0.035	0.117	-0.196^b	0.090
For Profit Hospital	0.226^a	0.091	0.337^a	0.099	-9.3E-05	0.067
Not For Profit Hospital	0.215^a	0.087	0.524^a	0.094	-0.268^a	0.069
Surgery Safety	0.303^a	0.112	0.668^a	0.107	0.312^a	0.085
Surgery Safety interacted with:						
Medicare	-0.566^a	0.099	-1.338^a	0.105	-0.529^a	0.082
Medicaid	-0.706^a	0.155	-0.378^a	0.126	-0.328^a	0.105
Commercial	-0.436^a	0.098	-1.187^a	0.100	-0.659^a	0.081
For Profit Hospital	-0.085	0.083	0.555^a	0.082	0.101	0.068
Not For Profit Hospital	0.311^a	0.075	0.204^a	0.075	0.522^a	0.058
Teaching Hospital	-0.967^a	0.056	-0.816^a	0.041	-0.049^c	0.029
Nursing Intensity	-8.791^a	0.643	-0.496^a	0.113	-32.924^a	4.777
Distance * Nursing Intensity	0.042	0.032	0.036^a	0.004	1.182^a	0.184
Capital Intensity	0.028	0.019	-0.020	0.015	0.051^a	0.007
Distance * Capital Intensity	0.005^a	0.001	0.005^a	0.001	-2.83E-04	3.77E-04
For Profit Hospital	-0.082^b	0.037	-0.292^a	0.031	-0.187^a	0.034
Not For Profit Hospital	0.385^a	0.036	-0.010	0.027	0.082^a	0.031
ASC specific						
Specialty ASC	0.777^a	0.029	0.567^a	0.024	0.773^a	0.025
Distance to Emergency Center	-0.020^a	0.006	-0.049^a	0.004	-0.043^a	0.004
Distance * ASC Specialty	0.023^a	0.002	0.015^a	0.001	0.008^a	0.001
Common						
Beds	0.002^a	8.88E-05	0.001^a	5.75E-05	0.001^a	4.82E-05
Distance	-0.013^a	0.005	0.012^a	0.005	0.032^a	0.004
Distance interacted with:						
Beds	-1.18E-05^a	2.93E-06	0^a	2.43E-06	-1.12E-05^a	2.41E-06
Age	-0.001^a	6.81E-05	-0.001^a	6.95E-05	-0.001^a	5.97E-05
Male	0.007^a	0.002	0.007^a	0.002	0.001	0.001
White	-0.034^a	0.002	-0.01^a	0.002	-0.013^a	0.002
Number of procedures	-0.006^a	0.001	-0.001^a	3.50E-04	3.31E-07	3.03E-04
Number of diagnosis	-0.002^a	0.001	-0.005^a	0.001	-0.004^a	3.67E-04
Medicare	0.019^a	0.004	-0.034^a	0.004	-0.038^a	0.003
Medicaid	-0.002	0.007	-0.021^a	0.005	-0.023^a	0.004
Commercial	0.015^a	0.004	-0.024^a	0.004	-0.035^a	0.002
			Top Level Equation (Base - ASC)			
Age	-0.017^a	0.001	-0.021^a	0.001	-0.022^a	0.001
Male	0.014	0.028	0.033	0.022	0.066^a	0.022
White	1.621^a	0.033	0.022	0.030	0.209^a	0.027
Medicare	1.445^a	0.067	-0.499^a	0.093	0.005	0.068
Medicaid	2.515^a	0.119	-0.208^c	0.119	0.597^a	0.094
Commercial	1.738^a	0.064	-0.806^a	0.090	-0.471^a	0.064
Number of procedures	0.604^a	0.015	0.095^a	0.005	0.035^a	0.004
Number of diagnosis	0.745^a	0.014	0.337^a	0.008	-0.03^a	0.004
Dissimilarity parameters						
Hospital	1.202^a	0.044	0.944^a	0.032	0.768^a	0.029
ASC	0.755^a	0.023	0.643^a	0.019	0.735^a	0.020
p value from LR test for IIA ()	0.000		0.000		0.000	

Upper limits on the dissimilarity coefficients, for hospital nest, implied by Börsch-Supan conditions are are 2.41, 1.63 and 1.27 for years 1998, 2002 and 2006, respectively.
Upper limits on the dissimilarity coefficients, for ASC nest, implied by Börsch-Supan conditions are are 1.49, 1.34 and 1.58 for years 1998, 2002 and 2006, respectively.

^{a} p-value < 0.01
^{b} p-value < 0.05
^{c} p-value < 0.10

Table 9. Selected Marginal Effects (% change) based on Nested Logit Results

	1998	2002 Average	2006
		Nervous System & Musculoskeletal	
Hospital Nest			
High-Risk (Surgery Safety), All	0.23	-0.31	-0.72
For Medicare	-0.05	-1.94	-1.65
For Commercial	0.21	0.10	-1.08
High-Risk (Nursing Safety), All	-3.66	-2.27	-0.93
For Medicare	-2.95	-1.31	-0.26
For Commercial	-6.17	-3.19	-1.84
Distance from the Patient	-0.39	-0.40	-0.33
ASC Nest			
Specialty	-6.65	-1.83	-0.06
Distance from the Patient	-0.39	-0.41	-0.37
ASC Distance to Emergency Center	-1.29	-0.29	0.07
		Eye Surgery	
Hospital Nest			
High-Risk (Surgery Safety), All	-0.98	-1.34	0.10
For Medicare	-1.26	-1.60	0.36
For Commercial	0.43	-0.82	-0.51
High-Risk (Nursing Safety), All	-1.71	-1.74	-0.62
For Medicare	-1.37	-1.17	-0.49
For Commercial	0.43	-0.82	-0.51
Distance from the Patient	-0.16	-0.13	-0.12
ASC Nest			
Specialty	12.86	16.72	16.99
Distance from the Patient	-0.41	-0.42	-0.43
ASC Distance to Emergency Center	0.40	-0.09	0.19
		Digestive System	
Hospital Nest			
High-Risk (Surgery Safety), All	-0.38	-1.89	0.54
For Medicare	-1.07	-3.35	0.83
For Commercial	0.04	-2.02	-0.20
High-Risk (Nursing Safety), All	-2.04	-3.13	-1.82
For Medicare	-0.43	-1.82	-0.86
For Commercial	-4.52	-4.20	-2.38
Distance from the Patient	-0.51	-0.57	-0.42
ASC Nest			
Specialty	9.36	9.15	11.30
Distance from the Patient	-0.38	-0.74	-0.67
ASC Distance to Emergency Center	-0.18	-0.63	-0.56

Notes:
The table presents average marginal effects.
The safety related (High-Risk) marginal effects are presented at an all level as well as divided by Medicare and Commercial payer type.
'Specialty' indicates the marginal effect for being a specialty ASC.

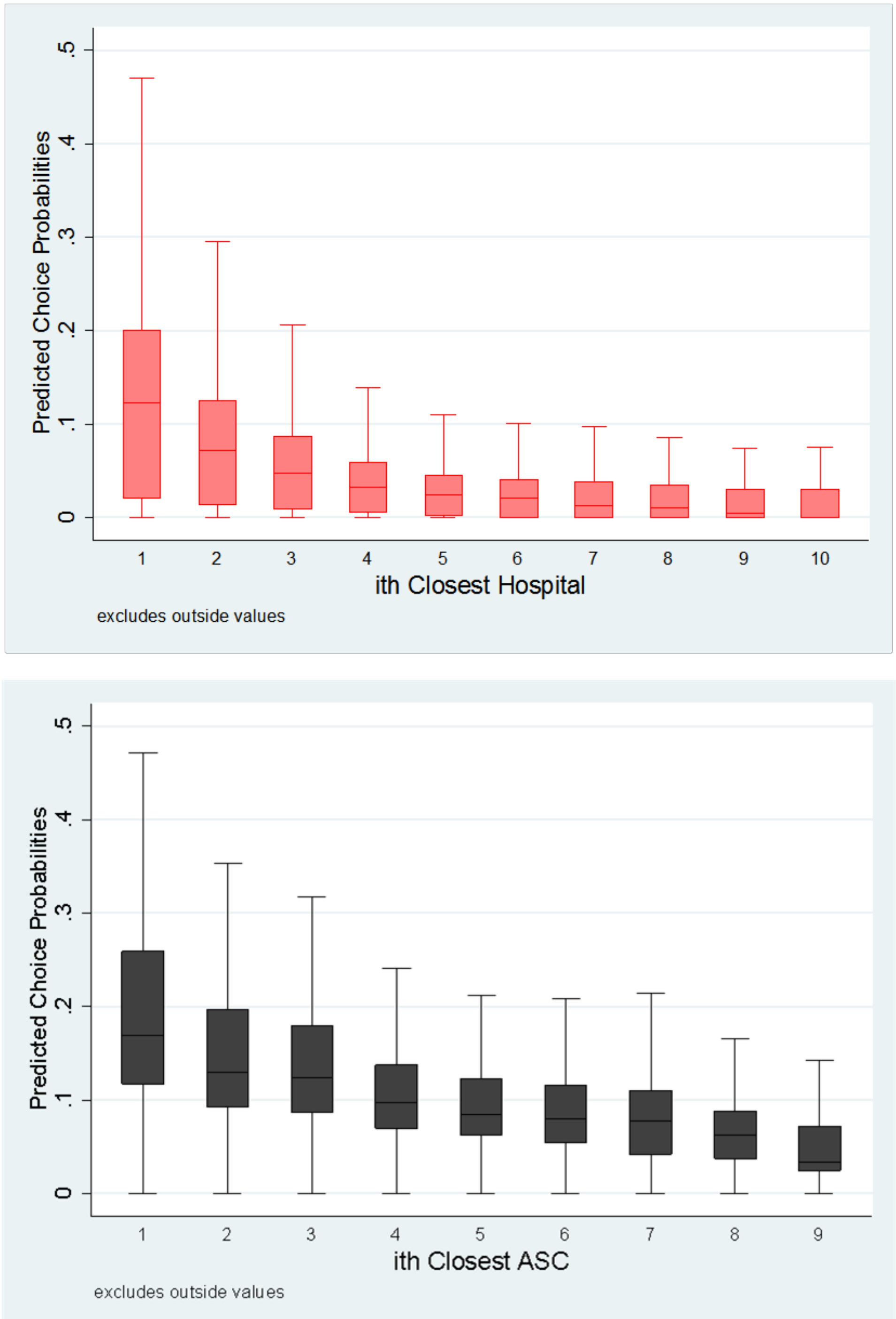


FIGURE 4. Predicted Choice Probability for the ith Closest Facility

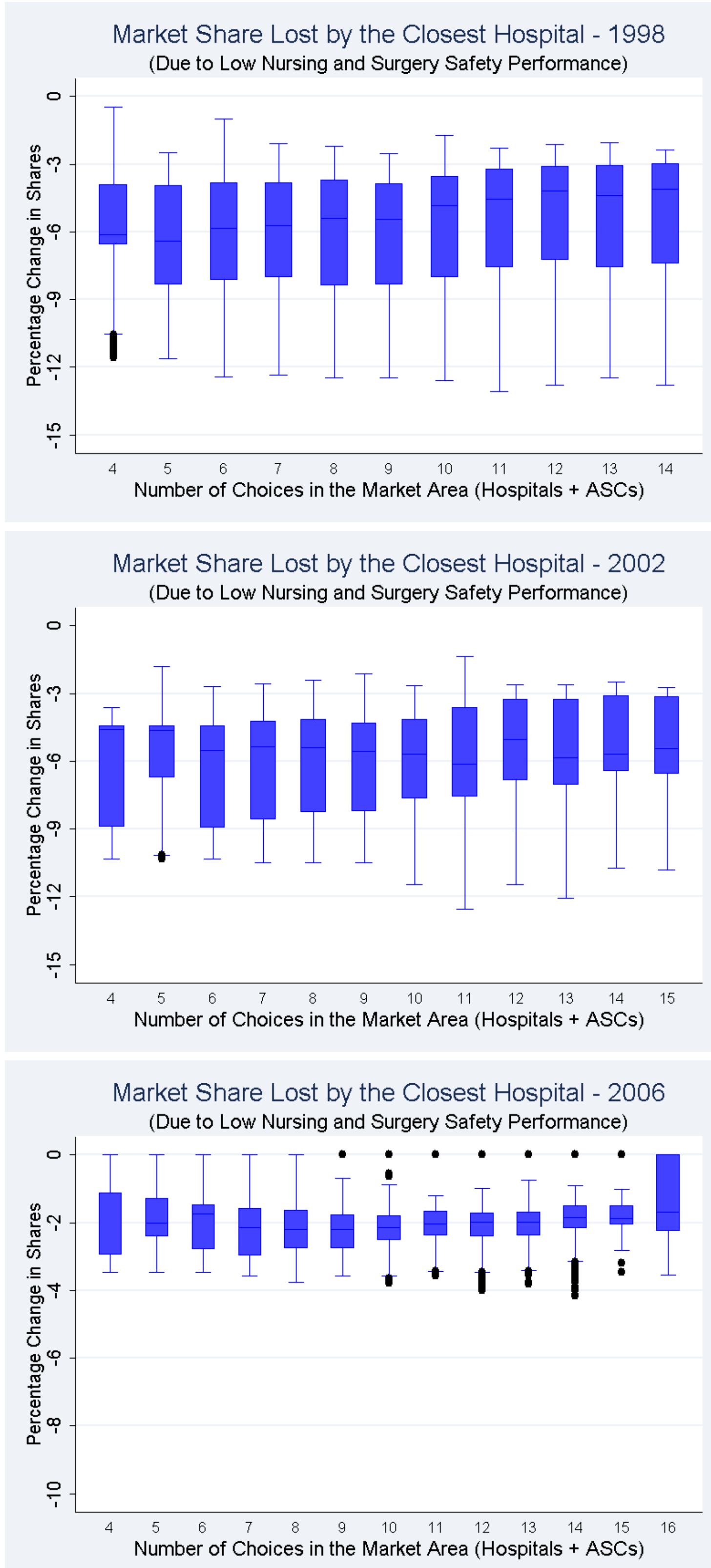


FIGURE 5. Simulated Marginal Effect - Loss of Market Share for a High-Risk Hospital (Both, Low Nursing and Surgery Safety)

Table 10. Simulated Share (%) Change (When Closest Hospital turns High-Risk)

	1998	2002	2006
		Loss/Gain (%)	
Market Share Change for[1]:			
Nervous System & Musculoskeletal			
Closest Hospital[2]	-5.51	-3.83	-2.63
Second Closest Hospital	0.65	0.63	0.4
Closest Ambulatory Surgery Center	1.84	0.99	0.54
All hospitals in the choice set[3] (Lost to ASCs)	-3.79	-2.35	-1.68
Eye Surgery			
Closest Hospital	-8.72	-5.84	-1.25
Second Closest Hospital	0.05	0.24	0.14
Closest Ambulatory Surgery Center	3.29	2.22	0.35
All hospitals in the choice set (Lost to ASCs)	-8.04	-5.1	-0.93
Digestive System			
Closest Hospital	-3.49	-8.62	-1.81
Second Closest Hospital	0.79	1.93	0.35
Closest Ambulatory Surgery Center	0.84	1.99	0.4
All hospitals in the choice set (Lost to ASCs)	-1.72	-4.52	-1.07

Notes:
[1] Change measured for various facilities when the closest hospital to the patient becomes a high-risk hospital
[2] Closeness is measured from patient zip code residence.
[3] Change in the choice probability of the hospital nest.

Table 11. Descriptive Statistics for Entry Model Variables

Variable	Mean	Std. Dev
Predicted volume - Multi Specialty entrant	25.27	13.99
Predicted volume - Nervous & Musculoskeletal entrant	8.16	5.50
Predicted volume - Eye Surgery entrant	23.99	18.35
Predicted volume - Digestive System entrant	12.94	7.44
Volume treated at high-risk hospitals (nursing)	6.86	6.80
Volume treated at high-risk hospitals (surgery)	7.67	7.95
No. of high-risk nursing safety hospitals	10.21	6.49
No. of high-risk surgery safety hospitals	9.00	5.21

Notes:
Predicted volumes and volumes at high-risk hospitals are in 1000's.
Volume at high-risk hospitals is the outpatient volume served in the potential entrant's market service area.
Number of high-risk hospitals is measured for the potential market service area of the entrant.

Table 12. Coefficient Estimates from the Entry Model - Probit Results

Model	(1) Baseline	(2) Nursing	(3) Complications	(4) Surgery	(5) Complications
Predicted volume - Multi Specialty entrant	0.277^a	0.195^a	0.171^b	0.168^b	0.179^b
	(0.075)	*(0.081)*	*(0.09)*	*(0.081)*	*(0.081)*
Predicted volume - Nervous & Musculoskeletal entrant	0.270^a	0.199^a	0.180^b	0.181^b	0.179^b
	(0.076)	*(0.081)*	*(0.088)*	*(0.079)*	*(0.081)*
Predicted volume - Eye Surgery entrant	0.102	0.040	0.003	0.020	0.006
	(0.081)	*(0.084)*	*(0.094)*	*(0.085)*	*(0.087)*
Predicted volume - Digestive System entrant	0.266^a	0.187^b	0.170^b	0.158^b	0.171^b
	(0.076)	*(0.082)*	*(0.089)*	*(0.082)*	*(0.082)*
Safety Measures					
No. of high-risk hospitals		0.128^a	-	0.190^a	-
		(0.048)		*(0.047)*	
Volume of patients treated at high-risk hospitals		-	0.124^b	-	0.152^a
			(0.059)		*(0.049)*
d(Pr entry)/d(Safety measure)		**2.4%**	**2.3%**	**3.5%**	**2.8%**
N=1496					

Notes:
Standard errors in parenthesis.
Explanatory variables enter as z-scores in all the specifications.
Number of high-risk hospitals is measured for the potential market service area of the entrant and the effect is estimated separately for high-risk hospitals due to nursing complications and high-risk due to surgery complications.
Outpatient volume treated at high-risk hospitals is measured for the potential market service of the entrant.
Predicted probability of entry on average, across specifications, is 11%.
[a] p-value < 0.01
[b] p-value < 0.05
[c] p-value < 0.10

9. Appendix

According to the Daly-Zachary-McFadden (DZM) conditions in Börsch-Supan (1990), for consistency with stochastic utility maximization, the dissimilarity coefficients are required to lie within the unit interval. This condition ensures the non-negativity of the density function. However, Börsch-Supan (1990) pointed out that the condition is too stringent and suggested that the nested logit specification should be viewed as an approximation to the true underlying demand system and that the stochastic utility maximization should not be expected to hold globally, but only for the data points sensible for specific application of the choice model.

Herriges and Kling (1996) while correcting the mistake in Börsch-Supan (1990), lay down the relaxed consistency conditions. These conditions, in turn, are derived from the differentiation of the joint probability term in the nested logit. Relying on their theorem 1 and its corollary, the necessary restrictions (we call them Börsch-Supan conditions), in a two level nested logit model, on the dissimilarity coefficients using the terminology from this paper can be written as:

$$\lambda_k \leq \frac{1}{1 - P_{iB_k}}, \; k = \textit{hospital or ASC}$$

and,

$$\lambda_k \leq \frac{4}{3(1 - P_{iB_k}) + [(1 + 7P_{iB_k})(1 - P_{iB_k})]^{1/2}}$$

Here, P_{iB_k} is the marginal probability of choosing nest k and λ_k is the dissimilarity coefficient. Out of the two conditions given above, it's the second condition that is more restrictive and provides an upper bound that is comparable to the DZM's bound of 1 for global maximization. Herriges and Kling (1996) in their paper, provide a descriptive analysis of what upper limits these conditions imply for different nest choice probabilities. For instance, with the nest choice probability of 0.5, the upper bound comes out to be 1.28.

We estimated nested logit models for a twelve year period from 1997 to 2008, for three CCS type models of Nervous System and Musculoskeletal System, Eye Care and Digestive System. The dissimilarity coefficients in our estimations from 1997, 1998 and 1999 are much higher than 1 for the hospital nest, especially in the case of Eye Care models. Using the average marginal probability of nest choice from our estimation sample, we find that the Börsch-Supan conditions are easily met in all 36 of our estimations, except for the Eye Care models in year 1997, 1998 and 1999. The limits implied and the actual dissimilarity coefficients, for the results not presented here, are available on request from the authors.