Costs and Benefits of Competing Health Care Providers:
Trade-Offs in the Outpatient Surgery Market

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ABSTRACT

Over the past 30 years, outpatient surgery has become an increasingly important part of medical care in the United States. This paper examines ambulatory surgery centers (ASCs), which have been praised as a low-cost, convenient alternative to outpatient surgery in hospitals, but criticized for "cream skimming" profitable patients and procedures, important sources of revenue for general hospitals. For a national sample of Medicare patients that varies over time and controlling for physician fixed effects, we show that ASCs treat healthier patients than hospital outpatient departments—the highest risk quartile of patients were half as likely to be treated in an ASC than those in the healthiest quartile. Controlling for patient characteristics, we find that ASCs perform procedures faster than hospital outpatient departments. Combined with the fact that ASCs receive lower reimbursements than hospitals, outpatient surgery is less costly in ASCs. To the extent that ASCs provide cheaper and faster care than hospitals, we then consider whether they do so at the expense of quality of care. Using the variation in ASC use generated by exogenous changes in Medicare payments, we find that treatment in an ASC is associated with better health outcomes, holding patient risk constant; in fact, high-risk patients treated in an ASC are less likely to be admitted to a hospital within 7 days of an outpatient surgery, and less likely to visit an ER on the same day as an outpatient surgery. These results suggest that health policy planners have to trade off the superior and cheaper treatment in ASCs against the subsidy outpatient surgeries provide to hospitals.

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1. Introduction

Technological developments in medicine have drastically changed the provision of surgical care in the United States over the last 30 years. Advances in anesthesia and laparoscopic techniques in the 1980s and 1990s made it possible for patients who previously spent days in the hospital recovering from a surgical procedure to instead be discharged the same day as surgery (Sloss et al. 2006, Kozak et al. 1999). The introduction of the inpatient prospective payment system (IPPS) in 1983 created additional incentives for hospitals to shift patient care from inpatient to outpatient departments (Leader and Moon 1989). Subsequently, the number of outpatient surgeries nationwide increased considerably, from 3.5 million in 1981 to over 17 million in 2010, and outpatient procedures now represent roughly 60 percent of all surgeries (Avalere Health and American Hospital Association 2007 and 2011).

A large part of the growth in outpatient surgery has occurred in ambulatory surgical centers (ASCs). Whereas hospitals with outpatient departments provide other types of care, such as inpatient and emergency services, ASCs exclusively provide outpatient surgery. The share of all outpatient procedures performed in ASCs grew from 4 percent in 1981 to almost 40 percent in 2005 (Avalere Health and American Hospital Association 2007 and 2011). Over 90 percent of ASCs are physician-owned, and 96 percent are for-profit (ASC Association 2007, MedPAC 2010).[1] Since surgeons often have operating privileges in both freestanding ASCs and hospitals, they may choose to refer patients to either type of outpatient setting.

ASCs have been praised for their potential to provide less expensive, faster services for low-risk procedures, and more convenient locations for patients and physicians (Hair, Hussy, and Wynn 2012, Paquette et al. 2008, Grisel et al. 2009, Haugh 2006, Government Accountability Office 2006). Additionally, since most surgery centers focus on a limited number of services, ASCs may provide higher quality care at a lower cost than hospital outpatient departments that provide a broad range of services

[1] Only 18 percent of U.S. general hospitals are for-profit and less than one percent are physician-owned (American Hospital Association 2012, Silva 2010). Due to the federal "Stark Law," physicians are prohibited from referring Medicare or Medicaid patients to hospitals with which they have a financial relationship (e.g., investment or ownership), limiting physician ownership of general hospitals. However, the law exempts physicians who have an ownership stake in an entire hospital, such as an ASC or specialty hospital. See Casalino (2008) for more details on the Stark laws.

(Casalino, Devers, and Brewster 2003). The U.S. Office of the Inspector General has promoted "greater utilization of ASCs because of the substantial cost savings to Federal health care programs when procedures are performed in ASCs rather than in more costly hospital inpatient or outpatient facilities" (Office of the Inspector General 1999). If ASCs provide faster, cheaper outpatient services, do they do so at the expense of quality of care or breadth of procedures?

Critics of ASCs argue that these facilities "cream skim" or "cherry pick" more profitable patients and procedures, drawing patients who are more likely to have better outcomes, as well as important revenue streams, from hospitals. Representing the American Hospital Association (AHA) at a Federal Trade Commission hearing in 2003, the CEO of the AtlantiCare hospital system noted that, "The rapid growth of specialty care providers threatens community access to basic health services and jeopardizes patient safety and quality of care" (Lynn 3/27/03, p. 27-28).[2] In response to arguments that ASCs face lower costs than hospital outpatient departments, the Centers for Medicare and Medicaid Services (CMS) froze ASC payment rates in 2003 and has steadily reduced ASC payments, while increasing payments to hospital outpatient departments, since 2008. Despite the rapid growth in ASCs and the policy responses to this growth, there is little empirical evidence backing the claims attributed to them. Likewise, there has been almost no research examining the impact on ASC operation of such policy factors as reimbursement rates.

In this paper, we fill this void by addressing two questions about ambulatory surgery centers. First, do ASCs treat a different patient mix than hospitals? Physicians, ASCs, and hospital outpatient departments each receive a separate payment for every outpatient procedure, which does not vary by the health of the patient. Therefore, one way to increase ASC profitability is to substitute towards relatively healthier patients who may be less costly to treat. This may be a particularly acute problem for hospitals if surgeons have access to both the ASC and hospital sectors. In a cross sectional data set, it is difficult to identify cream skimming if physicians have different client bases and receive different payments based on

[2] Examples of specialty hospitals, as described by Lynn, include ambulatory surgery centers, children's hospitals, psychiatric hospitals, heart hospitals, cancer hospitals, dialysis clinics, pain centers, imaging centers, and mammography centers.

where a procedure is performed. We circumvent both problems by using Medicare claims from 2007 through 2009. We restrict our analysis to Medicare patients in order to study a subset of patient claims that do not vary by insurer. The Medicare data also contain unique physician identifiers, which allows us to control for the underlying patient case mix for physicians via physician fixed effects. Our model then asks whether, holding physician constant, physicians sent risker patients to one sector or another. We construct a measure of patient risk using ICD-9 diagnosis codes, age, and sex. We find that holding the identity of the physician constant, the probability of the surgery being performed in an ASC is monotonically decreasing in patient risk. Patients in the highest risk quartile were half as likely to be treated in an ASC compared to those in the healthiest quartile.

As part of this analysis, we estimate cost differences between procedures performed in ASCs and hospital outpatient departments, and between patients of different levels of underlying health. Since ASCs have not historically reported cost data to organizations such as Medicare or Medicaid, this question is at present difficult to address. It is made more difficult by the fact that we demonstrate that ASCs treat much healthier patients than hospitals. Despite these limitations, we can infer one aspect of cost: the time it takes to perform procedures. Using data from the 2006 National Survey of Ambulatory Surgery, we establish that holding physician characteristics (including risk score) constant, it takes substantially longer to perform outpatient surgeries in a hospital setting than in an ASC. Therefore, given a fixed capacity at any point in time, ASCs can perform more procedures per day than hospitals. After controlling for patient characteristics, patients spend nearly 26 percent less time in ASCs than in hospitals for outpatient procedures. The disparity in the time per procedure is also a function of patient risk level. Not surprisingly, our results indicate that patient health is a strong predictor of time spent in surgery and in post-operative care. Holding facility constant, patients in the highest quartile of patient risk take 13 percent longer in surgery than the healthiest quartile of patients. This suggests an important mechanism through which cream skimming could directly affect hospital volume and revenue if hospitals treat increasingly unhealthy patients.

The second question our research addresses is: do ASCs provide superior care to hospital outpatient departments? One argument in favor of ASCs is that they may offer higher quality care due to specialization. However, if hospitals are better equipped to treat high-risk patients than surgery centers, we may expect that treating higher risk patients in ASCs will have negative consequences for patient outcomes. In order to address this question, we use exogenous changes in facility fees across outpatient setting, procedure, and over time that affect a physician's decision about whether to treat patients in an ASC or a hospital. In the Medicare program, there are two types of payments for each surgical procedure. The first is a physician payment that is the same amount per procedure regardless of where the procedure if performed. The second is a facility fee that varies over time and by procedure, where the fee is a function of the setting in which the procedure is performed. Medicare payments for outpatient services are set according to federally determined payment groups and adjusted for local labor costs using the hospital inpatient wage index. Medicare fees for ASCs and hospital outpatient facilities have historically been based on different payment systems, so the ratio of the two payments varies across procedure, time, and geographic area.

We estimate the relationship between scaled ASC payments, interacted with a patient's risk score quartile, and whether a patient was treated in an ASC. We find that Medicare facility fees are an important determinant of whether a patient was treated at an ASC or a hospital, and that as ASC payments increase relative to hospital payments, riskier patients are treated in ASCs. Although the riskiest quartile of patients are much less likely to be treated in an ASC than the healthiest quartile, a 0.1 increase in the ASC/hospital payment ratio is associated with a .013 percentage point (2.7 percent) increase in the probability of being treated in an ASC for this group.

We examine health outcomes associated with treating higher risk patients in surgery centers by focusing on two quality of care measures: inpatient admission and ER visits on the same day as, 1 to 7 days after, and 8 to 30 days after an outpatient procedure. Since Medicare facility fees are determined nationally, they represent a plausibly exogenous source of variation at the local-level. We use the interaction between a patient's risk score quartile and the ASC/hospital payment ratio in his or her hospital region as an exogenous source of variation in ASC treatment, to examine differences in patient outcomes across facility settings. We find that ASC treatment reduces the probability of 7-day inpatient admission and same day ER visits for patients with the greatest morbidity. This suggests that ASCs provide higher quality care than hospital outpatient departments, even for the riskiest patients.

A number of papers have documented that increased competition with ASCs is associated with lower hospital outpatient volume (Courtemanche and Plotzke 2010, Lynk and Longley 2002, Bian and Morrisey 2007), and anecdotal evidence suggests that hospitals respond to losing profitable cases to ASCs by raising prices for other hospital service lines (Berenson, Bodenheimer, Pham 2006, MedPAC 2006). To date, proponents and critics of ASCs have predominantly voiced their appeals in isolation of one another, without acknowledging the trade-offs that exist between providing cost-effective, high quality care, and subsidizing less profitable procedures and patients. In this paper, we use exogenous variation in Medicare facility payments to inform this trade-off. Our findings indicate that ASCs do in fact provide faster, cheaper, and better outpatient care, but, as this prior literature illustrates, this may come at the cost of reducing revenue sources from hospitals that provide services which may be socially important.

2. Background

2.1 Growth in Outpatient Procedures and Ambulatory Surgery Centers

Outpatient surgery (i.e., ambulatory surgery) is surgery that does not require an overnight stay. In 2010, 64 percent of surgeries in the U.S. were done on an outpatient basis, in hospital outpatient departments, ambulatory surgery centers, and physician offices (American Hospital Association 2011). The number of outpatient surgeries has grown considerably in the U.S. since the early 1980s. Figure 1 shows the growth in outpatient surgeries accompanied by a decline in inpatient surgeries between 1981 and 2010. Previous research on the outpatient surgery market has attributed much of its growth to two factors: technological advances in medicine, and changes in Medicare reimbursement policy (FASA 2005, Koenig et al. 2009). Indeed, Figure 1 indicates that most of the change in outpatient surgeries occurred in the early 1980s, when Medicare both began covering procedures performed in ASCs and also introduced the Inpatient Prospective Payment System (IPPS), and leveled out in 2002, shortly after Medicare introduced the Outpatient Prospective Payment System (OPPS). Inpatient surgeries declined until about 1995, and have since remained constant. These trends suggest that between 1981 and 1995, there was substitution of outpatient for inpatient surgeries, as well as expansion in the surgery market.

CMS defines an ambulatory surgery center (ASC) as a "distinct entity that operates exclusively for the purpose of providing surgical services to patients not requiring hospitalization and in which the expected duration of services would not exceed 24 hours following an admission" (Ambulatory Surgical Services 2009). The share of all outpatient surgeries in freestanding ASCs increased from 4 percent of the market in 1981 to 38 percent in 2005, shown in Figure 2. While the share of surgeries performed in physician offices grew over this period as well, ASCs in particular have posed a competitive threat to hospitals. Hospital executives have expressed concern that ASCs have potentially "unfair" cost advantages because they treat healthier patients, are not required to provide unprofitable services, and are less regulated than hospitals (Casalino, Devers, Brewster 2003, Vogt and Romley 2009).[3] Accordingly, hospital systems and industry organizations like the American Hospital Association (AHA) have waged "a full scale attack on niche providers through their lobbying efforts" (Cimasi 2005). CMS has also made deliberate efforts to change policies to encourage treatment in one type of facility over another (Scully 3/23/03, p. 46).

The vast majority of ASC patients are covered by private insurance or Medicare. Figure 3 shows the number of outpatient surgeries in ASCs and hospitals by insurance type for 1996 and 2006. The number of surgeries in ASCs has increased relative to the number of surgeries in hospitals for all types of insurance coverage categories (private or commercial, Medicare, Medicaid, self-pay, and other).[4] Among

[3] All Medicare-certified ASCs must be certified by a state agency, or private accredited. Although facilities must initially obtain this qualification, the Office of Inspector General has criticized CMS for insufficient oversight of states and accreditors regarding recertification and compliance, leading to very lenient regulation of ASCs. CMS also requires participating hospitals to comply with patients' rights requirements and implement quality improvement programs, which it does not require of ASCs (CMS 2003, Office of Inspector General 2002).
[4] Other insurance types include TRICARE, worker's compensation, and other government insurance.

Medicare patients, the number of surgeries in ASCs grew nearly 300 percent, compared to an 18 percent increase in the number of surgeries in hospital outpatient departments.

2.2 Overview of Medicare Payments

Before examining changes in the ASC market for Medicare patients, it is instructive to outline the structure of Medicare payments for outpatient surgical procedures. For any surgical procedure, Medicare payments are separated into three components: a facility fee (e.g., to cover overhead costs, nursing and tech staff, and equipment and drugs directly related to the procedure), professional (physician) fees, and fees for other services (e.g., physical therapy, a skilled nursing facility, and durable medical equipment). While physicians receive the same amount for an outpatient procedure regardless of whether it occurred in an ASC or a hospital, facility payments differ across settings. In general, reimbursements for outpatient procedures in hospitals are set higher than in ASCs because hospitals must meet additional regulatory requirements and treat patients who are more medically complex (MedPAC 2003b). For example, in 2003, the national facility fee for a cataract removal was $973 in an ASC and $1,160 in a hospital. However, that same year, the facility fee for an upper gastrointestinal (GI) endoscopy was $446 in an ASC and $387 in a hospital (MedPAC 2003a). Over 90 percent of ASCs are at least partly owned by physicians. When a physician treats a patient in an ASC over which he or she has some ownership, that physician captures part of the facility fee from Medicare. Consequently, previous research has found that physicians with financial interests in hospitals have a higher rate of self-referrals, and volume in surgery centers is higher for physician owners than non-owners (Yee 2011, He and Mellor 2012, Mitchell 2008 and 2010, Casalino 2008, Lynk and Longley 2002).

Differences between ASC and hospital outpatient payments have varied over time. When Medicare first started covering outpatient procedures in 1982, hospital procedures were reimbursed using a cost-based system where ASC procedures were grouped into one of 4 payment categories based on cost and clinical similarity, and every procedure in a particular category was reimbursed at the same rate. Importantly, across both settings, facilities were paid the same fee for a procedure regardless of the health of the patient. These payments were updated annually for inflation—hospital procedures by the hospital market basket and ASC procedures by the Consumer Price Index for All Urban Consumers (CPI-U)—but were not otherwise adjusted until Medicare expanded to eight payment groups in 1990, and nine in 1991 (MedPAC 2010).

In 2000, Medicare's traditional cost-based reimbursement system for outpatient care in hospitals was replaced with the Outpatient Prospective Payment System (OPPS). Like the payment group structure of ASCs, OPPS established 200 Ambulatory Payment Classifications (APCs) for hospital outpatient procedures. Noting the drastic growth in ASCs relative to hospital outpatient departments around the same time, CMS subsequently made efforts to reduce ASC payments. In the 2003 Federal Trade Commission hearings on health care and competition, the former Administrator of CMS, Thomas Scully, remarked, "I can tell you when I drive around the country and see where ASCs are popping up, I can tell who we're overpaying" (Scully 2/26/03, p. 46). The Medicare Prescription Drug, Improvement, and Modernization Act of 2003 froze ASC payment updates and directed the Government Accountability Office (GAO) to examine the relative costs of procedures performed in ASCs and hospital outpatient departments to inform implementation of a new cost structure by January 1, 2008 (GAO 2006). Between 2008 and 2011, Medicare phased in a new system for ASC payments based on the 200 Ambulatory Payment Classifications (APC) in the OPPS, and expanded the number of covered ASC procedures (MedPAC 2010). The rates were set such that facility fees for ASCs would be approximately 59 percent of facility fees for hospital outpatient departments, phased in fully by 2012.

This policy change reduces incentives to treat patients in ASCs, benefitting hospitals that use revenue from outpatient procedures to subsidize less profitable procedures. However, if ASCs provide more cost effective outpatient services without compromising patient safety, this could have negative consequences for overall healthcare spending on outpatient care. In the sections that follow, we examine differences in treatment patterns across outpatient setting to estimate cost and quality differences between ASCs and hospital outpatient departments.

3. Do ASCs treat a different patient mix than hospitals?

3.1 Cream Skimming

ASCs have been criticized for skimming the most profitable patients in the outpatient surgery market. It has been well documented that patients who have health insurance with higher reimbursement rates are more likely to be treated in ambulatory surgery centers (Mitchell 2010, Pham et al. 2004, Hadley and Reschovsky 2006, Gabel et al. 2008, Hollingsworth et al. 2010). Similarly, ASCs on average treat healthier patients and perform higher profit procedures than hospital outpatient departments (Wynn et al. 2004, Winter 2003, Plotzke and Courtemanche 2011). David and Neuman (2011) compare treatment patterns among physicians who practice exclusively in ASCs ("non-splitters") and those who practice in both ASCs and hospitals ("splitters"). They find that physicians who treat patients in both settings deliver care to higher risk patients overall but select relatively healthier patients for treatment in ASCs. Research on cream skimming has been conducted for other physician-owned facilities such as specialty hospitals as well. For example, Swanson (2012) examines patient selection in cardiac specialty centers, and concludes that the distribution of patients across hospitals is driven by physicians' average preferences over hospitals rather than cherry picking.

Although previous research documents differences in the composition of patients and procedures across facility types, it often relies on cross-sectional data and is unable to account for variation between physicians. For example, there may be underlying differences between physicians who work in ASCs and those who work in hospitals that influence the types of patients that are referred to each type of facility. The authors are also unable to make statements about differences in the quality of care across outpatient settings, since healthier patients likely have better surgical outcomes than riskier patients regardless of the quality of care they receive, and healthier patients may be more likely to choose ASCs over hospital outpatient departments.[5] In this paper, we restrict our analysis to cases performed by physicians who

[5] While patient preferences are also a factor in the location of treatment, coinsurance rates did not vary over the period of our study so we do not expect that preferences changed during this time. The variation we exploit comes from facility fees, discussed later.

operate in both ASCs and hospitals. In doing so, we are able to identify within-physician patient selection to account for sorting of patients by acuity between physicians.

The impact of cream skimming on finances of general hospitals remains to be shown (Casalino, Devers, and Brewster 2003). As one hospital administrator remarked, “It cannot be described any other way as that they skim and cherry-pick on the front end…. They don't take Medicaid patients, they certainly don't take charity cases and medical conditions. The comorbidities come to the hospitals” (Ralph 3/26/03, p. 12). However, since physician reimbursement and facility fees per outpatient procedure do not vary by the health of the patient, it is not immediately evident why it would benefit surgery centers to favor healthier patients. Holding insurance provider constant, a higher risk patient would be more costly to care for only if he or she required more resources.

One critical resource for outpatient procedures is time. For example, in a study of knee arthroscopies (knee scopes) performed by one surgeon, Gadinsky et al. (2012) found that patients with a BMI greater than 40 spent significantly longer (28 minutes, or 23 percent) in the operating room than those with a BMI under 25. If this finding is generalizable to other surgeons, settings, or procedures, it suggests that a patient’s health could impact the total volume of surgeries. In this paper we focus on a sample of Medicare patient claims to estimate cream skimming among patients for whom a particular type of outpatient facility receives the same payment for a procedure regardless of the health of the patient.

3.2 Estimating Cream Skimming in ASCs

One problem with previous research on cream skimming is that surgeons who operate in ASCs have a different patient mix than those who only operate in hospitals, so the patients of these two types of physicians may have very different outcomes regardless of the type of care they receive. These differences could reflect physician preferences for different types of patients (or vice versa), differences in patient mix across hospital systems, or sorting within physician practices, e.g., if older physicians have more leverage in a practice and therefore more ability to choose settings and patients. If physicians who operate more in ASCs have a healthier group of patients than those who do not, any estimation of the relationship between patient health and ASC treatment that does not account for differences in case mix would be biased.

To address this, we construct an empirical model that estimates the relationship between a patient's health and the likelihood of ASC treatment that accounts for physician heterogeneity using physician fixed effects

$$ASC_i = X_i\beta + \sum_r Risk_{ir}\alpha_r + \sum_p Proc_{ip}\delta_p + \sum_j Phys_{ij}\gamma_j + \sum_p\sum_j Proc_{ip} \times Phys_{ij}\rho_{jp}\sum_t Year_{it}\theta_t + \varepsilon_i \quad (1)$$

In this model, ASC_i is an indicator equal to one if the procedure for patient claim i was performed in an ASC. We include a vector of demographic characteristics, X_i, including age group, sex, ethnicity, and an indicator variable equal to one if a patient is eligible for Medicare because of end stage renal disease. $Risk_{ir}$ is a dummy variable indicating a patient's health risk quartile r, where the first (healthiest) quartile is omitted. Since different procedures may be more prevalent in one type of facility, which could affect a patient's probability of treatment in an ASC, we include procedure fixed effects ($Proc_{ip}$). To account for physician-specific characteristics that may drive treatment decisions, as discussed earlier, we also include fixed effects for physicians ($Phys_{ij}$) and physician by procedure fixed effects ($Physn_{ij}$ x $Proc_{ip}$).[6] The variation in our model is therefore driven by a particular physician's decision to treat patients in one outpatient sector over another, for physicians who care for patients in both ASCs and hospitals. Finally, we control for time varying factors that are common across patients by including a vector of dummy variables for year of procedure ($Year_{it}$). If a patient's risk score group is negatively related to ASC treatment—i.e., if α_2, α_3, and α_4, are less than zero—then riskier patients are less likely to be treated in an ASC than in a hospital outpatient department. To account for possible correlation within a geographic region over time, we cluster standard errors by Hospital Service Area (HSA).

In order to estimate the above model, we need a dataset that includes detailed patient and surgery information, as well physician identifiers. We achieve this using the Medicare Limited Data Set for 2007

[6] The physician fixed effects absorb geographic fixed effects. Therefore, we do not need to separately include state or other geographic fixed effects in this model.

through 2009. These data contain all institutional and non-institutional claims for a 5 percent sample of Medicare beneficiaries, including both hospital outpatient departments and ASCs. For each patient claim, we observe patient diagnoses and procedures, payment amount, dates of service, patient demographics, and an identifier for the attending and operating physicians in the procedure.[7] Procedures in Medicare claims are coded using the Health Care Common Procedure Coding System (HCPCS). Each HCPCS code is assigned to a procedure category using Berenson-Eggers Type of Service (BETOS) Codes, which represent readily understood clinical categories as well as groupings used in Medicare payments. For the remainder of this paper, we define "procedure" in Medicare claims as the BETOS code.

Descriptive statistics for patient claims are presented by physician and facility type in Table 1.[8] We consider two types of physicians: the full sample of physicians (those who treat patients in either ASCs or hospitals, or both), and those who treat patients in both types of facilities, which is the group that identifies the key parameters of interest in our fixed effect model.[9] Overall, patients treated by physicians who operate in both ASCs and hospitals are very similar to patients in the full sample.[10] We then compare characteristics of patients in ASCs with those in hospitals for each physician type. For the full physician sample, patients treated in hospitals are younger, less likely to be female, more likely to be black, and more likely to have end stage renal disease or a disability as the primary for Medicare entitlements.[11] Patients treated in ASCs and hospitals are in general much more alike for the subset of physicians who operated in both types of settings than for the full sample of physicians, though patients in hospitals are more likely to be on disability or have end stage renal disease.

The distribution of procedures also varies by physician type. In the full sample of physicians, all of the top 5 procedures in terms of ASC volume (cataract removals, colonoscopies, upper GI endoscopies,

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[7] CMS changed its system for identifying physicians from unique physician identification numbers (UPIN) to National Provider Identifiers (NPI) beginning in 2007. We obtain NPI values where missing from the National Plan and Provider Enumeration System (NPPES), available at http://nppes.viva-it.com/NPI_Files.html.

[8] Over 40 percent of patients of physicians who operate in both types of facilities undergo more than one outpatient procedure in a year, so we observe multiple claims for these individuals.

[9] Physicians who work in both types of facilities are a subset of physicians who work in either type of facility.

[10] Given the large sample size, all differences are statistically significant.

[11] Patients who are under age 65 can qualify for Medicare benefits if they have a disability or end stage renal disease. Since a greater share of patients treated in hospitals are on disability as their primary reason for entitlement, it is not surprising that the average age of patients in ASCs is higher than the average age of patients treated in hospitals.

minor musculoskeletal procedures, and other eye procedures) comprised much larger shares of total procedures in ASCs than in hospitals. Again, these differences are much smaller for the restricted group of physicians. For example, cataract surgeries comprised 3 percent of procedures performed in hospitals among the full sample of physicians and 28 percent of procedures performed in ASCs. Among claims for procedures done by physicians that worked in both types of facilities, cataract surgeries represented 10 percent of hospital claims and 14 percent of ASC claims. This suggests that a number of physicians only provide some services, e.g., cataract surgeries, in one type of setting. Including physicians who exclusively treat patients in either ASCs or hospitals, and do not make case-by-case decisions to operate in one facility over another that would lead to cream skimming, would bias our estimates.

The results from Table 1 suggest that if we were to include all Medicare claims without accounting for idiosyncratic differences among physicians, our cream skimming estimates would be biased because physicians who operate in both types of facilities have a different patient composition than those who just operate in one type of setting. To address this problem, we restrict our sample to claims from procedures performed by physicians who operate in both types of facilities. We employ a physician fixed effects model to control for underlying differences between physicians that do not vary over time.

To measure underlying patient health, we generate patient risk scores using the Johns Hopkins University ACG Case-Mix System (v. 10) developed by the Health Services Research and Development Center. The ACG System uses ICD-9CM diagnosis codes and patient characteristics to construct measures of health status. The predictive modeling feature of the ACG software produces a concurrent weight (CW) that is a summary measure of the current individual health status and resource utilization. The CW is constructed so that the national average is 1.0 with higher values denoting poorer health and likely higher expenditures; for example, a patient with a weight of 2.0 is twice as sick, and expected to use twice as many resources, as a person with a weight of 1.0.

Patient acuity varies across outpatient settings. Figure 4 shows kernel density plots of patient risk scores in hospital outpatient departments and ASCs. Panel A presents the distribution of risk scores using Medicare claims for physicians who treated patients for any type of procedure in both types of facilities.

Panel B presents the risk score distribution using all Medicare patients from the 2006 National Survey of Ambulatory Surgery (NSAS). Both panels indicate that greater shares of patients with lower risk scores are treated in ASCs than in hospital outpatient departments. For ease of interpretation, we use aggregated measures of risk scores that have been grouped into four quartiles based on predicted patient resource utilization.

Table 2 presents results for the physician fixed effects model using Medicare 5 percent claims. The first column includes estimates for all procedures in the full physician sample. Results in columns 2 and 3 include all procedures in the sample of physicians restricted to those who work in both ASCs and hospitals, without and with physician fixed effects, respectively. Since the scope of procedures is much larger in hospitals than in ASCs, we also restrict our analysis to the top 5 procedures by ASC volume to ensure that we are using a comparable set of procedures across settings.[12] Estimates for these 5 procedures are provided in the second column. The remaining columns indicate results from separate regressions for each of the top 5 procedures based on ASC surgical volume: cataract surgeries, colonoscopies, upper GI endoscopies, minor musculoskeletal procedures, and other eye procedures. The share of patients treated in an ASC by risk quartile, and the share of claims in each risk quantile, are included in curly and square brackets, respectively. In all cases, patients that are less healthy (i.e., higher risk score quartiles) are significantly less likely to be treated in an ASC than those in lower risk score quartiles. Among claims in the full physician sample, 18 percent of first quartile (healthiest) patients are treated in an ASC compared with 6 percent of fourth quartile (riskiest) patients. For the restricted physician sample (Columns 2 and 3), 76 percent of first quartile (healthiest) patients are treated in an ASC compared to 36 percent of fourth quartile (riskiest) patients. ASC treatment also varies by procedure. Whereas 85 percent of first quartile patients undergoing cataract surgery were treated in an ASC, only 76 percent of patients in the same risk score group undergoing minor musculoskeletal procedures were treated in an ASC. The probability of

[12] The top 5 procedures by ASC volume account for 82 percent of claims in ASCs compared to 74 percent of claims in hospital outpatient departments.

ASC treatment is monotonically decreasing in risk for cataract surgeries, colonoscopies, and upper GI endoscopies.

Regression results indicate that the probability of being treated in an ASC decreases as a patient's risk score group increases, across all types of procedures. Results are much larger for the full physician sample than for the restricted sample, indicating that including all physicians leads to overstating the extent of cream skimming. Including fixed effects for the restricted physician sample reduces the magnitude of the coefficients slightly (column 3).[13] Holding physician constant, patients in the highest risk score quartile undergoing any procedure are still nearly 40 percentage points less likely to be treated in an ASC than patients in the healthiest quartile. In other words, the riskiest quartile of patients is more than half as likely to be treated in an ASC as the healthiest quartile. Cataract patients in the highest risk quartile are 68 percentage points less likely than the healthiest patients to be treated in an ASC. These results indicate that even accounting for differences across physicians and only looking at the subset of physicians who treat patients in both hospitals and ASCs, physicians are much more likely to refer healthy patients to ASCs.

3.3 Cost Differences Between Outpatient Procedures in ASCs and Hospitals

In Section 3.2, we documented that a substantial amount of cream skimming exists in ASCs. If outcomes are better for risky patients when they are treated in hospitals, then physicians may choose to treat riskier patients in hospitals where they are likely to fare better. Given that facilities are paid the same fee for an outpatient procedure regardless of the underlying health of the patient, it is not immediately obvious why hospitals would be opposed to cream skimming. In other words, a facility does not capture a higher payment from Medicare by treating patients of higher or lower risk. For healthier patients to be more profitable, it must be the case that they are less costly to care for than riskier patients. In this section we examine the cost of treating risky patients in terms of one important cost to hospitals: time. We

[13] Differences between specifications with and without physician fixed effects are significant at the 10 percent level.

consider the potential cost to physicians of treating riskier patients by estimating the relationship between a patient's risk score quartile, defined earlier, and procedure time:

$$ln\left(Time_i\right) = X_i\beta_1 + NumProc_i\beta_2 + \sum_r Risk_{ir}\alpha_r + \sum_p Proc_{ip}\,\delta_p + \sum_k Facility_{ik}\,\gamma_k + \varepsilon_i \quad (2)$$

In this model, $Time_i$ denotes the procedure time in minutes for patient claim i. $NumProc_i$ is the total number of procedures for a claim. $Risk_{ir}$ is a dummy variable indicating the group r in which a patient's risk score falls, where the healthiest group of patients (risk score group 1) is omitted. As before, we include procedure fixed effects ($Proc_{ip}$) to account for time differences across procedures. Some hospitals or ASCs may on average be quicker at doing all cases; to account for this heterogeneity, we include facility fixed effects ($Facility_{ik}$) so that our model measures differences in time by patient risk, not the efficiency of any particular hospital.[14] We also include controls for patient demographic characteristics X_i (age, sex, and disabled).[15] The coefficients α_2, α_3, and α_4 therefore capture the average percent difference in procedure time for patients in higher risk groups relative to the healthiest group of patients.

We know of only one nationally representative data set that includes information about surgery time. The National Survey of Ambulatory Surgery (NSAS) is a survey of ambulatory surgery in hospitals and freestanding surgery centers in the U.S., conducted by the Centers for Disease Control from 1994 to 1996, and 2006. The 2006 data include patient diagnoses, demographics, and surgical procedure(s) as well as information about length of surgery and recovery for 52,000 visits at 437 facilities. The data include separate measures of time spent in the operating room (OR) prior to surgery, time in surgery, time in post-operative care, and total procedure time.[16]

Table 3 presents descriptive statistics for three groups of patients from the 2006 NSAS: all patients, patients using Medicare as any source of payment, and, for reasons described earlier, Medicare

[14] Since the facility fixed effects capture whether a facility is an ASC or a hospital, we do not include a dummy for ASC treatment in addition to the facility fixed effects.
[15] We classify a patient as disabled if he or she is under age 65 and on Medicare.
[16] Total procedure time includes non-surgery OR time, surgery time, post-operative time, and transport time between the OR and recovery room time.

patients undergoing one of the top 10 procedures based on surgical volume, in ASCs.[17] ASC patients in the NSAS are, on average, older, more likely to live in an MSA, and less likely to be disabled than patients in hospital outpatient departments. ASCs also treat fewer patients with Medicaid as their primary source of insurance, but more patients with other types of insurance or self-pay. We calculate risk scores using the same methods discussed in Section 3.2, and divide patients into risk score quartiles based on the full sample of patients. Not surprisingly, ASC patients are more likely to fall in a lower risk score group than hospital patients, and much less likely to be in the highest risk score groups.

Medicare patients in the NSAS are older than other patients, and less healthy in terms of risk score than the full sample of patients. Among Medicare patients, differences between ASC and hospital patients are similar to differences discussed for the full sample of NSAS patients. While Medicare patients on the whole are slightly riskier than the full sample of patients, those undergoing one of the top 10 procedures based on ASC volume are on average much healthier than other patients. Among Medicare patients undergoing one of the top 10 surgical procedures, those treated in ASCs are older, more likely to live in an MSA, more likely to be disabled, and more likely to be female.

Average surgery times vary considerably by and within procedure, and across settings. Since our procedure categories each contain several individual procedures and also vary somewhat across datasets due to different procedure coding systems, we focus on procedure time for three procedure groups that contain a small number of procedures and are comparable across datasets: cataract surgeries, colonoscopies, and upper GI endoscopies. Figure 5 presents the distribution of total time spent in an outpatient facility, between entering the OR and leaving post-operative care, for the each of these procedures among Medicare patients.[18] Much like the risk score density plots in Figure 4, the distribution of time in ASCs is to the left the time distribution of hospitals. The figures indicate that at any particular point in the distribution, patients spend less time in ASCs than in hospital outpatient departments for a

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[17] Procedures in the NSAS are coded based on the ICD9-CM procedure codes and grouped into clinical categories using the Clinical Classifications Software from the Healthcare Cost and Utilization Project. These do not exactly correspond to procedures in Medicare data, which are based on BETOS codes. The top 10 procedures by ASC surgical volume are listed for each sample in Table A.1.

[18] Patients that underwent more that one procedure are omitted from Figure 5.

given procedure. Additionally, the variance in total procedure time is larger in hospitals, suggesting that either hospitals receive a wider range of patients for whom procedure time varies, or hospitals are not as consistent at timing procedures as ASCs.

Table 4 presents results from the Model (2), with separate regressions for non-surgery OR time, surgery time, post-operative time, and total procedure time. For each time outcome, we run separate regressions with and without facility fixed effects. Regressions without facility fixed effects give an estimate of how much faster ASCs are, on average, at performing procedures than hospitals, controlling for observed patient characteristics. Since the NSAS data do not contain physician identifiers, we are concerned that average differences in procedure time may be masked by the fact that different types of physicians operate in different types of facilities. We therefore include facility fixed effects so that our estimates are driven by differences in patient risk level rather than average differences across facilities.

Specifications without facility fixed effects suggest that ASCs are substantially faster than hospitals. Patients spend on average 25.5 percent less total time (30 minutes) in ASCs than in hospitals for outpatient procedures. Much of this appears to be driven by differences in non-surgery OR and post-operative time. Patient risk level is also a strong predictor of all time components. However, facility fixed effects account for much of the difference in non-surgery OR time; once we add in fixed effects, the difference in time between the highest and lowest risk score quartiles practically disappears for this category. Controlling for differences across facilities, total time is 6.3 percent (7 minutes) longer for third quartile patients and 5.1 percent (6 minutes) longer for fourth quartile patients relative to the healthiest quartile of patients. Surgery for a patient in the highest two risk quartiles on average takes 9.6 percent (2.9 minutes) and 13.3 percent (4 minutes) longer, respectively, than surgery on patients in the healthiest group. Patients in these groups also spend longer in post-operative care—6.3 percent (4 minutes) and 4.1 percent (3 minutes), respectively. Importantly, these results suggest that higher risk patients are more costly to physicians and facilities in terms of time. This also suggests that the different composition of patients in hospitals and ASCs, in terms of patient risk, may contribute to the time differences across outpatient settings depicted in Figure 5.

Given that ASCs and hospitals have different distributions of procedure time, we next examine whether the relationship between patient risk and time in a facility is confined to a particular part of the distribution. Since both time in surgery and in post-operative care vary with patient risk, we run these regressions for total procedure time. Table 5 presents results from quantile regressions of risk score quartile on total time, controlling for the same covariates used in the previous model. The first gives results from OLS regressions of risk score quartile on total time, from column 4 of Table 4. We used STATA's *qreg* command to produce these estimates, which does not allow us to include probability weights or facility fixed effects. For comparability, column 2 shows results from the specification in column 1 without facility effects, and column 3 gives these results without facility effects or weights. Where we do not include facility fixed effects, we include a dummy variable indicating whether a procedure was performed in an ASC. Comparing these results to column 1, it appears that these modifications have little effect.

We find that the positive association between patient risk and total time is similar across the conditional time distribution. However, being treated in an ASC is associated with a downward shift in the time distribution, particularly at higher quantiles; that is, the time advantage for ASCs grows as we move from 10^{th} to 90^{th} percentile of the time distribution. While the relationship between patient health and procedure time does not appear to be confined to a particular part of the distribution, the coefficients on the ASC indicator across the distribution suggest that ASCs have the biggest time advantage in the higher conditional quantiles.

We have shown that cream skimming exists to a large extent in ASCs, controlling for physician fixed effects—very healthy patients are more than twice as likely to be treated in ASCs than the highest risk patients. In both types of outpatient settings, higher risk patients take longer in surgery and in post-operative care than very healthy patients. Holding patient risk constant, ASCs appear to be substantially faster at treating patients than hospital. Together these results suggest that treating patients in ASCs is faster and cheaper (in terms of time costs) than treating patients in hospital outpatient departments, supporting previous claims that ASCs provide services at lower costs than hospital outpatient departments

(Hair, Hussy, and Wynn 2012, Haugh 2006, Government Accountability Office 2006, Office of the Inspector General 1999).

4. Do ASCs Provide Superior Care to Hospital Outpatient Departments?

We have documented that ASCs on average treat healthier patients than hospitals, but that, holding patient risk constant, they are cheaper and faster at doing so. In this section, we consider whether ASCs are also "better" than hospitals in terms of quality of patient care. Estimating quality of care outcomes in ASCs is difficult in single equation models because, as we have shown, ASCs have a different patient mix than hospital outpatient departments. Because ASCs treat healthier patients, differences in patient outcomes between ASCs and hospitals may be due to differences in underlying health rather than differences in quality of care. We address this problem by using variation in ASC use generated by changes in Medicare facility fees to estimate the effect of ASC treatment on patient outcomes by risk score group. Before doing this, we consider the relationship between facility payments and ASC market share.

4.1 Facility Payments and ASC Market Share

In addition to sicker patients being more costly to treat, ASCs and hospitals receive different facility fees. Medicare payments to outpatient facilities are set nationally and adjusted to account for geographic differences in labor costs.[19] Specifically, the facility fee consists of a labor portion that is adjusted by a local wage index, and an unadjusted non-labor portion. CMS estimates that labor costs are higher in hospitals than in ASCs, and therefore set the labor portion as 60 percent of the facility fee for hospital outpatient departments and 50 percent of the fee for ASCs (MedPAC 2003a).[20] The wage index is updated annually based on average wages in acute care hospitals in a labor market area relative to the national average hourly wage, calculated separately for individual urban areas, with one rural wage index

[19] Outpatient payments are also adjusted for rural, cancer, and children's hospitals as well as extraordinarily costly services and new technologies (MedPAC 2008).
[20] Coinsurance rates also vary by outpatient facility, but did not change for hospitals during the period of our analysis.

for each state (MaCurdy et al. 2009).[21] Because Medicare calculates the wage indexes using large geographic areas, hospitals that are located in the same urban area but that face different costs may receive the same wage index value. At the same time, hospitals that are near one another but in different urban areas would have different indices. Importantly, since facility payments are set at the federal level, adjustments are relatively coarse, and ASC and hospital payments are adjusted by the same wage index, changes in ASC and hospital payments represent a plausibly exogenous source of variation in Medicare reimbursement.

To look at this mechanism, we consider the relationship between the share of Medicare outpatient surgeries treated in an ASC and the ratio of the average ASC payment to average hospital payment. We use total facility payments from Medicare claims data to calculate the average payment for each facility type (ASC and hospital outpatient department), by Hospital Service Area (HSA) and year.[22] HSAs, or local hospital markets, are defined by assigning ZIP codes to the hospital area where the greatest proportion of their Medicare residents were hospitalized in a region. The U.S. is comprised of 3,436 HSAs. We obtained HSA-zip code crosswalks from the Dartmouth Atlas of Healthcare.[23]

To generate ratios of ASC payments to hospital payments, we first let φ_{ifpht} denote the facility fee for patient claim *i*, in facility type *f* (ASC or hospital), for procedure *p*, in HSA *h*, in year *t*. We denote the median payment from all claims for a particular facility type, procedure, HSA, and year as $\tilde{\varphi}_{fpht}$. To scale the payment amount for each procedure, we divide y the median ASC payment in year *t* by the median hospital outpatient payment in 2007, adjusted annually for inflation using the Center for Medicare and Medicaid Services' hospital market basket:

$$P_{pht} = \frac{\tilde{\varphi}_{ASC,pht}}{\tilde{\varphi}_{Hospital,ph}}$$

[21] Medicare defined urban areas by Metropolitan Statistical Areas (MSAs) until 2003, and Core Based Statistical Areas (CBSAs) thereafter. In 2008, there were 374 MSAs and 3,436 CBSAs in the U.S. (Nussle 2008).

[22] To generate payment estimates, we use the combined revenue center payment and patient responsibility amount associated with a procedure for the Medicare outpatient plains, and the total allowed charges (which includes the line provider payment amount, deductible, and coinsurance) for ASC claims. In both cases we restrict our analysis to the first procedure listed for each claim.

[23] http://www.dartmouthatlas.org/tools/downloads.aspx

This measurement of the ratio of ASC payments to hospital outpatient payments therefore varies by procedure, HSA, and year. We restrict our sample to HSAs where we observe at least 10 claims in both ASCs and hospitals for a particular procedure in a particular year, allowing us to calculate the ratio of payments between the two types of facilities.

Average HSA payments by facility are shown by year and procedure for the five highest volume ASC procedures in Table 6. Instead of national payment rates, which are fixed across all localities, we use facility payments from Medicare claims that have been adjusted for local labor costs, so level and relative payments to ASCs and hospitals vary across procedure and over time. For all procedures except minor musculoskeletal procedures, payments for hospitals exceeded payments to ASCs in 2007. During the period of our study, ASC payments stayed roughly constant or decreased while hospital payments increased, and the average ratio of ASC payments to hospital outpatient payments decreased. These changes correspond to policy changes made by CMS to reduce ASC payments relative to hospital payments, discussed earlier.[24]

To illustrate changes in ASC payments relative to hospital payments over time, Figure 6 plots ASC and hospital payments by procedure for 2007 and 2009. ASC payments are presented on the horizontal axis and hospital outpatient payments are on the vertical axis. Each bubble represents the median facility payment for one of the top 5 outpatient procedures; the size of the bubble denotes the number of Medicare claims for a particular procedure. The 45-degree line denotes equal payment to ASCs and hospital outpatient departments. Like the average HSA-level payments presented in Table 6, Panel A of Figure 6 shows that in 2007, facility fees for most of the top 5 procedures were higher in hospitals than ASCs, i.e., the ratio of ASC to hospital payments was less than one. While payments to ASCs stayed roughly constant or decreased between 2007 and 2009, most payments for hospital outpatient surgeries

[24] The "Average ASC/Hospital Payment Ratio" value in Table 6 is the average of the HSA-level payment ratios, which is calculated by first constructing the ratio of the median ASC payment in a year to the median hospital outpatient payment in 2007, by HSA, and averaging these values across all HSAs. It is therefore not the same as the ratio of the average ASC payment and average hospital payment listed in Table 6.

increased; consequently, the graph for 2009 (Panel B) shows a shift in the payment ratio in favor of hospitals.

Using this variation in facility fees, we examine the relative payments made to ASCs and hospitals as a possible mechanism driving ASC growth. We first consider the relationship between relative ASC/hospital payments and the share of all Medicare procedures in an HSA that were performed in an ASC. The scatterplot in Figure 7 depicts the relationship between the change in scaled ASC payments between 2007 and 2009, and ASC market share for HSAs where we observe at least 10 Medicare claims for procedures in both types of outpatient settings. Each point denotes the change in the ASC/hospital payment ratio and the change in the share of Medicare patients treated in an ASC for a particular procedure from 2007 to 2009. The figure shows that the ASC/hospital payment ratio is positively correlated with ASC market share.

We estimate this relationship more precisely with the following model:

$$ASCShare_{pht} = P_{pht}\, \beta_1 + \delta_p + \lambda_h + \nu_t + \varepsilon_{pht} \tag{3}$$

Here, $ASCShare_{pht}$ is the share of all patients treated in ASCs for procedure p, in HSA h, in year t. P_{pht} is the ratio of ASC to hospital payments by HSA and year in one of the top 5 procedure groups: cataract removal/lens insertion, colonoscopy, upper GI endoscopy, minor musculoskeletal procedures, or other eye procedures. As in earlier specifications, we also include procedure, HSA, and year fixed effects, and balance the data across all three of these dimensions. Therefore, only HSAs with claims for a procedure in both ASCs and hospitals in all years of the data are included in our sample.[25]

Results presented in Table 7 confirm that higher ratios of ASC to hospital payments are associated with higher ASC market share, holding fixed procedure, HSA, and year. To put this in context, an annual increase of 0.1 in a payment ratio—a change that we find plausible based on estimates in Table 6—would be associated with a 0.004 increase in ASC market share. Over the period of our study, ASC-to-hospital ratios decreased. As an example, between 2007 and 2009, the payment ratio for upper GI

[25] Because we balance panels across facility type and year for each procedure and HSA, we lose observations as we add additional procedures with fewer annual claims. We therefore limit our sample for this analysis to the top 5 procedures.

endoscopies decreased from 0.88 to 0.74, a change of 0.14; using the estimates in Table 7, this change would be associated with a 0.006 percentage point *drop* in ASC market share. In our balanced HSA panel, 50 percent of all upper GI endoscopies were performed in ASCs in 2007, so the change in the payment ratio would equate to a one percent drop in ASC market share for this procedure in two years. These results suggest that Medicare facility payments are important drivers of ASC market share and CMS policies to decrease ASC payments relative to hospital payments may have contributed to the leveling out of market growth depicted in Figure 1.

4.2 Payment Ratios and ASC Treatment

The results presented thus far indicate that physicians care for healthier patients in ASCs than in hospital outpatient departments. We have also shown that the ratio of ASC/hospital payments is positively associated with ASC market share. Building on Equation (2), we use the variation in ASC use generated by fee changes to estimate the relationship between treatment in an ASC and interactions between the average ratio of ASC to hospital payments in a patient's HSA and his or her risk score quantile.

$$ASC_i = X_i\beta + \sum_r \left(Risk_{i,r}\alpha_{1,r} + Risk_{i,r} \times P_i^{pht}\alpha_{2,r}\right) + \sum_p Proc_{ip}\,\delta_p + \sum_j Phys_{ij}\,\gamma_j + \sum_p \sum_j Proc_{ip} \times Phys_{ij}\,\rho_{jp} + \sum_t Year_{it}\theta_t + \varepsilon_i \qquad (4)$$

In this model, P_i^{pht} denotes the payment ratio that corresponds to claim *i* based on procedure, HSA, and year. The coefficients $\alpha_{2,1}$, $\alpha_{2,2}$, $\alpha_{2,3}$, and $\alpha_{2,4}$ capture the change in the probability of treatment in an ASC by risk score quantile as ASC payment rates increase relative to those in hospital outpatient departments in 2007. We estimate this model by breaking patient risk scores into halves, terciles, and quartiles; this strategy enables us to determine which types of patients, based on risk score quantile, are driving changes in ASC treatment. Shares of all procedures performed in an ASC are presented, by risk score quantile, in Table 8.

Results are presented in column 1 of Table 9 using two risk groups (Panel A), three risk groups (Panel B), or four risk groups (Panel C). By increasing the number of quantiles, we show that the relationship between risk score group and likelihood of ASC treatment is driven by patients in the third and fourth risk score quartiles, though results are less precise as we increase the number of risk score groups. As in Table 2, the likelihood of treatment in an ASC decreases monotonically as patient health decreases, across all panels. However, as ASC payments increase, riskier patients are more likely to be treated in an ASC. This is not surprising given that the share of patients treated in ASCs is much lower for sicker groups of patients than for healthier ones; for example, 83 percent of first quartile patients undergoing one of the top 5 procedures did so in ASCs compared to 42 percent of fourth quartile patients (Table 2). This group therefore has the greatest margin for change.

4.3 Location of Treatment and Patient Outcomes

The benefits of treating patients in ASCs in terms of cost efficiency would be mitigated if patient health outcomes were worse in these settings. The risk of serious complications associated with outpatient procedures is low relative to many inpatient procedures, but not trivial. For example, for screening colonoscopies, the risk of an adverse event—such as perforation of the bowel, bleeding, or reaction to anesthetic—is 2.8 per 1000 procedures (American Society of Gastrointestinal Endoscopy 2011). Stein et al. (2011) found that, among Medicare patients, the probability of serious complication for cataract surgery was 0.4 percent. In addition to complications associated with outpatient procedures, patients may acquire healthcare-associated infections (HAIs) during an ASC or hospital visit. Following a rise in HAIs acquired in outpatient settings, Schaefer et al. (2010) examined a sample of ASCs in three states and found that lapses in infection control practices were common in these facilities.

Several papers have tried to assess differences in quality of care between ASCs and hospitals (Hollingsworth et al. 2012, Woods et al. 2007, Fleisher et al. 2004). Since the patient mix in ASCs is on average healthier than in hospital outpatient departments, simply comparing patient outcomes across settings would likely lead to overestimations of the quality of care that ASCs provide relative to hospitals. Similarly, evidence presented earlier suggests that patients treated by physicians who work in both ASCs and hospitals are different from patients of physicians who work exclusively in one type of setting. Even after adjusting for patient risk factors, if unobserved patient characteristics are correlated both with probability of ASC treatment and outcomes, estimates of the relationship between ASC treatment and patient outcomes would be biased.

We use variation in Medicare facility fees between 2007 and 2009 as a source of exogenous variation in ASC treatment to estimate the effect of ASC use on patient outcomes. We focus our analysis on two patient outcomes: inpatient admission and emergency room visits following an outpatient procedure. These measures have been used in the medical literature to estimate quality differences in outpatient settings. For example, Fleisher et al. (2004) found that hospital outpatient departments had higher rates of inpatient admission and ER visits than ASCs within 7 days of, or between 8 and 30 days after, outpatient procedures. In contrast to these findings, Hollingsworth et al. (2012) showed that same day hospital admission was higher for Medicare patients undergoing urological procedures in an ASC than for those treated in a hospital. In addition to their use by researchers, CMS has recognized hospitalizations as important quality measures for outpatient surgery. As of October 2012, ASCs are required to report direct hospital transfers and hospital admissions to CMS as part of the Ambulatory Surgical Center Quality Reporting (ASCQR) Program.[26]

We identify hospital admissions and emergency room visits using inpatient and outpatient claims data for 2007 through 2009.[27] We calculate the time in days between an outpatient procedure and a hospital visit using the date of the outpatient procedure and the date of the first subsequent inpatient admission or ER visit. Among all claims in our restricted physician sample, 0.1 percent of patients were admitted to a hospital on the same day as, 1 percent was admitted between 1 and 7 days, and 3.1 percent was admitted between 8 and 30 days of an outpatient surgery. Similarly, 0.3, 1.5, and 4.1 percent of patients visited an ER on the same day as, 1 to 7 days after, or 30 days after outpatient surgery, respectively. With the exception of same day hospital admission, patients treated in a hospital outpatient department were more likely than those treated in an ASC to be subsequently admitted to a hospital or visit an ER.

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[26] Information about the ASCQR Program is available at http://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/ASC-Quality-Reporting/.
[27] Patients that are seen in an ER may be admitted to the hospital as an inpatient or not admitted to the hospital.

We estimate a reduced form model to identify the effect of being treated in an ASC on our two patient outcomes, where the dependent variable is an indicator for whether a patient was admitted to a hospital or visited an ER following outpatient surgery. Since changes in ASC payment are positively related to ASC market share, we use this ratio as a source of exogenous variation in ASC treatment:

$$y_i = X_i\beta + \sum_r \left(Risk_{i,r}\omega_{2,r} + Risk_{i,r} \times P_i^{pht}\omega_{2,r} \right) + \sum_p Proc_{ip}\delta_p + \sum_j Phys_{ij}\gamma_j + \sum_p \sum_j Proc_{ip} \times Phys_{ij}\rho_{jp} + \sum_t Year_{it}\theta_t + \varepsilon_i \quad (5)$$

In this model, y_i denotes whether a patient had an inpatient admission or ER visit within 0, 1 to 7, or 8 to 30 days of outpatient surgery.[28] The remaining variables are defined as in Equation (4), and we cluster standard errors by HSA.

The results in Table 9 (columns 2 to 4) show that when ASC payments increase, 7-day inpatient admission rates and same day ER visits decline for patients in higher risk quantiles. We find no relationship between facility payments and same day inpatient admission, or 30-day inpatient admission and ER visits. These reduced form results indicate that the decline in hospital admission and ER visits is driven by higher quality ASC care as long as Medicare fee schedule changes are exogenous to relative quality changes in ASC versus hospital care.

In conjunction with the first stage results from Equation (4), these estimates provide the local average treatment effect of ASC treatment on inpatient admission. To scale results reported in Table 9 and estimate of the effect of ASC treatment on hospitalizations, we use an instrumental variables (IV) model where we instrument the four payment ratio-by-quantile interactions for the four (endogenous) ASC-by-quantile interactions. If patients are better off when treated in ASCs, we expect the probability of hospitalization would decrease as treatment in ASCs increases. On the other hand, if ASCs do a poorer job than hospitals of treating relatively sicker patients, we expect that patients would be more likely to get admitted to a hospital or visit the ER as the payment ratio increases.

IV estimates of the effect of ASC treatment on inpatient admission and ER visits, by quantile, are presented in Table 10. F-statistics from first stage regressions, shown in brackets, are large, alleviating

[28] An inpatient admission or ER visit within zero days of outpatient surgery indicates a same day hospitalization.

concerns about weak instruments.[29] The results indicate that ASC treatment has a large negative effect on 7-day inpatient admission and same day ER visits for patients in higher risk quantiles. Patients in the highest risk quartile are less likely to visit an ER on the same day, 1 to 7 days, and 8 to 30 days of an outpatient surgery after ASC treatment than if they had undergone outpatient surgery in a hospital. These results suggest that the shift of the riskiest patients to ASCs does not appear to have negative consequences for patient health in terms of inpatient admission and ER visits.

5. Discussion

Inpatient admissions and ER visits may reflect medical needs that are unrelated to a previous outpatient surgery. To better understand the mechanism through which ASC treatment would decrease subsequent hospitalization and ER visits, we estimate the effect of ASC treatment on ER visits that are associated with medical errors and infections using ICD-9-CM Adverse Event Codes from the Utah/Missouri Patient Safety Project. The Patient Safety Project defines an adverse event as "an undesirable and unintended injury resulting from a medical intervention" (Van Tuinen et al. 2005). Estimates of the effect of ASC treatment on adverse events that resulted in an ER visit are presented in Table A.3. The estimates are imprecise, but suggest that ASC treatment leads to fewer ER visits due to adverse events among high risk patients. Interestingly, the results also indicate that healthier patients may be more likely to visit an ER due to an adverse event in the 1 to 7 days following treatment in an ASC. Given that high risk patients are more likely to be treated in an ASC as payments to ASCs increase, the greater likelihood of ER visits among lower risk patients could be related to different patient care and infection exposure associated with changing patient composition in ASCs.

Diagnostic or exploratory procedures, such as colonoscopies and upper GI endoscopies, make up a large share of outpatient surgeries. While these procedures have complications that might result in inpatient admission, discussed earlier, they also detect more serious diseases that could lead to an

[29] Results for all first stage regressions are shown in Table A.2.

inpatient admission for reasons other than complications associated with a diagnostic outpatient procedure. To ensure that our results are not driven by inpatient admissions associated with these procedures, we estimate the IV model restricted to corrective procedures. We use descriptions of the top HCPCS codes for each procedure category to approximate the intent and scope of a procedure in order to assign procedures to one of these two categories. Among the top 5 procedures, we define corrective procedures as cataract surgery, minor musculoskeletal procedures, and other eye procedures; 95,371 (35 percent) in our sample are considered corrective.

IV estimates for corrective procedures are presented in Table A.4. When we isolate our investigation by procedure type, the sample sizes decrease leading to less precise estimation. Still, the results indicate that higher risk patients undergoing one of the three identified corrective procedures in an ASC are not more likely to be admitted for an inpatient hospital stay following an outpatient procedure. This suggests that the positive effects of ASC treatment on inpatient admission are not driven solely by diagnoses associated with exploratory procedures that lead to inpatient admission.

6. Conclusion

In this paper, we examined cream skimming in ASCs and the quality of care in these facilities. We showed that ASCs have a healthier patient mix than hospitals, but estimates that include procedures performed by all physicians likely overstate the effect of cream skimming because physicians who refer physicians to both types of facilities have a very different patients mix from those that only refer patients to one type of facility. However, even limiting our sample to a subset of physicians who work in both ASC and hospital sectors, healthier patients are much more likely to be treated in ASCs. Using exogenous changes in the ratio of ASC facility fees to hospital outpatient facility fees for Medicare patients between 2007 and 2009, we find that changes in payments that favor ASCs induce physicians to refer increasingly risky patients to ASCs. Further, these patients have better health outcomes in terms of inpatient admission and ER visits following an outpatient procedure.

We have documented that one way this cream skimming affects hospitals is that riskier patients are more costly to treat in terms of time spent both in surgery and recovery for an outpatient procedure. While ASCs offer cost effective treatment and superior patient outcomes for many outpatient procedures, acute care hospitals provide a wider range of outpatient services and provide unprofitable services that may be valuable to society. Hospital administrators argue that through cream skimming in ASCs, hospitals are losing important revenue streams that subsidize less profitable procedures and patients. With less ability to cost shift across procedures, hospitals may reduce the amount of unprofitable services they provide or offer lower quality care overall in order to reduce costs. On the other hand, hospitals could increase use of profitable services that are not provided in ASCs or try to attract patients with other amenities. Both of these responses could lead to higher overall medical costs.

The findings in this paper provide insight into anticipated effects of recent changes in Medicare policies that increase hospital payments relative to ASC payments. We have shown that ASCs on average provide cheaper, faster, and better care for outpatient procedures than hospitals. Reducing payments to ASCs appears to have limited growth in the ASC market, suggesting that policymakers are subsidizing hospitals at the expense of providing cheap, high quality care in ASCs.[30] However, one way in which ASCs may provide superior care is through specialization. Table 1 indicates that the top 5 highest volume procedures in ASCs comprise over 80 percent of all cases, whereas hospitals take on a much larger range of outpatient procedures. This may be due in part to limitations by insurance companies on what procedures are reimbursed in ASCs. In 2008, CMS began covering an additional 800 outpatient procedures in ASCs, including any surgical procedures other than those that pose a significant safety risk or generally require an overnight stay. If more procedures are offered at different types of facilities, patients will have greater flexibility over location of treatment, which could increase demand for ASCs and possibly outpatient care in general and offset the slowing rate of ASC growth discussed in Section 4.

[30] Dua and Fournier (2010, 2012) provide evidence that physicians and patients migrate to ASCs in response to declining quality in hospitals. The policy change we exploit in this analysis works in the opposite direction—declining ASC/hospital payment ratios lead to increased treatment in hospitals—alleviating concerns about possible confounding effects of this mechanism.

On the other hand, if ASCs start providing more services, this could also negatively impact any gains from specialization observed in previous years.

This illustrates a trade-off for health policy planners, between the superior and cheaper treatment patients receive in ASCs, and the subsidy these services provide for hospitals. While ASCs provide superior care at lower costs for a subset of outpatient services, hospitals provide a broader range of services and care for unprofitable patients. Future research should consider the effect of competition with ASCs on hospital finances as well as the quality and scope of the care that hospitals provide. Likewise, health care policies should jointly consider the faster, cheaper, and better care provided in ASCs with the socially valued services that hospitals provide.

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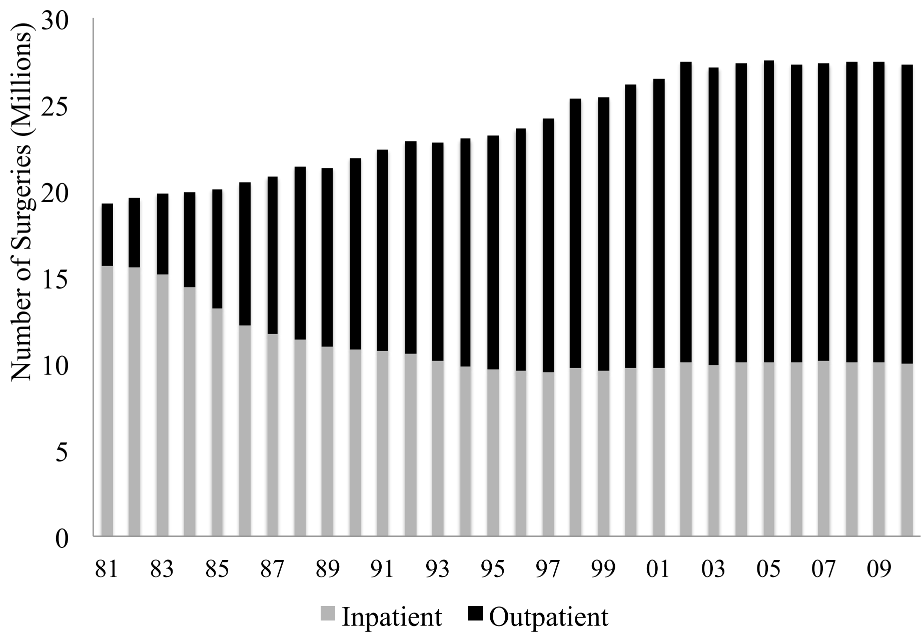
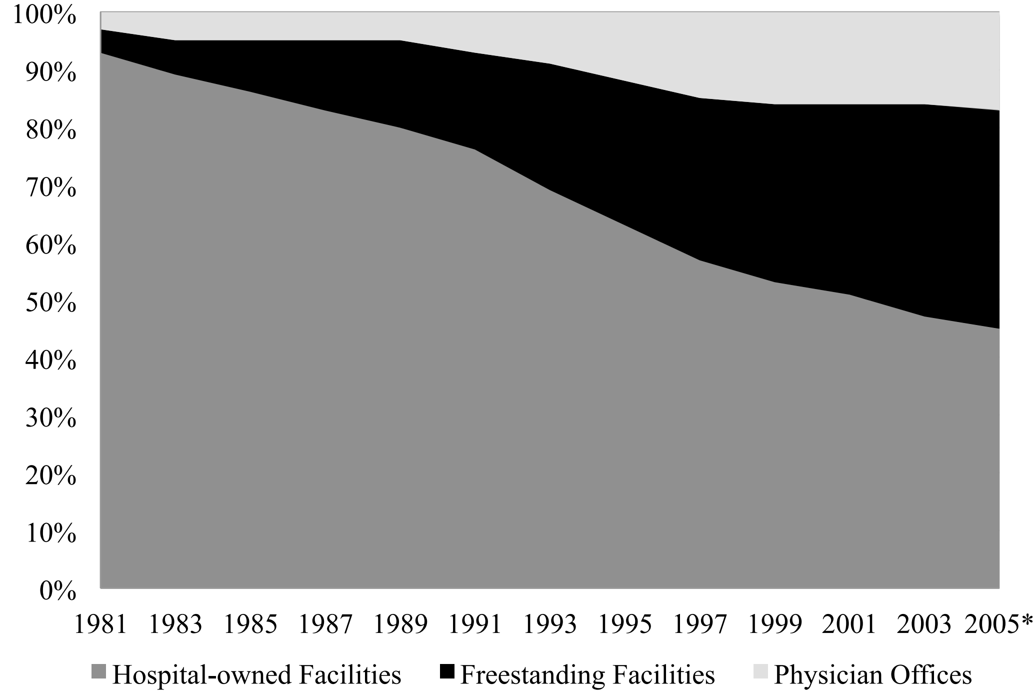
Figure 1
Inpatient and Outpatient Surgery Volume, 1981-2010



Source: American Hospital Association and Avalere Health (2007, 2011)

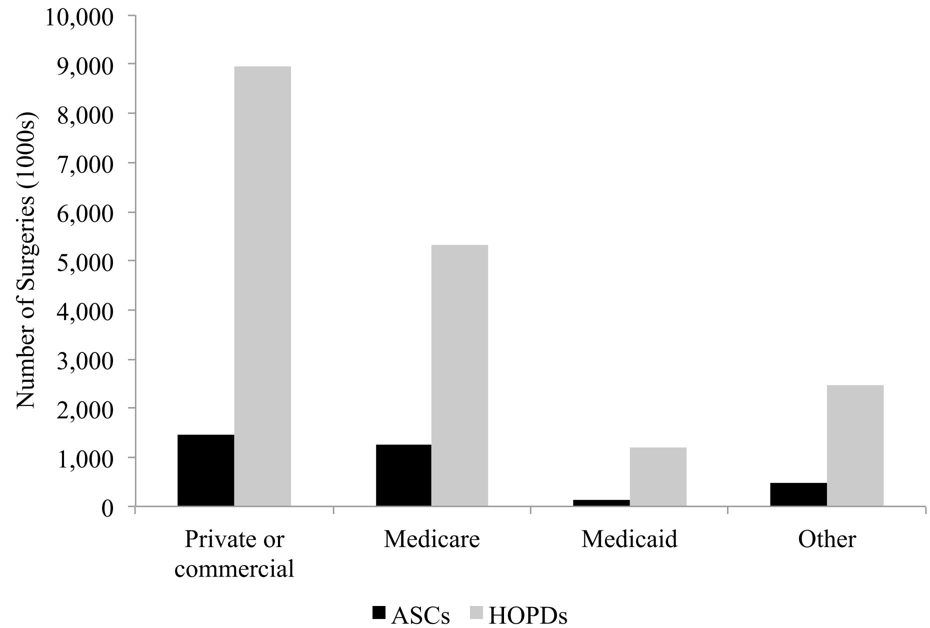
Figure 2
Percent of Outpatient Surgeries by Facility Type, 1981-2005



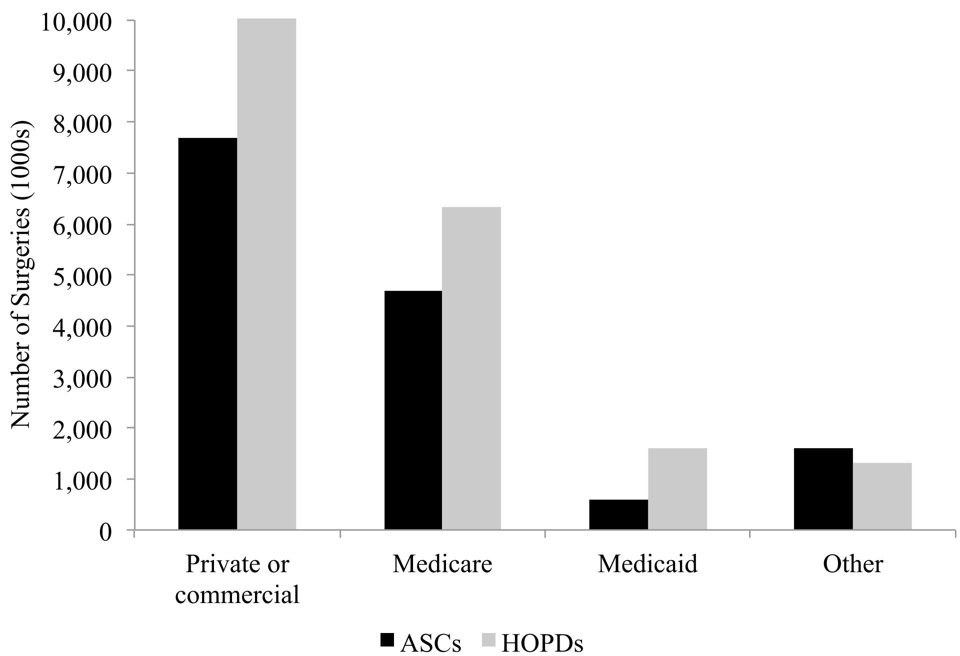
Source: American Hospital Association and Avalere Health (2011)

Figure 3
Outpatient Surgeries by Patient's Primary Insurance
National Survey of Ambulatory Surgery

Panel A: 1996



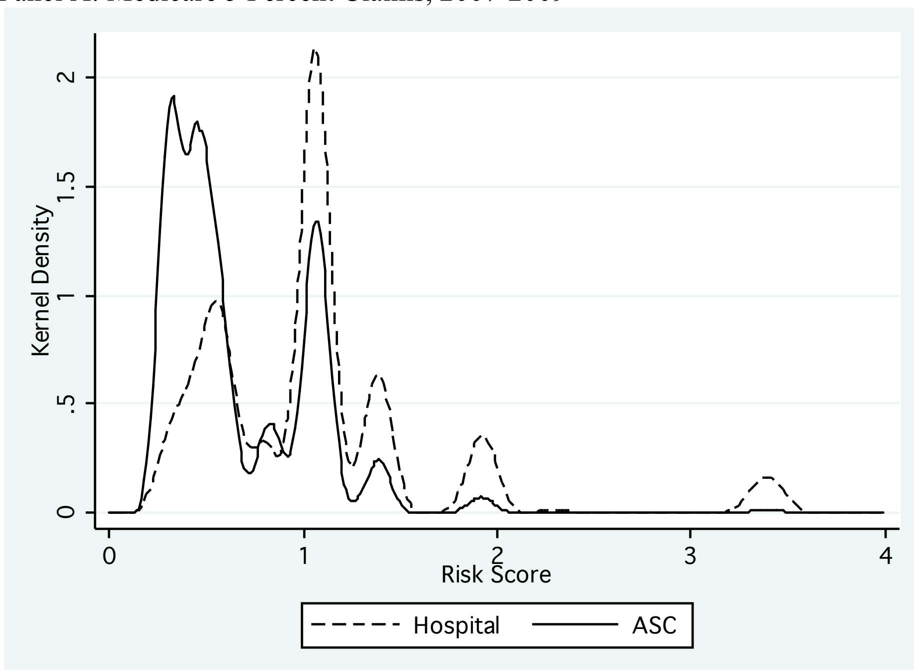
Panel B: 2006



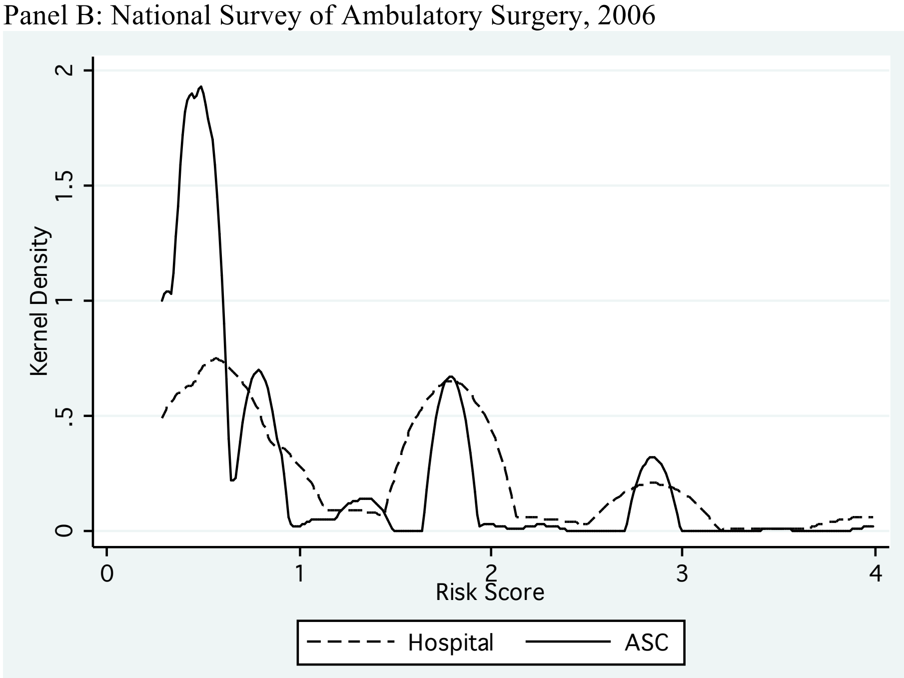
Notes: "Other insurance" includes Worker's Compensation, TRICARE, charity care, and other government insurance.

Figure 4
Patient Risk Score Kernel Density Plots by Facility Type, Medicare Patients, All Procedures

Panel A: Medicare 5 Percent Claims, 2007-2009



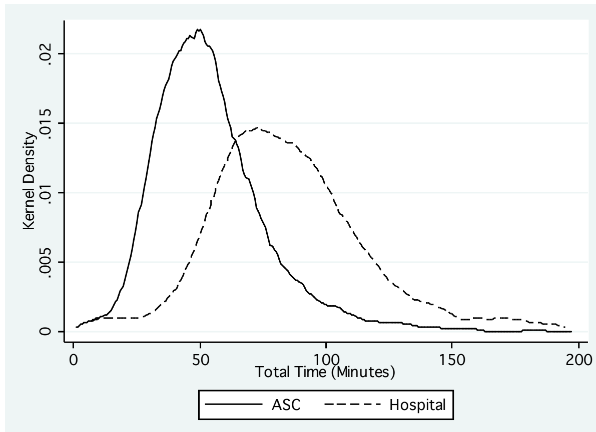
Panel B: National Survey of Ambulatory Surgery, 2006



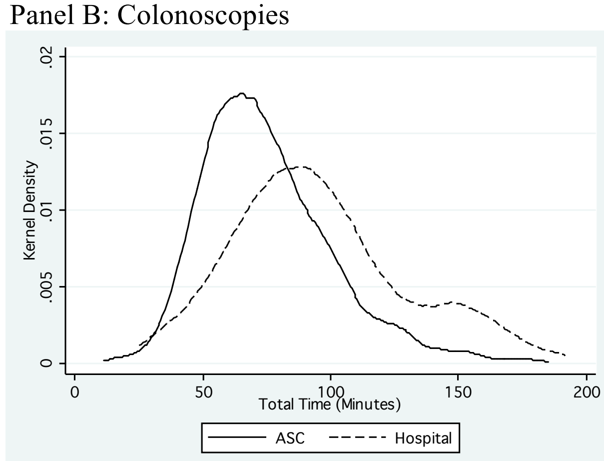
Notes: Sample size is 706,033 patient claims in Panel A, and 16,925 patient claims in Panel B. Graphs restricted to claims for patients with risk scores less than 4 (less than 1 percent of claims are from patients with risk scores greater than 4). Risk scores are based on concurrent weights calculated using the Johns Hopkins University ACG Case-Mix System (v. 10).

Figure 5
Total Time by Procedure and Facility, All Medicare Patients
2006 National Sample of Ambulatory Surgery

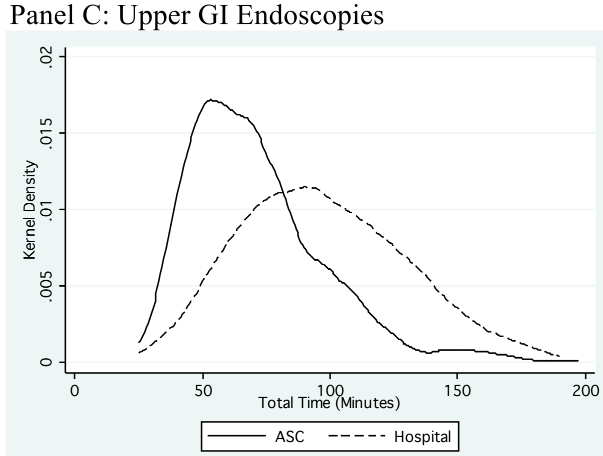
Panel A: Cataract Procedures



Panel B: Colonoscopies



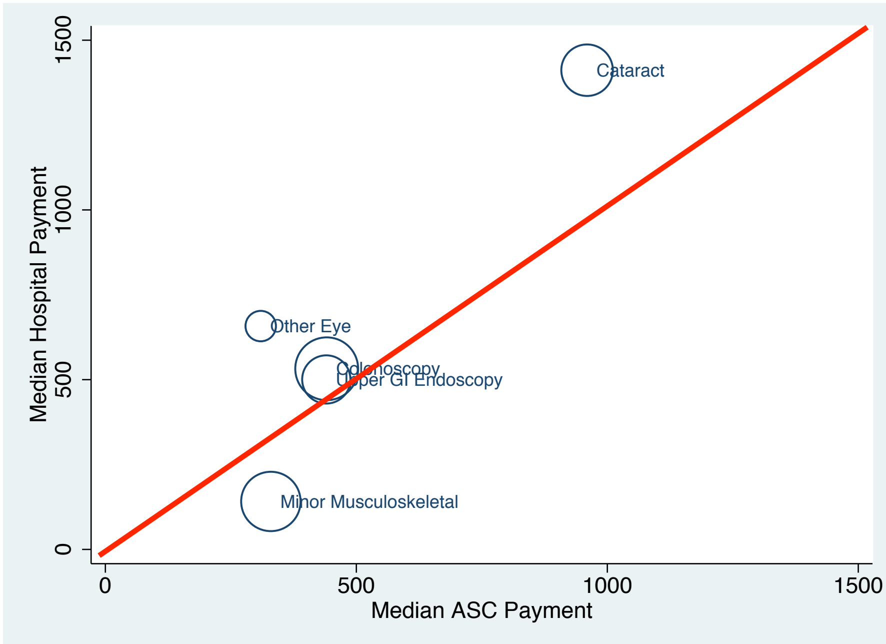
Panel C: Upper GI Endoscopies



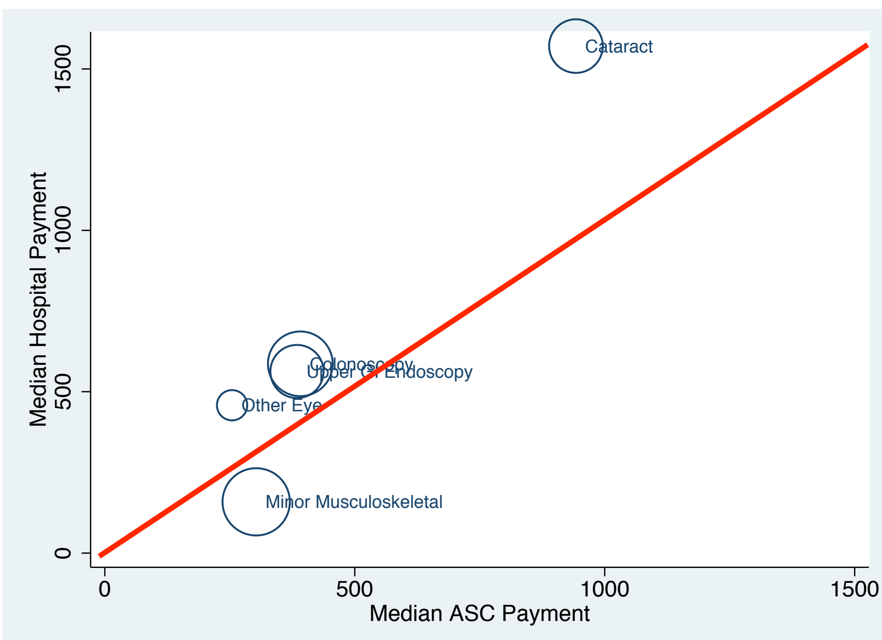
Notes: Total time includes the time in minutes between entering the operating room and leaving postoperative care, including transport or waiting time.

Figure 6
ASC and Hospital Outpatient Payments (Nominal $), by Procedure
Medicare 5 Percent Claims, 2007 & 2009

Panel A: 2007

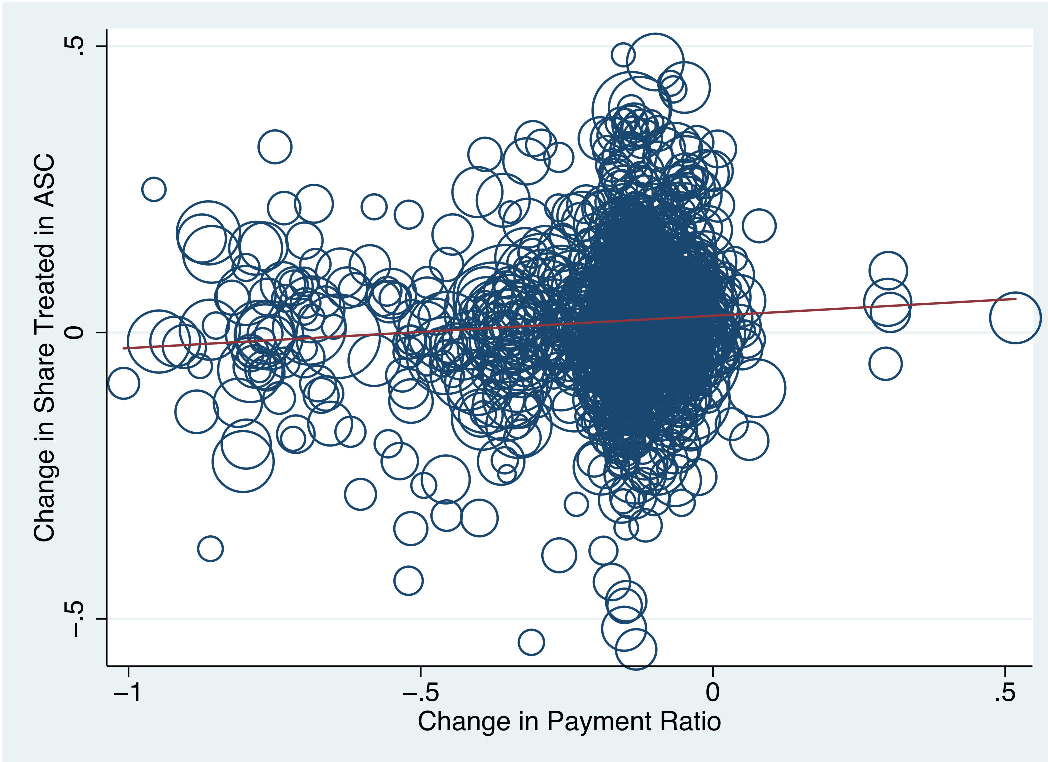


Panel B: 2009



Notes: Bubble size represents number of Medicare claims for a particular procedure, based on HSAs where with at least 10 claims in both ASCs and hospitals for a given procedure. Line is 45-degree line. Procedures performed by physicians who only treated patients in one type of facility (ASC or hospital) were omitted.

Figure 7
ASC/Hospital Payment Ratio and Share of Patients Treated in ASC, By Hospital Service Area
Top 5 Procedures, 2007 & 2009
Medicare 5% Claims



Notes: Each point represents a Hospital Service Area (HSA). Bubble size represents number of claims in an HSA in 2009. Payment ratio is calculated by dividing the median ASC payment for each year by the median hospital payment in 2007, by HSA and procedure. Change calculated as difference in payment ratio, or share of patients treated in an HSA, between 2007 and 2009. Top 5 procedures include cataract removal, colonoscopy, upper GI endoscopy, minor musculoskeletal procedures, and other eye procedures. Change calculated only for HSAs where with at least 10 claims for each procedure in both ASCs and hospitals. Procedures performed by physicians who only treated patients in one type of facility (ASC or hospital) were omitted.

Table 1
Descriptive Statistics for Outpatient Claims by Facility Type
All Procedures, Medicare 5 Percent Claims Data, 2007-2009
Means (Standard deviations)

Physician Sample:	All			Treats in Both		
Facility Type:	All	Hospitals	ASCs	All	Hospitals	ASCs
Patient Demographics						
Age	71.28	70.85	73.58	72.60	72.35	72.79
	(13.11)	(13.64)	(9.50)	(10.29)	(11.11)	(9.63)
Female	0.608	0.605	0.624	0.611	0.613	0.609
	(0.488)	(0.489)	(0.484)	(0.488)	(0.487)	(0.488)
Black	0.098	0.105	0.064	0.071	0.076	0.068
	(0.298)	(0.306)	(0.244)	(0.257)	(0.265)	(0.252)
Hispanic	0.017	0.017	0.016	0.014	0.014	0.014
	(0.129)	(0.129)	(0.126)	(0.117)	(0.118)	(0.116)
ESRD as Primary Reason for Medicare Receipt	0.029	0.033	0.008	0.013	0.020	0.008
	(0.169)	(0.179)	(0.092)	(0.114)	(0.139)	(0.091)
Disability as Primary Reason for Medicare Receipt	0.196	0.215	0.095	0.126	0.149	0.109
	(0.397)	(0.411)	(0.294)	(0.332)	(0.356)	(0.311)
Type of Procedure						
Cataract Removal	0.066	0.027	0.276	0.120	0.097	0.137
	(0.248)	(0.161)	(0.447)	(0.325)	(0.295)	(0.344)
Colonoscopy	0.070	0.043	0.214	0.252	0.153	0.326
	(0.255)	(0.203)	(0.410)	(0.434)	(0.360)	(0.469)
Upper GI Endoscopy	0.048	0.037	0.108	0.160	0.157	0.163
	(0.213)	(0.188)	(0.310)	(0.367)	(0.364)	(0.369)
Minor Musculoskeletal	0.071	0.061	0.130	0.105	0.082	0.122
	(0.258)	(0.238)	(0.337)	(0.307)	(0.274)	(0.328)
Other Eye Procedure	0.024	0.010	0.098	0.039	0.030	0.046
	(0.152)	(0.100)	(0.297)	(0.194)	(0.171)	(0.209)
Number of Claims	4,534,825	3,825,431	709,394	623,309	267,879	355,430

Notes: Procedures where physician identifier was missing were omitted. The physician sample "Treats in Both" indicates the sample of physicians for whom we observe patient claims in both ASCs and hospital outpatient departments.

Table 2
Probability of Treatment in ASC, Linear Probability Model with Physician Fixed Effects, by Procedure
Parameter Estimate (Standard Error) {Share Treated in ASC} [Share of Claims in Risk Score Quartile]
Medicare 5 Percent Claims Data, 2007-2009

Sample	(1) All Procedures	(2) All Procedures	(3) All Procedures	(4) Top 5 Procedures	(5) Cataract	(6) Colonoscopy	(7) Upper GI Endoscopy	(8) Minor Musculoskeletal	(9) Other Eye
Risk Score Quartile 1	*Omitted*	*Omitted*	*Omitted*	*Omitted*	*Omitted*	*Omitted*	*Omitted*	*Omitted*	*Omitted*
	{0.4078}	{0.7567}	{0.7567}	{0.8310}	{0.8506}	{0.8732}	{0.8534}	{0.7628}	{0.7690}
	[0.1769]	[0.2511]	[0.2511]	[0.2615]	[0.6649]	[0.1141]	[0.1501]	[0.2847]	[0.5194]
Risk Score Quartile 2	-0.1158***	-0.1166***	-0.0884***	-0.0857***	-0.1730***	0.0048	-0.0589***	-0.1047***	-0.0316**
	(0.0028)	(0.0046)	(0.0037)	(0.0043)	(0.0191)	(0.0033)	(0.0054)	(0.0113)	(0.0123)
	{0.1596}	{0.6692}	{0.6692}	{0.8110}	{0.6844}	{0.8726}	{0.7823}	{0.5354}	{0.7862}
	[0.2115]	[0.2500]	[0.2500]	[0.2413]	[0.0506]	[0.3663]	[0.2645]	[0.1185]	[0.2608]
Risk Score Quartile 3	-0.1704***	-0.2818***	-0.2542***	-0.2572***	-0.5891***	-0.1308***	-0.2453***	-0.0711***	-0.3347***
	(0.0041)	(0.0064)	(0.0059)	(0.0067)	(0.0143)	(0.0069)	(0.0082)	(0.0135)	(0.0195)
	{0.1119}	{0.4925}	{0.4925}	{0.5949}	{0.2171}	{0.6951}	{0.5276}	{0.7015}	{0.3396}
	[0.2675]	[0.2490]	[0.2490]	[0.2506]	[0.1591]	[0.2722]	[0.2336]	[0.3607]	[0.1180]
Risk Score Quartile 4	-0.2003***	-0.4343***	-0.3853***	-0.4131***	-0.6838***	-0.2945***	-0.4207***	-0.1758***	-0.4977***
	(0.0046)	(0.0074)	(0.0070)	(0.0077)	(0.0141)	(0.0086)	(0.0095)	(0.0188)	(0.0218)
	{0.0599}	{0.3590}	{0.3590}	{0.4230}	{0.1477}	{0.5218}	{0.3413}	{0.5592}	{0.2301}
	[0.3440]	[0.2500]	[0.2500]	[0.2467]	[0.1255]	[0.2474]	[0.3518]	[0.2360]	[0.1018]
# Observations	4,524,827	620,952	620,952	419,522	74,438	156,013	99,406	65,286	24,379
# Physicians	358,723	26,819	26,819	16,323	3,225	8,200	7,439	4,212	3,024
R^2	0.3889	0.2681	0.5988	0.4757	0.5874	0.4190	0.4392	0.5315	0.6093
Restricted Sample	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Physician FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Procedure FE	No	No	Yes	Yes	No	No	No	No	No
Physician x Procedure FE	No	No	Yes	Yes	No	No	No	No	No
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Risk score group 1 denotes the healthiest group of patients. “Restricted sample” indicates that procedures performed by physicians who only treated patients in one type of facility (ASC or hospital) were omitted. Controls include age <65, age 70-74, age 75-79, age 80-84, age 85+, black, female, Hispanic, and an indicator where ESRD was the only reason for Medicare eligibility. Standard errors clustered by HSA.

Table 3
Descriptive Statistics, 2006 National Survey of Ambulatory Surgery
Means (Standard Deviations)

	All Patients		Medicare Patients		Medicare - Top 10 Procedures	
	Hospitals	ASCs	Hospitals	ASCs	Hospitals	ASCs
Observations	16,673	35,560	4,633	12,354	2,323	9,850
Demographic Characteristics						
Age	51.30	53.17	70.62	71.60	71.57	72.08
	(21.70)	(20.52)	(11.83)	(10.78)	(10.61)	(9.95)
Female	0.57	0.58	0.55	0.59	0.57	0.60
	(0.49)	(0.49)	(0.50)	(0.49)	(0.50)	(0.49)
MSA Status	0.78	0.95	0.73	0.94	0.64	0.93
	(0.41)	(0.21)	(0.44)	(0.24)	(0.48)	(0.25)
Disabled	0.06	0.04	0.18	0.13	0.14	0.12
	(0.24)	(0.20)	(0.38)	(0.34)	(0.35)	(0.32)
Type of Insurance (Principal)						
Private	0.52	0.52	0.02	0.02	0.02	0.02
	(0.50)	(0.50)	(0.15)	(0.15)	(0.15)	(0.15)
Medicare	0.32	0.31	0.97	0.97	0.97	0.97
	(0.47)	(0.46)	(0.17)	(0.16)	(0.16)	(0.16)
Medicaid	0.08	0.04	0.00	0.00	0.00	0.00
	(0.27)	(0.19)	(0.05)	(0.01)	(0.05)	(0.00)
Other Insurance	0.03	0.05	0.00	0.00	0.00	0.00
	(0.17)	(0.22)	(0.03)	(0.04)	(0.00)	(0.00)
Self-Pay	0.02	0.05	0.00	0.00	0.00	0.00
	(0.16)	(0.21)	(0.01)	(0.00)	(0.00)	(0.00)
Risk Score Quartile						
Risk Score Quartile 1	0.17	0.27	0.19	0.41	0.29	0.46
	(0.37)	(0.44)	(0.39)	(0.49)	(0.45)	(0.50)
Risk Score Quartile 2	0.18	0.25	0.11	0.15	0.09	0.13
	(0.39)	(0.43)	(0.31)	(0.35)	(0.28)	(0.33)
Risk Score Quartile 3	0.29	0.28	0.21	0.22	0.20	0.20
	(0.45)	(0.45)	(0.41)	(0.41)	(0.40)	(0.40)
Risk Score Quartile 4	0.36	0.21	0.49	0.23	0.43	0.22
	(0.48)	(0.40)	(0.50)	(0.42)	(0.49)	(0.41)

Note: All estimates weighted using sample weights. “Other insurance” includes Worker’s Compensation, TRICARE, charity care, and other government insurance. Disabled indicates Medicare recipient under age 65. Top 10 procedures are listed in Table A.1.

Table 4
OLS Estimates for Procedure Time, All Procedures, All Facilities
2006 National Survey of Ambulatory Surgery

Dependent Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ln(Minutes) Spent In:	Non-Surgery OR	Non-Surgery OR	Surgery	Surgery	Post-Op	Post-Op	Total	Total
ASC	-0.331***		-0.177***		-0.183***		-0.255***	
	(0.042)		(0.049)		(0.013)		(0.009)	
Risk Score Quartile 2	0.028	-0.002	0.009	0.027	0.007	0.023	0.010	0.017
	(0.031)	(0.029)	(0.039)	(0.030)	(0.023)	(0.022)	(0.016)	(0.015)
Risk Score Quartile 3	0.026	0.019	0.075**	0.096***	0.063***	0.063***	0.057***	0.063***
	(0.026)	(0.022)	(0.030)	(0.025)	(0.020)	(0.022)	(0.015)	(0.013)
Risk Score Quartile 4	0.066**	0.009	0.103***	0.133***	0.036*	0.041	0.051***	0.051***
	(0.033)	(0.024)	(0.034)	(0.023)	(0.020)	(0.026)	(0.014)	(0.014)
Age	0.000	0.001	0.002***	0.002***	0.001***	0.001**	0.001***	0.001***
	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)
Female	0.004	-0.000	-0.018	-0.016	0.020	0.009	0.004	-0.000
	(0.012)	(0.011)	(0.017)	(0.016)	(0.013)	(0.012)	(0.009)	(0.008)
Disabled	0.003	0.010	0.061*	0.033	0.065**	0.037	0.063***	0.038*
	(0.031)	(0.028)	(0.032)	(0.031)	(0.033)	(0.030)	(0.024)	(0.021)
Medicare	-0.032	-0.031*	-0.035*	-0.029	-0.037*	-0.016	-0.033**	-0.022*
	(0.024)	(0.019)	(0.019)	(0.018)	(0.019)	(0.017)	(0.013)	(0.012)
Medicaid	0.032	0.029	-0.070**	-0.072***	-0.008	0.040	0.012	0.019
	(0.029)	(0.027)	(0.027)	(0.025)	(0.031)	(0.026)	(0.020)	(0.018)
TRICARE	-0.069	-0.057*	-0.035	-0.062	0.196***	0.021	0.084**	-0.013
	(0.052)	(0.030)	(0.044)	(0.061)	(0.055)	(0.045)	(0.035)	(0.033)
Worker's Comp	0.017	-0.011	0.070	0.069	0.102***	0.049	0.052**	0.030
	(0.041)	(0.029)	(0.076)	(0.044)	(0.036)	(0.031)	(0.026)	(0.024)
Other Government	0.004	-0.017	-0.074	-0.018	0.141**	0.047	0.055	0.025
	(0.050)	(0.070)	(0.069)	(0.046)	(0.056)	(0.050)	(0.037)	(0.040)
Self-Pay	0.104**	0.031	0.278***	0.236***	0.068	0.074*	0.148***	0.117***
	(0.050)	(0.030)	(0.074)	(0.053)	(0.044)	(0.043)	(0.030)	(0.029)
# Procedures	0.050***	0.062***	0.196***	0.235***	0.068***	0.076***	0.094***	0.110***
	(0.013)	(0.010)	(0.025)	(0.014)	(0.009)	(0.010)	(0.006)	(0.006)
Mean of Dependent Variable	20.83	20.83	29.47	29.47	62.96	62.96	115.87	115.87
	(25.55)	(25.55)	(36.48)	(36.48)	(57.51)	(57.51)	(88.67)	(88.67)
Observations	34,467	34,467	34,467	34,467	34,467	34,467	34,467	34,467
R-squared	0.356	0.501	0.461	0.531	0.236	0.505	0.470	0.606
Procedure FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Facility FE	No	Yes	No	Yes	No	Yes	No	Yes

Notes: Data are balanced across surgery and post-operative time components. Total time includes the time in minutes between entering the operating room and leaving postoperative care, including transport or waiting time. Controls include age, female, disabled (Medicare recipients under age 65), type of insurance, and total number of procedures. All estimates weighted using sample weights. Standard errors, clustered by facility, in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 5
OLS and Quantile Estimates for Total Procedure Time, All Procedures and All Facilities
2006 National Survey of Ambulatory Surgery

	OLS			Quantile				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				0.10	0.25	0.5	0.75	0.9
ASC		-0.255***	-0.253***	-0.177***	-0.213***	-0.246***	-0.283***	-0.295***
		(0.009)	(0.006)	(0.009)	(0.008)	(0.007)	(0.009)	(0.010)
Risk Score Quartile 2	0.017	0.010	0.040***	0.033**	0.035***	0.021*	0.018	0.028*
	(0.015)	(0.016)	(0.009)	(0.015)	(0.012)	(0.011)	(0.011)	(0.015)
Risk Score Quartile 3	0.063***	0.057***	0.066***	0.080***	0.070***	0.053***	0.060***	0.061***
	(0.013)	(0.015)	(0.009)	(0.013)	(0.011)	(0.011)	(0.011)	(0.012)
Risk Score Quartile 4	0.051***	0.051***	0.070***	0.082***	0.073***	0.053***	0.058***	0.068***
	(0.014)	(0.014)	(0.009)	(0.013)	(0.012)	(0.010)	(0.011)	(0.013)
Observations	34,467	34,467	34,467	34,467	34,467	34,467	34,467	34,467
R^2	0.606	0.470	0.494	0.296	0.308	0.330	0.328	0.309
Procedure FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Facility FE	Yes	No	No	No	No	No	No	No
Weights	Yes	Yes	No	No	No	No	No	No

Note: Data are balanced across time components. Total time is the time between entering the operating room and leaving postoperative care, not including transport or waiting time. All estimates weighted using sample weights. Controls include age, female, disabled (Medicare recipients under age 65), type of insurance, and total number of procedures. Bootstrapped standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 6
HSA Facility Payments in Nominal Dollars and Payment Ratios by Procedure, 2007-2009
Medicare 5 Percent Carrier Claims and Hospital Outpatient Data
Means (Standard Deviations)

		2007	2008	2009
Cataract Removal	Average ASC Payment	$962	$966	$960
		($87)	($73)	($76)
	Average Hospital Payment	$1,437	$1,515	$1,601
		($169)	($154)	($171)
	Average Payment Ratio	0.689	0.691	0.640
		(0.278)	(0.053)	(0.263)
	Number of HSAs	308	294	286
Colonoscopy	Average ASC Payment	$443	$419	$397
		($35)	($49)	($34)
	Average Hospital Payment	$545	$571	$602
		($57)	($61)	($64)
	Average Payment Ratio	0.817	0.791	0.687
		(0.086)	(0.081)	(0.036)
	Number of HSAs	524	526	504
Upper GI Endoscopy	Average ASC Payment	$434	$412	$387
		($51)	($45)	($39)
	Average Hospital Payment	$505	$534	$562
		($76)	($85)	($83)
	Average Payment Ratio	0.883	0.857	0.737
		(0.201)	(0.179)	(0.155)
	Number of HSAs	428	251	252
Minor Musculoskeletal Procedures	Average ASC Payment	$329	$315	$304
		($38)	($47)	($43)
	Average Hospital Payment	$213	$216	$232
		($146)	($162)	($170)
	Average Payment Ratio	2.620	2.557	2.28
		(1.76)	(1.715)	(1.531)
	Number of HSAs	455	481	489
Other Eye Procedures	Average ASC Payment	$327	$302	$285
		($59)	($75)	($105)
	Average Hospital Payment	$943	$641	$733
		($742)	($482)	($576)
	Average Payment Ratio	0.648	0.671	0.582
		(0.530)	(0.509)	(0.474)
	Number of HSAs	147	127	108

Notes: Payment ratio is calculated by dividing the median ASC payment for each year by the 2007 median hospital payment, by Hospital Service Area and procedure; the average payments are calculated over HSA-level median values, for all HSAs with at least 10 claims in both ASCs and hospitals for a given procedure.

Table 7
OLS Regressions of ASC Share on Facility Payment Ratio for Top 5 Procedures by HSA
Medicare 5 Percent Claims Data, 2007-2009

Payment Ratio	0.0393***
	(0.0081)
Colonoscopy	-0.0912***
	(0.0204)
Upper GI	-0.2544***
	(0.0207)
Minor Musculoskeletal	-0.3458***
	(0.0210)
Other Eye	-0.1144***
	(0.0270)
Year (2008)	0.0135***
	(0.0033)
Year (2009)	0.0257***
	(0.0046)
Mean of Dependent Variable	0.557
	(0.208)
Observations	4,224
R^2	0.6978
HSA Fixed Effects	Yes

Notes: Panels balanced by Hospital Service Area (HSA) across years, by procedure. Payment ratio is calculated by dividing the median ASC payment for each year by the median hospital payment in 2007, by HSA and procedure for all HSAs with at least 10 claims in both ASCs and hospitals for a given procedure. All estimates weighted by population of Medicare enrollee claims in each procedure-HSA-year cell. Standard errors, clustered by HSA, in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 8
Descriptive Statistics, ASC Treatment and Subsequent Hospital Visits
Medicare 5% Claims, Top 5 Procedures, 2007-2009
Means (Standard Deviations)

		Inpatient Admission			Emergency Room Visit			Adverse Event		
Dependent Variable	ASC	Same Day	1-7 Days	8-30 Days	Same Day	1-7 Days	8-30 Days	Same Day	1-7 Days	8-30 Days
Panel A: Risk Score Halves										
Bottom Half	0.847	0.001	0.008	0.027	0.002	0.014	0.036	0.001	0.004	0.012
	(0.360)	(0.033)	(0.091)	(0.162)	(0.049)	(0.116)	(0.187)	(0.030)	(0.066)	(0.110)
Top Half	0.563	0.001	0.011	0.036	0.004	0.017	0.045	0.001	0.006	0.016
	(0.496)	(0.035)	(0.105)	(0.186)	(0.062)	(0.130)	(0.208)	(0.035)	(0.078)	(0.125)
Panel B: Risk Score Terciles										
1st Tercile	0.840	0.001	0.007	0.024	0.002	0.013	0.035	0.001	0.004	0.011
	(0.366)	(0.029)	(0.084)	(0.154)	(0.043)	(0.111)	(0.184)	(0.025)	(0.061)	(0.106)
2nd Tercile	0.772	0.001	0.010	0.032	0.003	0.016	0.041	0.001	0.006	0.014
	(0.420)	(0.037)	(0.101)	(0.176)	(0.056)	(0.127)	(0.199)	(0.035)	(0.075)	(0.116)
3rd Tercile	0.512	0.001	0.012	0.038	0.004	0.017	0.046	0.001	0.006	0.017
	(0.500)	(0.036)	(0.107)	(0.190)	(0.065)	(0.131)	(0.208)	(0.036)	(0.079)	(0.129)
Panel C: Risk Score Quartiles										
1st Quartile	0.860	0.001	0.007	0.024	0.002	0.012	0.035	0.000	0.004	0.012
	(0.347)	(0.027)	(0.084)	(0.154)	(0.043)	(0.110)	(0.185)	(0.022)	(0.059)	(0.108)
2nd Quartile	0.835	0.001	0.009	0.029	0.003	0.015	0.037	0.001	0.005	0.013
	(0.371)	(0.037)	(0.096)	(0.169)	(0.053)	(0.123)	(0.189)	(0.035)	(0.072)	(0.113)
3rd Quartile	0.651	0.001	0.010	0.032	0.003	0.016	0.043	0.001	0.005	0.014
	(0.477)	(0.035)	(0.100)	(0.175)	(0.055)	(0.127)	(0.202)	(0.033)	(0.073)	(0.117)
4th Quartile	0.467	0.001	0.012	0.040	0.005	0.018	0.048	0.001	0.007	0.018
	(0.499)	(0.036)	(0.109)	(0.196)	(0.068)	(0.133)	(0.214)	(0.037)	(0.083)	(0.133)
All Patients	0.703	0.001	0.010	0.031	0.003	0.015	0.041	0.001	0.005	0.014
	(0.457)	(0.034)	(0.098)	(0.174)	(0.056)	(0.123)	(0.198)	(0.033)	(0.072)	(0.118)
Observations	273,944	273,944	271,781	254,158	273,944	271,781	254,158	273,944	271,781	254,158

Notes: Procedures performed by physicians who only treated patients in one type of facility (ASC or hospital) were omitted. Adverse events are defined using ICD-9-CM Adverse Event Codes from the Utah/Missouri Patient Safety Project. For 7- and 30-day measures, observations that occurred within 7 and 30 days of the end of the calendar year (respectively) were omitted.

Table 9
ASC Treatment and Subsequent Hospital Visits by Risk Score Quantile, Top 5 Procedures
Linear Probability Model with Physician-Procedure Fixed Effects
Medicare 5 Percent Claims, 2007-2009

		Inpatient Admission			Emergency Room Visit		
Dependent Variable	ASC	0 Days	1-7 Days	8-30 Days	0 Days	1-7 Days	8-30 Days
Panel A: Risk Score Halves							
Top Half	-0.3200***	0.0005*	0.0035***	0.0089***	0.0023***	0.0033***	0.0071***
	(0.0099)	(0.0002)	(0.0008)	(0.0016)	(0.0004)	(0.0010)	(0.0019)
Bottom Half*Pmt Ratio	0.0436**	0.0002	-0.0012	-0.0008	-0.0004	-0.0004	-0.0012
	(0.0183)	(0.0002)	(0.0011)	(0.0021)	(0.0005)	(0.0013)	(0.0027)
Top Half*Pmt Ratio	0.1159***	0.0000	-0.0023**	-0.0026	-0.0012**	-0.0017	-0.0030
	(0.0183)	(0.0002)	(0.0010)	(0.0020)	(0.0005)	(0.0013)	(0.0026)
N	276,091	276,091	273,896	256,131	276,091	273,896	256,131
R^2	0.4964	0.0867	0.0865	0.0959	0.1391	0.0856	0.0984
Panel B: Risk Score Terciles							
Middle Third	-0.1112***	0.0002	0.0041***	0.0085***	0.0012**	0.0042***	0.0076***
	(0.0069)	(0.0003)	(0.0010)	(0.0017)	(0.0005)	(0.0012)	(0.0021)
Top Third	-0.3722***	0.0003	0.0052***	0.0138***	0.0030***	0.0053***	0.0116***
	(0.0113)	(0.0003)	(0.0009)	(0.0019)	(0.0005)	(0.0012)	(0.0023)
Bottom Third*Pmt Ratio	0.0461**	0.0001	-0.0010	-0.0004	-0.0005	0.0000	-0.0006
	(0.0183)	(0.0002)	(0.0011)	(0.0021)	(0.0005)	(0.0013)	(0.0028)
Middle Third*Pmt Ratio	0.0774***	0.0002	-0.0026**	-0.0037	-0.0009*	-0.0013	-0.0024
	(0.0189)	(0.0002)	(0.0011)	(0.0023)	(0.0005)	(0.0014)	(0.0029)
Top Third*Pmt Ratio	0.1206***	0.0001	-0.0024**	-0.0029	-0.0012**	-0.0020	-0.0035
	(0.0180)	(0.0002)	(0.0010)	(0.0021)	(0.0005)	(0.0013)	(0.0027)
N	276,091	276,091	273,896	256,131	276,091	273,896	256,131
R^2	0.4960	0.0867	0.0866	0.0961	0.1392	0.0857	0.0985
Panel C: Risk Score Quartiles							
2nd Quartile	-0.0568***	-0.0006	0.0018	0.0037*	0.0005	0.0031**	0.0058**
	(0.0071)	(0.0005)	(0.0011)	(0.0022)	(0.0006)	(0.0014)	(0.0028)
3rd Quartile	-0.2828***	0.0003	0.0037***	0.0068***	0.0018***	0.0043***	0.0076***
	(0.0112)	(0.0003)	(0.0012)	(0.0020)	(0.0006)	(0.0013)	(0.0024)
4th Quartile	-0.4482***	0.0002	0.0055***	0.0157***	0.0033***	0.0064***	0.0136***
	(0.0131)	(0.0003)	(0.0012)	(0.0022)	(0.0006)	(0.0015)	(0.0027)
1st Quartile*Pmt Ratio	0.0419**	0.0001	-0.0008	-0.0004	-0.0003	0.0001	-0.0003
	(0.0183)	(0.0002)	(0.0012)	(0.0022)	(0.0005)	(0.0014)	(0.0029)
2nd Quartile*Pmt Ratio	0.0377**	0.0007	-0.0017	-0.0017	-0.0008	-0.0009	-0.0027
	(0.0181)	(0.0004)	(0.0012)	(0.0026)	(0.0006)	(0.0015)	(0.0033)
3rd Quartile*Pmt Ratio	0.1086***	0.0000	-0.0021**	-0.0024	-0.0011**	-0.0012	-0.0026
	(0.0184)	(0.0002)	(0.0011)	(0.0022)	(0.0005)	(0.0013)	(0.0028)
4th Quartile*Pmt Ratio	0.1265***	0.0000	-0.0026**	-0.0030	-0.0012**	-0.0025*	-0.0038
	(0.0179)	(0.0002)	(0.0011)	(0.0023)	(0.0005)	(0.0014)	(0.0028)
N	276,091	276,091	273,896	256,131	276,091	273,896	256,131
R^2	0.5070	0.0867	0.0866	0.0961	0.1392	0.0857	0.0985

Notes: Controls include age <65, age 70-74, age 75-79, age 80-84, age 85+, black, female, Hispanic, and ESRD as the only reason for Medicare eligibility, as well year and physician-procedure fixed effects. Payment ratio is calculated by dividing the median ASC payment for each year by the median hospital payment in 2007, by Hospital Service Area (HSA) and procedure for all HSAs with at least 10 claims in both ASCs and hospitals for a given procedure. Procedures performed by physicians who only treated patients in one type of facility (ASC or hospital) were omitted. For regressions with 7- and 30-day measures as the dependent variable, observations that occurred within 7 and 30 days of the end of the calendar year (respectively) were omitted. Standard errors, clustered by HSA, in parentheses.

Table 10
Two-Stage Least Squares Estimates of the Effect of ASC Treatment on Subsequent Hospital Visits
By Risk Square Quantile, Top 5 Procedures
Linear Probability Model with Physician-Procedure Fixed Effects
Medicare 5 Percent Claims, 2007-2009
(Standard Error)[First Stage F-Statistic]

	Inpatient Admission			Emergency Room Visit		
Dependent Variable	0 Days	1-7 Days	8-30 Days	0 Days	1-7 Days	8-30 Days
Panel A: Risk Score Halves						
Bottom Half*ASC	0.0054	-0.0267	-0.0195	-0.0102	-0.0091	-0.0290
	(0.0039)	(0.0249)	(0.0482)	(0.0104)	(0.0296)	(0.0624)
	[142.97]	[141.14]	[128.28]	[142.97]	[141.14]	[128.28]
Top Half*ASC	-0.0016	-0.0178***	-0.0237	-0.0101***	-0.0163*	-0.0250
	(0.0013)	(0.0059)	(0.0155)	(0.0031)	(0.0091)	(0.0185)
	[2018.05]	[2003.04]	[1860.26]	[2018.05]	[2003.04]	[1860.26]
Observations	273,955	271,781	254,158	273,955	271,781	254,158
R-squared	0.0781	0.0772	0.0861	0.0897	0.0761	0.0904
Panel B: Risk Score Terciles						
Bottom Tercile*ASC	0.0032	-0.0202	-0.0061	-0.0104	0.0029	-0.0111
	(0.0043)	(0.0262)	(0.0507)	(0.0109)	(0.0315)	(0.0671)
	[98.50]	[97.11]	[90.17]	[98.50]	[97.11]	[90.17]
Middle Tercile*ASC	0.0028	-0.0442***	-0.0783**	-0.0126	-0.0278	-0.0425
	(0.0051)	(0.0153)	(0.0342)	(0.0088)	(0.0222)	(0.0431)
	[339.80]	[335.38]	[306.77]	[339.80]	[335.38]	[306.77]
Top Tercile *ASC	0.0002	-0.0207***	-0.0307*	-0.0096***	-0.0217**	-0.0345*
	(0.0016)	(0.0064)	(0.0165)	(0.0033)	(0.0096)	(0.0203)
	[1345.18]	[1336.10]	[1250.79]	[2234.12]	[1336.10]	[1250.79]
Observations	273,955	271,781	254,158	273,955	271,781	254,158
R-squared	0.0781	0.0773	0.0863	0.0897	0.0762	0.0905
Panel C: Risk Score Quartiles						
1st Quartile*ASC	0.0442	-0.0836	-0.0881	-0.0375	-0.0457	-0.1526
	(0.0286)	(0.0635)	(0.1446)	(0.0326)	(0.0896)	(0.1880)
	[97.10]	[95.96]	[89.49]	[97.10]	[95.96]	[89.49]
2nd Quartile*ASC	-0.1362	0.1855	0.2553	0.0859	0.1495	0.4863
	(0.0941)	(0.1699)	(0.4321)	(0.0964)	(0.2636)	(0.5810)
	[15.09]	[14.99]	[12.70]	[15.09]	[14.99]	[12.70]
3rd Quartile*ASC	0.0076	-0.0309**	-0.0386	-0.0164**	-0.0232	-0.0529
	(0.0057)	(0.0150)	(0.0331)	(0.0072)	(0.0204)	(0.0419)
	[1003.74]	[1001.20]	[928.50]	[1003.74]	[1001.20]	[928.50]
4th Quartile*ASC	0.0048	-0.0288**	-0.0367	-0.0136**	-0.0307*	-0.0529*
	(0.0039)	(0.0115)	(0.0227)	(0.0058)	(0.0166)	(0.0287)
	[693.35]	[686.51]	[671.38]	[693.35]	[686.51]	[671.38]
Observations	273,955	271,781	254,158	273,955	271,781	254,158
R-squared	0.0781	0.0772	0.0863	0.0897	0.0762	0.0905

Notes: Controls include age <65, age 70-74, age 75-79, age 80-84, age 85+, black, female, Hispanic, ESRD as the only reason for Medicare eligibility, and quantile dummy variables, as well year and physician-procedure fixed effects. Payment ratio is calculated by dividing the median ASC payment for each year by the median hospital payment in 2007, by Hospital Service Area (HSA) and procedure for all HSAs with at least 10 claims in both ASCs and hospitals for a given procedure. Procedures performed by physicians who only treated patients in one type of facility (ASC or hospital) were omitted. For regressions with 7- and 30-day measures as the dependent variable, observations that occurred within 7 and 30 days of the end of the calendar year (respectively) were omitted. Standard errors, clustered by HSA, in parentheses.

Table A.1
Top 10 Procedures Based on ASC Surgical Volume
Medicare 5 Percent Claims and National Survey of Ambulatory Surgery

Medicare 5 Percent Claims (2007)		National Survey of Ambulatory Surgery (2006)	
Procedure Group	Percent of All Procedures	Procedure Group	Percent of All Procedures
Cataract Removal/Lens Insertion	26.95	Lens and Cataract Procedures	28.69
Endoscopy - Colonoscopy	22.74	Colonoscopy and Biopsy	21.86
Minor Procedures - Musculoskeletal	12.71	Upper GI Endoscopy; Biopsy	10.80
Endoscopy - Upper GI	10.45	Insertion of Catheter or Spinal Stimulator	8.21
Eye Procedure - Other	9.35	Other non-OR Lower GI Therapeutic Procedures	4.61
Ambulatory Procedures - Other	3.19	Arthroscopy	1.98
Ambulatory Procedures - Musculoskeletal	2.72	Endoscopy and Biopsy of the Urinary Tract (Cystoscopy)	1.66
Endoscopy - Cystoscopy	2.62	Other Therapeutic Procedures on Eyelids	1.52
Endoscopy - Arthroscopy	1.88	Other Therapeutic Procedures on Muscles	1.32
Ambulatory Procedures - Skin	1.82	Excision of Skin Lesion	1.23

Notes: Medicare procedures coded using the Healthcare Common Procedure Coding System (HCPC) and grouped by Berenson-Eggers Type of Service (BETOS) Codes. NSAS procedures are coded by ICD-9 procedure codes and grouped using Clinical Classifications Software from the Healthcare Cost and Utilization Project.

Table A.2
First Stage Estimates of Effect of ASC Payments on ASC Treatment by Risk Score Quantile, Top 5 Procedures
Linear Probability Model with Physician-Procedure Fixed Effects
Medicare 5 Percent Claims, 2007-2009

Dependent Variable	Bottom Half* ASC	Top Half* ASC	Bottom Tercile* ASC	Middle Tercile* ASC	Top Tercile* ASC	1st Quartile* ASC	2nd Quartile* ASC	3rd Quartile* ASC	4th Quartile* ASC
Bottom Half *Payment Ratio	0.0448***	-0.0012							
	(0.0103)	(0.0102)							
Top Half *Payment Ratio	0.0270***	0.0889***							
	(0.0093)	(0.0110)							
Bottom Tercile*Payment Ratio			0.0423***	0.0025	0.0013				
			(0.0102)	(0.0048)	(0.0070)				
Middle Tercile*Payment Ratio			0.0256***	0.0437***	0.0081				
			(0.0096)	(0.0062)	(0.0075)				
Top Tercile*Payment Ratio			0.0231***	-0.0027	0.1001***				
			(0.0089)	(0.0048)	(0.0083)				
1st Quartile*Payment Ratio						0.0384***	0.0113***	-0.0084	0.0006
						(0.0082)	(0.0032)	(0.0060)	(0.0052)
2nd Quartile*Payment Ratio						0.0244***	0.0036	0.0038	0.0059
						(0.0076)	(0.0076)	(0.0059)	(0.0056)
3rd Quartile*Payment Ratio						0.0169**	0.0097***	0.0780***	0.0040
						(0.0073)	(0.0030)	(0.0070)	(0.0055)
4th Quartile*Payment Ratio						0.0183***	0.0094***	-0.0029	0.1017***
						(0.0069)	(0.0031)	(0.0062)	(0.0079)
F-Statistic	142.97	2018.05	98.50	339.80	1345.18	97.10	15.09	1003.74	693.35
Observations	273,955	273,955	273,955	273,955	273,955	273,955	273,955	192,421	192,421
R-squared	0.8228	0.6099	0.8520	0.7673	0.5869	0.6882	0.5551	0.6710	0.5443

Notes: Controls include age <65, age 70-74, age 75-79, age 80-84, age 85+, black, female, Hispanic, ESRD as the only reason for Medicare eligibility, and quantile dummy variables, as well year and physician-procedure fixed effects. Payment ratio is calculated by dividing the median ASC payment for each year by the median hospital payment in 2007, by Hospital Service Area (HSA) and procedure for all HSAs with at least 10 claims in both ASCs and hospitals for a given procedure. Procedures performed by physicians who only treated patients in one type of facility (ASC or hospital) were omitted. For regressions with 7- and 30-day measures as the dependent variable, observations that occurred within 7 and 30 days of the end of the calendar year (respectively) were omitted. Standard errors, clustered by HSA, in parentheses.

Table A.3
Two-Stage Least Squares Estimates of the Effect of ASC Treatment on Adverse Events
By Risk Square Quantile, Top 5 Procedures
Linear Probability Model with Physician-Procedure Fixed Effects
Medicare 5 Percent Claims, 2007-2009
(Standard Error)[First Stage F-Statistic]

	Emergency Room Visit for Adverse Event		
Dependent Variable	0 Days	1-7 Days	8-30 Days
Panel A: Risk Score Halves			
Bottom Half*ASC	-0.0022	0.0308*	0.0102
	(0.0023)	(0.0180)	(0.0291)
	[142.97]	[141.14]	[128.28]
Top Half*ASC	-0.0023**	-0.0034	-0.0089
	(0.0009)	(0.0048)	(0.0111)
	[2018.05]	[2003.04]	[1860.26]
Observations	273,955	271,781	254,158
R-squared	0.0742	0.0801	0.0849
Panel B: Risk Score Terciles			
Bottom Tercile*ASC	-0.0032	0.0333*	0.0129
	(0.0025)	(0.0193)	(0.0312)
	[98.50]	[97.11]	[90.17]
Middle Tercile*ASC	-0.0022	-0.0190*	-0.0560**
	(0.0034)	(0.0115)	(0.0222)
	[339.80]	[335.38]	[306.77]
Top Tercile *ASC	-0.0017*	-0.0019	-0.0092
	(0.0009)	(0.0050)	(0.0128)
	[1345.18]	[1336.10]	[1250.79]
Observations	273,955	271,781	254,158
R-squared	0.0742	0.0802	0.0851
Panel C: Risk Score Quartiles			
1^{st} Quartile*ASC	-0.0001	0.0247	-0.0768
	(0.0129)	(0.0491)	(0.1114)
	[97.10]	[95.96]	[89.49]
2^{nd} Quartile*ASC	-0.0097	0.0585	0.3528
	(0.0416)	(0.1269)	(0.3623)
	[15.09]	[14.99]	[12.70]
3^{rd} Quartile*ASC	-0.0020	-0.0081	-0.0320
	(0.0026)	(0.0111)	(0.0254)
	[1003.74]	[1001.20]	[928.50]
4^{th} Quartile*ASC	-0.0019	-0.0039	-0.0212
	(0.0020)	(0.0089)	(0.0173)
	[693.35]	[686.51]	[671.38]
Observations	273,955	271,781	254,158
R-squared	0.0742	0.0802	0.0851

Notes: Controls include age <65, age 70-74, age 75-79, age 80-84, age 85+, black, female, Hispanic, ESRD as the only reason for Medicare eligibility, and quantile dummy variables, as well year and physician-procedure fixed effects. Payment ratio is calculated by dividing the median ASC payment for each year by the median hospital payment in 2007, by Hospital Service Area (HSA) and procedure for all HSAs with at least 10 claims in both ASCs and hospitals for a given procedure. Procedures performed by physicians who only treated patients in one type of facility (ASC or hospital) were omitted. For regressions with 7- and 30-day measures as the dependent variable, observations that occurred within 7 and 30 days of the end of the calendar year (respectively) were omitted. Standard errors, clustered by HSA, in parentheses. Standard errors, clustered by HSA, in parentheses.

Table A.4
Two-Stage Least Squares Estimates of the Effect of ASC Treatment on Inpatient Hospital Admission
By Risk Square Quantile, Corrective Procedures
Linear Probability Model with Physician-Procedure Fixed Effects
Medicare 5 Percent Claims, 2007-2009
(Standard Error)[First Stage F-Statistic]

	Inpatient Admission		
Dependent Variable	0 Days	1-7 Days	8-30 Days
Panel A: Risk Score Halves			
Bottom Half*ASC	0.0045	-0.0344	-0.0453
	(0.0030)	(0.0213)	(0.0402)
	[386]	[380.35]	[358.93]
Top Half*ASC	0.0005	-0.0117*	-0.0133
	(0.0010)	(0.0062)	(0.0144)
	[3327.15]	[3299.12]	[3068.10]
Observations	95,371	94,609	88,311
R-squared	0.0494	0.0739	0.0853
Panel B: Risk Score Terciles			
Bottom Tercile*ASC	0.0030	-0.0369	-0.0542
	(0.0031)	(0.0230)	(0.0435)
	[255.19]	[251.08]	[240.74]
Middle Tercile*ASC	0.0029	-0.0165*	-0.0414**
	(0.0023)	(0.0094)	(0.0205)
	[984.42]	[972.52]	[892.33]
Top Tercile *ASC	0.0017	-0.0121*	-0.0112
	(0.0012)	(0.0065)	(0.0150)
	[1807.97]	[1795.57]	[1688.61]
Observations	95,371	94,609	88,311
R-squared	0.0494	0.0739	0.0854
Panel C: Risk Score Quartiles			
1st Quartile*ASC	0.0002	-0.0315	-0.0395
	(0.0036)	(0.0239)	(0.0435)
	[194.54]	[192.54]	[185.35]
2nd Quartile*ASC	0.0174	-0.0469*	-0.0733
	(0.0111)	(0.0255)	(0.0605)
	[59.21]	[58.10]	[54.33]
3rd Quartile*ASC	0.0011	-0.0155**	-0.0187
	(0.0012)	(0.0075)	(0.0175)
	[1356.44]	[1352.31]	[1258.93]
4th Quartile*ASC	0.0008	-0.0101	-0.0098
	(0.0009)	(0.0068)	(0.0164)
	[903.24]	[896.66]	[879.02]
Observations	95,371	94,609	88,311
R-squared	0.0496	0.0739	0.0853

Notes: Corrective procedures include cataract removal, minor musculoskeletal, and other eye procedures. Controls include age <65, age 70-74, age 75-79, age 80-84, age 85+, black, female, Hispanic, ESRD as the only reason for Medicare eligibility, and quantile dummy variables, as well year and physician-procedure fixed effects. Payment ratio is calculated by dividing the median ASC payment for each year by the median hospital payment in 2007, by Hospital Service Area (HSA) and procedure for all HSAs with at least 10 claims for each procedure in both ASCs and hospitals. Procedures performed by physicians who only treated patients in one type of facility (ASC or hospital) were omitted. For regressions with 7- and 30-day measures as the dependent variable, observations that occurred within 7 and 30 days of the end of the calendar year (respectively) were omitted. Standard errors, clustered by HSA, in parentheses. Standard errors, clustered by HSA, in parentheses.