Market Structure and Gender Disparity in Health Care: Preferences, Competition, and Quality of Care*

Ryan C. McDevitt†  James W. Roberts‡

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Abstract

This paper considers the relationship between market structure and health outcomes in a setting with stark preferences: urology patients disproportionately match with a urologist of the same gender. In the United States, however, fewer than 6% of urologists are women despite women constituting 30% of patients. We explain a portion of this disparity with a model of urology groups’ decisions to employ female urologists. We find groups are more likely to employ a female urologist as competition intensifies, which affects women’s health. Markets without a female urologist have a 4.1% higher death rate for female urological cancers, all else equal.

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†Simon Graduate School of Business, University of Rochester, ryan.mcdevitt@simon.rochester.edu
‡Department of Economics, Duke University, j.roberts@duke.edu
1 Introduction

In a market characterized by heterogeneous preferences, competition often leads firms to differentiate. Fixed costs, however, limit the extent of product variety available to consumers. While an extensive literature in economics has considered this topic, comparatively less work has focused on its implications for health outcomes. In this paper, we consider one form of product variety in health care, the gender distribution of physicians across medical groups, and show that competition influences both groups’ decisions to employ female doctors and, in turn, the health of female patients.

Because patients often exhibit a strong preference to receive care from a physician of the same gender, competition for patients among group practices may induce them to alter the gender mix of their doctors. At the same time, fixed costs limit the number and mix of doctors practicing in any given market. To explore how market structure and patient preferences affect the relative supply of female physicians, we examine the historically male-dominated field of urology, which provides a natural setting for this topic. While women constitute approximately 30% of urology patients in the United States, fewer than 6% of urologists are women and more than 90% of counties lack a female urologist. This gender disparity has important consequences for the health of women, as women in areas without a female urologist have significantly higher death rates from urological cancers, all else equal.

We begin our analysis by documenting that, as in other specialities, urology patients prefer to see a physician of the same gender. From detailed inpatient hospital data, we find that female urologists treat more than twice as many female patients than would be expected if patients and urologists matched randomly. Moreover, we estimate that women travel more than twice as far to consult a female urologist than a male urologist. These results reflect the potentially sensitive nature of urological conditions. For ailments related to the reproductive system of men and the urinary tracts of both men and women, many patients have strong feelings about the gender of their urologists.

In light of these gender-based preferences, we then estimate the market size required to support a given number of male or female urologists. We find that the population required to support the first female urologist in a market is approximately the same as the population needed to support sixteen male urologists. More importantly, the second female urologist in a market requires a population nearly 3.5 times as large as the first, whereas the range for additional male urologists falls between 1.8 and 2.5. The excess entry threshold for subsequent female urologists suggests that market structure may influence the gender disparity among urologists in a complicated manner. As such, we estimate a model of competition among urology groups that explains a meaningful proportion of the disparity.

In the model, groups make simultaneous decisions regarding the number of male and female urologists they employ, and their optimal choices depend on the expected responses of competitors. From the estimated parameters, we show that groups behave strategically when employing female urologists. Notably, as competition intensifies within a market, a group becomes more likely to employ a female urologist: a group in a market with a number of competing groups per capita one standard deviation above the mean is 93.1% more likely to employ a female urologist.
The predicted responses of competitors also affect a group’s decision. When a group expects to be the only one to employ a female urologist in its market, it is 48.3% more likely to employ a woman than when it expects a competitor to employ one. In addition, we find evidence of complementarities between male and female urologists, as a group that moves from being the smallest to the largest in our data becomes five times more likely to employ a woman, all else equal.

Using the estimated parameters of the model, we show that the number of female urologists practicing across the United States would increase by 40.9% absent the restraining effect of business-stealing among groups, which explains approximately 38.5% of the excess entry threshold for the second female urologist in a market. Without the facilitating effects of differentiation across groups and complementarity within groups, however, the number of female urologists would decline by 4.9%. In short, we demonstrate that competition and a group’s internal organization can both amplify and attenuate the gender disparity among urologists, depending on market structure. This finding complements previous work that has attempted to explain the gender disparity from other perspectives, such as supply-side restrictions imposed by the American Medical Association, as our analysis suggests that competitive forces have a marked effect on access to female urologists, a novel insight.

The lack of choice for patients in this setting has important consequences, as the availability of female urologists affects the health of women. We find that counties without a practicing female urologist have a 4.1% higher death rate from female urological cancers, all else equal. This higher death rate is consistent with women delaying or forgoing consultations with urologists when only male urologists are available, as the efficacy of cancer treatments depends critically on the stage at which a cancer is first diagnosed. In this sense, the structure of urology markets has meaningful implications for the welfare of women.

Based on these cancer regressions, we estimate the costs of improving women’s health outcomes from a counterfactual exercise in which groups receive subsidies to employ female urologists. Using the recovered parameters from our structural model, we find that subsidizing the most cost-efficient group to employ a female urologist in the 112 markets that currently lack one across the United States would cost $20.5 million annually and result in approximately 300 fewer urological cancer deaths among women each year. This amounts to an estimated cost of $68,360 for each year of a woman’s life saved, which falls within conventional benchmarks for the statistical value of an additional year of life.

Our paper relates to several strands of literature in industrial organization and health economics. First, we examine a market characterized by “preference externalities,” as defined by Waldfogel (2003). For a good distinguished by a preference externality, a consumer’s utility is non-decreasing in the number of consumers in the market who share his tastes, as an agglomeration of consumers with similar preferences is required to bring forth a product in the presence of fixed costs. Conversely, a consumer’s utility may be decreasing in the number of consumers who have tastes antithetical to his own. In this sense, the preferences of others affect an individual’s utility, and hence an externality is present. Following the analysis of radio markets in Waldfogel (2003), the effects of preference externalities have been considered in a variety of contexts, such
as local newspapers (George & Waldfogel 2003), local television (Waldfogel 2004), political mobilization (Oberholzer-Gee & Waldfogel 2005), restaurants (Waldfogel 2008), and funeral homes (Chevalier et al. 2008). We contribute to this growing line of literature by considering the effects of a preference externality (i) associated with gender, (ii) in a healthcare market, and (iii) in a model of imperfect competition. All of these represent novel empirical applications related to this topic.

Second, we contribute to the extensive literature in industrial organization that has developed structural models of market structure, entry, and exit. Specifically, Bresnahan & Reiss (1991) model the entry of firms in small, isolated markets, with the objective of estimating the rate at which the entry of competitors reduces incumbents’ variable profits. Mazzeo (2002) and Seim (2006) both relax the assumption of homogeneous firms in Bresnahan & Reiss by allowing firms to offer differentiated products and to have non-uniform competitive effects across product types. Furthermore, because our research questions are motivated by the nature of competition among urology groups and the extent to which female urologists complement male urologists, we build on the techniques of Augereau, Greenstein & Rysman (2006) and the identification strategies of Gentzkow (2007).¹ We discuss our contributions to this body of work in Section 5.

Third, our paper contributes to two distinct healthcare literatures. Among the expansive literature on healthcare market structure, Dranove et al. (1992), Brasure et al. (1999), and Schaumans (2009) estimate models in the spirit of Bresnahan & Reiss to explore the nature of competition in medical services. Dranove et al. and Brasure et al. both find limited effects of competition in their estimations, while Schaumans finds the effects differ depending on the type of medical specialist considered. In this paper, we consider a similar question for urologists. Also related to our work, Gaynor et al. (2010) examine the effects of competition on patient outcomes in English hospitals, finding that pro-competitive policies saved lives without increasing costs. In addition, Epstein et al. (2010) find that internally-differentiated partnerships promote matching between obstetrics patients and their physicians based on horizontal preferences for treatment styles. This relates to our paper in that urology groups differentiate themselves to promote matching between female patients and female urologists.

Relatedly, the general medical literature has considered at length how healthcare availability and product choice affect health outcomes. Most similar to our work are Odisho et al. (2009a,b), who document considerable variation in the availability of urologists across the United States and find that markets with fewer urologists per capita have higher mortality rates for urological cancers. In this paper, we argue that gender also represents an important dimension to consider when analyzing access to urologists, and explore the relationship between the availability of female urologists and female urological cancer deaths. Other papers have found that patients prefer physicians of the same gender. For instance, Adams (2003) provides a review of this topic and concludes that many female patients express a clear preference for female physicians. This underlies our motivation for studying preference externalities among female urology patients.

Finally, our paper also connects to the literature on the economics of discrimination started by

¹We also note that a strand of literature that considers the extent to which groups or partnerships can leverage their members' specialized skills, such as Garicano & Hubbard (2008), pertains to our topic, though we do not consider it explicitly in what follows.
Becker (1957). In our setting, patients make taste-based choices for urologists that are correlated with gender, which then has implications for labor-market outcomes. Others have considered this topic in regards to race. For instance, Holzer & Ihlanfeldt (1998) investigate the effects of customer discrimination on the employment and earnings of minorities, particularly African-Americans. They show that the racial composition of an establishment’s customers is correlated with the race of its workers, especially in jobs that involve direct contact with customers. Similarly, Leonard et al. (2010) find evidence that sales increase when a store’s workforce more closely resembles the demography of its potential customers, though the effects are most pronounced along the dimension of language. As it relates to gender disparity, Bertrand et al. (2010) study the gap in earnings for highly-educated professional men and women, focusing mostly on supply-side explanations for the observed wage imbalance.

We proceed with the remainder of our paper in Section 2 by describing our empirical setting and the data used in our analysis. In Section 3, we provide evidence that urologists’ patient mixes vary by gender. In Section 4, we document that these asymmetric patient mixes differentially influence the size of the market required to support male and female urologists. Building on this analysis, in Section 5 we propose and estimate a model of competition among urology groups that incorporates the non-uniform effects male and female urologists have on a group’s profits. In Section 6, we show that the availability of female urologists affects women’s health outcomes. Using the estimated parameters from our models, in Section 7 we consider a counterfactual analysis that measures the expected effects of subsidizing female urologists. We conclude in Section 8 with a summary of our findings. All tables appear in the appendix.

2 Background and Data for Urology

Patients consult urologists for a host of medical conditions, including non-surgical issues such as urinary tract infections, kidney and bladder stones, and enlarged prostates, as well as issues requiring surgery such as kidney, bladder, and prostate cancers, congenital abnormalities, and stress incontinence. The incidence rates of most urological conditions vary by gender. For example, men are more than twice as likely as women to become afflicted with kidney stones, while women are nearly five times as likely as men to develop interstitial cystitis. At the extreme, several urological conditions affect only men, e.g., prostate and testicular cancers, and several urological procedures are performed only on men, e.g., vasectomies. While estimates vary across sources, a reasonable approximation is that 70% of all urology patients are men (Nickel et al. 2005). From the patient data described below, we have confirmed that this gender mix also holds in treatment-weighted terms.

The availability of urologists across markets is determined, first and foremost, by the number of physicians trained in the specialty. To become a urologist, the educational requirements following the completion of an undergraduate degree are four years of medical school, and four to eight years of residency training, with additional training in subspecialties as desired.

2Specifically, urology is a surgical specialty that covers the male and female urinary tracts, as well as the male reproductive system. The organs covered by urology include the kidneys, ureters, urinary bladder, urethra, and the male reproductive organs. Urology can overlap with the fields of oncology, nephrology, gynecology, pediatric surgery, and endocrinology, and in some cases a patient could seek treatment from a specialist other than a urologist or from a general surgeon.
years of internship and residency. Urology is considered a competitive specialty in the sense that there are more applicants to residency and fellowship programs than positions available (Andriole et al. 2002).

Historically, women physicians have not specialized in urology, as the first board-certified female urologist, Elisabeth Pauline Picket, was not admitted until 1962, and only 39 women were practicing urologists as recently as 1980. Over the last decade, women have become more prevalent in urology and now constitute 21.3% of all urology residents. In absolute terms, however, urology still lags most other fields in terms of representation among women, and this trend will continue as the proportion of female urology residents remains below the proportion of female residents overall (≈50%).

As of 2006, the American Medical Association listed 10,518 urologists throughout the United States, which represents approximately 1.1% of the overall physician population. Of the more than 10,000 urologists across the country, only 583 were women. And while women are underrepresented among physicians in general (27.8%), women are disproportionately underrepresented in urology (5.5%).

One explanation for the relative lack of female urologists is simply that women physicians tend to avoid surgical fields such as urology due to their demanding and unpredictable hours (Lightner et al. 2005). Compared to other surgical specialties, however, urology is regarded as offering a more stable lifestyle because most urological surgeries are scheduled in advance, which makes the demands on a urologist’s time more predictable (Kerfoot et al. 2005). Despite this virtue, the proportion of women specializing in urology is lower than in general surgery: 5.5% compared to 15.2%. Even after controlling for the skewed gender distribution of urology patients and their potentially stark preferences, we would still expect roughly 9.1% of urologists to be women, using general surgery for comparison. At only 5.5%, the proportion of urologists who are women is 39.6% less than this comparison group. As such, the gender disparity in urology is not simply a byproduct of urology being a surgical specialty or of patients being predominately men.

Another source of the gender disparity within urology is the potential income generated by male and female urologists throughout their careers. A urologist’s income depends primarily on remuneration for services performed on his or her patients. Payment for any given treatment is determined by a complicated process dictated by many parties, including hospitals, insurance providers, and the federal government. In general, payment is increasing in the complexity and time-intensity of the procedure performed. Urologists perform a broad range of surgeries that vary along these dimensions, such as a ten-hour cystectomy with neobladder operations or thirty-minute vasectomies.

Profit margins also vary by procedure. While difficult to estimate precisely, practitioners indicate that office-based procedures tend to be more profitable than the same procedure conducted in a hospital because insurance providers often incentivize groups to avoid costly hospital charges.

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3 All physician statistics referenced in this section come from the American Medical Association’s “Physician Characteristics and Distribution in the U.S., 2007.”

4 The figures provided by the AMA include researchers and residents not yet practicing. From our practice data described below, only 3.6% of currently practicing urologists are women.
In practice, the majority of urological procedures that can be performed outside of a hospital are demanded exclusively by men (e.g., prostate procedures and vasectomies). This leads to a large discrepancy between the average profitability of male and female patients for a urologist, the implications of which we analyze in Section 4.

For our empirical analysis, we use data from the following sources:

**Physician Data**  Our data for physicians come from American Medical Information (AMI), a for-profit company that tracks healthcare professionals for sales and marketing purposes. AMI derives its list of doctors from public sources and verifies each listing through direct phone interviews. AMI’s data include information such as the physician’s name, address, group affiliation, and gender. We use two years of data, 2006 and 2009, for all practicing urologists in the United States. These data include only patient-facing, practicing physicians (e.g., exclude researchers and residents).

**Patient Data**  We use discharge data for all patients making a hospital stay in Florida between January 2006 and June 2008. These data are compiled by the Florida Agency for Health Care Administration and made available to researchers conducting health policy analysis. The data include demographic information for all patients making a hospital stay in Florida during this time period, such as their age, race, gender, insurance coverage, and ZIP code of residence, among others. In addition, the data contain the patients’ primary and secondary diagnoses, the procedures performed during their hospital stays, and a unique identifier for their physicians. We match the physician identifiers, which are their medical license numbers, to their office names in the Florida State Licensure Database, and then match the office names to the data obtained from AMI. Matching each patient to his or her urologist then allows us to measure the distance each patient travels to consult with his or her physician.

**Cancer Deaths Data**  We use the mortality rates for various cancers from the National Cancer Institute’s “State Cancer Profiles” website, which provides cancer statistics at the county level for 2001-2005. Specifically, we use the reported cancer deaths from all cancers, kidney cancers, bladder cancers, and prostate cancers. Data for counties with fewer than three deaths reported during this time period are suppressed by the National Cancer Institute to protect the confidentiality of patients, which effectively means that only relatively large, urban markets are included. We discuss how this selection bias might affect our analysis in Section 6.

**Demographic Data**  The demographic control variables we use in our estimations come from a variety of sources. We use the U.S. Census Bureau for the population and the median age of residents in each market. Data for per capita income in each market come from the Bureau of Economic Analysis. Finally, we utilize the number of male physicians, female physicians, and medical specialists in each market from the Department of Health and Human Service’s Area Resource File.
3 Urologists’ Heterogeneous Patient Mixes

As discussed in Section 1, many patients have gender-based preferences for their physicians (Adams 2003). In Urology, practitioners often affirm this claim, stating in Bradbury et al. (1997), for example, that they believe female patients prefer a female urologist. An analysis of urologists’ actual outpatient caseloads by Nickel et al. (2005) provides further evidence: the ratio of male to female patients for the average male urologist was 2.5 in their sample, while the ratio of female to male patients for a female urologist was 3.3.\(^5\)

Consistent with these claims, we find in the Florida hospital inpatient dataset that male and female urologists have starkly different patient mixes. Between January 2006 and June 2008, 60,647 patients admitted to hospitals in Florida required care from a urologist.\(^6\) Of these patients, 42,933 were men (70.8%) and 17,714 were women (29.2%), as shown in Table 1. At hospitals where at least one female urologist had admitting privileges, male urologists treated 74.4% male patients and 25.6% female patients.\(^7\) In contrast, female urologists treated 40.1% male patients and 59.9% female patients, implying that female urologists treat more than twice as many female patients as would be expected if patients and urologists matched randomly. Restricting the sample to elective procedures for which patients have greater freedom to choose their urologists amplifies this disparity. For elective procedures, male urologists treated 77.2% male patients and 22.8% female patients, while female urologists treated 34.2% male patients and 65.8% female patients.

Another measure of a female patient’s relative preference for a female urologist over a male urologist is her willingness to incur additional costs to see a woman, such as the distance traveled to consult a urologist. In the presence of non-negative travel costs, a female patient traveling farther to see a female urologist than a male urologist reveals that she has stronger preferences for female urologists, all else equal, because we observe that when a female urologist is available in a market, a male urologist is as well. We find that women in the Florida inpatient sample do demonstrate a willingness to travel farther to visit a female urologist. The median distance travelled by a female patient to the office of her urologist is 15.0 miles if her urologist is a woman, but only 8.6 miles if her urologist is a man.\(^8\) For elective procedures, this gap is even wider: 22.1 miles compared to 11.0.

In this section, we have demonstrated that male and female urologists’ patient mixes are

\(^5\)Even this wide imbalance potentially understates the true extent of women’s preferences in the sense that a female urologist is often not available in a market, and so we do not observe the choice that a female patient would have made if she had access to both a male and female urologist.

\(^6\)An important limitation of this data set is that it does not include outpatient procedures or office visits, both of which represent a substantial proportion of a typical urologist’s case load. Note, however, that the patient mixes in the Florida inpatient sample closely resemble those documented by Nickel et al. (2005), who included office visits. This provides reassurance that our observations of patients’ choices are not biased from focusing exclusively on hospital stays.

\(^7\)In the Florida inpatient sample, a patient often has both an attending physician and an operating physician. The modal case is that the patient has the same attending and operating physician. In the cases where the patient has an attending physician and an operating physician of different genders, we consider the patient to have a “female urologist.” This affects 71 of 60,647 patients, or 0.1%.

\(^8\)Distance is defined to be the number of miles between the ZIP Code centroid of the urologist’s office and the ZIP Code centroid of the address of the patient in the Florida inpatient sample. In some cases, a patient’s zip code was not reported or was from a state other than Florida (e.g., the patient was on vacation), which we dropped from the data. We also dropped all distances over 200 miles. These were primarily emergency visits, and our belief is that they, too, were patients on vacation and do not reflect the patient’s true preferences. In total, we drop 2,244 of 60,647 observations (3.7%).
correlated with their genders. Furthermore, some female patients exhibit a willingness to incur significantly greater costs to consult a female urologist. These findings serve as the motivation for our analysis of the relationship between market structure and access to female urologists in the following sections.

4 Urologists’ Market Entry Decisions

If men constitute 70% of urology patients and express a preference for male urologists, one might naturally expect the majority of urologists to be men. But if many women prefer female urologists and represent 30% of patients, an explanation for why most markets lack a female urologist is not immediately apparent. In this section, we consider more explicitly the market forces responsible for the gender disparity.

The dichotomy between the average profitability of male and female patients referenced in Section 2, when coupled with their preferences for urologists of the same gender discussed in Section 3, might result in a large disparity between the average incomes of male and female urologists given that female urologists’ patient mixes are skewed towards women. In practice, female urologists do earn less, on average, than their male colleagues. According to a survey by the Medical Group Management Association, the field of urology has the widest divergence in incomes between male and female physicians of all the major medical specialties, at over $80,000 annually. To the extent that reported income reflects a urologist’s profits, this large disparity suggests that female urologists are less profitable, on average, than their male counterparts, which could be explained by more-lucrative male patients self-selecting male urologists over female ones. Female urologists therefore will need comparatively larger markets than their male colleagues to find entry profitable.

To estimate the relationship between a market’s size and the number of urologists practicing within it, we next consider a market-entry model for male and female urologists. We define markets for urologists based on the travel patterns of patients, as determined by the Dartmouth Atlas Project (DAP). We use hospital referral regions as our preferred market definition because we consider them well suited for an analysis of urology markets.

From our physician data, we find that hospital referral regions are much more likely to have a male urologist than a female urologist, as shown in Table 2. The modal market at the HRR-
level has no practicing female urologist, while all 306 markets have at least one male urologist. In addition, the average HRR has 27.3 male urologists, compared to only 1.2 female urologists, as shown in Table 3. A simple model of market entry allows us to make inferences about the economic primitives underlying these stylized facts.

As outlined in Bresnahan & Reiss (1991), the observed number of urologists in a market reflects unobserved economic primitives such as demand, profit margins, and competitive behavior. Namely, urologists will enter a market until it becomes unprofitable to do so. The extent to which demand must increase to support the entry of incremental urologists thus imparts information about the nature of competition within a market under the assumption that observed market outcomes represent an equilibrium where all practicing urologists are profitable and further entrants would not be.

The results from a series of ordered probit models that take the observed number of male and female urologists in a market as the dependent variable are presented in Table 4. We find that the population and the median age of residents in a market are positively and significantly correlated with the number of practicing male and female urologists within it. We also find that the proportion of all physicians in the HRR who are women is positively and significantly correlated with the number of practicing female urologists, but negatively (though imprecisely estimated) correlated with the number of practicing male urologists. This relationship reflects unobserved market-level heterogeneity in the attractiveness of an HRR for women physicians that would influence a female urologist’s decision to practice in a market, such as patients’ preferences for women doctors or other characteristics that might make the area an attractive place to reside for female physicians.

From the estimates of the ordered probit models, we can derive lower bounds for the size of the market needed to support a given number of urologists. The market-size thresholds for both male and female urologists are reported in Table 5. We find that male urologists initially need less than a one-for-one increase in market size for each additional entrant, as indicated by a ratio less than one for the third urologist in a market. This is similar to the estimates of Brasure et al. (1999) who found ratios less than one for the second and third entrants in many physician specialties, with the interpretation that the first few subsequent entrants in a specialty allow for all participants to share fixed costs such as office space and on-call hours. After the entry of the fourth male urologist, the market-size ratios are consistently around one, which we interpret as reflecting perfect competition among urologists.

The thresholds for the number of female urologists practicing in an HRR differ markedly from those for male urologists, as shown at the bottom of Table 5. The market-size threshold to support the first female urologist in a market is approximately the same as the threshold for the sixteenth male urologist. That is, a female urologist needs a much larger market to induce entry than a male urologist does, all else equal. We also find evidence consistent with business-stealing among female urologists in most markets, as the estimated ratios are significantly greater than one for $\frac{S_2}{S_1}$ ($p < 0.005$) and $\frac{S_3}{S_2}$ ($p < 0.05$), though not for $\frac{S_4}{S_3}$ ($p > 0.10$). These ratios imply that doubling the population that supported the first female urologist would not lead to the entry of a second female urologist. As a falsification exercise, we also estimate the same entry thresholds.
for obstetricians and gynecologists.\textsuperscript{13} Because women comprise all obstetrics and gynecology patients, we should expect the pattern of entry for female obstetricians and gynecologists to more closely resemble that of male urologists than female urologists.\textsuperscript{14} In this case, we do not find the same evidence of business-stealing among female obstetricians and gynecologists that we do among female urologists, as all estimated ratios for the former are close to one. Whereas, the second female urologist in a market requires a population nearly 3.5 times as large as the first, the population needed to support the second female obstetrician or gynecologist in a market is roughly 1.5 times as large as the first, closely in line with male urologists.

As outlined by Bresnahan & Reiss, entry threshold ratios describe the nature of competition within a market, with price competition typically rationalizing ratios greater than one: as more firms compete by lowering prices, firms must attract more customers to break even. In this setting, however, price competition seems unlikely, especially in light of the thresholds observed for male urologists. Instead, the non-uniform threshold ratios for male and female urologists could stem from asymmetric changes in variable or fixed costs, such as the second female urologist in the market having to invest more effort to attract referrals because the incumbent has already established a reputation with primary-care physicians. Within-group complementarities and the effects of competition across groups also represent a potential explanation, and reflect the institutional details of urology well. We return to these explanations in the next section.

5 Urology Group Competition

The relative supply of female urologists in a market will depend on both the mix of patients in the area and the employment decisions of urology groups. As groups compete against one another for patients and leverage intra-group referrals, these forces will affect the entry thresholds for male and female urologists in a non-uniform way. We incorporate these institutional details into a model of competition among urology group practices to understand more fully the economic primitives responsible for the observed gender disparity.

As in other specialties, urologists form group practices to share fixed costs, on-call duties, and referral networks, among other motivations. Practicing within a group also allows a urologist to make intra-group referrals that conform with the Stark Laws that prohibit financially motivated extra-group patient referrals. Within a group, it is common for the partners to share profits and for non-partner physicians to earn a fixed salary (Encinosa III et al. 2007).

Urology groups compete with one another to attract patients, which takes the form of both price and quality competition. Price competition commonly results from negotiations with health insurance plans, but many prices are determined through unilaterally-dictated Medicare and Medicaid reimbursement rates (though a group can refuse to accept these patients). Examples of quality-based competition between urology groups include providing nicer facilities, offering longer hours of operation, or utilizing specialized equipment. Groups can also differentiate themselves by employing a female urologist, as some patients prefer this type of group to an all-male

\textsuperscript{13} Full results have been omitted due to space constraints, but are available from the authors upon request.
\textsuperscript{14} Also consistent with our arguments throughout this paper, obstetrics and gynecology has relatively more female physicians ($\approx 43.7\%$) than all other specialties except pediatrics ($\approx 53.9\%$).
Groups will be more likely to differentiate themselves as competition intensifies. We find evidence consistent with this, as monopoly markets have exclusively all-male groups in 93.5% of cases, while only 29.0% of markets with more than six groups do, as shown in Table 6. For additional context, we note in Table 7 that the average market has 3.0 groups in total and 0.4 groups employing a female urologist. In addition, the average group employs 3.8 urologists and approximately 12% of groups employ a female urologist, as shown in Table 8.

A group may also benefit from complementarities among its members as they refer patients to one another. As discussed in Section 2, the large discrepancy between the profitability of male and female urology patients may generate an incentive for urologists to trade off female patients for more lucrative male patients. The addition of a female urologist to a group thus allows greater flexibility in both matching patients according to gender preferences and sorting physicians according to tasks: female urologists can treat lower-margin female patients and attract additional female patients to the group, while male urologists can specialize on higher-margin male patients. Consistent with this claim, Lightner et al. (2005) finds that partners refer “time-consuming, low revenue cases to women urologists” and that the female urologists “were asked to shoulder a larger percentage of the clinic overhead in seeing time-consuming, nonsurgical patients” so that others could address “higher reimbursement surgical cases.”

When male urologists can leverage female urologists to increase the number of high-margin surgical cases they handle, female urologists will need a comparatively smaller market than they otherwise would to support themselves. This effect becomes more pronounced in larger groups, as they have more opportunities to reallocate patients among group members. Table 9 provides evidence supporting this claim: 5.3% of two-person groups employ at least one female urologist, while 33.8% of groups with eight or more urologists employ at least one. We incorporate this detail into our model of groups’ simultaneous decisions to employ a given number of male and female urologists by allowing for complementarity between male and female urologists.

Finally, because each market has a limited number of female urology patients, a group also faces an important risk from employing a female urologist in that she might not attract a sufficient number of female patients to offset the fixed portion of her salary. This risk influences the strategic decisions made by group practices, as a group that expects many of its competitors will employ a female urologist might make a different choice than a group that expects to be the only group in its market to employ one. For this reason, we also incorporate the potential for business-stealing among the groups that employ female urologists into our model.

As discussed above, the extent of competition among urology groups motivates a number of testable hypotheses that we consider in our empirical application below. Namely, (i) groups will be more likely to employ a female urologist if they face more competition because they will find differentiation comparatively more profitable; (ii) groups will be less likely to employ a female urologist if other groups in their market already employ one because competition between groups would render all female urologists in the market unprofitable; (iii) groups will be more likely to

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15 A group may be “obligated” to treat female patients to remain in good standing with insurance providers or referring primary-care physicians.
employ a female urologist if they also employ several male urologists because larger groups have more opportunities to match patients profitably to physician-types through intra-group referrals; and (iv) groups will be more likely to employ a female urologist if they have a smaller market share because they will prefer to differentiate from their competitors in order to build a patient base – unless they expect other groups will also employ female urologists, as this would undermine the effectiveness of differentiation.

5.1 Model

We now present and estimate a model of imperfect competition that incorporates the institutional details of urology to analyze the forces responsible for the gender disparity among urologists. Each urology group in our model makes a joint decision regarding how many male and female urologists to employ, choosing the combination that yields the highest profit in expectation. A group’s choice will influence its rivals, however, and we capture this effect in a discrete game of imperfect information. The model we propose below is conceptually similar to the ones developed by Seim (2006) and Augereau et al. (2006). We extend their models by allowing groups to make multinomial decisions regarding the number of male urologists they employ, a feature not incorporated into the bivariate probit model of Augereau et al. or the univariate setup of Seim.

Setup

Assume a group practice, $j$, operates in one, and only one, market, $l$. Each period, a group makes two decisions: how many male urologists to employ and how many female urologists to employ. Due to the heterogeneous preferences of patients, we model a group’s profits as depending on both the number and the gender of its urologists. Abstracting, for a moment, from a group’s expectation about its competitors’ decisions, we describe a group’s profits as

$$
\pi_{jl}(M,F) = \zeta_j(X_{jl}, \overline{N}_{jt}, M_j, F_j) = \zeta(X_{jl}, \overline{N}_{jt}, M_j, F_j, \varepsilon_{jlM}, \varepsilon_{jlF}),
$$

where $X_{jl}$ represents observable market and group characteristics that affect profits; $M_j$ represents the number of male urologists a group employs; $F_j$ is a dichotomous variable that reflects whether the group employs a female urologist; and $\overline{N}_{jt}$ is the competition that group $j$ faces in market $l$.

To build a stochastic model, we include group-specific payoff shocks associated with the returns from the total number of male urologists in the group and employing a female urologist, $\varepsilon_{jlM}$ and $\varepsilon_{jlF}$, respectively. We do not require these payoff shocks to be distributed independently from one another and we model them as private information to group $j$. The private-information assumption implies, for example, that each group receives an i.i.d. shock that affects its decision to employ a female urologist that is not observed by other groups or the econometrician. Each group,

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16 This is a reasonable assumption for our empirical setting since no urology group in our sample has offices in multiple markets.

17 Examples are market-level characteristics such as population, the average income and age of residents, etc. We also include group-level characteristics from past periods that affect a group’s decision in the current period. For example, we include the fraction of the urologists in the market in the previous period that were part of the group.

18 It is straightforward to allow $F_j$ to be a categorical variable instead of dichotomous. The lack of groups employing multiple female urologists in the data prompted this modeling decision.
however, knows the distribution governing the shocks. Private information reflects factors that are
unobservable to those outside of the group but which the group itself will take into consideration
when making its hiring decision. We find the private-information assumption natural for our
setting. For example, such factors as the gender distribution of a group’s existing patients, the
experience a group’s physicians have with performing certain procedures, the extent to which a
group’s members wish to curtail their on-call hours, or the misogynistic tendencies of a group’s
senior partners all represent information likely to be known by a group but not its competitors
or the researcher.

As suggested above, a complementarity may exist between the total number of male urolo-
gists and female urologists in a group. We capture complementarities among male and female
group members by estimating the correlation between the two error terms, \( \rho \), with the following
structure:

\[
\pi_{jl}(M, F) = X_{jl}\beta_M + g_M(\overrightarrow{N}_{jl}; \theta) + \varepsilon_{jlM} + X_{jl}\beta_F + g_F(\overrightarrow{N}_{jl}; \theta) + \varepsilon_{jlF},
\]

with

\[
(\varepsilon_{jlM}, \varepsilon_{jlF}) \sim BVN(0, 0, 1, 1, \rho) = \Phi(\cdot, \cdot, \rho).
\]

We model a group’s employment of male and female urologists as being affected by its com-
petitors’ choices through a linear specification of \( g(\cdot) \),

\[
g_t(\overrightarrow{N}; \theta) = \theta^W_t N_W + \theta^M_t N_M, \ t = \{M, F\},
\]

where \( N_W \) is the number of competitors in the market that employ a female urologist and \( N_M \) is
the number of male urologists employed by other groups in the market. This specification implies
that competitive effects are linear and that the marginal impact of another group is constant.\(^{20}\)

In our model, a group must form an expectation of \( N_W \) and \( N_M \) so that it can, in turn, form
an expectation of the returns from choosing a specific group type. From the linear specification
of competitive effects, we can write a group’s expected profits from employing \( M \) male urologists
and \( F \) female urologists as

\[
E[\pi_{jl}] = X_{jl}\beta_M + \theta^W_t E[N_W] + \theta^M_t E[N_M] + \varepsilon_{jlM} + X_{jl}\beta_F + \theta^W_t E[N_W] + \theta^M_t E[N_M] + \varepsilon_{jlF}.
\]

We allow a group to choose one of \( M \) discrete size categories for the number of male urologists
it employs. A group’s observed size choice, \( M_j \), is then assumed to reflect the latent profits

\[\pi_{jl}(M, F) = X_{jl}\beta_M + g(M, \overrightarrow{N}_{jl}; \theta) + \varepsilon_{jlM} + \varepsilon_{jlF} + \gamma M F,\]

where \( g(M, \overrightarrow{N}_{jl}; \theta) \) is a function that describes the impact that a group’s competitors will have on its profits. While ideally we
would allow for both \( \rho \) and an interaction term, \( \gamma \), these two parameters are not separately identified without richer data, such
as a longer panel of observations or valid instruments (Gentzkow 2007).

\(^{19}\) Another natural way to model such a complementarity is

\[\pi_{jl}(M, F) = X_{jl}\beta_M + g(M, \overrightarrow{N}_{jl}; \theta) + \varepsilon_{jlM} + \varepsilon_{jlF} + \gamma M F,\]

\(^{20}\) In principle, this linearity assumption could be relaxed, but the gains from doing so do not outweigh the computational
cost of estimating a model with expectations taken over nonlinear competition terms.
resulting from this choice, described as (with a slight abuse of notation)

\[
M_j = \begin{cases}
0 & \text{if } X_j\beta_M + \theta^W_M E[N_W] + \theta^M_M E[N_M] + \varepsilon_{jM} \leq c^M_1 \\
1 & \text{if } c^M_1 \leq X_j\beta_M + \theta^W_M E[N_W] + \theta^M_M E[N_M] + \varepsilon_{jM} \leq c^M_2 \\
\vdots & \\
m & \text{if } c^M_m \leq X_j\beta_M + \theta^W_M E[N_W] + \theta^M_M E[N_M] + \varepsilon_{jM} \leq c^M_{m+1} \\
M & \text{if } c^M_M \leq X_j\beta_M + \theta^W_M E[N_W] + \theta^M_M E[N_M] + \varepsilon_{jM}.
\end{cases}
\] (7)

Similarly, a group will employ a female urologist if the following inequality holds (assuming there are no constants in \(X_l\)):

\[
X_j\beta_F + \theta^W_F E[N_W] + \theta^M_F E[N_M] + \varepsilon_{jF} \geq c^F_1.
\] (8)

In this context, \(c^M_m\) and \(c^F_1\) represent the fixed costs a group would incur if it increased the number of male urologists it employs by one and if it employed a female urologist, respectively; that is, a group will employ an additional male urologist or employ a female urologist in the event that the shocks to its profits, \(\varepsilon_{jM}\) and \(\varepsilon_{jF}\), exceed the costs from doing so after controlling for observable characteristics.

The probability that a group chooses to employ \(m\) male urologists and to employ a female urologist is thus

\[
p^m_{jF} = Pr_j(M = m, F = 1) = Pr(c^M_m \leq X_j\beta_M + \theta^W_M E[N_W] + \theta^M_M E[N_M] + \varepsilon_{jM} \leq c^M_{m+1}, X_j\beta_F + \theta^W_F E[N_W] + \theta^M_F E[N_M] + \varepsilon_{jF} \geq c^F_1),
\] (9)

while the probability that a group chooses to employ \(m\) male urologists and not to employ a female urologist is defined similarly and denoted \(p^m_{j0}\).

In a Bayesian Nash equilibrium, \(p^M_{jF} = p^M_{kF} = p^M_{MF}\) for all \(k\) since we have assumed independent symmetric types (given group observables). It follows that

\[
\theta^W_t E[N_W] = \theta^W_t N \sum_{M=0}^{M_M} p^M_t, \quad t = \{M, F\}
\] (10)

and

\[
\theta^M_t E[N_W] = \theta^M_t N \sum_{M=0}^{M_M} (p^{MO} + p^{M1}) * M, \quad t = \{M, F\}.
\] (11)

From (10) and (11), every choice probability becomes a function of the other choice probabilities. Therefore, groups’ equilibrium conjectures about the distribution of group types form a fixed point solution to a system of \(2 \times M\) equations. We then maximize the log-likelihood function

\[
lnL = \sum_{l=1}^{L} \sum_{j=1}^{J} \sum_{M=0}^{M_M} \sum_{F=0}^{1} I(M = m, F = f)lnPr(M = m, F = f)
\] (12)

14
to recover our parameters of interest.

In our estimation, the unit of observation is a group that competes in a market, defined here to be an HRR. We observe a group twice, once in 2006 and again in 2009, and restrict our sample to those groups operating in both years. In practice, this means that we do not explicitly consider a dynamic game of entry and exit. Instead, we limit our analysis to incumbent groups that continue operating into the next period.

We allow a group to choose one of seven categories for the number of male urologists it employs, \( m \in \mathbf{M} \), with \( \mathbf{M} = \{2, 3, 4, 5, 6, 7, 8+\} \).\(^{21}\) We also control for the decisions groups made in 2006, which in practice are highly persistent across periods and including them serves as an initial condition that reduces the demands on the data for identification of the structural model.

For our estimation technique, we employ a bivariate ordered probit model that controls for groups’ endogenous decisions to employ female urologists. This is a novel estimation approach in the IO literature and builds on Seim (2006) and Augereau et al. (2006). Importantly, this technique allows groups to make multinomial decisions regarding the number of male urologists to employ, a feature not incorporated into the bivariate probit model of Augereau et al. or univariate model of Seim.

**Discussion** Before proceeding to the estimation results from the model, we pause to highlight how the various simplifying assumptions and restrictions made to facilitate computation might potentially affect our results. First, we do not consider a full dynamic game that would reflect more accurately the true nature of competition in this setting. Instead, we estimate a static and simultaneous game, with the interpretation that it represents a single period of a longer dynamic game.\(^{22}\) Relatedly, we do not explicitly model the entry and exit of urologists, nor wage and price setting.

In addition, it is well known that the number of competitors in a market is potentially endogenous, which complicates the empirical estimation of product choice and entry games (Berry & Reiss 2006). In our setting, a group’s realization of \( \varepsilon_{jlF} \) might be large because female urologists are particularly profitable in market \( l \), which would then lead \( N_W \) to be large as well. On the other hand, \( N_W \) might be small because a group, \( j \), likely will employ a female urologist, which would then deter other groups in the market from also employing a female urologist due to a business-stealing effect. The assumption that groups have imperfect information reduces this endogeneity problem because groups make decisions based on their expectations of \( N_W \), which are determined only by exogenous variables.\(^{23}\) We adopt this approach to resolve the complications arising from the endogenous determination of market participants.

The presence of multiple equilibria in our game represents another potential concern because it invalidates using maximum likelihood to estimate the parameters of the model unless we employ an arbitrary equilibrium-selection mechanism. Many equilibria could obtain in our model if, for instance, \( \theta_W > 0 \), which could result in an equilibrium outcome in which many groups employ

\(^{21}\)Our results are robust to alternative size classifications

\(^{22}\)A similar argument is made by Seim (2006) and Augereau et al. (2006). Conceptually, the profit function written above represents the combination of expected present and future profits in the given period.

\(^{23}\)A similar argument is made by Seim (2006).
a female urologist, or only very few do. This seems unlikely to occur in our setting given that
we have no evidence of positive network externalities among female urologists. If \( \theta_W^W < 0 \), an
equilibrium might obtain in which, say, Group A employs a female urologist and Group B does
not, and another in which Group B employs a female urologist and Group A does not. This
outcome seems more likely in our setting. In practice, we check for multiple equilibria by using
several different initial conditions for our choice probabilities and then solving for equilibria at
the parameters at the maximum likelihood. We find a unique solution in all cases.

Finally, in order to identify \( \theta \), we assume that a group’s decision in 2006 is exogenous. This
assumption would be invalid if, for instance, \( \varepsilon_{jF} \) were correlated within markets and persistent.
In this case, however, our estimates would be biased upwards because we would see either many
groups employing female urologists, or very few, implying that \( \theta_W^W > 0 \). Therefore, even in the
face of invalid instruments, we would have a conservative estimate of the competitive effects of
groups employing female urologists in the sense that our \textit{a priori} conjecture is that the effects
will be negative.

5.2 Results

We present the results from two specifications of our model in Table 10, which differ in how
competitive effects interact with group size. In the first specification, we find that groups become
more likely to employ a female urologist as competition intensifies: a group in a market that has
a number of competing groups per capita one standard deviation above the mean is 93.1% more
likely to employ a female urologist, as the estimated probability increases from 5.2% to 10.1%.
Groups are less likely to employ a female urologist, however, if they expect competing groups will
also employ one, as indicated by the negative coefficient on the expected number of competing
groups employing a female urologist in a market. To interpret the magnitude of this effect, a
group with four male urologists is 48.3% less likely to employ a female urologist if it expects a
competitor will employ one than if it expects no competitors will, with the estimated probability
decreasing from 7.3% to 5.0%.

Furthermore, we find a positive and statistically significant correlation between a group’s
size and its decision to employ a female urologist, which we estimate to be 0.244. To place
this correlation in the context of our setting, a move from the smallest group-size type to the
largest is associated with a 4.9-times increase in the likelihood that a group will employ a female
urologist, all else equal. We interpret this as evidence of complementarity between male and
female urologists within a group.

In the second specification, we consider the relationship between a group’s market share and
its expectation that competitors will employ a female urologist. A group’s market share, defined
as the proportion of all urologists in the market employed by the group in 2006, influences its
decision to employ a female urologist. Groups with comparatively smaller market shares are more
likely to employ a woman – unless they expect their competitors will employ one as well. We find
that a group that does not expect any of its competitors will employ a female urologist and has a
market share at the 25th percentile is 4.8% more likely to employ a female urologist than a group
with a market share at the 75th percentile. When these same groups expect a competitor in their
market will employ a female urologist, however, the group with the smaller share of the market is 55.2% less likely to employ one. This result is consistent with small groups differentiating themselves from larger competitors to gain market share. When groups with a larger share of the market fear losing patients to smaller, differentiated competitors, however, they will take preemptive steps to forestall others in their markets from employing female urologists.

We also find that unobserved factors which influence both the supply and demand of female physicians in the market, as proxied by the percent of practicing physicians in the market who are women, are positively and significantly correlated with a group’s decision to employ a female urologist. This explanatory variable could represent the overall preferences of patients for female physicians in the market, which would then increase a urology group’s propensity for hiring a female urologist through an increase in demand from patients. It could also reflect market characteristics that make a certain area attractive to female surgeons in general, which would then increase a urology group’s propensity for hiring a female urologist through a decrease in the expected costs associated with recruiting and compensation (e.g., a female urologist has a lower reservation wage because of her desire to live in a particular city).

We find groups’ type choices are persistent across periods. For instance, a group that employed a female urologist in 2006 is much more likely to employ one in 2009 when compared to groups composed exclusively of men. In addition, groups that were large in 2006 tended to also be large in 2009, as seen in the positive and increasing coefficients estimated for the categorical dummy variables for the number of male urologists in a group in 2006.

Finally, the estimated moments for each group-type across markets match the actual moments in the data well, as reported in Table 11. This provides reassurance that the model is reasonably specified.

From our estimated model of group competition, we find evidence consistent with the economic intuition outlined throughout this paper. Groups are more likely to employ female urologists as competition intensifies, but are less likely to do so if they expect their competitors will also employ them. In addition, larger groups are more likely to employ female urologists than smaller ones. In the following subsection, we show the implications of these results for the gender disparity in urology.

5.3 Implications for Entry Thresholds

The estimated parameters from our model allow us to understand the role of market structure in the gender disparity among urologists. Specifically, we can consider counterfactual situations where competition does not affect groups’ decisions to employ female urologists and male and female urologists do not complement one another within a group. To do so, we take the parameters estimated above, but assume that (i) there is no business-stealing among groups that employ female urologists, (ii) there is no complementarity between male and female urologists within a group, and (iii) there is no incentive for groups to differentiate by employing a female urologist. We then solve for the fixed point for groups’ choice probabilities under these new assumptions and find the resulting equilibrium number of female urologists who would practice across markets.

In our first counterfactual, we assume that business-stealing among groups that employ female
urologists does not reduce the probability that a group will employ a female urologist (i.e., $\theta = 0$ above). Without this effect, the number of female urologists across markets would increase by 40.9%. We also show in Specification (1) in Table 12 that the estimated entry threshold for the first female urologist in a market would be 784,432, which is markedly less than the threshold of 991,370 estimated using the observed market configurations in Section 4. As a result, an additional 16 markets would have at least one female urologist, which would reduce the number of markets without a practicing female urologist by 10.5%. In addition, the threshold ratio for the second female urologist in this counterfactual exercise is estimated to be 1.48, which compares to the observed threshold of 1.78 in Section 4. In this sense, the anticipated responses of competitors explain approximately 38.5% of the excess market size required to support a second female urologist (i.e., it partially explains why the ratio is greater than one). These results suggest that the potential for business-stealing among groups increases the size of the market required to support a female urologist.

In our second counterfactual, we assume that groups are not more likely to employ female urologists as competition intensifies and that male and female urologists do not complement one another within a group. We find that the number of female urologists across markets would decline by 4.9% absent these effects. The thresholds and ratios for the first and second female urologists mirror those found empirically, as shown in Specification (2) in Table 12. For the third and fourth female urologists in a market, however, the market-size thresholds are comparatively larger. This suggests that the primary benefits of competition and complementarity accrue to markets already being served by at least one female urologist.

Finally, we consider a counterfactual in which all three effects are not present. In this case, the number of female urologists practicing across markets would increase by 8.0%. We show in Specification (3) in Table 12 that five additional markets would have a female urologist. In addition, the average market size necessary to bring forth the first female urologist would decline from 991,370 to 914,814 and the ratio for the second female urologist would decline by 4.1%.

From these counterfactuals, we have isolated the economic primitives responsible for the non-uniform entry thresholds and ratios for female urologists. The effects of differentiation and complementarity serve to increase the number of female urologists in a market and push down entry thresholds and ratios, while the predicted responses of competitors decrease the number of female urologists in a market and push up entry thresholds and ratios. We must note, however, that these counterfactuals represent a partial equilibrium in the sense that we cannot model changes in the incremental supply of female urologists. To the extent that the supply of female urologists would gradually shift over time in response to the demand-side forces considered in these specifications, these counterfactual results would obtain.

6 Urological Cancer Deaths

The availability of urologists has important consequences for patients’ health. For instance, Odisho et al. (2009b) find that counties with fewer urologists per capita have significantly higher mortality rates for urological cancers. We consider a related question: Do women fare worse in
markets in which they have limited access to female urologists? Because many women demonstrate a strong preference for female urologists, they might delay seeking medical care or forgo consulting a urologist when that alternative is not available to them. For women afflicted with cancer, this could have particularly dire effects, as the stage at which a cancer is first detected and treated influences the ultimate efficacy of the treatment. And for women who attempt to substitute a male urologist for a female physician in another specialty, studies have shown that they may receive inferior care. For instance, Goepel et al. (2002) determined that stress incontinence in women was much more likely to be misdiagnosed by primary-care physicians and gynecologists than urologists.

Simple statistics demonstrate that women do, in fact, fare comparatively worse in markets that lack a female urologist. We show in Table 13 that the incidence of female urological cancer deaths per 100,000 residents is 14.6% higher in counties that do not have a practicing female urologist. Because the density of male urologists is not statistically different across these two groups of counties, access to male urologists is not responsible for the difference in mortality rates. Of course, many confounding factors also contribute to the disparity in urological cancer deaths, and we now consider a more careful statistical analysis of this relationship.

To measure the association between access to female urologists and the health outcomes of women, we estimate a series of ordinary least squares regressions related to urological cancer deaths. In these regressions, the unit of observation is a county and our sample includes the 228 counties that reported death rates for all urological cancers (kidney, bladder, and prostate) between 2001–2005. Note in Table 14 that these counties are skewed towards the largest counties in the United States because data are suppressed in counties with fewer than three reported deaths each year, as discussed in Section 2. The average population in this sample is nearly 750,000, which is considerably larger than the average population of 94,000 for all counties in the United States. For this reason, the policy implications of the following results are limited to the most densely populated areas of the country. We present the results of our estimations in Table 15.

In Column (1), the dependent variable is the number of female urological cancer deaths per 100,000 residents in a county. For our main parameter of interest – the density of female urologists in a market – the effect is as predicted: counties with comparatively more female urologists per capita have lower mortality rates from female urological cancers. The estimated coefficient is both statistically significant (p<0.05) and economically significant, as a one-standard-deviation increase from the mean density of female urologists is associated with a 2.7% lower mortality rate for female urological cancers. The positive and significant quadratic term indicates that the density of female urologists in a county has a diminishing effect, which suggests that the primary health benefits for women come from having access to at least one female urologist. In addition, the density of male urologists is associated with a slightly higher death rate, though is statistically indistinguishable from zero. In this sense, access to male urologists is not correlated with improved health outcomes for women in the same manner access to female urologists is.

\[24\] In the Florida inpatient data, we found little evidence that physicians not trained in urology perform the most common urological procedures.
Note that we also include a control for the overall cancer mortality rate for women in the county, which serves as a proxy for the factors that influence the mortality rate from urological cancers aside from the number of female urologists (e.g., the quality of hospital care, the number of oncologists, and the general health status of women in the county). The estimated coefficient for this variable is positive and statistically significant, and including it in the regression increases the $R^2$ from 0.52 to 0.80.

In Column (2), we consider the same regression for male urological cancer deaths. In this case, the main variable of interest – the number of male urologists per 100,000 residents in a county – has the predicted sign, but is not statistically significant at conventional levels. Similar to the equivalent control for female cancer deaths, the overall cancer death rate for men in the county explains most of the variation in male urological cancer deaths. Unlike Column (1), the estimated coefficient of the median age of a county’s residents is positive and statistically significant. This result can be explained partially by the fact that incidence rates of urological cancers are skewed towards older men for whom treatment options can be comparatively limited.

To estimate the non-linear benefits of having access to female urologists, in Column (3) we include a binary variable for whether a female urologist practices in a market. The estimated coefficient of this variable is economically and statistically significant, as having at least one female urologist practicing in a market is associated with a 4.1% lower cancer mortality rate for women. The qualitative interpretation of the remaining variables is the same as in Column (1).

In both specifications, we have found a statistically and economically meaningful relationship between women’s access to female urologists and their mortality rates from urological cancers. While we cannot make precise claims about the direction of causality in these regressions (for instance, it could be that female urologists prefer to practice in markets with lower cancer mortality rates), they nevertheless provide evidence that is consistent with the prediction that male and female patients’ health outcomes are affected by access to their most-preferred type of urologist. In this sense, the gender disparity in urology has important consequences for the quality of care received by women.

7 Subsidizing Female Urologists

Having shown that women fare worse in markets that lack a female urologist, we now estimate the costs of improving the death rates associated with female urological cancers by providing greater access to female urologists. Specifically, we estimate the subsidy that groups operating in markets without a practicing female urologist would require to employ a female urologist. This exercise combines the estimates from the model of group competition presented in Section 5 with those from the cancer mortality regressions presented in Section 6 to approximate the likely costs and benefits of bringing forth a female urologist to markets that lack one.

To outline the intuition of our counterfactual analysis, recall from Column (3) of Table 15 that counties with at least one practicing female urologist have mortality rates from female urological cancers approximately 0.252 lower for every 100,000 residents than counties without a practicing female urologist. Roughly speaking, then, a county with one million residents would
be predicted to have 2.5 fewer women die each year from urological cancers if it had a female urologist than if it did not, holding all else constant. Assuming a female urologist commands the mean annual salary of $300,000 estimated by the Medical Group Management Association, this would imply an effective cost of $120,000 for each woman’s life saved if we abstract away from all other costs associated with providing urological care other than a physician’s salary. This represents a conservative estimate, as a female urologist will provide other health benefits to the community in addition to reducing cancer deaths directly (e.g., a female urologist might facilitate more preventative urological care for women) and she will receive payment for the services she does perform, even if the payments are not large enough to render her self-sufficient. As such, this calculation represents an upper bound for the effective cost of improving health outcomes for this particular metric.

Before proceeding, we note that we do not use HRR-level cancer mortality rates due to the data limitations discussed in Section 2. Instead, we use the county-level statistics provided by the National Cancer Institute as a proxy for the HRR-level figures. As previously discussed, counties included in the cancer mortality data have much larger populations than the average U.S. county, as does the average HRR. We believe, therefore, that the cancer death rates of the large counties contained in the NCI data provide a reasonable approximation of the rates of an average HRR. Furthermore, we note in Table 16 that the average HRR without a female urologist has roughly the same number of practicing urologists as the average county without a female urologist that appears in the NCI data, as shown in Table 13. This provides reassurance that access to urologists in this group of markets is reasonably similar across the two samples.

From our estimates in Section 5, we can directly solve for the subsidy that a group would require to employ a female urologist. Specifically, recall that a group will employ a female urologist if the following condition holds:

\[
X_{jl} \beta_F + \theta_W E[N_W] + \theta_M E[N_M] + \epsilon_{jlF} \geq c_{1F},
\]

with \( \epsilon_{jlF} \) correlated with \( \epsilon_{jlM} \), which links its decision to employ a female urologist to its decision to employ a given number of male urologists.

In the event that (13) does not hold, we can solve for the subsidy, \( S_F \), that would make the group indifferent between employing a female urologist and not employing one, with

\[
S_F = c_{1F} - X_{jl} \beta_F - \theta_W E[N_W] - \theta_M E[N_M] - \epsilon_{jlF}.
\]

From this, we can estimate the expected subsidy a group would require to employ a female urologist, which is

\[
E[S_F|M = m, F = 0] = \hat{c}_{1F} - E[\epsilon_{jlF}|M = m, F = 0]
\]

where \( \hat{c}_{1F} = c_{1F} - X_{jl} \beta_F - \theta_W E[N_W] - \theta_M E[N_M] \).\(^{25}\)

We then find the group with the lowest

\[^{25}\text{To derive } E[\epsilon_{jlF}|M = m, F = 0] \text{ we note that a group will employ } m \text{ male urologists and no female urologists if}
\]

\[
c_{m}^{F} \leq X_{jl} \beta_{M} + \theta_{W} E[N_{W}] + \theta_{M} E[N_{M}] + \epsilon_{jlM} \leq c_{m+1}^{F}
\]

21
expected subsidy in each market that does not have a female urologist, as we interpret this as the most efficient way to allocate subsidies. In this manner, we subsidize one group in each of the 112 markets that lack a female urologist in 2006 and 2009.

Because the estimated thresholds from our model are unit free, we fix \( c^F_1 \) at $300,000 as a baseline for comparison. The economic interpretation of this assumption is that a group will employ a female urologist if it expects to recover her fixed salary of $300,000, on average. With this baseline, the average subsidy required by a group is $182,900, and ranges from $52,860 to $287,000. This range reflects group and market characteristics that would make hiring a female urologist more or less profitable. For instance, a large group would need a lower subsidy than a small group, on average. Across the 112 markets, the total subsidy would be $20.5 million and would result in 299.7 lives saved each year, with the average market saving 2.7 life-years at a cost of $68,360 each.

From our counterfactual analysis, we have estimated that the cost of each additional life-year saved in these markets falls within conventional benchmarks for the statistical value of an additional year of life.\(^{26}\) By this metric, the costs of counteracting the gender disparity in urology and improving the quality of care received by women do not appear prohibitively large.

8 Conclusion

In this paper, we have examined how patients’ heterogeneous preferences for urologists and competition among urology groups contribute to the gender disparity in urology. While women exhibit a clear preference for female urologists, the strength of men’s preferences for male urologists impedes women’s access to their most-preferred alternative. As a result, fewer than 6% of urologists are women despite women representing nearly 30% of all urology patients. In half of all healthcare markets across the country, a female urologist is not available.

We have analyzed the economic behavior responsible for this result. Namely, we have shown that the internal organization of group practices and the industrial organization of urology markets both have important implications for patients’ access to female urologists. While groups’ attempts to soften competition through horizontal differentiation act to increase the availability of female urologists, the business-stealing that would occur if multiple groups employed female urologists in a market reduces their value for groups and limits their availability.

We have also demonstrated that the effects of imperfect competition and heterogeneous preferences have a meaningful impact on the welfare of female patients. In related studies, researchers have claimed that preference minorities derive less utility from consuming sub-optimal products, though reasonably close substitutes to their ideal products are often available. For many women who require the care of a urologist, however, no close substitute to a female urologist exists.

\[ X_{ji} \beta_F + \theta_F E[N_W] + \varepsilon_{jiF} \leq c^F_1 \]

both hold. Furthermore, since \((\varepsilon_{jiM}, \varepsilon_{jiF}) \sim BVN(0, 0, 1, 1, \rho)\), we can solve for \(E[\varepsilon_{jiF}|M = m, F = 0]\) explicitly using the properties of the truncated bivariate normal distribution.\(^{26}\) We temper this interpretation, however, by noting that a urologist’s salary represents just one component of the overall cost of treatment for a cancer patient, meaning that the overall cost of each life saved as a result of additional female urologists is likely higher than the subsidies we have estimated in this section.
Given the delicate nature of the conditions treated by a urologist, it is perhaps not very surprising that some women find receiving treatment from a man uncomfortable. While in response women might substitute towards other healthcare providers, such as gynecologists or primary-care doctors, the level of care they will receive for urological issues is generally not equivalent. The negative correlation we have documented between female urological cancer deaths and the number of female urologists in a market exemplifies this.

Moreover, our findings suggest that the relationship between taste-based discrimination and competition can have meaningful consequences for health care. As in other related empirical papers, we have found that minority consumers respond markedly to changes in their choice set. In this case, promoting women physicians in historically male-dominated specialties by fostering competition among medical-care providers has important implications for the well-being of women.
References


### Table 1: Patient gender and urologist gender from the Florida inpatient data for all procedures and all hospitals (top), for all procedures for the hospitals at which a female urologist has admitting privileges (middle), and for elective procedures for the hospitals at which a female urologist has admitting privileges (bottom).

<table>
<thead>
<tr>
<th>Patient Gender</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>42,581</td>
<td>352</td>
<td>42,933</td>
</tr>
<tr>
<td></td>
<td>71.2%</td>
<td>40.1%</td>
<td>70.8%</td>
</tr>
<tr>
<td>Female</td>
<td>17,188</td>
<td>526</td>
<td>17,714</td>
</tr>
<tr>
<td></td>
<td>28.8%</td>
<td>59.9%</td>
<td>29.2%</td>
</tr>
<tr>
<td>Total</td>
<td>59,769</td>
<td>878</td>
<td>60,647</td>
</tr>
<tr>
<td></td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Patient Gender</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>7,671</td>
<td>352</td>
<td>8,023</td>
</tr>
<tr>
<td></td>
<td>74.4%</td>
<td>40.1%</td>
<td>71.7%</td>
</tr>
<tr>
<td>Female</td>
<td>2,636</td>
<td>526</td>
<td>3,162</td>
</tr>
<tr>
<td></td>
<td>25.6%</td>
<td>59.9%</td>
<td>28.3%</td>
</tr>
<tr>
<td>Total</td>
<td>10,307</td>
<td>878</td>
<td>11,185</td>
</tr>
<tr>
<td></td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Patient Gender</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>4,995</td>
<td>189</td>
<td>5,184</td>
</tr>
<tr>
<td></td>
<td>77.2%</td>
<td>34.2%</td>
<td>73.8%</td>
</tr>
<tr>
<td>Female</td>
<td>1,477</td>
<td>363</td>
<td>1,840</td>
</tr>
<tr>
<td></td>
<td>22.8%</td>
<td>65.8%</td>
<td>26.2%</td>
</tr>
<tr>
<td>Total</td>
<td>6,472</td>
<td>552</td>
<td>7,024</td>
</tr>
<tr>
<td></td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Urologists</td>
<td>Freq.</td>
<td>Percent</td>
<td>Cum.</td>
</tr>
<tr>
<td>------------</td>
<td>-------</td>
<td>---------</td>
<td>-------</td>
</tr>
<tr>
<td>1 – 10</td>
<td>93</td>
<td>30.39</td>
<td>30.39</td>
</tr>
<tr>
<td>11 – 20</td>
<td>89</td>
<td>29.08</td>
<td>59.48</td>
</tr>
<tr>
<td>21 – 40</td>
<td>59</td>
<td>19.28</td>
<td>78.76</td>
</tr>
<tr>
<td>41 – 100</td>
<td>54</td>
<td>17.65</td>
<td>96.42</td>
</tr>
<tr>
<td>100+</td>
<td>11</td>
<td>3.59</td>
<td>100.00</td>
</tr>
<tr>
<td>Total</td>
<td>306</td>
<td>100.00</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>153</td>
<td>50.00</td>
<td>50.00</td>
</tr>
<tr>
<td>1</td>
<td>78</td>
<td>25.49</td>
<td>75.49</td>
</tr>
<tr>
<td>2</td>
<td>27</td>
<td>8.82</td>
<td>84.31</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>6.54</td>
<td>90.85</td>
</tr>
<tr>
<td>4+</td>
<td>28</td>
<td>9.15</td>
<td>100.00</td>
</tr>
<tr>
<td>Total</td>
<td>306</td>
<td>100.00</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: The distribution of all urologists across hospital referral regions (top), and the distribution of female urologists across hospital referral regions (bottom) in 2006.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Urologists</td>
<td>28.422</td>
<td>32.615</td>
<td>1</td>
<td>232</td>
</tr>
<tr>
<td>Male Urologists</td>
<td>27.271</td>
<td>31.245</td>
<td>1</td>
<td>221</td>
</tr>
<tr>
<td>Female Urologists</td>
<td>1.15</td>
<td>1.826</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>Pct. Urologists Female</td>
<td>0.036</td>
<td>0.05</td>
<td>0</td>
<td>0.3</td>
</tr>
<tr>
<td>Total OBGYN</td>
<td>102.722</td>
<td>122.315</td>
<td>6</td>
<td>859</td>
</tr>
<tr>
<td>Male OBGYN</td>
<td>62.863</td>
<td>73.908</td>
<td>3</td>
<td>553</td>
</tr>
<tr>
<td>Female OBGYN</td>
<td>39.859</td>
<td>50.281</td>
<td>0</td>
<td>311</td>
</tr>
<tr>
<td>Pct. OBGYN Female</td>
<td>0.364</td>
<td>0.109</td>
<td>0</td>
<td>0.75</td>
</tr>
<tr>
<td>Total Physicians</td>
<td>4415.337</td>
<td>6348.524</td>
<td>185</td>
<td>45025</td>
</tr>
<tr>
<td>Male Physicians</td>
<td>3056.464</td>
<td>4217.714</td>
<td>154</td>
<td>29879</td>
</tr>
<tr>
<td>Female Physicians</td>
<td>1358.873</td>
<td>2159.355</td>
<td>23</td>
<td>16221</td>
</tr>
<tr>
<td>Pct. Physicians Female</td>
<td>0.259</td>
<td>0.058</td>
<td>0.088</td>
<td>0.4</td>
</tr>
<tr>
<td>Population</td>
<td>1671.387</td>
<td>2040.018</td>
<td>150.293</td>
<td>17553.872</td>
</tr>
<tr>
<td>Per Capita Income</td>
<td>31.4</td>
<td>7.100</td>
<td>5.951</td>
<td>67.269</td>
</tr>
<tr>
<td>Median Age</td>
<td>36.874</td>
<td>2.812</td>
<td>25.675</td>
<td>45.348</td>
</tr>
<tr>
<td>N</td>
<td>306</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3: Summary statistics for hospital referral regions in 2006.
<table>
<thead>
<tr>
<th></th>
<th>(1) Urologists</th>
<th>(2) Female Uro.</th>
<th>(3) Male Uro.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log Population</td>
<td>1.523***</td>
<td>0.687***</td>
<td>1.557***</td>
</tr>
<tr>
<td></td>
<td>(0.108)</td>
<td>(0.101)</td>
<td>(0.109)</td>
</tr>
<tr>
<td>Median Age</td>
<td>0.105***</td>
<td>0.048*</td>
<td>0.108***</td>
</tr>
<tr>
<td></td>
<td>(0.022)</td>
<td>(0.027)</td>
<td>(0.022)</td>
</tr>
<tr>
<td>Per Capita Income</td>
<td>-0.019*</td>
<td>-0.012</td>
<td>-0.020*</td>
</tr>
<tr>
<td></td>
<td>(0.011)</td>
<td>(0.012)</td>
<td>(0.011)</td>
</tr>
<tr>
<td>Pct. Physicians Female</td>
<td>0.426</td>
<td>3.712**</td>
<td>-0.088</td>
</tr>
<tr>
<td></td>
<td>(1.571)</td>
<td>(1.830)</td>
<td>(1.571)</td>
</tr>
<tr>
<td>Threshold 1</td>
<td>20.400***</td>
<td>11.841***</td>
<td>20.857***</td>
</tr>
<tr>
<td></td>
<td>(1.678)</td>
<td>(1.704)</td>
<td>(1.688)</td>
</tr>
<tr>
<td>Threshold 2</td>
<td>20.836***</td>
<td>12.714***</td>
<td>21.297***</td>
</tr>
<tr>
<td></td>
<td>(1.655)</td>
<td>(1.717)</td>
<td>(1.665)</td>
</tr>
<tr>
<td>Threshold 3</td>
<td>21.584***</td>
<td>13.150***</td>
<td>22.116***</td>
</tr>
<tr>
<td></td>
<td>(1.649)</td>
<td>(1.728)</td>
<td>(1.660)</td>
</tr>
<tr>
<td>Threshold 4</td>
<td>22.069***</td>
<td>13.587***</td>
<td>22.557***</td>
</tr>
<tr>
<td></td>
<td>(1.656)</td>
<td>(1.739)</td>
<td>(1.667)</td>
</tr>
<tr>
<td>Observations</td>
<td>306</td>
<td>306</td>
<td>306</td>
</tr>
<tr>
<td>Pseudo $R^2$</td>
<td>0.151</td>
<td>0.136</td>
<td>0.151</td>
</tr>
</tbody>
</table>

Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Entry thresholds for urologists at the HRR-level in 2006.
<table>
<thead>
<tr>
<th>Threshold</th>
<th>Market Size</th>
<th>Mkt. Size Per</th>
<th>Ratio</th>
<th>Ratio Std. Err.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 → 2</td>
<td>75,752</td>
<td>37,876</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 → 3</td>
<td>100,530</td>
<td>33,510</td>
<td>0.88</td>
<td>0.18</td>
</tr>
<tr>
<td>3 → 4</td>
<td>170,029</td>
<td>42,507</td>
<td>1.27</td>
<td>0.19</td>
</tr>
<tr>
<td>4 → 5</td>
<td>225,790</td>
<td>45,158</td>
<td>1.06</td>
<td>0.08</td>
</tr>
<tr>
<td>5 → 6</td>
<td>261,483</td>
<td>43,581</td>
<td>0.97</td>
<td>0.05</td>
</tr>
<tr>
<td>6 → 7</td>
<td>322,145</td>
<td>46,021</td>
<td>1.06</td>
<td>0.06</td>
</tr>
<tr>
<td>7 → 8</td>
<td>390,901</td>
<td>48,863</td>
<td>1.06</td>
<td>0.05</td>
</tr>
<tr>
<td>8 → 9</td>
<td>440,648</td>
<td>48,961</td>
<td>1.00</td>
<td>0.04</td>
</tr>
<tr>
<td>9 → 10</td>
<td>497,014</td>
<td>49,701</td>
<td>1.02</td>
<td>0.04</td>
</tr>
<tr>
<td>10 → 11</td>
<td>585,427</td>
<td>53,221</td>
<td>1.07</td>
<td>0.03</td>
</tr>
<tr>
<td>11 → 12</td>
<td>664,406</td>
<td>55,367</td>
<td>1.04</td>
<td>0.04</td>
</tr>
<tr>
<td>12 → 13</td>
<td>728,513</td>
<td>56,039</td>
<td>1.01</td>
<td>0.03</td>
</tr>
<tr>
<td>13 → 14</td>
<td>791,411</td>
<td>56,529</td>
<td>1.01</td>
<td>0.03</td>
</tr>
<tr>
<td>14 → 15</td>
<td>841,457</td>
<td>56,097</td>
<td>0.99</td>
<td>0.02</td>
</tr>
<tr>
<td>15 → 16</td>
<td>937,229</td>
<td>58,577</td>
<td>1.04</td>
<td>0.03</td>
</tr>
<tr>
<td>16 → 17</td>
<td>1,060,123</td>
<td>62,360</td>
<td>1.06</td>
<td>0.04</td>
</tr>
<tr>
<td>17 → 18</td>
<td>1,142,707</td>
<td>63,484</td>
<td>1.02</td>
<td>0.03</td>
</tr>
<tr>
<td>18 → 19</td>
<td>1,243,189</td>
<td>65,431</td>
<td>1.03</td>
<td>0.03</td>
</tr>
<tr>
<td>19 → 20</td>
<td>1,340,576</td>
<td>67,029</td>
<td>1.02</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Threshold</th>
<th>Market Size</th>
<th>Mkt. Size Per</th>
<th>Ratio</th>
<th>Ratio Std. Err.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 → 1</td>
<td>991,370</td>
<td>991,370</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 → 2</td>
<td>3,531,306</td>
<td>1,765,653</td>
<td>1.78</td>
<td>0.38</td>
</tr>
<tr>
<td>2 → 3</td>
<td>6,661,170</td>
<td>2,220,390</td>
<td>1.26</td>
<td>0.17</td>
</tr>
<tr>
<td>3 → 4+</td>
<td>12,583,124</td>
<td>3,145,781</td>
<td>1.42</td>
<td>0.22</td>
</tr>
</tbody>
</table>

Table 5: Entry threshold ratios for male urologists (top) and female urologists (bottom) at the HRR-level in 2006.
<table>
<thead>
<tr>
<th># of Groups w/ Female</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3+</th>
<th>Total</th>
</tr>
</thead>
<tbody>
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<td>2</td>
<td>3+</td>
<td>Total</td>
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<td>0</td>
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<td>0.0%</td>
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</tr>
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<td>0</td>
<td>0</td>
<td>77</td>
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<td>6.5%</td>
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<td>0.0%</td>
<td>25.2%</td>
</tr>
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<td>0</td>
<td>61</td>
</tr>
<tr>
<td></td>
<td>77.1%</td>
<td>21.3%</td>
<td>1.6%</td>
<td>0.0%</td>
<td>19.9%</td>
</tr>
<tr>
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<td>27</td>
<td>15</td>
<td>1</td>
<td>1</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>61.4%</td>
<td>34.1%</td>
<td>2.3%</td>
<td>2.3%</td>
<td>14.4%</td>
</tr>
<tr>
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<td>16</td>
<td>4</td>
<td>3</td>
<td>0</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>69.6%</td>
<td>17.4%</td>
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<td>0.0%</td>
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</tr>
<tr>
<td>5</td>
<td>10</td>
<td>9</td>
<td>4</td>
<td>0</td>
<td>23</td>
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<td>45.5%</td>
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<tr>
<td>7+</td>
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<td>12</td>
<td>4</td>
<td>6</td>
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<tr>
<td>Total</td>
<td>221</td>
<td>63</td>
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<td>7</td>
<td>306</td>
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</table>

Table 6: Observed market configurations in hospital referral regions in 2006.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Urologists</td>
<td>28.422</td>
<td>32.615</td>
<td>1</td>
<td>232</td>
</tr>
<tr>
<td>Male Urologists</td>
<td>27.271</td>
<td>31.245</td>
<td>1</td>
<td>221</td>
</tr>
<tr>
<td>Female Urologists</td>
<td>1.15</td>
<td>1.826</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>Urology Groups</td>
<td>3.049</td>
<td>3.231</td>
<td>0</td>
<td>24</td>
</tr>
<tr>
<td>Uro. Groups with Female</td>
<td>0.379</td>
<td>0.715</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Population</td>
<td>1671.387</td>
<td>2040.018</td>
<td>150.293</td>
<td>17553.872</td>
</tr>
<tr>
<td>Per Capita Income</td>
<td>31.4</td>
<td>7.100</td>
<td>5.951</td>
<td>67.269</td>
</tr>
<tr>
<td>Median Age</td>
<td>36.874</td>
<td>2.812</td>
<td>25.675</td>
<td>45.348</td>
</tr>
<tr>
<td>Physician Specialists</td>
<td>70.657</td>
<td>34.893</td>
<td>16.633</td>
<td>189.409</td>
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<tr>
<td>Pct. Physicians Female</td>
<td>0.259</td>
<td>0.058</td>
<td>0.088</td>
<td>0.4</td>
</tr>
<tr>
<td><strong>N</strong></td>
<td><strong>306</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 7: Market-level summary statistics for HRR in 2006.
<table>
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<th>Variable</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group Size</td>
<td>3.838</td>
<td>2.802</td>
<td>2</td>
<td>29</td>
</tr>
<tr>
<td>Males in Group</td>
<td>3.685</td>
<td>2.705</td>
<td>0</td>
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<tr>
<td>Females in Group</td>
<td>0.153</td>
<td>0.45</td>
<td>0</td>
<td>4</td>
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<tr>
<td>Group Has Female</td>
<td>0.124</td>
<td>0.33</td>
<td>0</td>
<td>1</td>
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<tr>
<td>Market Share</td>
<td>0.14</td>
<td>0.154</td>
<td>0.009</td>
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</tr>
<tr>
<td>N</td>
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<td></td>
<td></td>
<td>933</td>
</tr>
</tbody>
</table>

Table 8: Group-level summary statistics for HRR in 2006.

<table>
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<tr>
<th>Females in Group</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3+</th>
<th>Total</th>
</tr>
</thead>
<tbody>
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<td>Group Size</td>
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<td></td>
<td></td>
</tr>
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<td>0</td>
<td>355</td>
</tr>
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<td>94.7%</td>
<td>4.8%</td>
<td>0.6%</td>
<td>0.0%</td>
<td>38.1%</td>
</tr>
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<td>0</td>
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</tr>
<tr>
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<td>87.7%</td>
<td>11.4%</td>
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<td>0.0%</td>
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</tr>
<tr>
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<td>18</td>
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<tr>
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<td>83.3%</td>
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<td>1.7%</td>
<td>0.0%</td>
<td>12.9%</td>
</tr>
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<td>73</td>
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<td>3</td>
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</tr>
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<td>0.0%</td>
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</tr>
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<td>0</td>
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<td>38</td>
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<td>0.0%</td>
<td>4.1%</td>
</tr>
<tr>
<td>7</td>
<td>31</td>
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<td>2</td>
<td>0</td>
<td>39</td>
</tr>
<tr>
<td></td>
<td>79.5%</td>
<td>15.4%</td>
<td>5.1%</td>
<td>0.0%</td>
<td>4.2%</td>
</tr>
<tr>
<td>8+</td>
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<td>5</td>
<td>5</td>
<td>68</td>
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<tr>
<td></td>
<td>66.2%</td>
<td>19.1%</td>
<td>7.4%</td>
<td>7.4%</td>
<td>7.3%</td>
</tr>
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<td>16</td>
<td>5</td>
<td>933</td>
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<td></td>
<td>87.6%</td>
<td>10.2%</td>
<td>1.7%</td>
<td>0.5%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Table 9: Observed urology group structures in 2006.
| Female | | (1) | (2) | | | | Males | | (1) | (2) |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Expected Groups with Female | | -0.199 | -0.399 | ** | -0.027 | 0.020 | | | |
| | | (0.105) | (0.151) | | (0.065) | (0.092) | | | |
| Expect Comp. Male Urologists | | -0.691 | -0.619 | -0.345 | -0.378 | | | | |
| | | (0.443) | (0.434) | | (0.227) | (0.224) | | | |
| Competing Groups | | 2.875 | ** | 2.606 | | 0.987 | 1.142 | | |
| | | (1.546) | (1.548) | | (0.837) | (0.847) | | | |
| Market Share | | -0.042 | -0.171 | -0.007 | -0.061 | | | | |
| | | (0.631) | (0.654) | | (0.337) | (0.336) | | | |
| Market Share * Exp. Groups with Female | | 2.991 | ** | -1.533 | | | | | |
| | | (1.262) | | (0.858) | | | | | |
| HRR Population | | 0.010 | 0.013 | 0.007 | 0.005 | | | | |
| | | (0.010) | (0.010) | | (0.006) | (0.006) | | | |
| HRR Population | | -0.000 | -0.000 | -0.000 | -0.000 | | | | |
| | | (0.000) | (0.000) | | (0.000) | (0.000) | | | |
| Per Capita Income | | 0.003 | 0.002 | 0.004 | 0.005 | | | | |
| | | (0.012) | (0.012) | | (0.008) | (0.008) | | | |
| Median Age in HRR | | -0.041 | -0.037 | 0.026 | 0.023 | | | | |
| | | (0.034) | (0.034) | | (0.017) | (0.017) | | | |
| M.D. Specialists in HRR | | -0.002 | -0.001 | -0.003 | -0.004 | | | | |
| | | (0.003) | (0.003) | | (0.002) | (0.002) | | | |
| Pct. M.D. Female in HRR | | 5.912 | ** | 5.427 | | 1.545 | 1.917 | | |
| | | (2.460) | (2.466) | | (1.310) | (1.331) | | | |
| Male 3 in 2006 | | -0.034 | -0.090 | 0.964 | 0.990 | | | | |
| | | (0.173) | (0.175) | | (0.100) | (0.101) | | | |
| Male 4 in 2006 | | 0.055 | -0.006 | 1.726 | 1.763 | | | | |
| | | (0.207) | (0.212) | | (0.130) | (0.132) | | | |
| Male 5 in 2006 | | 0.463 | ** | 0.353 | 2.217 | 2.285 | | | |
| | | (0.221) | (0.236) | | (0.150) | (0.155) | | | |
| Male 6 in 2006 | | 0.228 | 0.079 | 2.730 | 2.821 | | | | |
| | | (0.301) | (0.324) | | (0.182) | (0.184) | | | |
| Male 7 in 2006 | | 0.452 | 0.351 | 3.100 | 3.161 | | | | |
| | | (0.390) | (0.389) | | (0.243) | (0.239) | | | |
| Male 8+ in 2006 | | 0.758 | ** | 0.491 | 4.176 | 4.325 | | | |
| | | (0.255) | (0.289) | | (0.270) | (0.291) | | | |
| Female in 2006 | | 2.472 | ** | 2.450 | | 0.197 | 0.222 | | |
| | | (0.166) | (0.166) | | (0.123) | (0.122) | | | |

** Estimated Correlation **

| Number of Males & Female | 0.244 | 0.257 | | |
| | (0.072) | (0.075) | | |

** Type Thresholds **

| Male Threshold 3 | 1.682 | ** | 1.634 | ** |
| | | (0.755) | (0.756) | | |
| Male Threshold 4 | 2.568 | ** | 2.522 | ** |
| | | (0.758) | (0.759) | | |
| Male Threshold 5 | 3.280 | ** | 3.236 | ** |
| | | (0.762) | (0.762) | | |
| Male Threshold 6 | 3.808 | ** | 3.767 | ** |
| | | (0.766) | (0.767) | | |
| Male Threshold 7 | 4.143 | ** | 4.102 | ** |
| | | (0.774) | (0.774) | | |
| Male Threshold 8+ | 4.487 | ** | 4.447 | ** |
| | | (0.779) | (0.780) | | |
| Female Threshold | 1.824 | 1.857 | | |
| | | (1.565) | (1.566) | | |

** Observations **

933 | 933 | |

** LL **

-1419.4415 | -1415.4447 | |

** Standard errors in parentheses **

* p < 0.10, ** p < 0.05, *** p < 0.01

** Table 10: Estimation results for structural group-choice model. **
<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expect Male 2 Groups</td>
<td>2.408</td>
<td>2.201</td>
<td>0</td>
<td>9.845</td>
</tr>
<tr>
<td>Actual Male 2 Groups</td>
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<td>Expect Male 3 Groups</td>
<td>1.489</td>
<td>1.256</td>
<td>0.001</td>
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<tr>
<td>Actual Male 3 Groups</td>
<td>1.404</td>
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<td>5</td>
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<td>Expect Male 4 Groups</td>
<td>0.949</td>
<td>0.781</td>
<td>0.005</td>
<td>3.281</td>
</tr>
<tr>
<td>Actual Male 4 Groups</td>
<td>0.994</td>
<td>1.246</td>
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</tr>
<tr>
<td>Expect Male 5 Groups</td>
<td>0.512</td>
<td>0.416</td>
<td>0.011</td>
<td>1.806</td>
</tr>
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<td>Actual Male 5 Groups</td>
<td>0.476</td>
<td>0.739</td>
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<td>Expect Male 6 Groups</td>
<td>0.248</td>
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<td>Actual Male 6 Groups</td>
<td>0.244</td>
<td>0.518</td>
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</tr>
<tr>
<td>Expect Male 7 Groups</td>
<td>0.205</td>
<td>0.173</td>
<td>0.001</td>
<td>0.781</td>
</tr>
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<td>Actual Male 7 Groups</td>
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<td>0.494</td>
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<td>Expect Male 8 Groups</td>
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<td>Actual Male Urologists</td>
<td>24.042</td>
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</table>

Table 11: A comparison of the summary statistics for the moments in the estimated model (Expect) with the moments from the data (Actual).
<table>
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<td>25.82</td>
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<td>5.56</td>
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<td>306</td>
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<td>306</td>
<td>306</td>
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</table>

<table>
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<tbody>
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</tr>
<tr>
<td>1 → 2</td>
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<td>1.48</td>
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<td>1,764,507</td>
<td>1.79</td>
<td>3,121,166</td>
<td>3,121,166</td>
<td>1.71</td>
</tr>
<tr>
<td>2 → 3</td>
<td>4,341,616</td>
<td>1,447,205</td>
<td>1.24</td>
<td>2,596,260</td>
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<td>1.47</td>
<td>6,164,063</td>
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</tr>
<tr>
<td>3 → 4+</td>
<td>6,558,725</td>
<td>1,639,681</td>
<td>1.13</td>
<td>15,224,476</td>
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<td>1.47</td>
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<td>10,236,184</td>
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</tbody>
</table>

Table 12: Estimated market configurations (top) and entry threshold ratios (bottom) for female urologists from a counterfactual simulation using the parameters from the group-choice model absent business-stealing effects (1), absent complementarity and differentiation effects (2), and absent business-stealing, complementarity, and differentiation effects (3).
<table>
<thead>
<tr>
<th>Mean of Variable</th>
<th>County Has Female Urologist</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Urological Cancer Deaths per 100,000</td>
<td>20.910</td>
<td>18.979</td>
</tr>
<tr>
<td>Female Urological Cancer Deaths per 100,000</td>
<td>6.694</td>
<td>5.843</td>
</tr>
<tr>
<td>Male Urological Cancer Deaths per 100,000</td>
<td>35.126</td>
<td>32.115</td>
</tr>
<tr>
<td>Non-Uro Cancer Deaths</td>
<td>188.210</td>
<td>170.962</td>
</tr>
<tr>
<td>Female Non-Uro Cancer Deaths per 100,000</td>
<td>191.943</td>
<td>177.576</td>
</tr>
<tr>
<td>Male Non-Uro Cancer Deaths per 100,000</td>
<td>185.193</td>
<td>164.747</td>
</tr>
<tr>
<td>Urologists</td>
<td>14.84</td>
<td>31.984</td>
</tr>
<tr>
<td>Female Urologists</td>
<td>0</td>
<td>1.977</td>
</tr>
<tr>
<td>Male Urologists</td>
<td>14.84</td>
<td>30.008</td>
</tr>
<tr>
<td>Urologists per 100,000</td>
<td>3.336</td>
<td>3.757</td>
</tr>
<tr>
<td>Female Urologists per 100,000</td>
<td>0</td>
<td>0.283</td>
</tr>
<tr>
<td>Male Urologists per 100,000</td>
<td>3.336</td>
<td>3.474</td>
</tr>
<tr>
<td>Population</td>
<td>478.017</td>
<td>956.335</td>
</tr>
<tr>
<td>Median Age</td>
<td>37.769</td>
<td>36.624</td>
</tr>
<tr>
<td>Per Capita Income</td>
<td>34.924</td>
<td>38.896</td>
</tr>
<tr>
<td>M.D. Specialists per 100,000</td>
<td>91.093</td>
<td>121.896</td>
</tr>
<tr>
<td>Pct. Physicians Female</td>
<td>0.271</td>
<td>0.297</td>
</tr>
</tbody>
</table>

N = 228


<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min.</th>
<th>Max.</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urologists per 100,000</td>
<td>3.572</td>
<td>1.479</td>
<td>0.737</td>
<td>9.152</td>
<td>228</td>
</tr>
<tr>
<td>Male Urologists per 100,000</td>
<td>3.413</td>
<td>1.438</td>
<td>0.59</td>
<td>9.152</td>
<td>228</td>
</tr>
<tr>
<td>Female Urologists per 100,000</td>
<td>0.159</td>
<td>0.212</td>
<td>0</td>
<td>1.455</td>
<td>228</td>
</tr>
<tr>
<td>Female Urologist in County</td>
<td>0.561</td>
<td>0.497</td>
<td>0</td>
<td>1</td>
<td>228</td>
</tr>
<tr>
<td>Total Urological Cancer Deaths</td>
<td>39.652</td>
<td>11.974</td>
<td>13.633</td>
<td>112.295</td>
<td>228</td>
</tr>
<tr>
<td>Female Urological Cancer Deaths</td>
<td>6.216</td>
<td>1.928</td>
<td>2.518</td>
<td>17.61</td>
<td>228</td>
</tr>
<tr>
<td>Male Urological Cancer Deaths</td>
<td>33.436</td>
<td>10.32</td>
<td>11.115</td>
<td>94.685</td>
<td>228</td>
</tr>
<tr>
<td>Non-Uro Cancer Deaths</td>
<td>178.527</td>
<td>50.498</td>
<td>80.341</td>
<td>582.425</td>
<td>228</td>
</tr>
<tr>
<td>Female Non-Uro Cancer Deaths</td>
<td>183.877</td>
<td>48.958</td>
<td>76.53</td>
<td>599.284</td>
<td>228</td>
</tr>
<tr>
<td>Male Non-Uro Cancer Deaths</td>
<td>173.715</td>
<td>53.673</td>
<td>73.739</td>
<td>567.494</td>
<td>228</td>
</tr>
<tr>
<td>Population</td>
<td>746.546</td>
<td>890.253</td>
<td>126.795</td>
<td>9935.475</td>
<td>228</td>
</tr>
<tr>
<td>Median Age</td>
<td>37.126</td>
<td>3.394</td>
<td>27.2</td>
<td>52.9</td>
<td>228</td>
</tr>
<tr>
<td>Per Capita Income</td>
<td>37.154</td>
<td>9.476</td>
<td>16.359</td>
<td>93.377</td>
<td>228</td>
</tr>
<tr>
<td>M.D. Specialists per 100,000</td>
<td>108.386</td>
<td>59.871</td>
<td>31.476</td>
<td>457.499</td>
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</tr>
</tbody>
</table>

N = 228

Table 14: Summary statistics for cancer deaths per 100,000 residents in counties in NCI data between 2001–2005.
<table>
<thead>
<tr>
<th></th>
<th>(1) Female</th>
<th>(2) Male</th>
<th>(3) Female</th>
<th>(4) Male</th>
<th>(5) Female</th>
<th>(6) Male</th>
<th>(7) Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female Urologists per 100,000</td>
<td>-1.184**</td>
<td>2.651</td>
<td>(0.566)</td>
<td></td>
<td>(2.274)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female Urologists per 100,000²</td>
<td>1.264**</td>
<td>-0.30</td>
<td>(0.607)</td>
<td></td>
<td>(2.441)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male Urologists per 100,000</td>
<td>0.003</td>
<td>-0.497</td>
<td>(0.163)</td>
<td></td>
<td>(0.650)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male Urologists per 100,000²</td>
<td>0.007</td>
<td>-0.025</td>
<td>(0.018)</td>
<td></td>
<td>(0.072)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female Urologist in County</td>
<td>-0.252*</td>
<td>0.726</td>
<td>(0.136)</td>
<td></td>
<td>(0.535)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urologists per 100,000</td>
<td>0.017</td>
<td>-0.321</td>
<td>(0.135)</td>
<td></td>
<td>(0.661)</td>
<td></td>
<td>-0.094</td>
</tr>
<tr>
<td>Urologists per 100,000²</td>
<td>0.005</td>
<td>-0.033</td>
<td>(0.014)</td>
<td></td>
<td>(0.072)</td>
<td></td>
<td>0.012</td>
</tr>
<tr>
<td>Population</td>
<td>-0.011</td>
<td>0.014</td>
<td>-0.008*</td>
<td>0.001</td>
<td>0.003</td>
<td>0.012</td>
<td>0.003</td>
</tr>
<tr>
<td>Median Age</td>
<td>0.039</td>
<td>0.481***</td>
<td>0.043</td>
<td>0.500***</td>
<td>0.050*</td>
<td>0.481***</td>
<td>0.827***</td>
</tr>
<tr>
<td>Per Capita Income</td>
<td>-0.011</td>
<td>0.005</td>
<td>-0.012</td>
<td>-0.006</td>
<td>-0.013</td>
<td>-0.003</td>
<td>-0.112***</td>
</tr>
<tr>
<td>M.D. Specialists per 100,000</td>
<td>-0.001</td>
<td>0.013**</td>
<td>-0.001</td>
<td>0.013**</td>
<td>-0.001</td>
<td>0.014**</td>
<td>0.016**</td>
</tr>
<tr>
<td>Female Non-Uro Cancer Deaths</td>
<td>0.032***</td>
<td>0.032***</td>
<td>0.032***</td>
<td></td>
<td>(0.002)</td>
<td>(0.003)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>Male Non-Uro Cancer Deaths</td>
<td>0.165***</td>
<td>0.163***</td>
<td>0.163***</td>
<td></td>
<td>(0.008)</td>
<td>(0.008)</td>
<td>(0.008)</td>
</tr>
<tr>
<td>Non-Uro Cancer Deaths</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.207***</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.515</td>
<td>-13.111***</td>
<td>-0.584</td>
<td>-13.466***</td>
<td>-0.751</td>
<td>-13.012***</td>
<td>-19.692***</td>
</tr>
<tr>
<td>Observations</td>
<td>228</td>
<td>228</td>
<td>228</td>
<td>228</td>
<td>228</td>
<td>228</td>
<td>228</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.800</td>
<td>0.887</td>
<td>0.799</td>
<td>0.884</td>
<td>0.796</td>
<td>0.883</td>
<td>0.885</td>
</tr>
</tbody>
</table>

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 15: OLS regressions that take the county-level urological cancer-death rate as the dependent variable.
Table 16: Summary statistics for hospital referral regions that receive subsidies in the counter-factual estimation.

<table>
<thead>
<tr>
<th>Market Receives Subsidy</th>
<th>Population</th>
<th>Male Urologists</th>
<th>Female Urologists</th>
<th>Per Cap. Inc.</th>
<th>Groups</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>2217.6</td>
<td>40.5</td>
<td>2.2</td>
<td>33.4</td>
<td>7.8</td>
<td>158</td>
</tr>
<tr>
<td>Yes</td>
<td>1068.9</td>
<td>15.2</td>
<td>0</td>
<td>29.2</td>
<td>3.3</td>
<td>112</td>
</tr>
<tr>
<td>Total</td>
<td>1741.1</td>
<td>30.0</td>
<td>1.3</td>
<td>31.6</td>
<td>5.9</td>
<td>270</td>
</tr>
</tbody>
</table>

Table 16: Summary statistics for hospital referral regions that receive subsidies in the counter-factual estimation.