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Market structure and gender disparity in health care: preferences, competition, and quality of care

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We consider the relationship between market structure and health outcomes in a setting where patients have 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 imperfect competition in which urology groups strategically differentiate themselves by employing female urologists. These strategic effects may influence women's health, as markets without a female urologist have a 7.3% higher death rate for female bladder cancer, all else equal.

1. Introduction

■ In a market characterized by heterogeneous preferences, competition often leads firms to differentiate. Fixed costs, however, limit the extent of variety available to consumers. Although an extensive literature in economics has considered this topic, comparatively less work has focused on its implications for health outcomes. In this article, we consider one form of variety in health care, the gender of physicians within a medical group, and show that competition affects 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 influence their hiring decisions.

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At the same time, fixed costs limit the number of male and female 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. Although 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 may have important consequences for the health of women, as women in areas without a female urologist have significantly higher death rates from bladder cancer, all else equal.

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

In light of these gender-based preferences, we 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 3.7 times as large as the first, whereas the range for doubling the number of male urologists falls between 1.8 and 2.4. The excess entry threshold for subsequent female urologists suggests that market structure may have important implications for the gender disparity among urologists.

As such, we estimate a model of competition among urology group practices that explains a meaningful portion 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 expected competition from male urologists intensifies within a market, a group becomes more likely to employ a female urologist—and less likely when they expect competing groups to employ one. For the decision to employ male urologists, on the other hand, the direction of the competitive effects is reversed. 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 nearly seven 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 in the United States would increase without the restraining effect of business stealing across groups, as the number of markets without a female urologist would decline by 31.4%; this explains approximately 74.1% of the excess entry threshold for the second female urologist in a market. Without the facilitating effects of complementarities across male and female group members, however, the number of markets without a female urologists would increase by 22.9%. In short, we demonstrate that competition and a group's internal organization can either amplify or attenuate the gender disparity among urologists. 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 (AMA), 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 potentially has important consequences, as the availability of female urologists may affect the health of women. We find that counties without a practicing female urologist have a 7.3% higher death rate from female bladder cancer, 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 (Cárdenas-Turanzas et al., 2006). In this sense, the structure of urology markets has meaningful implications for the welfare of women and may represent a novel explanation for the persistent disparity in mortality rates that exists for male and female bladder cancer (Madeb and Messing, 2004).

Based on these findings, our article 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 nondecreasing in the number of consumers in the market who share his tastes, as an agglomeration of consumers with similar preferences is required to support a product in the presence of fixed costs; conversely, a consumer's utility may be decreasing in the number of consumers who have opposing preferences. 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 and Waldfogel, 2003), local television (Waldfogel, 2004), political mobilization (Oberholzer-Gee and Waldfogel, 2005), restaurants (Waldfogel, 2008), and funeral homes (Chevalier, Harrington, and Scott Morton, 2008). We contribute to this growing line of literature by considering the effects of a preference externality (i) associated with gender, (ii) in a health care market, and (iii) in a structural 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, such as Bresnahan and Reiss (1991), Mazzeo (2002), and Seim (2006). 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, and Rysman (2006) and the identification strategies of Gentzkow (2007).[1] We discuss our contributions to this body of work in Section 5.

Third, our work contributes to two distinct health care literatures. Among the expansive literature on health care market structure, Dranove, Shanley, and Simon (1992), Brasure et al. (1999), and Schaumans (2009) estimate models in the spirit of Bresnahan and Reiss (1991) to explore the nature of competition in medical services. Dranove et al. (1992) and Brasure et al. (1999) both find limited effects of competition in their estimations, whereas Schaumans (2009) finds the effects differ depending on the type of medical specialist considered. In this article, we consider a similar question for urologists. Also related to our work, Gaynor, Moreno-Serra, and Propper (2010) examine the effects of competition on patient outcomes in English hospitals, finding that procompetitive policies saved lives without increasing costs. In addition, Epstein, Ketcham, and Nicholson (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 work in that urology groups differentiate themselves to promote matching between female patients and female urologists.

Relatedly, a broad medical literature has considered the extent to which health care availability affects health outcomes. Most similar to our work are Odisho et al. (2009a, 2009b) 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 article, 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 cancer death rates. Other work has 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, whereas Chapple, Ziebland, and McPherson (2004) find that male patients cite embarrassment as a key reason for delaying

[1] We 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 and Hubbard (2008), pertains to our topic, though we do not consider it explicitly in what follows.

consultation with a urologist. This underpins our motivation for studying preference externalities among female urology patients.

Finally, our work also relates to the literature on the economics of discrimination started by Becker (1957). In our setting, patients make taste-based choices for urologists associated with gender, which then has implications for labor market outcomes. Others have considered this topic in regards to race. For instance, Holzer and 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 for jobs that require direct contact with customers. Similarly, Leonard, Levine, and Giuliano (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 differences, Bertrand, Goldin, and Katz (2010) study the gap in earnings for highly educated professional men and women, focusing mostly on supply-side explanations for the observed wage imbalance. As female urologists routinely claim that discrimination by male patients and colleagues affects their practice, such as in Jackson et al. (2009), our analysis explores the implications of this bias for strategic interactions among urology groups.

We proceed with the remainder of our article 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 nonuniform effects of male and female urologists on groups' profits. In Section 6, we show that the availability of female urologists is correlated with women's health outcomes. We conclude in Section 7 with a summary of our findings.

2. Background and data for urology

■ Urology is a branch of medicine that covers the male and female urinary tracts, as well as the male reproductive system. Patients consult urologists for a host of medical conditions, including nonsurgical issues such as urinary tract infections, kidney and bladder stones, and enlarged prostates, as well as issues requiring surgery such as bladder and prostate cancers, congenital abnormalities, and stress incontinence.[2] 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, whereas women are nearly five times as likely as men to develop interstitial cystitis. At the extreme, several urological conditions affect only men, such as prostate and testicular cancers, and several urological procedures are performed only on men, such as vasectomies. Although 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, 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 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, few women physicians have specialized in urology, as the first board-certified female urologist, Elisabeth Pauline Picket, was not admitted until 1962, and only 39 women

[2] Urology can overlap with the fields of oncology, nephrology, gynecology, pediatric surgery, and endocrinology. Note, however, that for the most prominent procedures covered by a urologist, such as bladder and prostate surgeries, the scope for substitution across other specialists is negligible.

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 (Smart, 2007). 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.

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.[3] Although women are under-represented among physicians in general (27.8%), women are disproportionately under-represented 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, making the demands on a urologist's time more predictable (Kerfoot et al., 2005). Despite this virtue, the proportion of women specializing in urology, at 5.5%, is lower than in general surgery, which stands at 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 based on the gender distribution of general surgery. 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 likely not just a by-product of it 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, with payment for any given treatment 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 10-hour cystectomy with neobladder operations or 30-minute vasectomies.

Profit margins also vary by procedure. Although 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 (Flanigan, 2006). In practice, the majority of urological procedures that can be performed outside of a hospital are demanded exclusively by men and are less time intensive (e.g., prostate procedures and vasectomies). This potentially 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.

Aside from concerns over income, female physicians may also avoid urology for nonmonetary reasons. Factors such as a lack of female mentors and discrimination from patients may prompt women to specialize in other fields, a supply-side response that no doubt contributes to the disparity in urology but lies beyond the scope of our analysis.

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 health care professionals for sales and marketing purposes.

[3] The figures provided by the AMA include researchers and residents not yet practicing (Smart, 2007). From our practice data described below, only 3.6% of patient-facing urologists are women as of 2006.

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, patient-facing urologists in the United States (e.g., the data 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 compiled by the Florida Agency for Health Care Administration. 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 (NCI) "State Cancer Profiles" website, which provides cancer statistics at the county level for 2002–2006. Specifically, we use the reported cancer deaths from all cancers, bladder cancers, and prostate cancers. Data for counties with fewer than three deaths reported during this time period are suppressed by the NCI 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 data from the US 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 use the number of male physicians, female physicians, and uninsured patients 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 attest that gender influences their preferences for a physician (Adams, 2003). In urology, practitioners often affirm this claim, stating in Bradbury, King, and Middleton (1997), for example, that they believe female patients prefer a female urologist, and in Grimsby and Wolter (2013) that male patients routinely refuse to see female urologists. 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, whereas the ratio of female to male patients for a female urologist was 3.3.

Consistent with these claims, we find in the Florida hospital inpatient data set that male and female urologists have markedly different patient mixes. Between January 2006 and June 2008, 60,647 patients admitted to hospitals in Florida required care from a urologist.[4] Of these patients, 42,933 were men (70.8%) and 17,714 were women (29.2%). At hospitals where at least one female urologist had admitting privileges, male urologists treated 74.4% male patients and 25.6% female patients.[5] In contrast, female urologists treated 40.1% male patients and 59.9%

[4] Note that these data do not include outpatient procedures or office visits, both of which represent a substantial proportion of a typical urologist's caseload; however, the patient mixes in the Florida inpatient sample closely resemble those documented by Nickel et al. (2005), who included office visits.

[5] In the cases where a 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%.

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, whereas 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. We find that women in the Florida inpatient sample do travel farther to visit a female urologist. For patients making a stay at hospitals with at least one 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.[6] 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 correlated with their genders.[7] Furthermore, some female patients incur significantly greater costs to consult a female urologist. Although these patterns could reflect that (i) female urologists are more likely to specialize in treating female urological conditions, and (ii) female patients are more likely to consult such a specialist, this correlation will nevertheless motivate our analysis of the relationship between market structure and access to female urologists in the following sections, as gender remains a key determining factor for patients' choice of a urologist in either event.

4. Urologists' market entry decisions

■ 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 naturally result in a large disparity between the average incomes of male and female urologists given that female urologists' patient mixes are skewed toward women. In practice, female urologists do earn less, on average, than their male colleagues. According to a survey by the Medical Group Management Association (MGMA), 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, though female urologists earn more than the average female physician (MGMA, 2007).[8] 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 (Grimsby and Wolter, 2013). 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).[9] We use hospital referral regions as our preferred market definition because

[6] We define distance as the number of miles between the zip code centroid of the urologist's office and the zip code centroid of the patient's home address. We exclude patients with zip codes outside of Florida and those traveling more than 200 miles. In total, we drop 2,244 of 60,647 observations (3.7%).

[7] All of the qualitative results referenced in this section are robust to multivariate econometric analyses, which are omitted due to space constraints but available from the authors upon request.

[8] Note that these are simple summary statistics and do not control for experience, market size, and so forth.

[9] DAP designates hospital referral regions (HRR) by determining where patients are referred for major cardiovascular surgical procedures and for neurosurgery. The size of an HRR varies, with some smaller than a county, and others almost as large as an entire state.

TABLE 1 The Distribution of all Urologists Across Hospital Referral Regions (Top), and the Distribution of Female Urologists Across Hospital Referral Regions (Bottom) in 2006 from the American Medical Information Physician Data

Urologists	Frequency	Percent	Cumulative
1–10	93	30.39	30.39
11–20	89	29.08	59.48
21–40	59	19.28	78.76
41–100	54	17.65	96.42
100+	11	3.59	100.00
Total	306	100.00	
Female Urologists	Frequency	Percent	Cumulative
0	153	50.00	50.00
1	78	25.49	75.49
2	27	8.82	84.31
3	20	6.54	90.85
4+	28	9.15	100.00
Total	306	100.00	

TABLE 2 Summary Statistics for Hospital Referral Regions in 2006 from the Data Sources Described in Section 2

Variable	Mean	Standard Deviation	Minimum	Maximum
Total urologists	28.422	32.615	1	232
Male urologists	27.271	31.245	1	221
Female urologists	1.15	1.826	0	12
% Urologists female	3.592	5.003	0	30
% Physicians female	25.902	5.776	8.793	39.975
Population ('000)	1671.387	2040.018	150.293	17553.872
Median age	36.874	2.812	25.675	45.348
Physicians per 100K	219.652	83.736	84.84	507.26
Per-capita income ('000)	31.4	7.1	5.951	67.269
% Uninsured	16.806	4.632	8.843	33.39
Urology groups	3.987	4.195	0	31
Urology groups w/Female	0.487	0.846	0	5
N		306		

we consider them well suited for an analysis of urology markets, and because they have been used in previous studies in economics (Chandra et al., 2013).

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 1. The modal market at the HRR-level (hospital referral regions) has no practicing female urologist, whereas 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 2. A simple model of market entry allows us to make inferences about the economic primitives underlying these stylized facts.

As described by Bresnahan and Reiss (1991), the observed number of urologists in a market reflects unobserved economic primitives such as demand, profit margins, and competitive interactions; 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 3. We find that the

TABLE 3 Market Entry Estimates for Female and Male Urologists at the Hospital Referral Region-Level in 2006. The Dependent Variable is the Number of Female or Male Urologists Active in the Market

	Female Urologists	Male Urologists
Log population	0.668***	1.551***
	(0.103)	(0.11)
Median age	0.058*	0.099***
	(0.030)	(0.024)
Physicians per 100K	0.000	0.002*
	(0.001)	(0.001)
% Uninsured	0.017	−0.005
	(0.017)	(0.015)
Per-capita income ('000)	−0.013	−0.026**
	(0.013)	(0.012)
% Physicians female	0.041*	−0.022
	(0.025)	(0.02)
Threshold 1	12.347***	20.051***
	(1.918)	(1.797)
Threshold 2	13.222***	20.494***
	(1.93)	(1.777)
Threshold 3	13.657***	21.319***
	(1.939)	(1.773)
Threshold 4	14.093***	21.768***
	(1.949)	(1.779)
⋮	NM	⋮
Observations	306	306
Pseudo R^2	0.137	0.153

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

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 could reflect unobserved market-level heterogeneity in the attractiveness of an HRR for women physicians that might influence a female urologist's decision to practice in a market, such as patients' general preferences for women doctors.

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 4. 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 of less than one for the third urologist in a market. This finding is similar to the estimates of Brasure et al. (1999) who report 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 4. 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 all greater than one.

TABLE 4 Entry Threshold Ratios for Male Urologists (Top) and Female Urologists (Bottom) at the Hospital Referral Region-Level in 2006 Derived from the Parameters in Table 3

Threshold	Market Size	Market Size Per	Ratio	Ratio Standard Error
1 → 2	73,499	36,749	NM	NM
2 → 3	97,765	32,588	0.887	0.182
3 → 4	166,415	41,603	1.277	0.191
4 → 5	222,252	44,450	1.068	0.085
5 → 6	258,018	43,003	0.967	0.049
6 → 7	318,822	45,546	1.059	0.058
7 → 8	388,280	48,535	1.066	0.052
8 → 9	438,588	48,732	1.004	0.038
9 → 10	495,370	49,537	1.017	0.038
⋮	⋮	⋮	⋮	⋮
15 → 16	935,597	58,475	1.044	0.033
⋮	⋮	⋮	⋮	⋮
Threshold	**Market Size**	**Market Size Per**	**Ratio**	**Ratio Standard Error**
0 → 1	994,153	994,153	NM	NM
1 → 2	3,681,505	1,840,752	1.852	0.421
2 → 3	7,066,899	2,355,633	1.279	0.185
3 → 4+	13,560,296	3,390,074	1.439	0.228

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.[10] Because women constitute all obstetrics and gynecology patients, we might expect the pattern of entry for female obstetricians and gynecologists to more closely resemble that of male urologists than female urologists.[11] In keeping with this intuition, 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 3.7 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 and Reiss (1991), 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 reducing prices, firms must attract more customers to break even. In light of the entry thresholds of approximately one for male urologists, however, price competition is unlikely to explain why the thresholds for female urologists are greater than one, as rates are negotiated at the group level and do not vary by the doctor's gender. Instead, the nonuniform 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 business stealing across groups also represent a potential explanation, and reflect the institutional details of urology well. We consider these explanations in the next section.

[10] Full results have been omitted due to space constraints, but are available from the authors upon request.

[11] Also consistent with our arguments throughout this article, obstetrics and gynecology has relatively more female physicians (≈43.7%) than all other specialities except pediatrics (≈ 53.9%).

TABLE 5 Observed Market Configurations in Hospital Referral Regions Used for Structural Group Model in Section 5

	Number of Groups w/Female				
Number Groups	0	1	2	3+	Total
0	12	0	0	0	12
	100.0%	*0.0%*	*0.0%*	*0.0%*	*3.9%*
1	40	3	0	0	43
	93.0%	*7.0%*	*0.0%*	*0.0%*	*14.1%*
2	39	17	1	0	57
	68.4%	*29.8%*	*1.8%*	*0.0%*	*18.6%*
3	30	8	4	0	42
	71.4%	*19.1%*	*9.5%*	*0.0%*	*13.7%*
4	21	7	2	0	30
	70.0%	*23.3%*	*6.7%*	*0.0%*	*9.8%*
5	8	12	2	0	22
	36.4%	*54.6%*	*9.1%*	*0.0%*	*7.2%*
6	6	9	4	0	19
	31.6%	*47.4%*	*21.1%*	*0.0%*	*6.2%*
7+	15	22	18	26	81
	18.5%	*27.2%*	*22.2%*	*32.1%*	*26.5%*
Total	171	78	31	26	306
	55.9%	*25.5%*	*10.1%*	*8.5%*	*100.0%*

5. Urology group competition

■ The relative supply of female urologists in a market will depend on the preferences of patients and the employment decisions of urology groups. As groups compete against one another for patients and leverage intragroup referrals, these forces will affect the entry thresholds for male and female urologists in a nonuniform way. In this section, we incorporate such institutional details into a model of competition among urology group practices to uncover the economic mechanisms underlying the gender disparity among urologists.

As in other specialities, 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 intragroup referrals that conform with the Stark Laws prohibiting financially motivated referrals across groups. Within a group, it is common for the partners to share profits and for nonpartner physicians to earn a fixed salary (Encinosa III, Gaynor, and Rebitzer, 2007).

Urology groups compete with one another to attract patients, which takes the form of 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. As argued above, groups may also differentiate themselves by employing a female urologist, as some patients prefer this type of group to an all-male competitor.

Groups may be more likely to differentiate themselves as competition intensifies. We find reduced-form evidence consistent with this claim, as monopoly markets have exclusively all-male groups in 93.0% of cases, whereas only 18.5% of markets with more than six groups do, as shown in Table 5. In addition, the average group employs 3.4 urologists and approximately 14% of groups employ a female urologist, as shown in Table 6.

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

TABLE 6 **Group-Level Summary Statistics Across Hospital Referral Regions Used for Structural Group Model in Section 5**

Variable	Mean	Standard Deviation	Minimum	Maximum
Group size	3.444	4.486	0	87
Males in group	3.246	4.196	0	78
Females in group	0.198	0.585	0	9
Group has female	0.144	0.351	0	1
Market share	0.109	0.153	0	1
N			1642	

TABLE 7 **Observed Urology Group Structures Across Hospital Referral Regions Used for Structural Group Model in Section 5**

	Females in Group				
Group Size	0	1	2	3+	Total
Exit	287	0	0	0	287
	100.0%	*0.0%*	*0.0%*	*0.0%*	*17.5%*
2	497	45	2	0	544
	91.4%	*8.3%*	*0.4%*	*0.0%*	*33.1%*
3	255	31	5	0	291
	87.6%	*10.7%*	*1.7%*	*0.0%*	*17.7%*
4	148	27	4	0	179
	82.7%	*15.1%*	*2.2%*	*0.0%*	*10.9%*
5	78	20	5	0	103
	75.7%	*19.4%*	*4.9%*	*0.0%*	*6.3%*
6	42	16	10	0	68
	61.8%	*23.5%*	*14.7%*	*0.0%*	*4.1%*
7+	99	32	31	8	170
	58.2%	*18.8%*	*18.2%*	*4.7%*	*10.4%*
Total	1406	171	57	8	1642
	85.6%	*10.4%*	*3.5%*	*0.5%*	*100.0%*

patients for more lucrative male patients.[12] 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, whereas 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 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 to support themselves. This effect becomes more pronounced in larger groups, as they have more opportunities to reallocate patients among group members. Table 7 provides reduced-form evidence supporting this claim: 8.6% of two-person groups employ at least one female urologist, whereas 41.8% of groups with seven or more urologists employ at least one.[13] Because this relationship may be affected by other market characteristics, our model of groups' simultaneous decisions to employ a given number of male and female urologists allows for complementarities between

[12] A group may be "obligated" to treat female patients to remain in good standing with insurance providers or referring primary-care physicians.

[13] The percentage of a group's members who are women also increases with group size.

male and female urologists, which then allows us to establish the statistical significance of this correlation.

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 in the event that male patients refuse to see her, as discussed in Section 2. 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, the model also incorporates the potential for business-stealing among the groups that employ female urologists.

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 from male urologists 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 also employ one because competition among groups would render all female urologists in the market less profitable; (iii) groups will be more likely to employ a female urologist if they also employ several male urologists because larger groups have more opportunities to match patients profitably across physicians through intra–group referrals; and (iv) groups will be less likely to employ a female urologist as market power increases because patients' inelastic demand for urologists renders differentiation less profitable.

□ **Model.** We now present and estimate a model of imperfect competition to uncover the mechanisms underlying 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 also influence its rivals, and we capture this effect through a discrete game of imperfect information. The model we propose below is conceptually similar to the ones developed by Seim (2006) and Augereau, Greenstein, and Rysman (2006). We extend their models by allowing groups to make multinomial decisions regarding the number of male urologists they employ.

□ **Setup.** Assume a group practice, j, operates in one, and only one, market, l.[14] 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

$$\pi_{jl}(M, F) = \zeta_j(X_{jl}, \overrightarrow{N}_{jl}, M_j, F_j) = \zeta(X_{jl}, \overrightarrow{N}_{jl}, M_j, F_j, \varepsilon_{jlM}, \varepsilon_{jlF}), \tag{1}$$

where X_{jl} represents observable market and group characteristics that affect profits;[15] 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;[16] and $\overrightarrow{N}_{jl}$ 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, ε_{jlM} and ε_{jlF}, which we model 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

[14] In the data, no urology group operates offices in more than one HRR.

[15] 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.

[16] It is straightforward to allow F_j to be a categorical variable instead of binary. The lack of groups employing multiple female urologists in the data prompted this modelling decision.

to employ a female urologist that is not observed by other groups or the econometrician. Each group, 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 hiring urologists. 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 urologists and female urologists in a group. We capture complementarities among male and female group members by estimating an interaction term, γ, which leads to the following payoff structure:[17]

$$\pi_{jl}(M, F) = X_{jl}\beta_M + g_M(\overrightarrow{N}_{jl};\theta) + \varepsilon_{jlM} + X_{jl}\beta_F + g_F(\overrightarrow{N}_{jl};\theta) + \varepsilon_{jlF} + \gamma MF, \tag{2}$$

with $(\varepsilon_{jlM}, \varepsilon_{jlF}) \sim BVN(0, 0, 1, 1, 0)$, where $BVN(\cdot)$ is the bivariate normal distribution.

We model a group's employment of male and female urologists as being affected by its competitors' choices through a linear specification of $g(\cdot)$,

$$g_t(\overrightarrow{N};\theta) = \theta_t^W N_W + \theta_t^M N_M,\ t = \{M, F\}, \tag{3}$$

where N_W is the number of competitors in the market that employ a female urologist and N_M is the number of competing male urologists in the market. This specification implies that competitive effects are linear and that the marginal impact of another group is constant.

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

$$\begin{aligned} E[\pi_{jl}] = {} & X_{jl}\beta_M + \theta_M^W E[N_W] + \theta_M^M E[N_M] + \varepsilon_{jlM} \\ & + X_{jl}\beta_F + \theta_F^W E[N_W] + \theta_F^M E[N_M] + \varepsilon_{jlF} + \gamma MF. \end{aligned} \tag{4}$$

We allow a group to choose one of $\overline{M}$ 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 resulting from this choice, described as (with a slight abuse of notation)

$$M_j = \begin{cases} 0 & \text{if } X_{jl}\beta_M + \theta_M^W E[N_W] + \theta_M^M E[N_M] + \gamma_M F_{jl} + \varepsilon_{jlM} \le c_1^M \\ 1 & \text{if } c_1^M \le X_{jl}\beta_M + \theta_M^W E[N_W] + \theta_M^M E[N_M] + \gamma_M F_{jl} + \varepsilon_{jlM} \le c_2^M \\ \cdots & \\ m & \text{if } c_m^M \le X_{jl}\beta_M + \theta_M^W E[N_W] + \theta_M^M E[N_M] + \gamma_M F_{jl} + \varepsilon_{jlM} \le c_{m+1}^M \\ \cdots & \\ \overline{M} & \text{if } c_{\overline{M}}^M \le X_{jl}\beta_M + \theta_M^W E[N_W] + \theta_M^M E[N_M] + \gamma_M F_{jl} + \varepsilon_{jlM}. \end{cases} \tag{5}$$

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

$$X_{jl}\beta_F + \theta_F^W E[N_W] + \theta_F^M E[N_M] + \gamma_F M_{jl} + \varepsilon_{jlF} \ge c_1^F. \tag{6}$$

In this context, c_m^M and c_1^F 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;

[17] Though ideally we would allow for a correlation in the error terms in addition to the interaction term, γ, these two parameters are not separately identified without richer data, such as a longer panel of observations or valid instruments (Gentzkow, 2007).

that is, a group will employ an additional male urologist or employ a female urologist in the event that the shocks to its profits, ε_{jlM} and ε_{jlF}, exceed the costs from doing so given its observable characteristics.

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

$$p_j^{m1} \equiv \begin{cases} Pr_j(M = m, F = 1) = \\ Pr(c_m^M \leq X_{jl}\beta_M + \theta_M^W E[N_W] + \theta_M^M E[N_M] + \gamma_M F_{jl} + \varepsilon_{jlM} \leq c_{m+1}^M, \\ \qquad X_{jl}\beta_F + \theta_F^W E[N_W] + \theta_F^M E[N_M] + \gamma_F M_{jl} + \varepsilon_{jlF} \geq c_1^F), \end{cases} \tag{7}$$

and the probability that a group chooses to employ m male urologists and not to employ a female urologist is defined similarly and denoted p_j^{m0}.

In a Bayesian Nash equilibrium, $p_j^{MF} = p_k^{MF} = p^{MF}$ for all k because we have assumed independent symmetric types (given group observables). It follows that

$$\theta_t^W E[N_W] = \theta_t^W N \sum_{M=0}^{\overline{M}} p^{M1},\ t = \{M, F\} \tag{8}$$

and

$$\theta_t^M E[N_M] = \theta_t^M N \sum_{M=0}^{\overline{M}} (p^{M0} + p^{M1}) * M,\ t = \{M, F\}. \tag{9}$$

From (8) and (9), 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 $2 \times \overline{M}$ equations. We then maximize the log-likelihood function

$$lnL = \sum_{l=1}^{L} \sum_{j=1}^{J} \sum_{M=0}^{\overline{M}} \sum_{F=0}^{1} I(M = m, F = f) ln Pr(M = m, F = f), \tag{10}$$

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. We allow a group to choose one of six categories for the number of male urologists it employs, $m \in \mathbf{M}$, with $\mathbf{M} = \{2, 3, 4, 5, 6, 7+\}$, or to exit the market.[18] 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 calibration of the structural model.

For estimation, we use a bivariate ordered probit model that controls for groups' endogenous decisions to employ female urologists. This is a novel estimation approach building on Seim (2006) and Augereau, Greenstein, and Rysman (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. (2006) or univariate model of Seim (2006).

□ **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

[18] Our results are robust to alternative size classifications.

and simultaneous game, with the interpretation that it represents a single period of a longer dynamic game.[19]

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 and Reiss, 2006). In our setting, a group's realization of ε_{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. As noted by Seim (2006), 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.

The presence of multiple equilibria in our game represents another potential concern because it would invalidate using maximum likelihood for estimation unless we arbitrarily select an equilibrium. Many equilibria could obtain in our model if, for instance, $\theta_F^W > 0$, which could result in an equilibrium outcome in which many groups employ 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 $\theta_F^W < 0$, 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 θ, we assume that a group's decision in 2006 is exogenous. This assumption would be invalid if, for instance, ε_{jlF} were correlated within markets and persistent. In this case, however, our estimates would be biased upward because we would observe either many groups employing female urologists, or very few, implying that $\theta_F^W > 0$. 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 *a priori* conjecture is that the effects will be negative.

□ **Results.** We present the results from our model in Table 8 and find that competitive interactions have a significant impact on groups' hiring decisions. Most notably, groups are less likely to employ a female urologist when they expect competing groups will also employ one, as indicated by the negative coefficient on the expected per-capita number of competing groups employing a female urologist in a market. To interpret the magnitude of this effect, a one standard deviation increase above the mean makes a group with four male urologists 53.6% less likely to employ a female urologist, with the estimated probability decreasing from 4.0% to 2.7%.[20] Counteracting this effect, groups become more likely to employ a female urologist as competition from male urologists intensifies: a group expecting to face per-capita male urologists one standard deviation above the mean is 24.8% more likely to employ a female urologist compared to those at the mean, as the estimated probability increases from 4.1% to 5.1%.

Furthermore, we find a positive and statistically significant correlation between a group's size and its decision to employ a female urologist. 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 7.1-times increase in the likelihood that a group will employ a female urologist, all else equal, which compares to a 2.6-times increase based on a random allocation of female urologists for these

[19] 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.

[20] The statistics reported in this section are based on calculations from the marginal effects implied by the estimated parameters of the model.

TABLE 8 Estimation Results for Structural Group-Choice Model Described in Section 5. Threshold Cutoffs and Fixed Effects for Group Choices in 2006 Estimated but not Reported

	(1) Female in Group	(2) Males in Group
Expected female urologists	−4.514**	1.542*
	(1.939)	(0.918)
Expected male urologists	0.113*	−0.180***
	(0.066)	(0.043)
Herfindahl Index	0.402	−0.364
	(0.835)	(0.449)
Market share	2.707**	−0.083
	(1.139)	(0.540)
Herfindahl Index * market share	−8.325**	0.489
	(3.259)	(0.830)
Population	−0.001	0.001
	(0.002)	(0.001)
Physicians per 100K	0.000	0.000
	(0.001)	(0.001)
% Uninsured	1.793	−0.173
	(1.189)	(0.608)
Per capita income	0.003	−0.005
	(0.008)	(0.005)
Median age	−0.009	0.027**
	(0.026)	(0.013)
% Female physicians	4.413**	−0.976
	(1.826)	(1.012)
Complementarity (γ)	0.250***	0.764***
	(0.031)	(0.091)
Observations	1642	1642
LL	−461.696	−2440.203
Moments	Mean	Standard Deviation
Expected number of groups with female	1.704	1.544
Actual number of groups with female	1.627	1.666
Expected number of groups with 2 males	4.047	3.382
Actual number of groups with 2 males	4.038	3.820
Expected number of groups with 3 males	2.048	1.708
Actual number of groups with 3 males	1.895	1.748
Expected number of groups with 4 males	1.347	1.134
Actual number of groups with 4 males	1.333	1.592
Expected number of groups with 5 males	0.765	0.656
Actual number of groups with 5 males	0.636	0.965
Expected number of groups with 6 males	0.408	0.359
Actual number of groups with 6 males	0.314	0.544
Expected number of groups with 7+ males	0.978	0.976
Actual number of groups with 7+ males	0.753	1.059
Expected number of group exits	1.715	1.551
Actual number of group exits	2.070	2.123

Standard errors clustered by hospital referral regions in parentheses.
*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

same group sizes. We interpret this as evidence of complementarity between male and female urologists within a group.

We also consider the relationship between a group's market power and its decision to 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 larger market shares are more likely to employ a woman–unless they participate in a concentrated market. This result is consistent with groups differentiating themselves to gain market share. When groups wield market power, however, they face less incentive to differentiate due to patients' comparatively inelastic demand for urologists.

We also find that unobserved factors which influence the supply and demand of female physicians in the market, as proxied for 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).

Groups' expectations about competitors also influence their hiring decisions for male urologists, but in the converse manner to their decisions to hire female urologists. That is, groups that face more competition from female urologists in a market respond by hiring more male urologists, and those that face more competition from male urologists respond by hiring fewer themselves. In this sense, the cross- and within-type competitive effects are consistent with the findings from previous work on strategic differentiation, notably those from Mazzeo (2002) for low- and high-quality motels.

Finally, the estimated means and standard deviations for each group type across markets match the observed moments in the data well, as reported at the bottom of Table 8. This provides reassurance that the model is reasonably specified.

From our estimated model of group competition, we find evidence consistent with the hypothesized mechanisms discussed throughout this article. 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.

□ **Implications for entry thresholds.** The estimated parameters from our model allow us to consider how market structure contributes to the gender disparity among urologists. Specifically, we can simulate counterfactual outcomes where (i) competition does not affect a group's decision to employ a female urologist, and (ii) 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 or (ii) there is no complementarity between male and female urologists within a group. We then resolve the model 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., $\theta_F^W = 0$ above). Without this effect, the number of markets without a female urologist would decline by 31.4%, falling to 105 from 153. Reflecting this, Specification (1) in Table 9 shows that the estimated entry threshold for the first female urologist in a market would be 497,076, which is markedly less than the threshold of 994,153 estimated using the observed market configurations in Section 4. In addition, the simulated threshold ratio for the second female urologist in this counterfactual exercise falls to 1.22 and becomes statistically indistinguishable from one (i.e., $p > 0.10$), which compares to the observed threshold of 1.85 in Section 4. In this sense, the anticipated responses of competitors explain approximately 74.1% 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.

TABLE 9 Estimated Market Configurations (Top) and Entry Threshold Ratios (Middle and Bottom) for Female Urologists from a Counterfactual Simulation Using the Parameters from the Group-Choice Model Absent Business-Stealing Effects (Left and Middle) and Absent Complementarity Effects (Right and Bottom), as Described in Section 5

	No Business Stealing			No Complementarity		
Female Urologists	Frequency	Percent	Cumulative	Frequency	Percent	Cumulative
0	105	34.31	34.31	188	61.44	61.44
1	61	19.93	54.25	57	18.63	80.07
2	44	14.38	68.63	27	8.82	88.89
3	27	8.82	77.45	19	6.21	95.10
4+	69	22.55	100.00	15	4.90	100.00
Total	306	100.00		306	100.00	

No Business Stealing

Threshold	Market Size	Market Size Per	Ratio	Ratio Standard Error
$0 \rightarrow 1$	497,076	497,076	NM	NM
$1 \rightarrow 2$	1,211,992	605,996	1.22	0.164
$2 \rightarrow 3$	2,317,578	772,526	1.27	0.141
$3 \rightarrow 4+$	3,822,882	955,720	1.24	0.125

No Complementarity

Threshold	Market Size	Market Size Per	Ratio	Ratio Standard Error
$0 \rightarrow 1$	1,755,389	1,755,389	NM	NM
$1 \rightarrow 2$	5,802,030	2,901,015	1.65	0.362
$2 \rightarrow 3$	13,670,814	4,556,938	1.57	0.295
$3 \rightarrow 4+$	33,022,992	8,255,748	1.81	0.406

In our second counterfactual, we assume that male and female urologists do not complement one another within a group. We find that the number of markets without a female urologist would increase by 22.9% absent this effect, increasing from 153 to 188. Although the threshold ratios in this counterfactual essentially mirror those found empirically, as shown in Specification (2) in Table 9, the threshold levels increase considerably. In this scenario, the first female urologist would need a population of approximately 1,755,389 to enter, with subsequent female urologists also requiring comparatively larger increases in market size.

From these counterfactuals, we have considered two prominent mechanisms responsible for the nonuniform entry thresholds and ratios for female urologists. The effects of complementarity serve to increase the number of female urologists in a market and push down entry thresholds, whereas 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 neither structural parameter fully explains the disparity. As such, other forces beyond the model, such as the incremental supply of female urologists, governed by women’s preferences to specialize in different fields of medicine, also influence this market.

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 from urological cancers. We now consider the related question of whether 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 may delay seeking medical care or forgo consulting a urologist when that alternative is not available to them. For women afflicted with bladder cancer, this could have particularly dire consequences, as the

TABLE 10 Summary Statistics for Counties Appearing in the National Cancer Institute Data as of 2006, with Data Sources Described in Section 2

Variable	Mean	Standard Deviation	Minimum	Maximum
Urologists per 100K	3.508	1.513	0.737	9.266
Male urologists per 100K	3.355	1.47	0.59	9.266
Female urologists per 100K	0.153	0.215	0	1.455
Female urologist in county	0.511	0.501	0	1
Female bladder cancer death rate	2.421	0.623	1	4.9
Male urological cancer death rate	31.542	4.497	16.5	46.7
Female cancer death rate	189.157	52.205	83.986	674.724
Male cancer death rate	176.602	53.303	84.511	557.897
Population ('000)	663.793	824.214	98.473	9737.955
Physicians per 100K	102.466	59.315	29.042	457.499
Median age of population	37.232	3.444	27.2	52.9
Per-capita income ('000)	40.228	10.976	17.737	112.102
% Uninsured	16.028	5.079	7.7	32.9
% Female physicians	28.211	5.67	13.961	43.109
N		276		

stage at which a cancer is first detected and treated influences the ultimate efficacy of the treatment (Cárdenas-Turanzas et al., 2006). Reflecting this possibility, bladder cancer—the most prominent cancer among women treated by urologists and the ninth most common among all female cancers in the United States—has the widest disparity between female and male survival rates (Cook et al., 2011). Although health-policy researchers have studied this phenomenon at length, the source of the disparity remains largely unresolved (Madeb and Messing, 2004; Shariat et al., 2009). As bladder surgery is performed almost exclusively by urologists and bladder procedures are gender neutral by their nature, omitted variables related to the presence of other specialists, including those specializing in female urology, are unlikely to account for the full disparity; that is, even though female urologists may have more experience treating certain female urological conditions, such as pelvic floor dysfunction, any skills resulting from such experience would be unlikely to affect outcomes related to *female* bladder cancer specifically. In this case, the presence of a female urologist in a market may, by itself, provide a novel explanation not yet explored in the literature.

Simple statistics suggest that women do, in fact, fare comparatively worse in markets without a female urologist. From the NCI data described in Section 2, the incidence of female bladder cancer deaths per 100,000 residents is 13% higher in counties that do not have a practicing female urologist, even though the density of male urologists is not statistically different. Of course, many confounding factors also contribute to the disparity in bladder 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 OLS regressions related to urological cancer deaths. In these regressions, the unit of observation is a county, and our sample includes the 276 counties that reported death rates for both primary urological cancers (i.e., bladder and prostate) between 2002–2006. Note in Table 10 that these counties are skewed toward the largest counties in the United States because data are suppressed for those with fewer than three reported deaths each year, as discussed in Section 2. The average population in this sample is approximately 660,000, which is considerably larger than the average population of 94,000 for all counties in the United States, limiting the policy implications of the following results to the most densely populated areas of the country. We present the results of our estimations in Table 11.

In Column (1), the dependent variable is the number of female bladder cancer deaths per 100,000 residents in a county, and our main parameter of interest is a binary variable for whether a female urologist practices in a market. The estimated coefficient of this variable is economically

TABLE 11 OLS Regressions that Take the County-Level Urological Cancer-Death Rate as the Dependent Variable. Cancer-Death Rate in Columns (5) and (6) Excludes Female Bladder Cancer

	Urological Cancer Death Rate				Cancer Death Rate	
	(1) Female	(2) Female	(3) Male	(4) Male	(5) Female	(6) Female
Female urologist in county	−0.184**		−0.089		0.959	
	(0.073)		(0.541)		(1.929)	
Urologists Per 100K	0.014		0.097		0.137	
	(0.029)		(0.211)		(0.753)	
Female urologists Per 100K		−0.704**		−0.848		−1.376
		(0.329)		(2.389)		(8.610)
Female urologists Per 100K^2		0.498		3.996		−0.913
		(0.373)		(2.681)		(9.700)
Male urologists Per 100K		0.062		−0.387		1.804
		(0.086)		(0.619)		(2.229)
Male urologists Per 100K^2		−0.005		0.047		−0.181
		(0.009)		(0.067)		(0.243)
Population	−0.000	−0.000	−0.000	0.000	0.003**	0.003**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
Physicians per 100K	−0.000	−0.000	−0.002	−0.002	0.024	0.025
	(0.001)	(0.001)	(0.007)	(0.007)	(0.024)	(0.024)
Median age of population	0.013	0.013	−0.510***	−0.531***	−1.514***	−1.550***
	(0.017)	(0.018)	(0.123)	(0.124)	(0.442)	(0.454)
Per-capita income	−0.006	−0.006	−0.008	0.003	0.428***	0.429***
	(0.005)	(0.005)	(0.035)	(0.035)	(0.122)	(0.124)
% Uninsured	−0.026***	−0.027***	−0.186***	−0.189***	−1.545***	−1.534***
	(0.008)	(0.008)	(0.061)	(0.061)	(0.200)	(0.203)
% Female physicians	−0.015*	−0.014	0.042	0.026	0.435*	0.445*
	(0.009)	(0.009)	(0.066)	(0.066)	(0.234)	(0.236)
Male urological cancer death rate	0.038***	0.039***			0.077	0.095
	(0.008)	(0.008)			(0.219)	(0.223)
Female urological cancer death rate			2.020***	2.034***	1.001	0.785
			(0.431)	(0.427)	(1.597)	(1.602)
Female cancer death rate	0.001	0.001	0.006	0.007		
	(0.002)	(0.002)	(0.017)	(0.017)		
Male cancer death rate	−0.001	−0.001	0.014	0.014	1.040***	1.038***
	(0.003)	(0.003)	(0.020)	(0.019)	(0.029)	(0.029)
Constant	1.772**	1.671**	44.144***	45.383***	47.155**	45.846**
	(0.711)	(0.731)	(4.478)	(4.518)	(18.451)	(18.947)
Observations	276	276	276	276	276	276
R^2	0.260	0.259	0.246	0.263	0.929	0.929

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

and statistically significant ($p < 0.05$), as having at least one female urologist practicing in a market is associated with a 7.3% lower mortality rate for women. Note that we also include controls for the county's overall cancer mortality rate and the rate for male urological cancers, which serve as proxies for the factors that influence death rates from female bladder cancer aside from access to a female urologist (e.g., the quality of hospital care, the number of oncologists, and the general health status of women in the county).

In Column (2), our main parameter of interest is the density of female urologists in a market, and the interpretation is similar to Column (1): counties with comparatively more female urologists per capita have lower mortality rates from female bladder cancer. The estimated coefficient is again both statistically significant ($p < 0.05$) and economically meaningful, as a one-standard-deviation increase from the mean density of female urologists is associated with a 4.0% lower mortality rate for female urological cancers. The positive 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 the first 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 as access to female urologists is.

In Columns (3) and (4), we consider the same regressions as above but for male urological cancer deaths. For these regressions, the qualitative interpretations are largely the same as before, save for the number of male urologists per 100,000 residents in Specification (4). Here, having more male urologists per capita is associated with a lower male urological cancer death rate, but is not statistically significant at conventional levels. Unlike Columns (1) and (2), the estimated coefficient for the median age of a county's residents is negative and statistically significant. This result can be explained partially by the fact that death rates of aggressive prostate cancers are skewed toward younger men for whom treatment options can be comparatively limited.[21]

As a falsification test, Columns (5) and (6) consider similar regressions as above, but with total female cancer deaths (excluding bladder cancer) as the dependent variable. In these regressions, the presence of female urologists should have no meaningful association with the overall cancer death rate, and in both specifications the effects are statistically indistinguishable from zero and economically negligible. Moreover, counties with a larger proportion of female physicians do not have a lower death rate from female cancers overall, suggesting that the mechanisms governing female urological cancer deaths do not affect other, potentially less sensitive cancers.

From these regressions, we have found a statistically and economically meaningful relationship between women's access to female urologists and their mortality rates from urological cancers. Although 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 correlated with having access to their most-preferred type of urologist. In this sense, the gender disparity among urologists may have important consequences for the quality of care received by women and pertains to the well-documented, yet largely unexplained, gap in survival rates for bladder cancers across men and women.

7. Conclusion

■ In this article, we have examined how patients' heterogeneous preferences for urologists and competition among urology groups contribute to the gender disparity in urology. Although women exhibit a clear preference for female urologists, the strength of men's preferences for male urologists may impede 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.

We have analyzed the economic mechanisms responsible for this result. Namely, we have shown that the internal organization of group practices and the industrial organization of urology markets have important implications for patients' access to female urologists. Although 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 suboptimal 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. Given the delicate nature of the conditions treated by a urologist, it is perhaps not very surprising

[21] The coefficient for median age has a positive but insignificant sign in regressions equivalent to Columns (3) and (4) restricted to male bladder cancer deaths.

that some women find receiving treatment from a man uncomfortable. Although women might substitute toward other health care providers, such as gynecologists or primary-care doctors, the level of care they will receive for urological issues is generally not equivalent—and in some cases, such as bladder cancer, not possible. The negative correlation we have documented between female urological cancer deaths and the number of female urologists in a market exemplifies this.

In principle, the parameters from our model could be used by policy makers to estimate the costs of reducing urological cancer deaths. Specifically, the threshold c_1^F provides a benchmark for how close a group was to hiring a female urologist, all else equal. Receiving a subsidy large enough to exceed this threshold would make employing a female urologist financially viable for a group, and doing so would reduce female urological cancer deaths by 0.183 per 100,000 residents in those markets not currently served by one. In our calculations, the cost of the subsidies required to bring a female urologist to each HRR across the country is small compared to the number of women's lives that would be saved.

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

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