"A" Business by Any Other Name: Firm Name Choice as a Signal of Firm Quality

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This paper considers when a firm's deliberately chosen name can signal meaningful information. The average plumbing firm whose name begins with A or a number receives five times more service complaints than other firms and also charges higher prices. Relatedly, plumbers with A names advertise more in the Yellow Pages and on Google, and doing so is positively correlated with receiving complaints. As the use of A names is more prevalent in larger markets, I reconcile these findings with a simple model in which firms have different qualities and consumers have heterogeneous search costs.

I. Introduction

Firms choose names deliberately. Often, their choices aim to influence consumers. A firm might claim to provide high-quality service by including the word "quality" or "best" in its name or to charge low prices by calling itself a "discount" provider. When consumers cannot verify the claims implied by a firm's name, however, they might dismiss them as cheap talk. This paper examines when a firm's name can signal meaningful information about itself.

Consider, for example, the market for residential plumbing services. A typical customer hires a plumber infrequently and does so using little

information aside from the business's name. In response, many plumbing firms choose their names strategically to attract business. For example, 21 percent of plumbing firms in the city of Chicago, such as A-AAAA Sewer & Drains and AAAA Scott's Plumbing, use names that begin with an A or a number. As these names appear near the front of the plumbing category in the Yellow Pages, they may be more likely to attract the attention of customers who start their search at the first listing. Because firms freely choose their names, however, the benefits of using a name that begins with an A or a number must come with a trade-off; if they did not, all firms would prefer to use such a name.

One key trade-off is the type of customer a name attracts. An infrequent customer with an unimportant project, such as a homeowner with a broken pipe, will not devote much time to searching for a plumber; almost any will do an adequate job, and calling the first listing in the phone book reduces the time spent finding one. By contrast, a customer with an important or extensive job, such as a large home renovation, will dedicate more time to finding a good plumber, perhaps dismissing ones with names like A-AAAA Sewer & Drains. A firm using a name that starts with an A or a number thus faces the opportunity cost of primarily attracting customers with a low willingness to search rather than those with more elaborate jobs.

Firms differ, however, in the relative values they place on these different types of customers. At one extreme, a low-quality plumber will not benefit much from attracting a customer with an extensive project because he will not satisfy him initially and will not be recommissioned. A high-quality plumber, on the other hand, will prefer not to attract infrequent customers with small projects if doing so costs him the opportunity to work on a larger job. As a result of these trade-offs, a firm will deliberately select a name that attracts the best mix of customers given its underlying quality, potentially making names a credible signal.

Sorting on names in this manner prevails among plumbing firms in Illinois: those with names that begin with an A or a number receive more than five times as many complaints with the Better Business Bureau, on average, and more than three times as many complaints per employee. Several robustness checks suggest that the association between names and complaints is not simply a result of differences in business volume or customer composition for A firms. Data from Dun & Bradstreet show that A firms have a ratio of sales to employees similar to that of other firms; data from Angie's List show that A firms receive worse average ratings; and data from Yelp show that A firms receive worse average ratings even after controlling for reviewer fixed effects.

In this sense, a firm's name provides meaningful information to consumers even though a low-quality firm could easily mask its true quality by using a different type of name. Firms that do attempt to conceal their

identities by concurrently using both types of names provide starkly worse service: plumbing firms in Illinois that use both a name that begins with an A or a number and a name that does not receive more than 15 times as many complaints, on average.

A firm's name choice also relates to its pricing decisions. Because the Yellow Pages lists names alphanumerically, ordered search models such as that of Arbatskaya (2007) predict that search costs cause prices to decline with the order in which a firm is viewed by consumers. Again, these predictions hold empirically in metro Chicago, with A firms commanding an 8.4 percent price premium for the same type of work.

As smaller markets with more word of mouth and fewer providers to choose from likely have lower search costs for services like plumbing, variation in market size provides a direct test of the role of consumer search in the results above. Notably, the proportion of firms using A names and the extent of quality dispersion across name types both increase with market size. Because market size relates to asymmetric information for reasons such as reputation, referrals, and repeat business, these findings suggest that it is predominantly the low-quality firms that choose names designed to attract uninformed customers with a low willingness to search.

Related to this result, firms' investments to reduce search costs are also correlated with complaints for characteristics other than names: firms that spend more on Yellow Pages advertising receive appreciably more complaints, which contrasts with the theoretical prediction that advertisements will signal high quality (Milgrom and Roberts 1986). Similarly, plumbers that advertise on Google's search page receive more than 13 times as many Better Business Bureau complaints as other plumbers and nearly one less star on Yelp, a finding that conflicts with recent models of position auctions for search advertising in which the winning firms provide the best match for customers (Athey and Ellison 2011).

By comparison, the model in this paper helps explain the relation between advertising intensity and firm quality. Because advertisements in the Yellow Pages and on Google disproportionately attract uninformed customers with a low willingness to search, a low-quality plumbing firm has a greater incentive to pay for such ads, just as it has a greater incentive to use a name that appears among the top listings in the Yellow Pages. As a result, costly advertising does not signal high quality for plumbers, and the efficiency gains predicted to arise from position auctions have not occurred in this particular market.

These findings contribute to several strands of literature. First, they relate to the economic implications of names. Previous work has considered many topics in this area, such as name trading (Tadelis 1999), reputation (Cabral and Hortacsu 2010; McDevitt 2011; Roberts 2011), labor market outcomes (Bertrand and Mullainathan 2004; Fryer and Levitt 2004; Einav and Yariv 2006), voting behavior (Meredith and Salant 2013), en-

trepreneurship (Belenzon and Chatterji 2013), and stock price returns (Cooper, Dimitrov, and Rau 2001). No prior work (to my knowledge) has considered a model in which the content of a firm's name signals meaningful information and tested its implications empirically.

Second, this paper contributes to the literature on signaling. An extensive body of work has considered the circumstances under which firms can credibly signal information about themselves, such as Salop and Stiglitz (1977), Cooper and Ross (1984), Milgrom and Roberts (1986), and Bagwell and Riordan (1991). More closely related to the objectives of this paper, Shin (2005) develops a model in which advertisements with vague information about a firm's prices can nevertheless provide meaningful information to consumers. When a firm incurs costs to sell a product, either directly or in the form of opportunity costs, attracting the wrong mix of customers by sending deceptive signals about low prices ultimately leads to lower profits. As a result, firms have no incentive to mislead consumers, and an equilibrium can obtain in which firms separate by choosing different advertising strategies given their types. A similar mechanism governs the name choices of firms in this paper.

Finally, this paper contributes to the literature on consumer search. Specifically, Arbatskaya (2007) considers a model of ordered search in which prices decline as a firm's position in the search results increases. Also related, Armstrong, Vickers, and Zhou (2009) examine the effects of prominence in search markets in which one firm is sampled first by all consumers, and the firm with the highest-quality product has the greatest incentive to become prominent. In a similar vein, a growing theoretical literature that includes Athey and Ellison (2011) and Chen and He (2011) has argued that position auctions enhance consumer welfare because high-quality firms submit higher bids for favorable listings on Internet search engines, enabling consumers to search more efficiently. Instead, this paper shows that lower-quality plumbing firms dominate the most prominent positions in both the Yellow Pages and position auctions.[1]

The remainder of this paper proceeds with Section II, which explains the data sources used throughout the empirical analysis. Section III describes the empirical setting and highlights its prominent stylized facts. Section IV develops a stylized model of firm name choice and consumer search, derives a separating equilibrium, and outlines its testable implications. Section V presents the results from reduced-form estimates of the model and verifies that its implications hold. Section VI presents conclusions. Finally, the Appendix describes the supplemental data sets used as robustness checks for the paper's main results, and an online appendix contains additional tables and figures.

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[1] Armstrong and Zhou (2011) also consider a series of models related to search, prominence, and prices and discuss how the relationship between quality and prominence found in this paper might occur.

II. Data Description

The paper's primary data for all plumbing firms operating in Illinois come from a June 2008 download of the Web-based version of ReferenceUSA, which contains information on businesses based on their listings in Yellow and White Pages throughout the United States. ReferenceUSA markets itself as a comprehensive resource for generating sales leads and conducting market research, and its data have been used in previous academic research.[2] The firm-specific information contained in ReferenceUSA includes the firm's name, address, phone and fax numbers, website URL, years in operation, advertising expenditures in the Yellow Pages, and number of employees. Because of access limitations, descriptive statistics for the name choices of businesses in nonplumbing categories come from the 2005 edition of American Business Disc, the offline counterpart of ReferenceUSA.

The primary measure of firm quality used throughout this paper is the number of complaints filed against the firm with the Better Business Bureau. The data for each plumbing firm operating in Illinois come from a June 2008 download of the Better Business Bureau's website, which lists a historical record of complaints filed against a business during the preceding 3 years. As its main function, the Better Business Bureau acts as an intermediary between consumers and firms to resolve disputes through a formal process. First, a staff member reviews each complaint filed with the Better Business Bureau and forwards it to the accused company within 2 business days if deemed legitimate. Next, if the company has not responded within 14 days, the Better Business Bureau makes a second attempt to resolve the issue. Finally, after two unsuccessful attempts at resolution, the complaint becomes a part of the business's record with the Better Business Bureau.

Data from the Better Business Bureau have advantages over other sources of quality information for two primary reasons. First, the Better Business Bureau provides a more comprehensive coverage of plumbing firms operating in Illinois; for instance, only 43 firms appeared in yelp.com's Chicago plumbing category as of March 2009, and its listings are limited almost exclusively to the city of Chicago. By comparison, every business has at least an implicit record with the Better Business Bureau, as one can infer the quality of a firm that has no reported complaints. Second, the Better Business Bureau verifies the legitimacy of each complaint, which makes its records more robust to the potential manipulation of reviews that may affect user-generated sites (Mayzlin, Dover, and Chevalier 2012).

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[2] For instance, Waldfogel (2008) used ReferenceUSA, while Seim (2006) and Ellickson (2007) both used the offline version of ReferenceUSA, American Business Disc, in their empirical work.

As robustness checks for the Better Business Bureau data, reviews of plumbers obtained from yelp.com, Angie's List, and Consumer's Checkbook are also considered. On yelp.com, an online platform in which users submit and read reviews of businesses, reviewers rate a business's quality from one to five stars, with five representing better service. These ratings then appear on the business's Yelp page, where users can view both aggregate statistics and individual reviews. Review data from yelp.com were collected twice, first in March 2009 and again in April 2013. For the 2009 yelp.com US plumbers data, the data set comprises the 21 cities designated as "popular" by yelp.com at that time.[3] In addition to the original 21 cities from 2009, the 2013 yelp.com US plumbers data set includes four additional "popular" cities: Las Vegas, Oakland, California, Palo Alto, California, and Saint Louis. Data were also collected in 2009 for all restaurants in Chicago and for all businesses in Chicago listed under 15 major home service categories.[4]

Because Yelp makes available the entire record of its users' reviews, its data have an advantage on that dimension over the Better Business Bureau's, which do not provide information on the consumers who file complaints. To explore how reviewers' rating tendencies might affect inferences about firm quality, the ratings histories of Yelp users who had reviewed at least one plumbing firm in Chicago were downloaded in April 2013; this data set comprises 52,134 reviews from 1,211 unique reviewers and is used as a robustness check in Section V.

Angie's List provides a service similar to that of yelp.com, though the site requires members to pay a subscription fee to post and read reviews. A business can receive a grade of A–F on Angie's List, with A representing better service and coded as 5, while F is coded as 0. Illinois plumber reviews from Angie's List were collected in March 2009.

A third source of quality data is Consumer's Checkbook, a nonprofit organization that compiles reviews of businesses. Its data for the plumbing category in Illinois were also collected in March 2009. A business can receive a rating of 1–100 on checkbook.com, with 100 representing better service. Consumer's Checkbook also constructs a price index for plumbing services based on normalized prices for routine plumbing projects.

Pricing data for plumbing firms in Illinois come from an exhaustive phone survey of the 2,670 listings in ReferenceUSA. Between July 2008 and December 2008, each listing within the plumbing category in Refer-

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[3] Those cities are Atlanta, Austin (Texas), Boston, Chicago, Dallas, Denver, Detroit, Honolulu, Houston, Los Angeles, Miami, Minneapolis, New York, Philadelphia, Portland (Oregon), Sacramento, San Diego, San Francisco, San Jose, Seattle, and Washington, DC.

[4] The 15 home service categories are plumbing contractors, carpet and rug cleaners, electric contractors, landscape contractors, roofing contractors, pest control services, heating contractors, taxicabs, lawn maintenance, tree service, air conditioning contractors, towing-automotive, concrete contractors, movers, and locks and locksmiths.

enceUSA was called regarding its fixed service charge, hourly rate, earliest start date, and emergency hours. An attempt to contact each listed name was made until successful, up to a maximum of three times, which resulted in price quotes from 543 firms. A limitation of this survey is that the effective price of actual projects cannot be determined. For instance, a firm that quoted a low hourly rate could charge an ultimately higher price by taking longer to complete a project. In almost all cases, firms refused to provide detailed estimates for standard projects, such as fixing a broken pipe, without assessing the project in person.

Plumbing firms sometimes operate under more than one name, such as the firm in figure 1—linked clearly by its plumbing license in the two advertisements—that uses at least four distinct names. Several approaches were used to determine which plumbing firms in Illinois use more than one name. First, names listed in ReferenceUSA were matched to a common owner using phone numbers, fax numbers, websites, and addresses. Second, names were linked to one another using the known aliases listed in the firm's Better Business Bureau record, when available. Finally, several firms were discovered to use more than one name during the phone survey, for example, when a call to firm X was answered by an individual stating he was from firm Y. Matches were also cross-referenced on the Illinois Secretary of State's website.[5] By these measures, the 2,670 entries in ReferenceUSA were linked to 2,293 independent firms.

In the event that a firm uses more than one name, its firm-level variables from the Better Business Bureau are constructed by summing the number of complaints listed for each of its names, except when the Better Business Bureau displays a single complaint figure for the entire set of a firm's known aliases, in which case no aggregation is necessary. For the ReferenceUSA data, a firm's number of employees, advertising expenditures, and years in operation are assumed to be the maximum of those variables among all the names listed for the firm, and a firm is assumed to serve the metro Chicago area if at least one of the names belonging to the firm does. Finally, a firm is considered to use a name that begins with an A or a number if at least one of its names begins with an A, a number, or a symbol (e.g., #).

Advertising data from Google were collected on two separate occasions: first in June 2009 and then again in April 2013. To obtain these data, an automated script conducted searches on Google related to plumbing services in Illinois for the first scrape and for the 25 US cities designated as "popular" on yelp.com for the second scrape. For example, the script

[5] To remain in good standing, a firm must register its name with the county clerk of the county(ies) in which it operates. The Secretary of State then issues a Certificate of Good Standing for those businesses meeting the state's requirements and enforces the requirement that a newly registered name must be "distinguishable" from those names already registered in the state.

Fig. 1.—A plumbing firm that uses more than one name in Illinois, as determined by a unique license number in each advertisement linked to four names. Source: Northshore Real Yellow Pages.

entered the term "Chicago plumbers" on Google and extracted the paid advertising listings that appeared at the top and right-hand side of Google's results, along with the position of each advertisement within the search results.[6] For the June 2009 data, the script conducted 5,477 searches that resulted in 12,153 ad listings; the advertisements on Google were then matched to the plumbing firms listed in ReferenceUSA, with relevant advertisements linked to 85 firms.[7] For the April 2013 data, the script conducted 4,290 searches that resulted in 19,398 ad listings; the advertisements on Google were then matched to the plumbing firms listed on Yelp, with relevant ads linked to 332 firms.

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[6] The complete list of search terms used is provided in the online appendix.

[7] A number of paid listings were irrelevant for plumbing services in Illinois, such as advertisements for "plumbing fixtures," or for search aggregator sites such as Angie's List.

III.   Empirical Setting and Regularities

The Yellow Pages provide a natural starting point for a study of firm names. Most commonly, Yellow Pages list businesses under different category headings in alphanumerical order, with local phone companies distributing copies to their subscribers annually at no charge. Publishers sell advertising space within the directory, with prices varying by region, business category, and size (Busse and Rysman 2005). While the directories declined in popularity over the past decade, the Yellow Pages Association estimates that users still made 13.4 billion print Yellow Page references in 2007, and 87 percent of US households made at least one reference.

Previous studies have shown that consumers tend to search Yellow Pages listings from the top down (Lohse 1997). In response, some businesses choose names solely to appear near the beginning of their categories. And though one might suspect that this practice would be more prevalent for the most popular categories in the Yellow Pages, which are shown in table 1, it is not. Whereas approximately 9.3 percent of businesses listed in Chicago's Yellow Pages use a name that begins with an A or a number, only 6.2 percent of businesses among the 15 most viewed categories do. While seemingly counterintuitive, the placement of a business's listing in the Yellow Pages likely influences customers less in these categories. For example, most patients would not choose a surgeon simply by calling the first listing in the phone book.

Other categories, however, have disproportionately many firms that use a name beginning with an A or a number, also shown in table 1 for the city of Chicago. By revealed preference, firms in these categories have chosen this type of name for a reason. It must provide some benefit, and a common feature among this group points to what the benefit might be: many of these categories are for businesses used infrequently by customers with urgent needs inside their homes, such as locksmiths, electricians, and plumbers. For these categories, customers do not incur transportation costs to obtain the service, and so a firm's physical location has little bearing on their choice of a provider. As such, a firm's other characteristics, including its name, will have relatively more influence on customers, as the firm simply has fewer ways to differentiate itself.

Consistent with this claim, the top home service categories in the Yellow Pages have a larger proportion of firms with names that begin with an A or a number, as shown in the online appendix. In Chicago, 22.6 percent of businesses in these categories use names that begin with an A or a number, significantly above the citywide average of 9.3 percent. Tellingly, the home service categories among the top 15 where businesses have the most repeated interaction with customers—lawn maintenance and landscaping services—have relatively fewer businesses that

TABLE 1
FREQUENCY OF USING "A" NAMES BY YELLOW PAGES CATEGORY

Rank	Heading	Usage (Millions)	A Names (%)
	A. Top Categories by Usage		
1	Restaurants	1,269.5	4.6
2	Physician and surgeons	1,088.9	5.5
3	Automobile parts—new and used	517.8	16.9
4	Automobile repairing and service	392.5	14.5
5	Pizza	295.7	3.4
6	Attorneys/lawyers	290.1	3.9
7	Automobile dealers—new and used	273.0	10.2
8	Dentists	246.4	6.5
9	Plumbing contractors	234.8	21.0
10	Hospitals	208.6	5.4
11	Beauty salons	206.4	7.2
12	Department stores	205.6	5.9
13	Insurance	204.1	19.9
14	Veterinarians	153.0	12.4
15	Tire dealers	136.8	7.2
	B. Top Categories by Share of A Names		
1	Locks and locksmiths	26.9	65.9
2	Towing-automotive	32.3	28.9
3	Taxi and limousine service	62.7	21.2
4	Convenience stores	NA	21.2
5	Plumbing contractors	234.8	21.0
6	Associations	NA	20.8
7	Insurance	204.1	19.9
8	Roofing contractors	69.0	15.2
9	Cellular telephone services	9.8	14.9
10	Art galleries and dealers	NA	14.9
11	Employment agencies	43.1	14.8
12	Automobile repairing and service	392.5	14.5
13	Electric contractors	78.9	14.1
14	Travel agencies and bureaus	28.5	13.5
15	Painters	24.4	13.3

SOURCE.—American Business Disc, 2005; Yellow Pages Association, 2008.

NOTE.—Panel A shows the Yellow Pages categories ranked by national usage in 2006, defined as the number of times individuals view a particular heading annually, and the proportion of businesses using names that begin with an A or a number in the city of Chicago. Panel B shows the Yellow Pages categories ranked by proportion of businesses using names that begin with an A or a number in the city of Chicago for categories with 200 or more listings and excludes business listings that contain only addresses (e.g., apartment buildings). NA for usage means that the category was not among the top 300 for usage, as tracked by the Yellow Pages Association.

use names beginning with an A or a number: only 4.5 percent and 7.7 percent, respectively. For these firms, success depends more on satisfying customers repeatedly than on attracting attention with a particular name.

Among these home service categories, the market for plumbing services in Illinois embodies all of the stylized facts just described and

has several features that make it especially attractive for a study of firm names. The supply of plumbing services in Illinois depends, first and foremost, on the number of licensed plumbers in the state. In Illinois, the Department of Public Health regulates plumbers and plumbing-related activities, and its program licenses approximately 7,300 plumbers and 3,000 apprentice plumbers. To meet the state's standards, plumbers must pass a state licensing exam after completing a 48–72-month apprentice program under a licensed plumber and maintain their skills with continuing education. Throughout Illinois, local municipalities occasionally institute their own plumbing regulations and licensing requirements.

Plumbers often work for a firm, and these firms vary widely in terms of their service quality according to the Better Business Bureau. Firms' complaints have a highly skewed distribution: the median number of complaints filed against a firm is zero, whereas a firm at the 99th percentile received seven. In other words, almost all firms provide adequate service, with only 5 percent of firms generating 85 percent of the complaints. In this setting, however, complaints represent a noisy measure of quality, as the time and effort required to file a formal complaint likely deter all but the most disgruntled customers from doing so. The content of complaints on review sites bears this out, as they often describe willfully fraudulent behavior rather than mere dissatisfaction with the quality of service. In this sense, complaints primarily represent a signal that a firm provides bad service rather than a continuous measure of quality that ranges from low end to luxury.

Plumbing firms make deliberate name choices, using names that start with an A or a number more often than firms in most other categories. In Illinois, approximately 12.9 percent of plumbing firms use at least one name that begins with an A or a number, such as A-AAAA Sewer & Drains, AAAA Scott's Plumbing, A Aabbey Plumbing, and A Abest Rooter. The tendency to do so is greater for firms within metro Chicago: 15.7 percent of plumbing firms serving the metro area use at least one name that begins with an A or a number, compared to 8.3 percent outside metro Chicago. As shown in figure 2, these patterns also emerge in markets outside of Illinois: the average proportion of plumbing firms using a name that begins with an A or a number increases steadily with market size across the United States. By contrast, a category with similar Yellow Pages usage but in which demand bears no apparent relation to a firm's name—beauty salons—has no such pattern.

Plumbing firms that use a name beginning with an A or a number differ from other firms in many respects, as shown in table 2. On average, they are younger, spend more on advertising, and are more likely to serve metro Chicago. Most notably, firms that use names beginning with an A or a number receive more than five times as many complaints overall and more than three times as many complaints per employee.

Plumbers with "A" Names
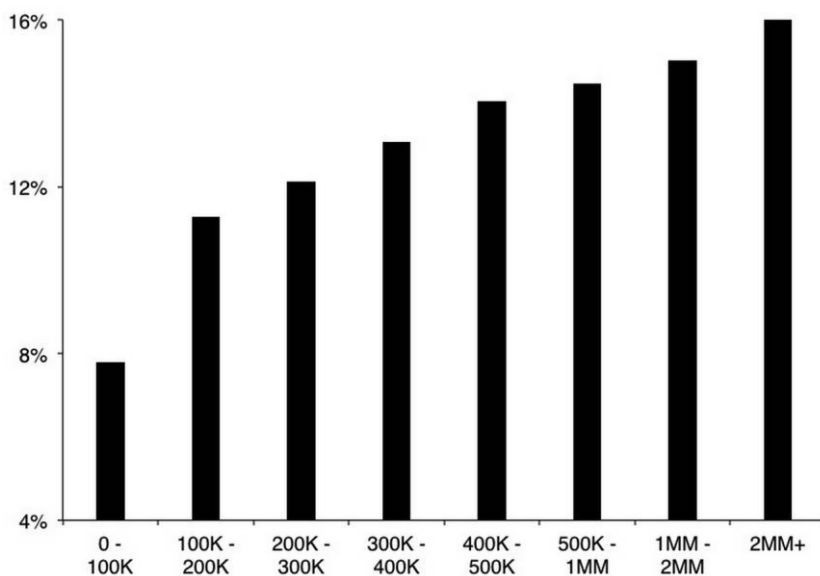
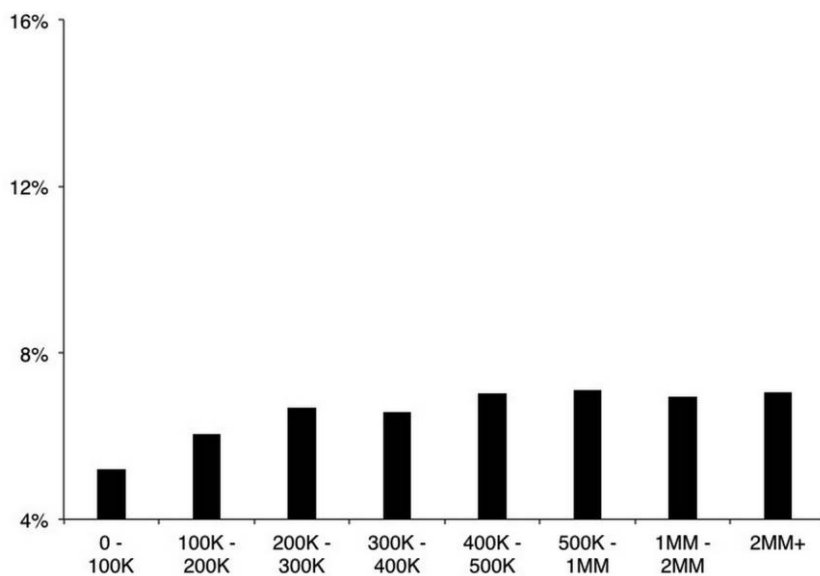## Beauty Salons with "A" Names

Fig. 2.—Proportion of plumbing firms (*top*) and beauty salons (*bottom*) using names that begin with an A or a number by market size across the United States. A market is defined to be a county. Within a given market size bin, "proportion" is the average proportion of firms using names that begin with an A or a number across markets. Source: American Business Disc, 2005.

TABLE 2
SUMMARY STATISTICS FOR ILLINOIS PLUMBING FIRMS BY NAME TYPE

| | A. CONDITIONAL SUMMARY STATISTICS BY A NAMES | | |
| | Name Begins with A | | |
MEAN OF VARIABLE	No	Yes	t-Statistic
Complaints	.248	1.339	6.79
Complaints per employee	.101	.387	3.35
Employees	5.530	6.325	.83
Firm age	12.767	10.729	3.67
Ad spending	5,149.7	6,805.1	2.43
Metro Chicago	.599	.756	5.21
Number of names	1.091	1.631	13.67
Observations	1,998	295	

| | B. CONDITIONAL SUMMARY STATISTICS BY MULTIPLE NAMES | | |
| | Multiple Names | | |
MEAN OF VARIABLE	No	Yes	t-Statistic
Complaints	.191	2.180	11.25
Complaints per employee	.090	.569	5.02
Employees	5.239	9.197	3.68
Firm age	12.425	13.233	1.30
Ad spending	4,703.3	11,334.6	8.83
Metro Chicago	.600	.798	5.91
Name begins with A	.100	.386	12.64
Observations	2,065	228	

SOURCE.—ReferenceUSA and the Better Business Bureau.
NOTE.—Conditional summary statistics for plumbing firms operating in Illinois based on whether the firm does or does not use a name that begins with an A or a number (panel A) or uses multiple names (panel B). If a firm uses more than one name, its firm-level variables are constructed by taking the maximum of the variables for employees, advertising expenditures, and firm age listed for all of its names. A firm's complaints are the sum of complaints listed for its names, except when the Better Business Bureau has already aggregated complaints across a firm's aliases. A firm is assumed to serve the metro Chicago area if at least one of the names belonging to the firm does. A firm is considered to use a name that begins with an A or a number if at least one of its names begins with an A, a number, or a symbol (e.g., #).

Table 3 contains the average ratings for firms from other sources of quality information: yelp.com, Angie's List, and Consumer's Checkbook. In all cases, plumbing firms that use names beginning with an A or a number receive significantly lower ratings. As a falsification test, table 3 also shows that restaurants do not have the same correlation between their names and ratings.

In addition to using a name that begins with an A or a number, a second type of name choice deserves note. Unlike firms in most settings, plumbing firms can operate under more than one name. A plumbing firm

TABLE 3
SUMMARY STATISTICS FROM ONLINE REVIEW SITES

REVIEW SOURCE	MEAN FIRM RATING: NAME BEGINS WITH A			MEAN NUMBER OF REVIEWS: NAME BEGINS WITH A			MEAN PRICE INDEX: NAME BEGINS WITH A			NUMBER OF FIRMS REVIEWED: NAME BEGINS WITH A		
	No	Yes	t-Statistic	No	Yes	t-Statistic	No	Yes	t-Statistic	No	Yes	% A
Yelp.com Chicago plumbers (2013)	3.891	3.208	2.72	6.492	3.861	1.01				179	36	16.7
Yelp.com Chicago plumbers (2009)	4.054	2.833	2.45	3.838	1.333	1.20				37	6	14.0
Yelp.com US plumbers (2013)	3.86	3.734	1.88	6.811	6.521	.41				2,950	524	15.1
Yelp.com US plumbers (2009)	3.721	2.776	4.10	2.799	1.776	1.69				274	49	15.2
Yelp.com Chicago home service (2009)	3.797	3.458	1.36	3.56	2.889	.82				150	36	19.4
Angie's List Illinois plumbers (2009)	4.507	4.151	2.33	19.666	11.321	.94				371	53	12.5
Checkbook.com Illinois plumbers (2009)	74.940	67.958	1.93	39.170	41.625	.28	99.570	104.824	1.26	182	24	11.7
Yelp.com Chicago restaurants (2009)	3.578	3.621	.80	29.236	29.246	.00				4,795	223	4.4

NOTE.—Conditional summary statistics for firms appearing on yelp.com, Angie's List, and Consumer's Checkbook (checkbook.com) based on whether the firm does or does not use a name that begins with an A or a number. A firm is considered to use a name that begins with an A or a number if at least one of its names begins with an A, a number, or a symbol (e.g., #). A business can receive 1–5 stars on yelp.com, with 5 representing better service. Reviews are the number of users who rated the business. For the 2009 yelp.com US plumbers data, the data set comprises the 21 cities designated as "popular" by yelp.com in 2009: Atlanta, Austin, Boston, Chicago, Dallas, Denver, Detroit, Honolulu, Houston, Los Angeles, Miami, Minneapolis, New York, Philadelphia, Portland, Sacramento, San Diego, San Francisco, San Jose, Seattle, and Washington, DC. In addition to the original 21 cities from 2009, the 2013 yelp.com US plumbers data set includes four additional "popular" cities: Las Vegas, Oakland, Palo Alto, and Saint Louis. The 15 home service categories are plumbing contractors, carpet and rug cleaners, electric contractors, landscape contractors, roofing contractors, pest control services, heating contractors, taxicabs, lawn maintenance, tree service, air conditioning contractors, towing-automotive, concrete contractors, movers, and locks and locksmiths. A business can receive a grade of A–F on Angie's List, with A representing better service and coded as 5, and F is coded as 0. A business can receive a rating of 1–100 on checkbook.com, with 100 representing better service. The price index is a set of normalized prices for routine plumbing projects constructed by checkbook.com for the firm.

might use more than one name for many reasons, such as to disassociate from past failures or to have more listings in the Yellow Pages with which to attract customers (McDevitt 2011). While the majority of firms in Illinois (over 90 percent) have only one name, 228 firms use more than one, and they differ considerably from single-named firms, as shown in table 1. On average, firms that use more than one name have more employees, are older, spend more on advertising in the Yellow Pages, are more likely to serve metro Chicago, and receive more complaints. In addition, approximately 38.6 percent of firms that use more than one name have at least one beginning with an A or a number, compared with 10.0 percent for firms that use only one name.

Finally, table 4 presents summary statistics from the price survey of plumbing firms described in Section II. Firms with a name that begins with an A or a number are more likely to charge a fixed service fee, have higher fixed fees and hourly rates, and charge more overall for a 2-hour project that incorporates both a fixed fee and an hourly rate.[8] All of these results are consistent with a setting in which consumers search the Yellow Pages in a top-down manner, as suggested by ordered search models (Arbatskaya 2007). In addition, firms using a name that begins with an A or a number are slightly more likely to provide emergency service (though the t-statistic is small), which suggests that they cater (slightly) more to customers with urgent needs and, hence, a low willingness to search.

IV.   Ordered Search and Uninformed Consumers

The following setup combines the signaling models of Salop and Stiglitz (1977) and Cooper and Ross (1984) with the ordered search model of Arbatskaya (2007) in a way that, when taken together, can explain the principal stylized facts discussed in Section III. Under certain conditions, the resulting sorting equilibrium yields comparative statics consistent with the observed patterns in the data: on average, firms that use a name beginning with an A or a number provide lower-quality service and charge higher prices, with this distinction becoming more pronounced as market size, and hence the proportion of uninformed consumers, increases.

Firms.—Consider a market for a service with free entry and arbitrarily many potential entrants. Firms supply either high- or low-quality service, $q \in \{0, 1\}$, with $q = 1$ representing a success and $q = 0$ a failure. By assumption, high-quality firms always provide service that results

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[8] Some firms apply a fixed fee to the first hour of service, while others do not. This feature is explicitly accounted for when the 2-hour project price is constructed.

TABLE 4
SUMMARY STATISTICS FROM PRICE SURVEY

| | NAME BEGINS WITH A | | |
MEAN OF VARIABLE	No	Yes	t-STATISTIC
Fixed fee	48.789	85.634	4.74
Hourly rate	100.173	121.847	3.97
Has fixed fee	.584	.756	2.97
2-hour price	209.488	251.591	3.76
Provides emergency service	.33	.378	.85
Complaints	.425	2.84	6.51
Complaints per employee	.118	.386	4.15
Observations	461	82	

NOTE.—Conditional summary statistics for plumbing firms operating in Illinois that responded to the price survey based on whether the firm does or does not use a name that begins with an A or a number. A firm's fixed fee is the amount it charges for consultation, which may or may not be applied to the final price of the project if the firm is ultimately commissioned. A firm's hourly rate is its charge per hour of service. A firm's 2-hour price includes its fixed service charge if it is not applied to the final price. Source: Firm responses.

in a success; they are "honest" in the terminology of Cooper and Ross (1984). Low-quality firms, however, have no incentive to provide successful service in the equilibrium described below.

   Consumers.—Let two types of $I \in \mathbb{R}$ consumers demand the service: emergency customers, denoted E, and renovation customers, denoted R. Each consumer type has a project of size T_i, with $1 \le T_E < T_R$. Here, consumers receive utility $V_R > V_E > 0$ from a success and zero from a failure. Assume that an exogenous proportion $\alpha \in (0, 1)$ of consumers are E-type, while $1 - \alpha$ are R-type.

   As in Cooper and Ross (1984), assume that an exogenous fraction of each consumer type, $\theta_i \in (0, 1)$, are fully informed about service qualities, while the remaining $1 - \theta_i$ consumers are uninformed. Fully informed consumers know both the price and quality of each firm, while the uninformed know only the price; this reflects the idea that it is easier for consumers to obtain price information (e.g., over the phone) than quality information (i.e., plumbing work is an experience good). Examples of why a consumer might be better informed in this setting include that he has used the service before, received a referral from a neighbor, or visited a review site. Naturally, informed consumers transact only with high-quality firms, while the uninformed choose randomly among all firms. Further, assume that θ_i is positively correlated with T_i—that is, $\theta_E \le \theta_R$—so that consumers with more extensive projects have at least as much information about firms' qualities.

   Names.—Firms choose one of two types of names, $n \in \{A, Z\}$, and consumers select a firm on the basis of its name. Consumers can contact an

A-type name at no cost but incur a cost of $S > 0$ to contact a Z-type name. In this setting, each type of name represents a distinct group of firm listings that the consumer chooses from, and S represents the cost of contacting a firm from the Z-type group. One might conceptualize each name type as representing a group of listings that appear on distinct pages and S as reflecting the cost of turning the page or clicking through to the next set of search results; this could be an explicit cost such as time and effort or a psychic cost such as inertia and habit. Once the page has been turned, a consumer can freely choose any name on the page.

Costs.—A firm bears an average hourly cost, $AC_i^q(x)$, to provide x hours of q-quality service to an i-type consumer. Assume that $AC_i^q(x)$ is U-shaped with respect to x. As shown in Cooper and Ross (1984), this U-shaped cost structure is crucial for the existence of a competitive equilibrium with asymmetric information because too many low-quality firms would enter the market and drive out uninformed consumers in the constant-returns case. Further, let $AC_R^q(x) < AC_E^q(x)$. Average hourly costs decline with T_i in this way because of fixed project costs, so that

$$\frac{\partial AC(x)}{\partial T} < 0. \tag{1}$$

For instance, each project requires consultation, paperwork, billing, diagnosis, travel, and so on, and these costs do not vary (much) by the variable hours of labor required for the job. As a result, a plumber who works mainly on small projects will have higher average hourly costs than a plumber who works mainly on large ones, given that the opportunity cost of their time is similar. As such, when plumbers sort by the types of projects they undertake, as they do in the separating equilibrium considered below, their average cost curves reflect this difference.

Assume also that low-quality firms' average cost curves lie below high-quality firms' such that $AC_i^L(x) < AC_i^H(x)$. For instance, if it requires 1 hour to fix a pipe properly, a low-quality firm might work only 5 minutes before claiming to have completed the job. Moreover, assume that the shapes of the average cost curves for low-quality and high-quality firms over their relevant domains are such that

$$AC_E'(x) = AC_R'(x) \quad \text{and} \quad AC_E''(x) = AC_R''(x). \tag{2}$$

Entry.—Assume that firms are monopolistically competitive in that firms and consumers are numerous enough so that each believes his own actions do not affect the strategies of others. As in Rosen (1974), competition and free entry ensure that any price and quality combination transacted in equilibrium must earn zero economic profits; if they did not, firms would enter and drive down prices until they did.

Note that services in this setting fit what Nelson (1974) terms "experience goods," as uninformed consumers will not know the true quality of service until after the transaction: they know only the conditional distribution of quality in equilibrium. As such, some firms will exploit uninformed consumers by providing low-quality service.

Assume that uninformed buyers form rational expectations about a firm's quality given the number of firms offering each level of quality for each name. Uninformed consumers thus face a lottery, and the probability that they will choose a high-quality firm is

$$\pi_n = \frac{J_n^H}{J_n^H + J_n^L},\tag{3}$$

where J_n^H is the number of high-quality firms using an n-type name, and J_n^L is the number of low-quality firms. This yields the threshold probability, $\check{\pi}_n$, for uninformed consumers to remain in the market at a given name:

$$\check{\pi}_n V_i - p_n T_i = 0.\tag{4}$$

When $\pi_n < \check{\pi}_n$, uninformed consumers prefer not to participate in the market because the risk of getting a low-quality firm is too great, placing an upper bound on the number of low-quality firms that can enter the market before it unravels. Assume that average cost curves are such that high-quality firms will always have prices below an informed customer's willingness to pay, so high-quality firms and informed consumers always participate in the market.

Prices.—Let A-name firms charge $p_A > 0$ per hour of service and Z names charge $p_Z > 0$, with $\hat{p}_n$ denoting the hourly price charged by a firm using an n-type name in equilibrium. As in Milgrom and Roberts (1986), rational consumers infer that any price other than the equilibrium price charged by high-quality firms will be offered by a low-quality firm because, by assumption, high-quality firms always charge the competitive price.

Search.—Because of ordered search, buyers decide which page of search results to select from, A or Z, and then choose one of the listed firms; this assumption fits the finding from previous studies that consumers often search lists from the top down, perhaps out of habit (Rubinstein and Salant 2006). As buyers make this decision to maximize expected utility, search costs then determine the extent of price dispersion. Note that informed consumers seek out a Z-name firm only if

$$(p_A - p_Z)T_i > S,\tag{5}$$

that is, when the price savings from search outweigh the costs. To ease exposition, an informed R-type customer here must still bear S even

though the motivation was that an informed customer has had previous experience using the firm and likely would not need to incur the same costs as an uninformed customer would to seek him out. In the sorting equilibrium considered below, this arguably unsatisfying assumption will not affect the results. Note also that if $p_Z > p_A$, informed consumers will not search, as they always transact with a high-quality firm. Moreover, uninformed consumers search if

$$(\pi_Z - \pi_A)V_i + (p_A - p_Z)T_i > S, \tag{6}$$

that is, when the price savings and expected quality gain from search outweigh the costs.

Equilibrium.—Given the assumptions above, an equilibrium comprises a set of prices $\{\hat{p}_A, \hat{p}_Z\}$ and a distribution of firm types $\{\hat{J}_A^H, \hat{J}_A^L, \hat{J}_Z^H, \hat{J}_Z^L\}$ such that (i) each firm maximizes its profits given the entry, name, and price decisions of other firms, as well as the search decisions of consumers; (ii) every firm earns zero economic profits; and (iii) consumers choose firms optimally.

A. Sorting by Name

The above setup allows for several possible equilibria, though the following is most relevant for understanding the empirical regularities outlined in Section III. Here, define a *competitive sorting equilibrium* to be one in which firms engage in monopolistic competition and their names are correlated with their quality, while consumers have asymmetric information and conduct ordered search. If such an equilibrium exists, it will have the following characteristics.

CHARACTERISTIC 1. The expected sales of each name and firm type are

- $\hat{x}_A^H$ such that $AC_E^H(x_A^H)$ is minimized for high-quality firms using A-type names;
- $\hat{x}_Z^H$ such that $AC_R^H(x_Z^H)$ is minimized for high-quality firms using Z-type names;
- $\hat{x}_A^L$ such that $AC_E^L(\hat{x}_A^L) = \hat{p}_A$ for low-quality firms using similar A-type names; and
- $\hat{x}_Z^L$ such that $AC_R^L(\hat{x}_Z^L) = \hat{p}_Z$ for low-quality firms using Z-type names.

Free entry dictates that firms enter until these levels hold, which occurs when firms earn zero economic profits. This implies that equilibrium prices are such that

$$AC_R^H(\hat{x}_Z^H) = \hat{p}_Z < \hat{p}_A = AC_E^H(\hat{x}_A^H),$$

which relates to sorting by consumer types as expectations line up in equilibrium: consumers with larger projects, and thus a higher willingness to search, transact with firms using Z-type names, which then reduces their average hourly costs, which then leads them to charge lower prices because of free entry.

CHARACTERISTIC 2. The price and quality for each name and firm type are as follows:

- $(\hat{p}_A, 1)$ offered by high-quality firms using A-type names;
- $(\hat{p}_Z, 1)$ offered by high-quality firms using Z-type names;
- $(\hat{p}_A, 0)$ offered by low-quality firms using A-type names;
- $(\hat{p}_Z, 0)$ offered by low-quality firms using Z-type names.

By assumption, high-quality firms charge prices commensurate with the quality of service they provide, which coincide with their average costs at the minimum efficient scale. Low-quality firms, on the other hand, have no incentive to provide a level of service above the bare minimum, as doing so increases their costs but does not increase their chances of being selected by an uninformed consumer. And, since consumers know the price distribution for each name type, they expect that any price other than $\hat{p}_n$ comes from a low-quality firm, for which they have no willingness to pay.

CHARACTERISTIC 3. The equilibrium number of each type of firm, $\hat{J}_A^H$, $\hat{J}_A^L$, $\hat{J}_Z^H$, and $\hat{J}_Z^L$, satisfies the following:

- $\hat{x}_A^H = \dfrac{\alpha \theta_E T_E I}{\hat{J}_A^H} + \dfrac{\alpha(1 - \theta_E) T_E I}{\hat{J}_A^H + \hat{J}_A^L}$

for high-quality firms using A-type names;

- $\hat{x}_A^L = \dfrac{\alpha(1 - \theta_E) T_E I}{\hat{J}_A^H + \hat{J}_A^L}$

for low-quality firms using A-type names;

- $\hat{x}_Z^H = \dfrac{(1 - \alpha)\theta_R T_R I}{J_Z^H} + \dfrac{(1 - \alpha)(1 - \theta_R) T_R I}{\hat{J}_Z^H + \hat{J}_Z^L}$

for high-quality firms using Z-type names;

- $\hat{x}_Z^L = \dfrac{(1 - \alpha)(1 - \theta_R) T_R I}{\hat{J}_Z^H + \hat{J}_Z^L}$

for low-quality firms using Z-type names.

These four equations dictate entry conditions such that high-quality firms' expected sales minimize average costs and result in zero profits, while low-quality firms' sales also result in zero profits, though they lie on the declining part of their average cost curves, as in Cooper and Ross (1984). In other words, firms of each type enter until these conditions hold, which occurs when all firms earn zero economic profits and are indifferent about switching types.

CHARACTERISTIC 4.   Search costs, equilibrium prices, consumer types, and firm entry decisions are such that

- $(\hat{p}_A - \hat{p}_Z)T_R > S$ for informed R-type consumers;
- $(\hat{\pi}_Z - \hat{\pi}_A)V_R - (\hat{p}_Z - \hat{p}_A)T_R > S$ for uninformed R-type consumers;
- $(\hat{p}_A - \hat{p}_Z)T_E < S$ for informed E-type consumers;
- $(\hat{\pi}_Z - \hat{\pi}_A)V_E - (\hat{p}_Z - \hat{p}_A)T_E < S$ for uninformed E-type consumers.

Here, market characteristics stipulate that R-type consumers prefer to seek out firms using Z-type names, while E-type consumers do not. If this condition did not hold, consumers would not sort by project size and firms' average cost curves would no longer induce partial sorting by name type. Note also that if entry implies $J_n^H/(J_n^H + J_n^L) < \check{\pi}_n$ for some name, an equilibrium will not exist.

Taken together, these characteristics lead to the following claim.

CLAIM.   A competitive sorting equilibrium with asymmetric information exists.

The proof is by construction, with a numerical example that satisfies the conditions for the sorting equilibrium provided in the online appendix.

This equilibrium helps resolve the initial puzzle that a typical A-name firm charges higher prices despite providing lower-quality service. When a consumer's willingness to search depends on the extent of his project, which then relates to a firm's average costs, the seemingly counterintuitive connection between price and quality becomes more readily apparent.

The remainder of this subsection considers the properties of a competitive sorting equilibrium.

IMPLICATION 1.   The proportion of low-quality firms among A-type names is higher than among Z-type names.

Owing to consumer sorting and the resulting average cost curves, characteristic 3 implies

$$\frac{\hat{\pi}_Z}{\hat{\pi}_A} = \frac{\theta_R}{1 - \theta_R} \frac{1 - \theta_E}{\theta_E} \frac{\hat{x}_Z^L}{\hat{x}_Z^H - \hat{x}_Z^L} \frac{\hat{x}_A^H - \hat{x}_A^L}{\hat{x}_A^L}. \tag{7}$$

From $\theta_E \leq \theta_R$ and assumptions (1) and (2), it follows that $\hat{\pi}_Z/\hat{\pi}_A > 1$, so the proportion of high-quality firms is greater for Z-type names. To see

this, note that (2) implies $\hat{x}_A^H = \hat{x}_Z^H$ (recall that $\hat{x}$ is determined solely by average costs and consumer types). Moreover, (1) implies $\hat{x}_A^L < \hat{x}_Z^L$ given $AC_i^L(x) < AC_i^H(x)$, and low-quality firms produce on the declining portion of their average cost curves. At $\theta_E = \theta_R$, this result stems from the relative differences in average costs, which in turn stem from sorting by consumer types. At $\theta_E < \theta_R$, the disparity widens further.

The above setup yields three additional implications regarding the proportion of informed consumers in the market, θ, proxied for empirically with market size.

IMPLICATION 2. In any competitive sorting equilibrium, (i) the average quality for either name type increases with the proportion of informed consumers, (ii) the proportion of firms using A-type names declines relative to Z-type names as the proportion of informed consumers converges across types, and (iii) quality dispersion across names declines as more consumers become informed.

For part i, $\theta_i' > \theta_i$ implies that

$$\frac{\hat{\pi}_n'}{\hat{\pi}_n} = \frac{\theta_i'}{1 - \theta_i'} \frac{1 - \theta_i}{\theta_i} > 1, \tag{8}$$

and thus the average quality of either name type increases with the proportion of informed consumers in the market. For part ii, because

$$\frac{\hat{J}_Z^H + \hat{J}_Z^L}{\hat{J}_A^H + \hat{J}_A^L} = \frac{1 - \alpha}{\alpha} \frac{1 - \theta_R}{1 - \theta_E} \frac{T_R}{T_E} \frac{\hat{x}_Z^L}{\hat{x}_A^L}, \tag{9}$$

the proportion of firms using A-type names declines relative to Z-type names as $(1 - \theta_R)/(1 - \theta_E) \to 1$ from below. For part iii, if follows from

$$\frac{\hat{\pi}_Z}{\hat{\pi}_A} = \frac{\theta_R}{1 - \theta_R} \frac{1 - \theta_E}{\theta_E} \frac{\hat{x}_Z^L}{\hat{x}_Z^H - \hat{x}_Z^L} \frac{\hat{x}_A^H - \hat{x}_A^L}{\hat{x}_A^L} \tag{10}$$

that $\hat{\pi}_Z/\hat{\pi}_A$ declines as $(1 - \theta_R)/(1 - \theta_E) \to 1$ from below.

B. Survey Evidence

The responses from a survey of 100 US citizens aged 18 or older conducted on Amazon Mechanical Turk suggest that the model's assumptions coincide reasonably well with consumers' actual beliefs.[9] Of the 100 respondents, 76 had experience hiring a plumber, with an average of 2.8 past plumbing transactions. Most notably, 78 responded that they believe a firm would choose an A-type name to appear at the front of an alphabetical listing such as the Yellow Pages (or some similar variant),

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[9] The full survey results and the questionnaire appear in the online appendix.

suggesting that they are well aware of firms' motivations for choosing these names.

In regard to beliefs about quality, respondents gave three A-name firms an average rating of 2.9 out of 5, compared to a rating of 3.4 for three firms not using an *A*-type name ($p < .01$). Moreover, in an explicit choice between two firms, A-Anderson Walter Plumbing and Walter Bernhardt Plumbing, 23 responded that they would choose A-Anderson for a small job, while 19 would for a large job, a statistically negligible difference but in line with the model. Similarly, 29 respondents said that they would choose a plumbing firm using a name that begins with A-AAAA for a small, unimportant project, compared to 20 respondents for a very large, important project. Consistent with this response, 65 indicated that they would search longer to find a plumber for an important project, 27 would search about the same amount of time, and eight less. In addition, respondents who had more experience hiring plumbers gave lower ratings to A-name firms; to the extent that experience relates to θ, this result is also consistent with the model's predictions.

In regard to ordered search, 50 respondents said that they would begin searching for a plumber at the first listing, while 49 would begin at a random listing (one did not respond). For prices, 36 believe that A-name firms will charge higher prices, 53 about the same, and nine less. Coupled with average beliefs about quality across names, this suggests that the typical consumer expects quality-adjusted prices to decline with search.

Broadly speaking, a meaningful segment of consumers holds beliefs that are consistent with the model's assumptions regarding ordered search; that is, customers believe that a typical A-name firm will provide lower-quality service, and so they will search longer to obtain better quality-adjusted prices for their more important projects.

V. Empirical Analysis

To test the primary hypothesis of this paper, that firms using names that begin with an A or a number provide lower-quality service, consider the following regression:

$$y_j \sim \text{Poisson}(\lambda_j), \quad \ln(\lambda_j) = \beta_A A_j + \ln(E_j) + \alpha X_j, \tag{11}$$

where the dependent variable, y_j, is the number of complaints filed against the firm; A_j is an indicator variable equal to one if the firm uses a name that begins with an A or a number; E_j is the number of employees at the firm; and X_j is a vector of firm-specific variables such as advertising expenditures, years in operation, whether the firm uses multiple names, and whether the firm serves metro Chicago. To allow for the

possibility that firm size varies systematically by name, all specifications include the log number of employees as a control with its coefficient constrained to one; doing so accounts for differences in firms' exposure to complaints that might result from completing more transactions.

A. Main Results

Table 5 presents the results from a series of such Poisson regressions. As a baseline, specification 1 shows that the number of complaints filed against a firm is positively correlated with the amount it spends on advertising in the Yellow Pages, a finding at odds with the "money-burning" theory of Milgrom and Roberts (1986) but consistent with signaling by low-quality firms. In addition, older firms receive fewer complaints, perhaps reflecting a greater survival rate for high-quality firms or an accumulation of skills through experience. Finally, firms serving the metro Chicago area receive more complaints than firms outside the metro area.

Specification 2 confirms implication 1: firms that use a name beginning with an A or a number receive significantly more complaints. To interpret the marginal effect associated with using this type of name, note that the incident rate ratio for β_A is approximately 3.12, meaning that firms using an A-type name receive 212 percent more complaints than other firms, all else held fixed. The qualitative interpretation of the remaining controls in specification 2 is the same as in specification 1.

Specification 3 includes a control for firms that use more than one name. Consistent with the discussion in Section III related to advertising, firms that use multiple names receive 223 percent more complaints, all else equal, though this finding may also be related to a firm's dynamic concerns over reputation (McDevitt 2011). Including a control for having multiple names reduces the marginal effect of using an A name, bringing the incident rate ratio to 1.97, though the effect remains statistically significant ($p < .01$). The qualitative interpretation of the remaining controls in specification 3 is the same as in specifications 1 and 2.

Quality by market size.—A number of simple statistics show that the relationship between a firm's name and its service quality varies with market size, which proxies for the degree of asymmetric information in a market for the reasons discussed in Section IV. In line with part i of implication 2, firms within metro Chicago receive considerably more complaints, irrespective of their names: more than 4.4 times more complaints overall ($p < .01$) and more than 4.6 times more complaints per employee ($p < .01$). In line with part ii of implication 2, 15.7 percent of firms serving the more populous metro Chicago area use a name that begins with an A or a number, while only 8.2 percent of firms outside metro Chicago do ($p < .01$). In line with part iii of implication 2, the ratio

TABLE 5
Poisson Regressions of Complaints on Plumbing Firm Characteristics

	Complaints					
	(1)	(2)	(3)	(4)	(5)	(6)
Name begins with A		1.138***	.679***	.734**	.514	.577**
		(.288)	(.261)	(.289)	(.381)	(.279)
		[3.120]	[1.972]	[2.083]	[1.673]	[1.781]
Multiple names			1.172***	1.126***	1.567***	1.094***
			(.314)	(.344)	(.504)	(.334)
			[3.229]	[3.084]	[4.794]	[2.987]
On Google						.698**
						(.316)
						[2.009]
Ad spending ($000s)	.0468***	.0399***	.0320***	.0332***	.0190	.0274***
	(.00694)	(.00700)	(.00787)	(.00845)	(.0128)	(.00676)
	[1.048]	[1.041]	[1.032]	[1.034]	[1.019]	[1.028]
Firm age	−.0379**	−.0453***	−.0564***	−.0606***	−.0301	−.0629***
	(.0150)	(.0158)	(.0164)	(.0186)	(.0202)	(.0145)
	[.963]	[.956]	[.945]	[.941]	[.97]	[.939]
Metro Chicago	.870***	.738***	.633**			.478**
	(.225)	(.233)	(.246)			(.232)
	[2.387]	[2.092]	[1.883]			[1.613]
ln(employees)	1	1	1	1	1	1
Constant	−3.516***	−3.503***	−3.407***	−2.744***	−3.685***	−3.186***
	(.356)	(.349)	(.346)	(.371)	(.344)	(.294)
	[.03]	[.030]	[.033]	[.064]	[.025]	[.041]
Sample	All	All	All	Metro Chicago	Outside metro Chicago	All
Observations	2,293	2,293	2,293	1,420	873	2,293
Pseudo R^2	.159	.201	.234	.227	.139	.245

Note.—Poisson regressions in which the dependent variable is the number of complaints filed against the firm with the Better Business Bureau. Robust standard errors are in parentheses, and incident rate ratios are in brackets. All specifications include ln(employees) with its coefficient constrained to one. If a firm uses more than one name, its firm-level variables are constructed by taking the maximum of the variables for employees, advertising expenditures, and firm age listed for all of its names. A firm's complaints are the sum of complaints listed for its names, except when the Better Business Bureau has already aggregated complaints across a firm's aliases. A firm is assumed to serve the metro Chicago area if at least one of the names belonging to the firm does. A firm is considered to use a name that begins with an A or a number if at least one of its names begins with an A, a number, or a symbol (e.g., #). A firm is considered to advertise on Google if it appeared at least once in the Google paid search results. Test of equality for name begins with A across cols. 4 and 5: $\chi^2(1) = 0.21$, $p = .65$. Test of equality for multiple names across cols. 4 and 5: $\chi^2(1) = 0.52$, $p = .47$.

* $p < .10$.
** $p < .05$.
*** $p < .01$.

of complaints received by the average A- and not-A-name firm in metro Chicago is 4.9, which compares with a ratio of 2.8 outside metro Chicago ($p < .01$).

To explore these findings in finer detail, specification 4 of table 5 presents the same Poisson regression in (11) but restricted to firms that serve the metro Chicago area. In metro Chicago, having a name that begins with an A or a number is associated with receiving 108 percent more complaints, and this difference is statistically significant ($p < .05$). As predicted by implication 2, the signal a firm sends by using a name that begins with an A or a number conveys meaningful information within metro Chicago.

Specification 5 of table 5 instead restricts the set of firms to those that do not serve metro Chicago. Outside metro Chicago, firms that use A names receive 67 percent more complaints, but this difference is not statistically distinguishable from zero. In this sense, the content of a firm's name does not provide the same powerful signal of a firm's quality outside the metro area, as predicted by the model. Similarly, the effect of advertising on complaints outside of Chicago is barely half as large as it is for the metro area and not statistically significant, a result consistent with the spirit of the model. It is important to note, however, that while the difference in magnitudes between the metro and nonmetro areas is large, the standard errors are such that they are not statistically distinguishable from one another at conventional levels.

Prices by name.—As discussed above, ordered search models predict that prices decline as a firm's position in the search results increases. If ordered search applies to Yellow Pages listings, firms using names that begin with an A or a number will have higher prices, all else equal. To test this prediction, consider the following model:

$$p_j = \beta_A A_j + \alpha X_j + \varepsilon_j, \tag{12}$$

where the price a firm quoted for a representative 2-hour project, p_j, is the dependent variable; A_j is an indicator variable equal to one if the firm uses a name that begins with an A or a number; and X_j is a vector of firm-specific variables that includes the number of employees at the firm, advertising expenditures, years in operation, whether the firm serves metro Chicago, and whether the firm provides emergency service. Table 6 presents the results of these regressions, with specification 2 providing evidence consistent with ordered search: firms that use a name beginning with an A or a number charge higher prices. In this specification, firms that use at least one name beginning with an A or a number command a $21.05 premium, which is 8.4 percent above the average in metro Chicago, with other explanatory variables held at their sample means. This premium may seem large given a setup in which the cost of finding a better group

TABLE 6
OLS Regressions of Prices on Plumbing Firm Characteristics

	PRICE			
	(1)	(2)	(3)	(4)
Name begins with A		21.04**	21.06*	5.274
		(10.17)	(11.96)	(12.72)
Emergency service			9.848	3.154
			(7.990)	(8.146)
Begins with A × emergency				41.60**
				(20.26)
Employees	−.578***	−.595***	−.589***	−.571***
	(.178)	(.177)	(.153)	(.177)
Firm age	.671*	.789*	.791**	.726*
	(.399)	(.402)	(.382)	(.402)
Ad spending ($000s)	.148	.0538	.0090	.0413
	(.279)	(.282)	(.303)	(.284)
Metro Chicago	99.30***	97.10***	96.26***	95.83***
	(7.405)	(7.459)	(6.745)	(7.462)
Constant	149.9***	147.2***	144.7***	147.8***
	(8.533)	(8.606)	(7.687)	(8.914)
Observations	543	543	543	543
R^2	.260	.266	.268	.274

Note.—OLS regression in which the dependent variable is the project price of firms responding to the survey. Standard errors are in parentheses. A firm's project price is calculated for 2 hours and includes its fixed service charge if it is not applied to the final price. If a firm uses more than one name, its firm-level variables are constructed by taking the maximum of the variables for employees, advertising expenditures, and firm age listed for all of its names. A firm's complaints are the sum of complaints listed for its names, except when the Better Business Bureau has already aggregated complaints across a firm's aliases. A firm is assumed to serve the metro Chicago area if at least one of the names belonging to the firm does. A firm is considered to use a name that begins with an A or a number if at least one of its names begins with an A, a number, or a symbol (e.g., #).

* $p < .10$.
** $p < .05$.
*** $p < .01$.

of firms to choose from is merely flipping a few pages, but this "cost" may also reflect behavioral biases and consumer inattention.

In addition, specifications 3 and 4 provide suggestive evidence about the relationship between price and willingness to search. Firms that provide emergency service—and presumably attract customers with a lower willingness to search given their urgent needs—charge higher prices. As shown in specification 4, this effect is most pronounced for firms using *A*-type names, suggesting that the premium is not simply a compensating differential earned by firms that take on less desirable emergency work.

B. Potential Confounds

An immediate concern with translating a raw number of complaints to a measure of firm quality is that having more complaints might reflect

TABLE 7
Summary Statistics for Plumbing Firms from Supplemental Data Sources

| | Name Begins with A | | |
MEAN OF VARIABLE	No	Yes	t-Statistic
	A. Illinois Plumbing Firms in Dun & Bradstreet		
Employees	7.197	8.514	1.53
Sales	682,999	713,372	.32
Sales per employee	91,818	87,108	.60
Observations	309	37	
	B. San Francisco Plumbing Firm Permits		
Employees	6.724	6.979	.11
Permits	9.082	17.340	2.13
Permits per employee	2.413	2.061	.37
Observations	293	47	

Source.—Panel A: Dun & Bradstreet. Panel B: sfgov.org, ReferenceUSA.

Note.—Panel A contains conditional summary statistics for plumbing firms operating in Illinois included in the Dun & Bradstreet database based on whether the firm does or does not use a name that begins with an A or a number. Panel B contains conditional summary statistics for plumbing firms operating in San Francisco included in the City of San Francisco permit database based on whether the firm does or does not use a name that begins with an A or a number.

nothing more than the firm serving more customers. As using a name that begins with an A or a number represents a strategy aimed at generating more business, this appears to be an important confound. Several pieces of supporting evidence, however, suggest that unobserved business volume is unlikely to induce a spurious correlation between name choices and reported complaints.

The first piece of evidence against this interpretation comes from online review sites, summarized in table 3. If firms with an A or a number received considerably more business, they likely would also receive considerably more reviews from customers, which they do not. Moreover, on Yelp, Angie's List, and Consumer's Checkbook, firms using names that begin with an A or a number receive significantly lower average ratings, which would not result mechanically simply from completing more transactions.

A second piece of evidence comes from data on transaction volume obtained from three supplemental data sources that show no appreciable differences across name types. First, sales data for a sample of Illinois plumbing firms obtained from Dun & Bradstreet, as described in the Appendix, suggest that employees at A-name firms do not work systematically more hours than employees at other firms. As shown in table 7, sales per employee do not differ between firms that use an *A*-type name and those that do not. As such, the number of jobs completed per year would have to be drastically different across name types in order to ex-

plain the differences in complaints observed in the data. Second, data for plumbing permits issued to firms in San Francisco, also described in the Appendix, show that the number of permits obtained per employee in 2012 does not vary across name types. Finally, data on plumbing projects completed for New York City's Department of Housing, as described in the online appendix, again suggest that the number of jobs completed per year is not meaningfully different across name types.

A second, perhaps more subtle, concern with the empirical strategy above is that firms with names beginning with an A or a number might attract customers who are more predisposed to filing complaints, which would again bias the mapping of reported complaints to underlying firm quality. For instance, a customer with a plumbing emergency, and presumably a low willingness to search, might be both more likely to use the first plumber listed in the Yellow Pages and more likely to have a complicated repair that, irrespective of the plumber's quality, will lead to a complaint.

Analyzing the rating history of Yelp reviewers provides one method for assessing the extent of this potential bias. Table 8 presents summary statistics for the 1,211 unique users who had submitted a review for a plumbing firm in Chicago as of April 2013. On the basis of 52,134 reviews across all Yelp categories, A-name firms are in fact reviewed by

TABLE 8
ANALYSIS OF YELP USERS: SUMMARY STATISTICS

Variable	Mean	Standard Deviation	Minimum	Maximum	Observations
		User-Level Observation			
Total reviews—all categories	43.05	171.15	1	2,513	1,211
Mean rating—all categories	3.9	.936	1	5	1,211
Total reviews—plumbing category	1.086	.327	1	4	1,211
Mean rating—plumbing category	4.175	1.428	1	5	1,211
Mean rating—not plumbing category	3.812	.938	1	5	1,066
		Review-Level Observation			
Mean rating—not plumbing category|review for a plumber	3.556	1.011	1	5	121
Mean rating—not plumbing category|review for not a plumber	3.827	.916	1	5	1,048

SOURCE.—Yelp.com.
NOTE.—Summary statistics for Yelp users who reviewed at least one plumbing firm operating in Chicago as of April 2013. A business can receive 1–5 stars on Yelp, with 5 representing better service.

Yelp users who submit lower ratings for firms in other categories: the 121 reviews of A-name firms by reviewers who reviewed at least one firm in another category have an average nonplumbing category rating of 3.556, compared to 3.827 for the 1,048 reviews of non-A-name firms. The differences in customers' rating tendencies in other categories are not large enough to fully explain A-name firms' lower ratings, however, as shown in a regression of Yelp plumber ratings that controls for a reviewer's average rating of nonplumbers on Yelp, with results in column 1 of table 9. Perhaps even more convincing, column 2 shows the results from a regression that controls for reviewer fixed effects. Once again, A-name plumbing firms receive considerably lower ratings, with identification coming from the 22 Yelp users who reviewed at least one A- and one non-A-name plumbing firm.

Examining the firms that participated in the price survey provides a second robustness check. Limiting the sample to the 33.7 percent of respondents that provide emergency service helps isolate differences in the types of jobs fielded across firms. Here, one might argue that firms providing emergency service have similar customer bases and thus have customers with a similar underlying tendency for filing a complaint. Among the firms that provide emergency service, those with names that

TABLE 9
ANALYSIS OF YELP USERS:
OLS REGRESSIONS OF YELP RATINGS

	YELP RATING	
	(1)	(2)
Name begins with A	−.665***	−2.032***
	(.159)	(.389)
Mean rating—not plumbing category	.337***	
	(.0489)	
Constant	2.930***	4.344***
	(.203)	(.149)
Observations	1,169	1,315
R^2	.069	.104

SOURCE.—Yelp.com.
NOTE.—OLS regressions of the rating a plumber receives in a review. Standard errors clustered by user are in parentheses. Specification 1 includes a control for the user's average rating of firms on Yelp across categories other than plumbing. Specification 2 includes user-level fixed effects. A firm is considered to use a name that begins with an A or a number if at least one of its names begins with an A, a number, or a symbol (e.g., #). A business can receive 1–5 stars on Yelp, with 5 representing better service.
  * $p < .10$.
  ** $p < .05$.
  *** $p < .01$.

begin with an A or a number received 13.3 times as many complaints overall ($p < .01$) and 5.1 times as many complaints per employee ($p < .01$), providing further evidence that unobserved heterogeneity among customers is unlikely to be biasing the results.

C. Extension to Position Auctions with Consumer Search

Over the past decade, Internet search engines have become an increasingly popular substitute for printed Yellow Pages. Typically, search engines such as Google do not follow the Yellow Pages' convention of listing names in alphanumerical order under distinct category headings. Instead, a consumer who searches for "Chicago plumber" on Google will receive two sets of results on the page: (i) "organic" listings on the left-hand side and (ii) "sponsored" links at the top and right-hand side. Google determines the position of organic results by ranking the relevance of each link using a proprietary algorithm, while the position of sponsored links is based on firms' bids in a generalized second-price auction for keywords, where the kth-highest bidder wins the kth-highest link and pays the $k + 1$st–highest bid. On this type of platform, using a name that begins with an A or a number does not guarantee a firm a top position, potentially muting the signal a firm's name sends about its quality.

In light of this, a growing line of research contends that position auctions make search more efficient. For instance, Athey and Ellison (2011) develop a model in which advertisers differ in quality, consumers incur search costs from clicking on links, and consumers act rationally when choosing how many links to click on, and in what order to do so. Their model implies that only higher-quality firms will advertise on Google, with quality defined as the firm's ability to meet the consumer's needs. For a setting such as plumbing services, a consumer's need, more or less, is to find a plumber who provides adequate service—that is to say, service that will not lead to a complaint filed with the Better Business Bureau. A key distinction worth noting in this setting, however, is that the quality of plumbing services is not revealed to the consumer until after the transaction takes place, which contrasts with Athey and Ellison's setup in which consumers learn their match value immediately upon clicking a link.

To test this prediction of the theoretical position auction literature and its relation to offline search platforms, the data from ReferenceUSA and the Better Business Bureau were merged with plumbing-related search results from Google, as discussed in Section II. On average, plumbing firms in Illinois that advertise on Google have more employees, spend more on advertising in the Yellow Pages, are more likely to serve the metro Chicago area, are more likely to use an A-type name, and are more likely to use multiple names, as shown in table 10. In terms of quality, firms that advertise on Google receive more than 13 times as many complaints, on

TABLE 10
SUMMARY STATISTICS FOR PLUMBING FIRMS ADVERTISING ON GOOGLE

	ADVERTISE ON GOOGLE		
MEAN OF VARIABLE	No	Yes	*t*-STATISTIC
	A. Illinois Plumbing Firms in ReferenceUSA		
Complaints	.265	3.588	11.91
Complaints per employee	.128	.394	1.76
Employees	5.410	11.400	3.51
Firm age	12.483	13.070	.59
Ad spending	4,947.7	16,141.8	9.44
Metro Chicago	.608	.918	5.81
Name begins with A	.123	.282	4.33
Number of names	1.135	1.800	9.30
Observations	2,208	85	
	B. US Plumbing Firms on Yelp		
Yelp rating	3.934	2.956	12.25
Yelp reviews	6.422	10.036	4.23
Observations	3,142	332	

SOURCE.—Google search results, ReferenceUSA, the Better Business Bureau, and yelp.com.

NOTE.—Conditional summary statistics for plumbing firms operating in Illinois (panel A) and operating in the 25 "popular" cities on Yelp (panel B) based on whether the firm does or does not advertise on Google. A firm is considered to advertise on Google if it appeared in at least one sponsored link among the Google search results data described in Sec. II. If a firm uses more than one name, its firm-level variables are constructed by taking the maximum of the variables for employees, advertising expenditures, and firm age listed for all of its names. A firm's complaints are the sum of complaints listed for its names, except when the Better Business Bureau has already aggregated complaints across a firm's aliases. A firm is assumed to serve the metro Chicago area if at least one of the names belonging to the firm does. A firm is considered to use a name that begins with an A or a number if at least one of its names begins with an A, a number, or a symbol (e.g., #).

average, and receive more than three times as many complaints per employee. On Yelp, the same relation to quality holds: across the 25 cities considered, firms that advertise on Google receive ratings nearly one star lower, on average, as shown in panel B of table 10.

To control for confounding factors, specification 6 of table 5 presents the results from a Poisson regression analogous to (11) in which the dependent variable is the number of complaints filed against the firm. Notably, firms that advertise on Google in Illinois receive twice as many complaints, all else equal. In short, being among the winners of Google's position auctions for plumbing-related key words is correlated with receiving more complaints with the Better Business Bureau.

Because plumbing firms that advertise on Google provide lower-quality service, the primary implication of the high-quality sorting equilibrium for position auctions—that firms appearing among the sponsored links

will be more likely to meet the needs of consumers—does not hold for residential plumbing services. The model outlined in Section IV helps explain why: low-quality firms cannot satisfy customers with extensive projects and instead must attract infrequent customers with a low willingness to search who disproportionately use Internet search engines to seek out plumbers. High-quality firms, on the other hand, prefer to avoid this type of customer in favor of clients who will yield more lucrative relationships. The characteristics of firms advertising on Google align well with this theory: they spend more on advertising in the Yellow Pages, use *A*-type names more often, and have more listings overall. The correlation among these factors is consistent with the prediction that low-quality firms will indiscriminately find ways to attract uninformed customers with a low willingness to search, as the average firm that simultaneously employs all four methods receives 14.6 complaints, a rate that is an order of magnitude worse than the typical firm's.

VI.   Conclusion

A firm's deliberately chosen name can signal credible information about its quality. In the market for residential plumbing services in Illinois, firms that use a name beginning with an A or a number provide lower-quality service. The model in this paper illustrates why. Uninformed consumers with a low willingness to search settle for low-quality plumbers, while consumers with a high willingness to search expend greater effort to find high-quality ones. In turn, low-quality plumbers, whose poor service will not generate referrals or repeat business, disproportionately prefer to choose names that attract uninformed customers with a low willingness to search, whereas high-quality plumbers do not choose this type of name because they benefit comparatively more from working on large projects and building a loyal customer base than from fielding one-time emergency jobs.

This paper also considers the relationship between a firm's name and its prices, finding that firms with names chosen to appear at the beginning of the Yellow Pages command higher prices for the same type of work. Again, the model in this paper explains why. Consumers require an incentive to search, and in this case consumers search to transact with firms that charge lower prices and provide higher-quality service.

Finally, this paper shows that firms also signal their quality through methods other than their names. Placing costly advertisements in the Yellow Pages, for instance, is associated with providing poor service, a finding that stands in contrast to the "money-burning" theory of advertising. Similarly, position auctions do not screen out low-quality providers in this market despite a previous literature that suggests that firms' listings will be sorted from high to low quality: firms in Illinois that ad-

vertise on Google provide appreciably worse service. The same model of behavior that rationalizes the results for firm names also applies to advertising in the Yellow Pages or on Google, as the incentives for firms to signal their qualities to potential customers still predominate. Low-quality firms respond to the search behavior of uninformed consumers irrespective of the platform, whether by spending more on advertisements, choosing lower-ordered names, or obtaining more prominent positions on Google.

Appendix

This appendix describes two supplemental data sources used to consider whether unobserved business volume represents an important confound for the paper's main results. A third source, New York City housing data, is described in the online appendix.

Dun & Bradstreet Data

Dun & Bradstreet, which collects data on businesses so that lenders can assess their creditworthiness, provides estimates of firms' employee levels and sales. Of the 346 plumbing firms in Illinois included in the database as of May 2013, those with names that begin with an A or a number have slightly more employees and sales, though lower sales per employee, as shown in table 7 in Section V; none of these differences are statistically significant.

Although the Dun & Bradstreet data have their own shortcomings (e.g., they overweight large firms and underweight A-name firms), they provide some evidence on how business volume differs across name types. Namely, these data suggest that the average employee works a similar number of hours per year regardless of his firm's name. Although the number of jobs that these hours represent is still unknown, such sales data can nevertheless provide a benchmark for how much the hours-per-job rate would have to differ between different name types in order to overturn the results from the complaint regressions in table 5. A calibration exercise presented in the online appendix considers such a calculation.

San Francisco Permit Data

Data for plumbing permits issued in San Francisco provide another approximation of plumbers' job counts and are appealing compared to the revenue numbers above because they are not confounded by unobserved price differences. Some obvious shortcomings of these data, however, are that (i) they provide no information about the size of the jobs and (ii) not all plumbing jobs require a permit, which may disproportionately affect A-name firms that complete mostly small jobs.

Table 5 in Section V presents summary statistics for San Francisco plumbing firms appearing in the database for 2012 (http://dbiweb.sfgov.org/dbipts/; accessed in May 2013). As in previous data sets, the number of employees does not systematically differ by name type. Moreover, A-name firms received more permits, on average, though this difference disappears once employee levels are taken into account (perhaps suggesting that the number of employees is indeed a good proxy for business volume). Once again, these findings are consistent with the claim that A-name firms do not receive appreciably more business. Even at twice the number of jobs per year, this difference would not overturn the complaint regressions if the number of hours worked per year is similar on the basis of the calculations presented in the online appendix.

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