

# “A” Business by Any Other Name: Firm Name Choice as a Signal of Firm Quality\*

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## Abstract

This paper considers when a firm’s freely chosen name can signal meaningful information about its quality, and examines a setting in which it does. Plumbing firms with names beginning with an “A” or a number receive five times more service complaints, on average. In addition, firms use names beginning with an “A” or a number more often in larger markets, and those that do have higher prices. These results reflect consumers’ search decisions and extend to online position auctions: plumbing firms that advertise on Google receive more complaints, which contradicts prior theoretical predictions but fits the setting considered here.

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# 1 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’ name. In response, many plumbing firms choose names strategically to attract business. In the city of Chicago, for instance, approximately 21% of plumbing firms use names that begin with an “A” or a number, such as A-AAAA Sewer & Drains and AAAA Scott’s Plumbing. A plumbing firm presumably chooses this type of name to appear near the beginning of the plumbing category in the Yellow Pages, which potentially attracts customers who begin 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 tradeoff. If they did not, all firms would prefer to use such a name.

One key tradeoff is the type of customer a name attracts. An infrequent customer with a small 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 minimizes the time spent finding one. In contrast, a customer with an important or extensive project, such as a large 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 projects.

Firms differ, however, in terms of the relative value they place on a particular customer. For example, 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 for a customer with a more elaborate job. As a result of these tradeoffs, a firm will choose a name that results in the optimal mix of customers given its type, making the name a credible signal of quality.

This intuition holds for 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. In this sense, a firm’s name provides meaningful information to consumers even though a low-quality firm could disguise itself as a high-quality firm 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 fifteen times as many complaints, on average.

The choice of a name also affects pricing decisions. Because the Yellow Pages lists names alpha-numerically, ordered search models such as Arbatskaya (2007) predict that prices will decline with the order a firm is searched since consumers require an incentive to make costly searching worthwhile. Again, these predictions hold empirically. In metro Chicago, firms with names that begin with an “A” or a number command an 8.4% price premium, all else equal.

The way in which consumers search and the amount of information they have about firms drive these results. That is, if all consumers had full information or could easily acquire it, quality-adjusted price dispersion would seem unlikely to persist across names. A pair of complementary findings supports this contention, as both the proportion of firms using names that begin with an “A” or a number and the extent of quality dispersion across names increase with market size. Because market size relates to asymmetric information for reasons such as word-of-mouth, referrals, and repeat business, these findings are consistent with predominately low-quality firms choosing names to attract uninformed customers with a low willingness to search.

These patterns also emerge on search platforms other than the Yellow Pages, despite their ostensible differences. For instance, Internet search engines such as Google do not list firms alpha-numerically, but instead sort listings using proprietary algorithms for the left-hand side of their search results and position auctions for the top and right-hand side. Because firms must bid to appear among the paid listings, a series of recent papers argues that position auctions enhance welfare by excluding lower-quality firms from search results, as only high-quality firms will submit winning bids in anticipation of satisfying more customers. For instance, Athey & Ellison (2011) contend that, “sponsored link auctions create surplus by providing consumers with information about the quality of sponsored links which allows consumers to search more efficiently.”

Contrary to the prediction that only the highest-quality firms will win position auctions,

plumbing firms that advertise on Google receive more than thirteen times as many complaints, on average. The model in this paper explains why: because Google disproportionately attracts uninformed customers with a low willingness to search, a low-quality plumbing firm has a greater incentive to appear among the top paid listings on Google, just as it has a greater incentive to use a name that appears among the top listings in offline Yellow Pages. As a result, the predicted efficiency gains from position auctions have not occurred in this particular case.

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 & Hortacsu 2010, McDevitt 2011), labor market outcomes (Einav & Yarovit 2006, Fryer Jr & Levitt 2004, Bertrand & Mullainathan 2004), voting behavior (Meredith & Salant forthcoming), and stock price returns (Cooper et al. 2001). No prior work (to my knowledge) has considered a model in which a firm's choice of a 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 Milgrom & Roberts (1986), Bagwell & Riordan (1991), Cooper & Ross (1984), and Salop & Stiglitz (1977). 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 consumers by sending deceptive signals about low prices 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 intuition 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 search results increases. Also related, Armstrong et al. (2009) examine the effects of prominence in search markets where 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 Chen & He (2006) and Athey & Ellison (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. In contrast, this paper shows that lower-quality plumbing firms dominate the most prominent positions in both the Yellow Pages and position auctions.<sup>1</sup>

The remainder of this paper proceeds with Section 2 which describes the empirical setting and highlights several stylized facts. Section 3 develops a stylized model of firm name choice and consumer search, derives a separating equilibrium, and outlines its testable implications. Section 4 presents the results from reduced-form estimates of the model and verifies that the implications hold. Section 5 provides an extension to Internet position auctions. Section 6 concludes. Finally, Appendix A describes the data and Appendix B contains all tables and figures.

## 2 Empirical Setting and Regularities

The Yellow Pages, which refer to printed directories that list the phone numbers and addresses of businesses within a geographic area, provide a natural starting point for a study of firm names. Most commonly, Yellow Pages list businesses under different category headings in alpha-numerical 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 & Rysman 2005). While declining in popularity over the past decade, users still made 13.4 billion print Yellow Page references in 2007, and 87% of U.S. households made at least one reference (Yellow Pages Association 2008).

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 strategy 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% of businesses listed in Chicago's Yellow Pages use a name that begins with an "A" or a number, only 6.2% of businesses among the fifteen most-viewed categories do. While seemingly counterintuitive, the placement of a business' 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

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<sup>1</sup>Armstrong & 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.

an “A” or a number, as shown in Table 2 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 comprise businesses used infrequently by customers with urgent needs inside their homes, such as locksmiths, electricians, and plumbers. For home-service categories in which customers do not incur transportation costs, a firm’s physical location has little bearing on their choice of a provider. As such, a firm’s other characteristics, including its name, must 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, as shown in Table 3, have a larger proportion of firms with names that begin with an “A” or a number. In Chicago, 22.6% of businesses in these categories use names that begin with an “A” or a number, significantly above the city-wide average of 9.3%. Moreover, the home-service categories among the top fifteen where businesses have the most repeated interaction with customers — lawn maintenance and landscaping services — have relatively fewer businesses that use names beginning with an “A” or a number: only 4.5% and 7.7%, respectively. For these firms, success depends more on satisfying customers repeatedly than on attracting attention with a particular name.

Among the home-service categories, plumbing embodies all of the stylized facts just described, and focusing specifically on this market in Illinois allows for a more detailed analysis of the economic primitives responsible for them. 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- to 72-month apprentice program under a licensed plumber, and maintain their skills with continuing education. Throughout Illinois, local municipalities can institute their own plumbing regulations, and occasionally require separate licensing.

Plumbers often assemble within firms, and Table 4 presents the summary statistics for residential plumbing firms operating within Illinois.<sup>2</sup> Notably, plumbing firms vary greatly in terms of their service quality, with the number of complaints filed with the Better Business Bureau

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<sup>2</sup>Appendix A describes the data sources used throughout this paper

servicing as one measure of this. Firms' complaints have a highly skewed distribution: the median number of complaints filed against a firm is 0, while a firm at the 99th percentile received 7. In other words, almost all firms provide adequate service; only a few generate the majority of complaints. In this setting, however, complaints represent a noisy measure of quality, as the time and effort required to file a formal complaint likely deters 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 provide a discrete marker of bad firms rather than a continuous measure of quality that ranges from low-end to luxury providers.

Plumbing firms make deliberate name choices, using names beginning with an "A" or a number more often than firms in most other categories. In Illinois, approximately 12.9% 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. This tendency increases for firms within the metro-Chicago area: 15.7% of plumbing firms serving metro Chicago use at least one name that begins with an "A" or a number, compared to 8.3% outside metro Chicago. As shown in Figure 1, these patterns emerge in markets outside Illinois as well; 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. In contrast, a category with similar Yellow Pages usage but where market size bears no apparent relation to a firm's name choice — 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 5. 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 per employee. As a robustness check, Table 6 provides the average reviews 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 lower ratings. As a falsification test, note also in Table 6 that this correlation between a firm's name and its rating does not hold for restaurants.

An immediate concern with translating a raw number of complaints to a measure of firm quality is that having more complaints might reflect 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 help rule out this concern. For one, firms that use names beginning with an “A” or a number do not have more employees, on average. Because plumbing is labor intensive by nature, this implies that they do not consistently receive more business due to the capacity constraints of individual plumbers. Relatedly, firms using names that begin with an “A” or a number receive more complaints per employee, suggesting that they provide lower-quality service even after controlling for the amount of business they do receive. Further evidence comes again from Table 6. If firms using names that begin with an “A” or a number received significantly more business, they likely would also receive significantly more reviews from customers, which they do not. Moreover, Yelp.com, Angie’s List, and Consumer’s Checkbook specifically ask customers to rate service quality, and on all sites firms using names that begin with an “A” or a number receive lower average ratings, which would not result mechanically from having more transactions. Based on this series of findings, no evidence suggests that firms using names that begin with an “A” or a number systematically serve more customers.

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. For instance, note in Figure 2 that this firm, linked clearly by its plumbing license in the two advertisements, uses at least four distinct names. A plumbing 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%) use only one name, 228 firms use more than one and they differ considerably from single-named firms, as shown in Table 7. 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% of firms that use more than one name have at least one beginning with an “A” or a number, compared with 10.0% for firms that use only one name.

Because having multiple listings in the Yellow Pages serves as a form of advertising, it might be particularly effective for attracting uninformed customers with a low willingness to search. The characteristics of firms that use more than one name align well with this notion: they (i) spend more on actual Yellow Pages advertising, (ii) are more likely to use a name that begins with



an “A” or a number, and (iii) receive more complaints. In short, predominately low-quality firms use more than one name, and their behavior on other dimensions is consistent with a strategy aimed at attracting uninformed consumers.

Finally, Table 8 presents the summary statistics from a price survey of plumbing firms described in Appendix A. 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 two-hour project that incorporates both a fixed fee and an hourly rate, as shown in Table 9.<sup>3</sup> 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-stat is small), which suggests they cater (slightly) more to customers with urgent needs, and hence a low willingness to search.

The survey also sheds light on a second, perhaps more subtle, concern 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 more likely to use the first plumber listed in the Yellow Pages and also be more likely to have a complicated repair that, irrespective of the plumber’s quality, will lead to a complaint.

To rule out this concern, consider again the summary statistics from the price survey in Table 8. Limiting the sample to firms that participated in the price survey provides a first robustness check. Since these firms proved more responsive to fielding unsolicited calls, they may be more likely to rely on the Yellow Pages for bringing in business; also in keeping with this claim, survey respondents spent considerably more on Yellow Pages advertising. Perhaps not surprisingly, firms with names that begin with an “A” or a number had a higher response rate, making up 15.1% of the survey compared to 12.9% of the overall firm population. More telling: they had 6.6 times as many complaints ( $p < 0.01$ ) among this restricted sample of 543 firms. Further, 33.7% of the respondents indicated they provide emergency service. Again, 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 begin with an “A” or a number received 13.3 times as many complaints

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<sup>3</sup>Some firms apply a fixed fee to the first hour of service, while others do not. This feature is explicitly accounted for when the two-hour project price is constructed.

( $p < 0.01$ ) and 5.1 times as many per employee ( $p < 0.01$ ). In both sample restrictions, firms with names that begin with an “A” or a number receive considerably more complaints, providing some reassurance that unobserved heterogeneity among customers is not driving the results.

### 3 Ordered Search and Uninformed Consumers

A main result stands out from the empirical setting described above: some firms provide low-quality service at high prices, with their propensity for doing so depending on both name and market size. The way in which consumers seek out firms and the limited information they have about them underpin these stylized facts, and two well-known models help characterize the economic mechanisms responsible for them.

In Salop & Stiglitz (1977), consumers have different costs for acquiring information about firms’ prices, and hence an equilibrium can obtain where those with high search costs remain uninformed and pay more than the competitive price. Building on these insights, Cooper & Ross (1984) consider a setting in which uninformed buyers know firms’ prices but not qualities. In their setup, asymmetric information allows disreputable firms to offer low-quality goods at high prices. That is, dishonest firms enter the market to “rip off” uninformed buyers, distorting the information conveyed by prices. This feature fits the market for plumbing services well. While some consumers have full information about prices and quality — say, those who have received a referral or used the firm before — others remain uninformed and may inadvertently select a low-quality firm, providing an incentive for disreputable providers to enter the market.

In addition, consumers often seek out firms in a systematic manner, and ordered search models such as Arbatskaya (2007) help explain the correlation between firm names and prices. In Arbatskaya’s setup, prices decline in the order a firm is searched, so consumers with lower search costs obtain better prices by searching longer in equilibrium. The model also fits the setting here: not only do consumers have different amounts of information about firm qualities, they also have different incentives to search for firms. For instance, a consumer with a low willingness to search — say, someone with a leaky faucet and a high opportunity cost of time — may simply call the first listing in the Yellow Pages; his small project will not justify investing much time comparing different plumbers. A consumer with a high willingness to search — say, someone with a large renovation project and a low opportunity cost of time — may search more extensively, taking

the time to solicit multiple bids or referrals from others. And, due to the alpha-numerical listing of businesses in the Yellow Pages, this search process likely follows a well-defined order (at least for a non-trivial portion of consumers), as several studies have shown that the order in which a list is presented affects ultimate choices.<sup>4</sup> In fact, the Yellow Pages were one of the motivating examples considered by Arbatskaya (2007).

### 3.1 Setup

The following setup tailors the models of Salop & Stiglitz (1977), Cooper & Ross (1984), and Arbatskaya (2007) in a way that, when taken together, can explain the stylized facts discussed in Section 2. 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 in a success — they are “honest” in the terminology of Cooper & Ross (1984). Low-quality firms, by contrast, have no incentive for providing successful service in the equilibrium described below.

**Consumers** Let two types of  $I \in \mathbb{R}$  consumers demand the service,  $E$  and  $R$ .<sup>5</sup> Each consumer-type has a project of size  $T_i$ , with  $1 \leq T_E < T_R$ , and receives utility  $V_R > V_E > 0$  from a success, but 0 otherwise. Assume an exogenous proportion  $\alpha \in (0, 1)$  of consumers are  $E$ -type, while  $1 - \alpha$  are  $R$ -type.

As in Cooper & Ross (1984), assume an exogenous fraction of each consumer-type,  $\theta_i \in (0, 1)$ , is 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.<sup>6</sup> Examples of why a consumer might be better informed in this setting

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<sup>4</sup>See Rubinstein & Salant (2006) for a list of examples.

<sup>5</sup>Let  $E$  stand for “emergency” and  $R$  stand for “renovation.”

<sup>6</sup>This assumption can be relaxed so that consumers know only the distribution of prices, at the expense of making the exposition considerably more cumbersome. This assumption reflects the idea that it is easier for consumers to obtain price information (e.g., over the phone) than quality information (i.e., plumbing is an experience good).

include: he has used the service before, received a referral from a neighbor, or subscribed to a review site. Naturally, informed consumers only contract with a high-quality firm, while the uninformed choose randomly among firms. Further, assume  $\theta_i$  is positively correlated with  $T_i$  so that  $\theta_E \leq \theta_R$ .<sup>7</sup>

**Names** Suppose firms choose one of two types of names,  $n \in \{A, Z\}$ , and consumers select a firm based on 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 a consumer may choose from, and  $S$  represents the cost of contacting a firm from the  $Z$ -type group. More concretely, 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 to the next set of search results. 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 service with quality  $q$  for an  $i$ -type consumer. Assume  $AC_i^q(x)$  is U-shaped with respect to  $x$ , and  $AC_R^q(x) < AC_E^q(x)$ .<sup>8</sup> In this setting, average hourly costs decline with  $T_i$  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. This suggests that a plumber who works mainly on small projects has higher average hourly costs than a plumber who works mainly on large ones, given their opportunity costs of time are similar.<sup>9</sup> 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 low-quality firms' average cost curves lie below high-quality firms' such that  $AC_i^L(x) <$

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<sup>7</sup>This correlation captures the intuition that consumers with more extensive projects likely will expend more effort to become informed about firms' qualities without explicitly modeling the endogenous decision to acquire the information. As in Salop & Stiglitz (1977), one could endogenize the decision to acquire information about firm quality by including a separate cost for obtaining it.

<sup>8</sup>As shown in Cooper & Ross (1984), this cost structure is crucial for the existence of a competitive equilibrium with asymmetric information. In the constant returns case, too many low-quality firms enter the market, driving out uninformed consumers.

<sup>9</sup>Say a plumber can work a ten-hour day and each project requires an hour of travel, setup, and so on. In this case, a plumber could take two four-hour projects or one nine-hour project. All else equal, the plumber taking the smaller projects will need to command a higher hourly rate to maintain parity with the plumber taking larger projects.

$AC_i^H(x)$ .<sup>10</sup> Moreover, assume the curvatures of the average cost curves for low-quality and high-quality firms over the relevant domain are such that

$$AC'_E(x) = AC'_R(x) \text{ and } AC''_E(x) = AC''_R(x), \quad (2)$$

which implies that firms' average variable costs are equivalent.<sup>11</sup>

**Entry** Assume 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, or, equivalently, lie at the minima of the average cost curves. If they did not, firms would enter and drive down prices until they did.

Recall that this setting fits what Nelson (1974) terms “experience goods,” as uninformed consumers will not know the true quality of the service until after purchase; they only know the conditional distribution of quality in equilibrium. As such, some firms will exploit uninformed consumers by providing low-quality service.

Assume 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

$$\pi_n = \frac{J_n^H}{J_n^H + J_n^L}, \quad (3)$$

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,  $\tilde{\pi}_n$ , for uninformed consumers to remain in the market at a given name:

$$\tilde{\pi}_n V_i - p_n T_i = 0. \quad (4)$$

When  $\pi_n < \tilde{\pi}_n$ , uninformed consumers prefer not to participate in the market; the risk of getting a low-quality firm is too great. This places 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 informed customers' willingnesses to pay, so

<sup>10</sup>For instance, if it requires one hour to fix a pipe properly, a low-quality firm might spend only five minutes before claiming to have fixed it.

<sup>11</sup>Figure 3 provides a graphical illustration of average cost curves that satisfy these assumptions.

high-quality firms and informed consumers always participate in the market.

**Prices** Let  $A$ -name firms charge  $p_A > 0$  per unit 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 & 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** Due to ordered search, buyers decide which page of search results to select from,  $A$  or  $Z$ , and then choose one of the listed firms.<sup>12</sup> 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 its costs.<sup>13</sup> Clearly, if  $p_Z > p_A$ , informed consumers would not search, as they always transact with a high-quality firm. Similarly, 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 gain in expected quality from search outweigh its 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; (iii) consumers choose firms optimally.

### 3.2 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 2. If a competitive sorting equilibrium

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<sup>12</sup>Search behavior is exogenous in what follows. As noted previously, many studies have shown that consumers do conduct ordered search, perhaps out of habit.

<sup>13</sup>To ease exposition, assume an informed  $R$ -type customer must still bear  $S$  even though the motivation was that an informed customer is likely to have had previous experience using the firm and likely would not need to incur the same costs as an uninformed customer to seek him out. In the sorting equilibrium considered below, this arguably unsatisfying assumption will not affect the results.

with asymmetric information and ordered search exists, it will have the following characteristics:<sup>14</sup>

**Characteristic 1** *The expected sales of each name- and firm-type are:*

$\hat{x}_A^H$  s.t.  $AC_E^H(x_A^H)$  is minimized for high-quality firms using A-type names;

$\hat{x}_Z^H$  s.t.  $AC_R^H(x_Z^H)$  is minimized for high-quality firms using Z-type names;

$\hat{x}_A^L$  s.t.  $AC_E^L(\hat{x}_A^L) = \hat{p}_A$  for low-quality firms using A-type names;

$\hat{x}_Z^L$  s.t.  $AC_R^L(\hat{x}_Z^L) = \hat{p}_Z$  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. Note this implies 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 due to free entry.

**Characteristic 2** *The price and quality for each name- and firm-type are:*

$(\hat{p}_A, 1)$  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 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 the probability 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:*

$\hat{x}_A^H = \frac{\alpha\theta_E I}{\hat{J}_A^H} + \frac{\alpha(1-\theta_E)I}{\hat{J}_A^H + \hat{J}_A^L}$  for high-quality firms using A-type names;

$\hat{x}_A^L = \frac{\alpha(1-\theta_E)I}{\hat{J}_A^H + \hat{J}_A^L}$  for low-quality firms using A-type names;

$\hat{x}_Z^H = \frac{(1-\alpha)\theta_R I}{\hat{J}_Z^H} + \frac{(1-\alpha)(1-\theta_R)I}{\hat{J}_Z^H + \hat{J}_Z^L}$  for high-quality firms using Z-type names;

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<sup>14</sup>Table 10 provides a numerical example.

$$\hat{x}_Z^L = \frac{(1-\alpha)(1-\theta_R)I}{\hat{j}_Z^H + \hat{j}_Z^L} \text{ for low-quality firms using } Z\text{-type names.}$$

These four equations dictate entry conditions such that high-quality firms' expected sales minimize average costs and they earn 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 & 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:*

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

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 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  $\frac{J_n^H}{J_n^H + J_n^L} < \tilde{\pi}_n$  for some name, an equilibrium will not exist.

Taken together, these characteristics help resolve the initial puzzle that firms with  $A$ -type names charge higher prices despite providing lower-quality service, on average. 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 apparent.

If these four sufficient conditions hold, the main result of interest follows:

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

Due to consumer sorting and the resulting average cost curves, Characteristic 3 implies

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



From  $\theta_E \leq \theta_R$  and assumptions (1) and (2), it follows that  $\frac{\hat{x}_Z}{\hat{x}_A} > 1$ , so the proportion of high-quality firms is greater for  $Z$ -type names.<sup>15</sup> At  $\theta_E = \theta_R$ , this result stems from the relative steepness of each average cost curve, which in turn stems from sorting by consumer-types. At  $\theta_E < \theta_R$ , the disparity widens further.

This structure yields the intuitively pleasing result that proportionally more low-quality firms serve consumers with a low willingness to search. One might expect this result for a number of reasons. First, low-willingness-to-search customers naturally seem to be the most susceptible to fraud, especially those with urgent needs or unimportant projects, as they will devote little time to vetting plumbers. Second, low-quality firms seem relatively more likely to target small-project customers who pay higher hourly rates; the cost curve for a low-quality firm does not bind like it does for a high-quality firm. At the same time, market forces will limit the amount of fraud that transpires in equilibrium in the sense that the market will unravel if too many low-quality firms enter. Finally, while this result did not depend on low-willingness-to-search customers being less informed than those with a high willingness to search, the result would be even more stark if they were. So, if low-willingness-to-search customers also have less motivation to become informed about quality by, say, subscribing to a review sight or seeking out referrals, comparatively more firms will choose  $A$ -type names, with low-quality firms being even more inclined to do so than high-quality firms.

### 3.3 Comparative Statics when Information Depends on Market Size

The above setup yields three additional implications regarding the proportion of informed consumers in the market. While strictly speaking these results relate only to  $\theta$ , market size represents a relevant proxy for this dimension. As discussed above, the proportion of uninformed consumers might increase with market size for several reasons. For instance, large metro areas continually have a steady influx of new residents who will be unfamiliar with local service providers. Moreover, word-of-mouth might diffuse less rapidly in large markets (e.g., a small town newspaper might expose dishonest plumbers, whereas a large city newspaper would not find this newsworthy). As argued in McDevitt (2011), the extent to which market size is correlated with asymmetric information can explain many of the observed patterns regarding firm name choices,

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<sup>15</sup>To see this, note that (2) implies  $\hat{x}_A^H = \hat{x}_Z^H$  (recall  $\hat{x}$  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.

and the results from the following section are consistent with this claim.

To begin, consider the proportion of low-quality firms among either name-type:

**Implication 2** *The average quality for either name-type increases with the proportion of informed consumers.*

For  $\theta'_i > \theta_i$ , it follows that

$$\frac{\hat{\pi}'_n}{\hat{\pi}_n} = \frac{\theta'_i}{(1-\theta'_i)} \frac{(1-\theta_i)}{\theta_i} > 1, \quad (8)$$

and thus the average quality of either name-type increases with the proportion of informed consumers in the market. Again, this result accords with intuition: when consumers become better informed, low-quality firms become less likely to find entry profitable.

Information also influences the relative proportion of name-types. To see this, assume  $\theta_E < \theta_R$  but  $\frac{1-\theta_R}{1-\theta_E} \rightarrow 1$  as  $\theta_E$  and  $\theta_R$  increase, meaning that the proportion of uninformed  $E$ -type consumers declines at a faster rate than the proportion of uninformed  $R$ -types, which it will as  $\theta_R$  approaches one. This leads to the following testable implications:

**Implication 3** *The proportion of firms using  $A$ -type names declines relative to  $Z$ -type names as the proportion of informed consumers converges across types.*

Because

$$\frac{\hat{J}_Z^H + \hat{J}_Z^L}{\hat{J}_A^H + \hat{J}_A^L} = \frac{(1-\alpha)(1-\theta_R)}{\alpha(1-\theta_E)} \frac{\hat{x}_Z^L}{\hat{x}_A^L}, \quad (9)$$

the proportion of firms using  $A$ -type names declines relative to  $Z$ -type names as  $\frac{(1-\theta_R)}{(1-\theta_E)} \rightarrow 1$  from below. Alternatively, as  $\alpha$  approaches 0 and  $R$ -type consumers become relatively more prevalent, the proportion of firms using  $A$ -type names also declines. In either case,  $A$ -type names become comparatively less attractive for firms.

This leads to a final implication related to information and the average quality of firms across name-types.

**Implication 4** *Quality dispersion across names declines as more consumers become informed.*

From

$$\frac{\hat{\pi}_Z}{\hat{\pi}_A} = \frac{\theta_R}{(1-\theta_R)} \frac{(1-\theta_E)}{\theta_E} \frac{\hat{x}_Z^L}{\hat{x}_Z^H - \hat{x}_Z^L} \frac{\hat{x}_A^H - \hat{x}_A^L}{\hat{x}_A^L}, \quad (10)$$

$\frac{\hat{\pi}_Z}{\hat{\pi}_A}$  declines as  $\frac{1-\theta_R}{1-\theta_E} \rightarrow 1$ , meaning that quality dispersion across names declines as consumers become more informed.

### 3.4 Discussion

This stylized setup reflects the main features of the empirical setting and isolates the key aspects of interest. At the same time, it ignores some potentially relevant market characteristics in favor of tractability. For instance, “search” in this model is more associated with gaining access to a better set of providers than learning about their attributes. As an abstraction, this may seem overly restrictive — consumers, even knowing a better firm is just a page flip away, are still bound to go through the list in order and bear the costs of doing so. Incorporating a learning process or making search endogenous within the model would better match reality, but would arguably not add much to the analysis if one interprets ordered search and its associated costs as also including behavioral biases.

Moreover, while this setup may result in several equilibria, only a sorting equilibrium received consideration due to its relevance for the empirical setting. Under certain conditions, pooling among firm-types may result — say, when search costs are too high relative to price and quality differences across names. In this case, *R*-type customers would not seek out firms using *Z*-type names, which would then prompt all firms to pool on *A*-types. As a result, expected costs would be driven by the mix of *E*- and *R*-type customers in the market, and prices would then move proportionally with these costs. For the example considered in Table 10, this leads to slightly more high-quality firms entering, and slightly fewer low-quality, which brings the average quality in the market above the average quality across names in the sorting equilibrium.

Finally, the analysis depends critically on differences in fixed costs across job types. In practice, however, firms will not specialize to such a stark degree. Furthermore, other types of heterogeneity will also influence firms and customers, and the data provide evidence that these may have a meaningful effect on market outcomes. Namely, decisions such as advertising expenditures, firm size, total names, and pricing structure differ across name types, but do not appear in the setup above. Their exclusion from the model was an attempt to focus intuition on the fewest possible parameters that could still generate the motivating empirical regularities of Section 2.

## 4 Results

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

$$y_j = \beta_A A_j + \alpha X_j + \varepsilon_j, \quad (11)$$

where the dependent variable,  $y_j$ , is a measure of firm quality;  $A_j$  is an indicator variable equal to one if the firm uses a name that begins with an “A” or a number;  $X_j$  is a vector of firm-specific variables such as advertising expenditures, number of employees, years in operation, number of names, and service area; and  $\varepsilon_j$  is the error term.

Table 11 presents the results from a series of such regressions, with Specifications (1)–(3) using the number of complaints filed with the Better Business Bureau as the dependent variable and Specifications (4)–(6) using the complaint rate per employee.<sup>16</sup> As a baseline, Specification (1) shows that the number of complaints filed against a firm is positively correlated with the number of workers it employs and the amount it spends on advertising in the Yellow Pages. Older firms receive fewer complaints, though the difference is not statistically significant at conventional levels. 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  $\beta_A$  is approximately 3.379, meaning that firms using an  $A$ -type name receive 237.9% more complaints than other firms, all else equal.<sup>17</sup> 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 2 related to advertising, firms that use multiple names receive 357.1% more complaints, all else equal. Note again that using multiple names is also related to a firm’s dynamic reputation concerns, as discussed in McDevitt (2011). While not considered directly

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<sup>16</sup>Due to the over-dispersed count nature of the complaints data, a negative binomial regression is used for Specifications (1)–(3). A statistically significant over-dispersion parameter ( $p < 0.001$  in all regressions) suggests this is an appropriate specification, though all qualitative results are robust to using an OLS, Poisson, or zero-inflated count specification. OLS is used for Specifications (4)–(6).

<sup>17</sup>Recall that the IRR for a parameter  $\beta$  is  $e^\beta$ .

here, the mere fact that a firm uses more than one name does convey information to consumers, regardless of the mechanism that leads to this outcome. Controlling for the use of more than one name reduces the marginal effect of having at least one that begins with an “A” or a number, bringing the incident rate ratio to 2.0, though the effect remains statistically significant ( $p < 0.01$ ). The qualitative interpretation of the remaining controls in Specification (3) is the same as in Specifications (1) and (2).

Finally, Specifications (4)–(6) use the complaint rate per employee as the dependent variable and all results are robust to the potentially confounding factor of not observing the number of transactions per firm. While the number of employees is controlled for in the complaint count regressions to proxy for transaction volume, the complaint rate specification provides further reassurance that receiving more complaints is not being driven mechanically by serving more customers, in keeping with the discussion in Section 2.

**Quality by Market Size** To examine the relation between firm names and asymmetric information, let a market’s size proxy for the proportion of uninformed consumers within it for the reasons discussed in Section 3. A number of simple statistics show that the relationship between a firm’s name and its service quality varies with market size in the predicted ways. In line with Implication 2, firms within metro Chicago receive considerably more complaints, irrespective of their names: more than 4.4 times more complaints ( $p < 0.01$ ) and more than 4.6 time more complaints per employee ( $p < 0.01$ ). In line with Implication 3, 15.7% of firms serving the more populous metro-Chicago area use a name that begins with an “A” or a number, while only 8.2% of firms outside metro Chicago do. In line with Implication 4, the ratio of complaints received by the average firm that does and does not use a name beginning with an “A” or a number in metro Chicago is 4.9, which compares with a ratio of 2.8 for firms outside metro Chicago.

To explore these findings in finer detail, Table 12 presents a series of regressions restricted to firms that serve the metro-Chicago area, with Specification (2) showing that firms within metro Chicago that use at least one name beginning with an “A” or a number receive 270.9% more complaints, all else equal. When controlling for firms that use more than one name in Specification (3), having a name that begins with an “A” or a number is associated with an IRR of 2.3 and remains statistically significant. Specifications (4)–(6) that use the complaint rate per employee as the dependent variable provide similar results. As predicted by Implication 4, the

signal a firm sends by using a name that begins with an “A” or a number conveys meaningful information within metro Chicago.

Table 13 presents the results from the same series of regressions but restricted to firms that do not serve the metro-Chicago area. As shown in Specification (2), firms outside metro Chicago that use at least one name beginning with an “A” or a number receive 282.4% more complaints, all else equal. Controlling for firms that use more than one name in Specification (3), however, reduces the marginal effect of having a name that begins with an “A” or a number — bringing the IRR to 1.9 — and renders the coefficient only marginally statistically significant (t-stat = 1.71). Furthermore, the effect of using a name that begins with an “A” or a number is statistically indistinguishable from zero in Specifications (4)–(6) that use the complaint rate per employee as the dependent variable. In this sense, the content of a firm’s name does not provide the same meaningful signal of a firm’s quality outside the metro area, perhaps suggesting that the proportion of uninformed customers in these smaller markets is not large enough to allow low-quality firms to sort by name. These results may reflect that business depends more on referrals and word-of-mouth in smaller markets, or that relative search costs are lower for consumers.

**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 a series of OLS regressions taking the form

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

where the price a firm quoted for a representative two-hour project,  $p_j$ , is the dependent variable, and the remaining controls are as before. Table 14 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, all else equal. 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% above the average in metro Chicago holding other explanatory variables at their sample means.

This premium may seem large given a setup where the cost of finding a better group of firms to choose from is merely flipping a few pages, but this “cost” may also reflect behavioral biases and

consumer inattention. Perhaps even more striking, a subscription to Angie’s List costs only \$25 per year and would allow a consumer to locate a high-quality plumber that charges competitive prices without much additional effort — that these results still hold in Chicago despite the diffusion of Angie’s List and other review sites suggests that a large segment of consumers does not expend much effort seeking out plumbers, which leaves room for dishonest providers to serve the market.

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, an intuitively pleasing result.

## 5 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 alpha-numerical 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 using a proprietary algorithm that ranks the relevance of each link, and the position of sponsored links by ordering firms based on their bids in a generalized second-price auction for keywords.<sup>18</sup> 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 & 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 and in what order. 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

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<sup>18</sup>In this auction, the  $k^{th}$  highest bidder wins the  $k^{th}$  highest link and pays the  $k + 1^{st}$  highest bid.

plumber who provides adequate service, i.e., service that will not lead to a complaint filed with the Better Business Bureau.

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 Appendix A. On average, firms 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 at least one name that begins with an “A” or a number, and are more likely to use multiple names, as shown in Table 15. In terms of quality, firms that advertise on Google receive more than thirteen times as many complaints, on average, and receive more than three times as many complaints per employee.

To control for confounding factors, Table 16 presents the results from a series of regressions in which the dependent variable is the number of complaints filed against the firm in Specifications (1)–(3), and the rate of complaints per employee in Specifications (4)–(6). As shown in Specification (1), firms that advertise on Google receive 205.2% more complaints, all else equal. Specifications (2)–(3) include other controls related to firms’ names and the results remain similar to those in Specification (1). Further, the main results are robust to using the complaint rate per employee as the dependent variable in Specifications (4)–(6), though multicollinearity reduces some t-stats considerably; even imprecisely estimated, however, Specifications (4)–(6) still reject the claim that firms appearing in Google’s sponsored search results provide higher-quality service. 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 intuition outlined in Section 3 explains 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 contention: they spend more on advertising in the Yellow Pages, use names beginning with an “A” or a number more often, and have more listings overall. The



correlation among these factors is consistent with a firm strategy aimed at attracting uninformed customers who predominately have a low willingness to search.

This result suggests that replacing traditional offline media with online search platforms will not necessarily make search more efficient in every market. Because firms often face the same incentives across both types of search platforms, the same relationship between position and quality holds as well. This result is consistent, however, with the spirit of the position auction literature. Those firms that have the most to gain from winning the position auction, relatively speaking, will submit the highest bids.<sup>19</sup> For plumbing, it is the low-quality firms that have the most to gain by attracting uninformed customers with a low willingness to search.

## 6 Conclusion

A firm's freely 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 disproportionately prefer to self-select names that attract uninformed customers with a low willingness to search because their poor service will not lead to referrals or repeat business, while high-quality plumbers do not choose this type of name because they benefit comparatively more from large projects and building a loyal customer base than from one-time emergency jobs.

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

Finally, this paper provides evidence that position auctions do not make search more efficient in all cases. While the previous literature suggests that firms' listings will be sorted from high to low quality, the converse holds for residential plumbing services: firms in Illinois that advertise on Google provide lower-quality service. The same model of behavior that rationalizes the results

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<sup>19</sup>Jerath et al. (2011) consider a related setting where the "inferior" firm appears above the "superior" firm in position auctions and finds empirical support for their model. In their application, however, a firm's quality is defined subjectively based on how well known (i.e., large) it is, rather than through objective measures.

from the Yellow Pages applies to 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 submitting higher position auction bids.

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## A Data

Data for all plumbing firms operating in Illinois come from a June 2008 download of the web-based version of ReferenceUSA. ReferenceUSA contains information based on businesses' listings in Yellow and White Pages, and continually updates and cross-checks its database with direct phone calls and comparisons with other directories. ReferenceUSA markets itself as a comprehensive resource for generating sales leads and conducting market research, and has been used in previous academic research.<sup>20</sup> The firm-specific information contained in ReferenceUSA includes the firm's name, address, years in operation, advertising expenditures in the Yellow Pages, and number of employees. Data for the descriptive statistics in Tables 1–3 and Figure 1 come from the 2005 version of American Business Disc for the city of Chicago instead of ReferenceUSA due to access limitations.

Data for the number of complaints 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 three years. A staff member reviews each complaint filed with the Better Business Bureau and forwards it to the accused company within two business days if deemed legitimate. If the company does not respond within 14 days, the Better Business Bureau makes a second attempt to resolve the issue. After two unsuccessful attempts at resolution, the complaint becomes a part of the business' record. Data from the Better Business Bureau have advantages over other sources of quality information for plumbing firms because the Better Business Bureau provides a more-comprehensive coverage of the firms operating in Illinois and verifies the legitimacy of each complaint. All results in this paper, however, are robust to using quality information from other popular platforms, including Angie's List and Yelp.com, as discussed in Section 2.

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 to generate an initial list of aliases among the universe of plumbing firms. In addition, names were linked to one another using the known aliases listed in the firm's Better Business Bureau record, when available. Finally, all firms listed in ReferenceUSA were surveyed by phone and several were discovered to have more than one name.<sup>21</sup>

Two processes were used to verify the preliminary matches. First, firms must register their names with the Illinois Secretary of State, and matches were cross-referenced on the department's website.<sup>22</sup> Second, potential matches were verified during the phone surveys. Using these measures, the 2,670 names listed 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 ReferenceUSA and the Better Business Bureau are constructed by summing over the variables for employees,

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<sup>20</sup>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.

<sup>21</sup>This occurred most frequently when a call to Firm X was answered by an individual stating he was from Firm Y.

<sup>22</sup>A firm must register its name with the county clerk of the county(ies) in which it operates. In Cook County, for example, this requires an application fee of \$50 and publishing a public notice in the local media. 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.

advertising expenditures, and complaints listed for all of its names.<sup>23</sup> In addition, a firm's years in operation is assumed to be the maximum age of all the names listed for the firm and that a firm serves 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., "#").

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 ReferenceUSA was queried 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. In this manner, price quotes were obtained from 543 of 2,293 firms (23.7%). A limitation of this survey is that the effective price of actual projects cannot be determined. For instance, a firm with a lower stated hourly rate could charge an ultimately higher price by taking longer to complete a project.<sup>24</sup>

Advertising data from Google were collected in June 2009. To obtain these data, an automated script conducted searches on Google related to plumbing services in Illinois. For example, the script 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.<sup>25</sup> In total, the script conducted 5,477 searches that resulted in 12,153 advertising listings. The advertisements on Google were then matched to the plumbing firms listed in ReferenceUSA, with 5,623 relevant advertisements linked to 85 firms.<sup>26</sup>

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<sup>23</sup>While it would be interesting to examine within-firm variation across names for these variables, the manner in which the Better Business Bureau reports complaints makes doing so infeasible. When the Better Business Bureau recognizes that a firm has more than one name, it reports a single complaint figure for all of its names. Therefore, it is not possible to separately assign complaints to each name used by that firm for those cases.

<sup>24</sup>In almost all cases, firms refused to provide detailed estimates of standard projects, such as fixing a broken pipe, without assessing the project in person.

<sup>25</sup>The complete list of search terms used is available upon request.

<sup>26</sup>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.

## B Tables and Figures

Rank	Heading	Users (MM)	“A” Names
1	Restaurants	1,269.5	4.6%
2	Physician & Surgeons	1,088.9	5.5%
3	Automobile Parts-New & Used	517.8	16.9%
4	Automobile Repairing & Service	392.5	14.5%
5	Pizza	295.7	3.4%
6	Attorneys/Lawyers	290.1	3.9%
7	Automobile Dealers-New & 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%

Table 1: Categories with the most Yellow Pages usage and the proportion of businesses using names that begin with an “A” or a number in the city of Chicago. Source: Yellow Pages Association, 2008; American Business Disc, 2005.

Rank	Heading	“A” Names
1	Locks & Locksmiths	65.9%
2	Towing-Automotive	28.9%
3	Taxi & Limousine Service	21.2%
4	Convenience Stores	21.2%
5	Plumbing Contractors	21.0%
6	Associations	20.8%
7	Insurance	19.9%
8	Roofing Contractors	15.2%
9	Cellular Telephone Services	14.9%
10	Art Galleries & Dealers	14.9%
11	Employment Agencies	14.8%
12	Automobile Repairing & Service	14.5%
13	Electric Contractors	14.1%
14	Travel Agencies & Bureaus	13.5%
15	Painters	13.3%

Table 2: Categories with the largest proportion of businesses using names that begin with an “A” or a number in the city of Chicago. The sample includes categories with 200 or more listings and excludes business listings that only contain addresses (e.g., apartment buildings). Source: American Business Disc, 2005.

Rank	Heading	Users (MM)	“A” Names
9	Plumbing Contractors	234.8	21.0%
23	Carpet & Rug Cleaners	90.6	13.5%
25	Electric Contractors	78.9	14.1%
29	Landscape Contractors	74.1	7.7%
31	Roofing Contractors	69.0	15.2%
42	Pest Control Services	53.3	21.1%
48	Heating Contractors	46.1	20.6%
50	Taxi & Limousine Service	43.7	21.2%
51	Lawn Maintenance	43.6	4.5%
52	Tree Service	43.1	28.2%
59	Air Conditioning Contractors	38.3	17.7%
69	Towing-Automotive	32.3	28.9%
77	Concrete Contractors	29.2	10.4%
82	Movers	28.3	13.8%
87	Locks & Locksmiths	26.9	65.9%

Table 3: Categories with the most Yellow Pages usage among home-service categories and the proportion of businesses using names that begin with an “A” or a number in the city of Chicago. A category is defined to be “home service” if a customer typically would not travel to receive the service. Source: Yellow Pages Association, 2008; American Business Disc, 2005.

Variable	Mean	Std. Dev.	Min.	Max.
Complaints	0.389	2.601	0	57
Complaints per Employee	0.138	1.373	0	57
Employees	5.632	15.455	1	300
Firm Age	12.505	8.938	1	25
Ad Spending	5,362.7	10,937.5	0	50,000
Name Begins with “A”	0.129	0.335	0	1
Number of Names	1.16	0.659	1	16
Metro Chicago	0.619	0.486	0	1
N	2,293			

Table 4: Summary statistics for plumbing firms operating in Illinois. If a firm uses more than one name, its firm-level variables are constructed by summing over the variables for employees, advertising expenditures, and complaints listed for all of its names. A firm’s age is assumed to be the maximum age of all the names listed for the firm. 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., “#”). Source: ReferenceUSA and the Better Business Bureau.



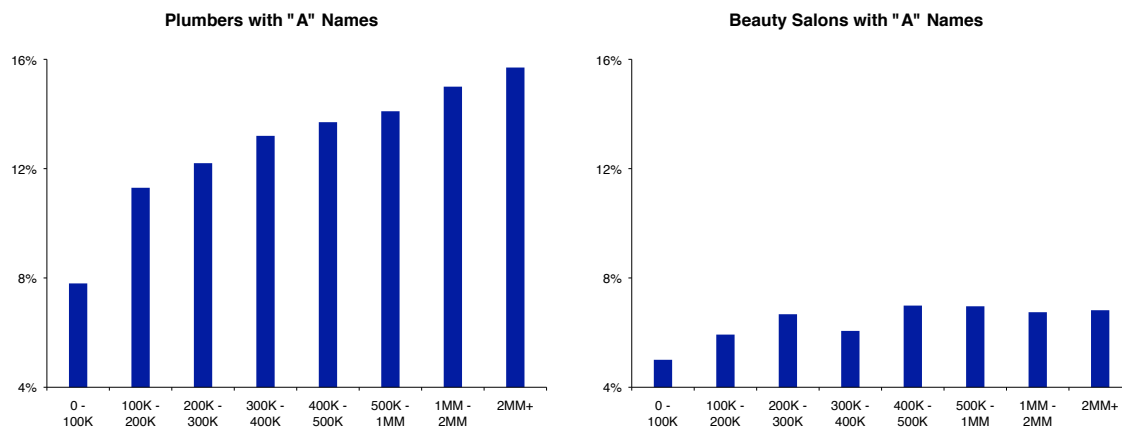


Figure 1: Proportion of plumbing firms (left) and beauty salons (right) using names that begin with an “A” or a number by market size across the United States. A market is defined to be a county. Within a given market-size bin, “proportion” is the average proportion of firms using names that begin with an “A” or a number across markets. Source: American Business Disc, 2005.

Mean of Variable	Name Begins with “A”		t-stat
	No	Yes	
Complaints	0.248	1.339	6.79
Complaints per Employee	0.101	0.387	3.35
Employees	5.530	6.325	0.83
Firm Age	12.767	10.729	3.67
Ad Spending	5,149.7	6,805.1	2.43
Metro Chicago	0.599	0.756	5.21
Number of Names	1.091	1.631	13.67
N	1,998	295	

Table 5: 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. If a firm uses more than one name, its firm-level variables are constructed by summing over the variables for employees, advertising expenditures, and complaints listed for all of its names. A firm’s age is assumed to be the maximum age of all the names listed for the firm. 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., “#”). Source: ReferenceUSA and the Better Business Bureau.

Review Source	Mean Firm Rating		Mean # of Reviews		Mean Price Index		# of Firms Reviewed	
	Name Begins with "A"	t-stat	Name Begins with "A"	t-stat	Name Begins with "A"	t-stat	Name Begins with "A"	% "A"
Yelp.com Illinois Plumbers	4.085	2.833	4.244	1.333	1.09	41	6	12.8
Yelp.com U.S. Plumbers	3.701	2.784	2.870	1.784	1.74	309	51	14.2
Yelp.com Illinois Home-Service	3.826	3.368	4.653	2.816	0.96	170	38	18.3
Angie's List Illinois Plumbers	4.497	4.145	20.957	24.618	0.35	376	55	12.8
Checkbook.com Illinois Plumbers	74.940	67.958	39.170	41.625	0.28	99.570	104.824	1.26
Yelp.com Illinois Restaurants	3.578	3.621	29.236	29.246	0.00	4,795	223	4.4

Table 6: 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. The 21 cities covered by yelp.com across the U.S. are 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 D.C. 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 & Locksmiths. 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. 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.



Figure 2: 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.

Mean of Variable	Multiple Names		t-stat
	No	Yes	
Complaints	0.191	2.180	11.25
Complaints per Employee	0.090	0.569	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	0.600	0.798	5.91
Name Begins with "A"	0.100	0.386	51.35
N	2,065	228	

Table 7: Conditional summary statistics for plumbing firms operating in Illinois based on whether the firm does or does not use more than one name. If a firm uses more than one name, its firm-level variables are constructed by summing over the variables for employees, advertising expenditures, and complaints listed for all of its names. A firm's age is assumed to be the maximum age of all the names listed for the firm. 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., "#"). Source: ReferenceUSA and the Better Business Bureau.

<b>Variable</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min.</b>	<b>Max.</b>
Fixed Fee	54.353	66.177	0	320
Hourly Rate	103.446	46.156	19.95	320
Has Fixed Fee	0.61	0.488	0	1
Two-Hour Price	215.846	94.641	39.9	640
Provides Emergency Service	0.337	0.473	0	1
Complaints	0.79	3.211	0	43
Complaints per Employee	0.158	0.548	0	7
Employees	9.297	20.569	1	300
Firm Age	14.823	9.153	1	25
Ad Spending	7,936.4	12,922.1	0	50,000
Metro Chicago	0.606	0.489	0	1
Name Begins with "A"	0.151	0.358	0	1
Number of Names	1.32	0.891	1	11
N	543			

Table 8: Summary statistics for plumbing firms operating in Illinois that responded to the price survey. 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 two hour price 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 summing over the variables for employees, advertising expenditures, and complaints listed for all of its names. A firm’s age is assumed to be the maximum age of all the names listed for the firm. 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., “#”). Source: Firm responses, ReferenceUSA, and the Better Business Bureau.

<b>Mean of Variable</b>	<b>Name Begins with "A"</b>		<b>t-stat</b>
	<b>No</b>	<b>Yes</b>	
Fixed Fee	48.789	85.634	4.74
Hourly Rate	100.173	121.847	3.97
Has Fixed Fee	0.584	0.756	2.97
Two-Hour Price	209.488	251.591	3.76
Provides Emergency Service	0.33	0.378	0.85
Complaints	0.425	2.84	6.51
Complaints per Employee	0.118	0.386	4.15
N	461	82	

Table 9: 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 two hour price includes its fixed service charge if it is not applied to the final price. Source: Firm responses.

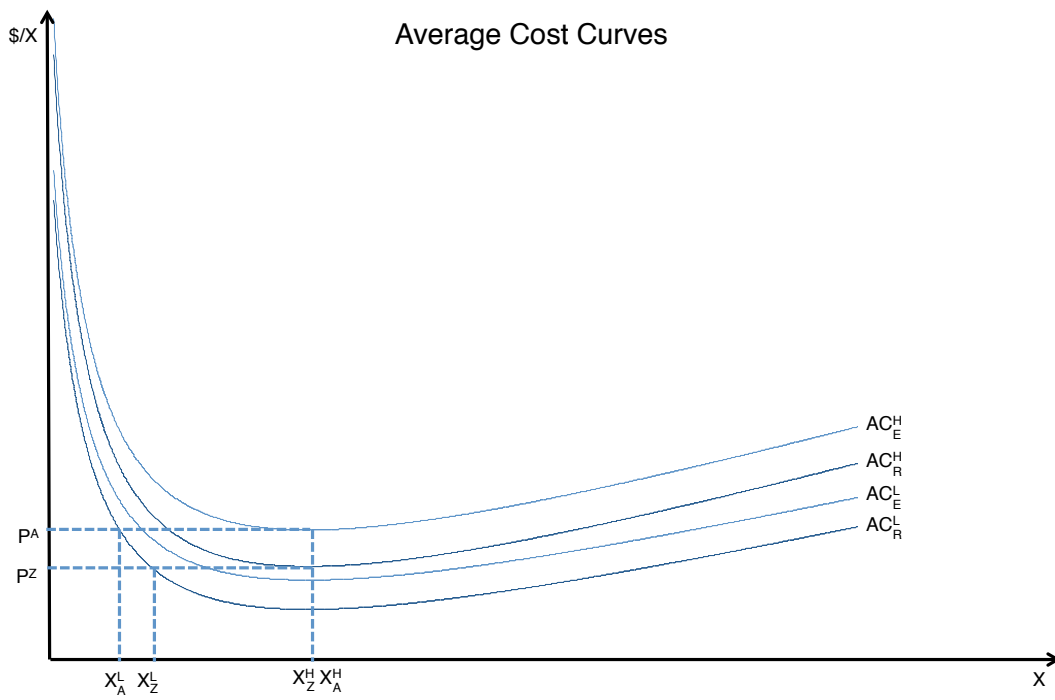


Figure 3: An example of average cost curves satisfying the assumptions of Section 3.

		Market Size	
Parameter		Large	Small
Exogenous	$I$	1000	500
	$T_R$	2	2
	$T_E$	1	1
	$V_R$	320	320
	$V_E$	160	160
	$S$	40	40
	$\alpha$	0.5	0.5
	$\theta_E$	0.5	0.51
	$\theta_R$	0.51	0.515
	$AC_E^H(x)$	$40 + 5x + 320x^{-1}$	$40 + 5x + 320x^{-1}$
	$AC_R^H(x)$	$22.5 + 5x + 320x^{-1}$	$22.5 + 5x + 320x^{-1}$
	$AC_E^L(x)$	$32 + 4x + 256x^{-1}$	$32 + 4x + 256x^{-1}$
	$AC_R^L(x)$	$21.5 + 4x + 256x^{-1}$	$21.5 + 4x + 256x^{-1}$
	Endogenous	$X_A^H$	8
$X_Z^H$		8	8
$X_A^L$		3.5	3.5
$X_Z^L$		3.7	3.7
$p_A$		120	120
$p_Z$		102.5	102.5
$J_A^H$		109.9	56
$J_A^L$		35	15
$J_Z^H$		117.7	59.4
$J_Z^L$		16	6.7
$\frac{J_Z}{J_A}$		0.92	0.93
$\pi_A$		0.758	0.789
$\pi_Z$		0.88	0.898
$\frac{\pi_Z}{\pi_A}$		1.16	1.14

Table 10: An example of a competitive sorting equilibrium in a large and small market.

	(1)	(2)	(3)	(4)	(5)	(6)
	Complaints	Complaints	Complaints	Comp./Emp.	Comp./Emp.	Comp./Emp.
Name Begins with "A"		1.218*** (0.267)	0.707** (0.309)		0.253*** (0.0844)	0.165** (0.0750)
Multiple Names			1.520*** (0.212)			0.407*** (0.0941)
Employees	0.0200** (0.00812)	0.0236*** (0.00857)	0.0206** (0.00862)	-0.00178*** (0.000562)	-0.00187*** (0.000588)	-0.00219*** (0.000699)
Ad Spending (\$'000s)	0.0557*** (0.00616)	0.0514*** (0.00690)	0.0421*** (0.00803)	0.00500* (0.00271)	0.00471* (0.00269)	0.00301 (0.00273)
Firm Age	-0.0118 (0.0142)	-0.0139 (0.0150)	-0.0102 (0.0173)	-0.00534* (0.00308)	-0.00473 (0.00317)	-0.00543* (0.00314)
Metro Chicago	1.158*** (0.227)	0.976*** (0.239)	0.917*** (0.272)	0.125*** (0.0424)	0.109** (0.0433)	0.0882** (0.0436)
Constant	-2.570*** (0.280)	-2.687*** (0.299)	-2.839*** (0.341)	0.110** (0.0498)	0.0818 (0.0541)	0.0852 (0.0538)
Observations	2293	2293	2293	2293	2293	2293
Pseudo $R^2$	0.069	0.082	0.102			
$R^2$				0.006	0.01	0.017

Robust standard errors in parentheses.

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

Table 11: Specifications (1)–(3) are negative binomial regressions in which the dependent variable is the number of complaints filed against the firm with the Better Business Bureau. Specifications (4)–(6) are OLS regressions in which the dependent variable is the number of complaints per employee filed against the firm with the Better Business Bureau. If a firm uses more than one name, its firm-level variables are constructed by summing over the variables for employees, advertising expenditures, and complaints listed for all of its names. A firm’s age is assumed to be the maximum age of all the names listed for the firm. 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., “#”).

	(1)	(2)	(3)	(4)	(5)	(6)
	Complaints	Complaints	Complaints	Comp./Emp.	Comp./Emp.	Comp./Emp.
Name Begins with "A"		1.311*** (0.259)	0.819*** (0.314)		0.317*** (0.109)	0.199** (0.0993)
Multiple Names			1.419*** (0.254)			0.442*** (0.113)
Employees	0.0157** (0.00683)	0.0229*** (0.00882)	0.0206** (0.00922)	-0.00158*** (0.000563)	-0.00167*** (0.000600)	-0.00195*** (0.000726)
Ad Spending (\$'000s)	0.0518*** (0.00691)	0.0446*** (0.00794)	0.0363*** (0.00910)	0.00479 (0.00335)	0.00444 (0.00331)	0.00287 (0.00335)
Firm Age	-0.0144 (0.0179)	-0.0242 (0.0194)	-0.0212 (0.0221)	-0.00792 (0.00509)	-0.00737 (0.00517)	-0.00885* (0.00514)
Constant	-1.327*** (0.361)	-1.562*** (0.460)	-1.762*** (0.545)	0.264** (0.105)	0.211* (0.113)	0.201* (0.113)
Observations	1420	1420	1420	1420	1420	1420
Pseudo $R^2$	0.045	0.061	0.078			
$R^2$				0.003	0.008	0.014

Robust standard errors in parentheses.

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

Table 12: *The sample is restricted to firms serving the metro-Chicago area.* Specifications (1)–(3) are negative binomial regressions in which the dependent variable is the number of complaints filed against the firm with the Better Business Bureau. Specifications (4)–(6) are OLS regressions in which the dependent variable is the number of complaints per employee filed against the firm with the Better Business Bureau. If a firm uses more than one name, its firm-level variables are constructed by summing over the variables for employees, advertising expenditures, and complaints listed for all of its names. A firm's age is assumed to be the maximum age of all the names listed for the firm. 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., "#").



	(1)	(2)	(3)	(4)	(5)	(6)
	Complaints	Complaints	Complaints	Comp./Emp.	Comp./Emp.	Comp./Emp.
Name Begins with "A"		1.341** (0.535)	0.656* (0.382)		0.0778 (0.0828)	0.0589 (0.0720)
Multiple Names			2.049*** (0.322)			0.281** (0.139)
Employees	0.0448** (0.0199)	0.0407* (0.0215)	0.0404* (0.0236)	-0.00263** (0.00111)	-0.00270** (0.00110)	-0.00297** (0.00120)
Ad Spending (\$'000s)	0.0741*** (0.0120)	0.0779*** (0.0129)	0.0687*** (0.0162)	0.00611** (0.00243)	0.00601** (0.00246)	0.00419* (0.00241)
Firm Age	-0.00605 (0.0215)	0.00899 (0.0169)	0.0178 (0.0182)	-0.00139 (0.00130)	-0.00113 (0.00110)	-0.000816 (0.000972)
Constant	-2.908*** (0.405)	-3.321*** (0.311)	-3.624*** (0.357)	0.0523** (0.0257)	0.0427** (0.0178)	0.0326** (0.0145)
Observations	873	873	873	873	873	873
Pseudo $R^2$	0.084	0.100	0.139			
$R^2$				0.028	0.033	0.075

Robust standard errors in parentheses.

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

Table 13: *The sample is restricted to firms not serving the metro-Chicago area.* Specifications (1)–(3) are negative binomial regressions in which the dependent variable is the number of complaints filed against the firm with the Better Business Bureau. Specifications (4)–(6) are OLS regressions in which the dependent variable is the number of complaints per employee filed against the firm with the Better Business Bureau. If a firm uses more than one name, its firm-level variables are constructed by summing over the variables for employees, advertising expenditures, and complaints listed for all of its names. A firm's age is assumed to be the maximum age of all the names listed for the firm. 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., "#").

	(1)	(2)	(3)	(4)
	Price	Price	Price	Price
Name Begins with "A"		21.04** (10.17)	21.06* (11.96)	5.274 (12.72)
Emergency Service			9.848 (7.990)	3.154 (8.146)
Begins with "A" * Emergency				41.60** (20.26)
Employees	-0.578*** (0.178)	-0.595*** (0.177)	-0.589*** (0.153)	-0.571*** (0.177)
Firm Age	0.671* (0.399)	0.789* (0.402)	0.791** (0.382)	0.726* (0.402)
Ad Spending (\$'000s)	0.148 (0.279)	0.0538 (0.282)	0.0090 (0.303)	0.0413 (0.284)
Metro Chicago	99.30*** (7.405)	97.10*** (7.459)	96.26*** (6.745)	95.83*** (7.462)
Constant	149.9*** (8.533)	147.2*** (8.606)	144.7*** (7.687)	147.8*** (8.914)
Observations	543	543	543	543
$R^2$	0.260	0.266	0.268	0.274

Standard errors in parentheses.

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

Table 14: OLS regression in which the dependent variable is the project price of firms responding to the survey. A firm's project price is calculated for two 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 summing over the variables for employees, advertising expenditures, and complaints listed for all of its names. A firm's age is assumed to be the maximum age of all the names listed for the firm. 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., "#").

Mean of Variable	Advertise on Google		t-stat
	No	Yes	
Complaints	0.265	3.588	11.91
Complaints per Employee	0.128	0.394	1.76
Employees	5.410	11.400	3.51
Firm Age	12.483	13.070	0.59
Ad Spending	4,947.7	16,141.8	9.44
Metro Chicago	0.608	0.918	5.81
Name Begins with "A"	0.123	0.282	4.33
Number of Names	1.135	1.800	9.30
N	2,208	85	

Table 15: Conditional summary statistics for plumbing firms operating in Illinois 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 result data described in Appendix A. If a firm uses more than one name, its firm-level variables are constructed by summing over the variables for employees, advertising expenditures, and complaints listed for all of its names. A firm’s age is assumed to be the maximum age of all the names listed for the firm. 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., “#”). Source: Google search results, ReferenceUSA, and the Better Business Bureau.

	(1)	(2)	(3)	(4)	(5)	(6)
	Complaints	Complaints	Complaints	Comp./Emp.	Comp./Emp.	Comp./Emp.
On Google	1.116*** (0.234)	0.942*** (0.256)	0.977*** (0.343)	0.195** (0.0889)	0.162* (0.0868)	0.107 (0.0900)
Name Begins with "A"		1.166*** (0.279)	1.176*** (0.306)		0.247*** (0.0844)	0.233*** (0.0893)
Begins w/ "A" * On Google			-0.127 (0.521)			0.207 (0.220)
Firm Age	-0.0136 (0.0147)	-0.0148 (0.0153)	-0.0148 (0.0155)	-0.00542* (0.00307)	-0.00482 (0.00316)	-0.00485 (0.00317)
Ad Spending (\$'000s)	0.0497*** (0.00622)	0.0478*** (0.00732)	0.0480*** (0.00752)	0.00441 (0.00274)	0.00423 (0.00272)	0.00413 (0.00272)
Employees	0.0168** (0.00726)	0.0203*** (0.00783)	0.0203*** (0.00781)	-0.00188*** (0.000572)	-0.00195*** (0.000600)	-0.00199*** (0.000612)
Metro Chicago	1.032*** (0.234)	0.883*** (0.245)	0.883*** (0.245)	0.117*** (0.0433)	0.103** (0.0441)	0.104** (0.0442)
Constant	-2.482*** (0.284)	-2.623*** (0.306)	-2.626*** (0.314)	0.112** (0.0496)	0.0843 (0.0538)	0.0867 (0.0543)
Observations	2293	2293	2293	2293	2293	2293
Pseudo $R^2$	0.073	0.085	0.085			
$R^2$				0.007	0.010	0.010

Robust standard errors in parentheses.

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

Table 16: Specifications (1)–(3) are negative binomial regressions in which the dependent variable is the number of complaints filed against the firm with the Better Business Bureau. Specifications (4)–(6) are OLS regressions in which the dependent variable is the number of complaints per employee filed against the firm with the Better Business Bureau. 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 Appendix A. If a firm uses more than one name, its firm-level variables are constructed by summing over the variables for employees, advertising expenditures, and complaints listed for all of its names. A firm’s age is assumed to be the maximum age of all the names listed for the firm. 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., “#”).