

# The Value of Competitor Information: Evidence from a Field Experiment

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### Abstract

Understanding the competitive environment is considered central to strategic decision-making, but growing evidence suggests that firms may lack knowledge about their competitors even when the costs to acquiring it are low. Is competitor information not as valuable as theorized? I empirically explore this question by running a field experiment in collaboration with Yelp across 3,218 businesses in the personal care industry, where treatment firms receive easily accessible information on their nearby competitors' prices. I find that over 46% of firms are not aware of their competitors' prices prior to receiving information. However, once firms receive competitor information, they are 17% more likely to change their prices and do so in performance-enhancing ways, which ultimately results in higher proxies of performance. Treatment effects are larger for firms that face higher levels of competition and firms without prior experience using price promotions, suggesting that a lack of competition or capabilities to use information may not fully explain firms' lack of knowledge. Given this large positive impact of competitor information, why had firms not invested in this information on their own? Evidence from interviews and a follow-up experiment across control firms suggest managers appear to have underestimated the value of paying attention to this information, because outdated knowledge they held falsely led them to believe they were already aware of it. These findings suggest that inattention may be a key barrier that leads firms to fail to realize gains from even readily accessible data.

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## 1 Introduction

Understanding the competitive environment is considered a central input to strategic decision-making. Firms require awareness of who their competitors are and what decisions they are making in order to respond to competitive threats and learn from competitors (e.g. Porter 1980, Wang and Shaver 2014, Marshall 1920, Ingram and Baum 1997). Accordingly, empirical work has assumed that firm decisions on price, quality, or location take into account competitor decisions, rationalizing that firms locate more closely to other firms to take advantage of information spillovers (Shaver and Flyer 2000, Alcacer and Chung 2007) or “optimally differentiate” in one dimension but not another to avoid competition (Baum and Haveman 1997, Semadeni 2006, Barlow et al 2019).

However, growing evidence suggests that firms of varying sizes across various markets lack knowledge about their competitors, even in settings where barriers to information acquisition appear to be low. Hotels fail to identify key competitors of similar price and size (Baum and Lant 2003). Department stores set their prices independent of competitor prices for the same products (Cyert and March 1963). Large textile manufacturers are unaware of common management practices like having an uncluttered factory floor, despite their widespread adoption (Bloom et al 2013). This lack of competitor knowledge may have large implications for firm performance: firms may fail to respond to competition or miss out on opportunities for performance improvements.

Why might firms lack knowledge about their competitors, even when it appears to be easily attainable? It may be that competitor information is not as valuable as theorized across many market contexts.<sup>1</sup> It may also be that even when it is indeed valuable and easily attainable, firms suffer from other barriers to realizing the value of competitor information.<sup>2</sup> While empirically identifying these underlying reasons is difficult due to confounding selection effects and the need to observe a large sample of firms across differing market contexts, doing so can provide a precise sense of what information firms use – and should use – in strategic decision-making. As competitor data becomes increasingly accessible in the digital age, unpacking this question has practical implications for when firms should invest in competitor intelligence and how they can overcome potential barriers in realizing gains from data.

In this paper, I empirically explore this question, using a field experiment across 3,218 businesses in the personal care industry to tease apart the value of competitor information. I focus on firms’ pricing decisions, a difficult strategic decision that determines how much value firms can capture. I collaborate with Yelp to physically send canvassers to all 3,218 firms for a standard marketing visit. Firms randomly assigned to treatment receive additional information during this visit on their relative price positioning compared to their 9 geographically closest competitors. I obtain measures of firms’ baseline knowledge of their competitors prior to treatment, and analyze how firms change their pricing and the implications for performance over a 12-month period.

I run this experiment across personal care businesses that offer nail services, as it enables precise identification of competitor knowledge and its value across thousands of firms in hundreds of local markets. A \$9.8 billion market in the U.S., nail salons represent the largest narrow vertical of local businesses (IBIS 2019). The large number of firms and local markets enables me to evaluate competitor knowledge and the value of competitor information across different firm attributes and degrees of market competition. Information on competitor prices is easily accessible in this market via phone calls

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<sup>1</sup> In less competitive markets, there may be little gains from acquiring competitor information. In more competitive markets, observing residual market demand may provide sufficient statistics for competitor information. Furthermore, competitor decisions and practices may not provide complementary value to firms that are pursuing differentiated strategies, and even potentially impede efficient search processes (Milgrom and Roberts 2000, Rivkin 2000, Boudreau et al 2016).

<sup>2</sup> Some firms may lack capabilities to take advantage of it due to prior experience or how they process and categorize competitor information (Cohen and Levinthal 1990, Porac et al 1989, Baum and Lant 2003).

or visits, enabling me to study why firms might lack competitor knowledge even when information is easily attainable.<sup>3</sup> Moreover, nail salons have standardized and observable measures of price positioning: every salon has a price for a regular manicure, which varies from approximately \$5 to \$150, and all other services are priced based upon this most basic service.<sup>4</sup> Measures of quality positioning can also be readily observed from the nail polish brands used, the cleanliness of the interior, and the luxuriousness of the décor. How these decisions are made resemble those of other retail businesses, as well as of small and medium enterprises (SMEs) more generally, which make up 99.7% of all U.S. establishments and 46% of GDP.<sup>5</sup>

To measure the value of competitor information, I construct a panel data set of monthly prices and proxies of performance over 12 months. A team of ~50 data collectors make phone calls each month to all 3,218 businesses to obtain prices of regular manicures. They also physically visit businesses at baseline and endline to observe their polish brands, cleanliness, and luxuriousness as measures of their quality. To measure proxies of performance, I collect an indicator of availability for an appointment on the next day during a peak hour, as well as purchase intentions from the Yelp platform, which include calls to the business, page views, and map directions views. I also work with the city government of San Francisco to obtain data on business sales taxes.

At baseline, a large percentage of firms appear to lack competitor knowledge, including those that face higher levels of competition. When asked by canvassers who their primary competitors are and what prices they are charging prior to treatment, over 46% of firms are not able to state specific competitors or prices. Consistent with this evidence, I find a large dispersion of prices across firms that offer similar levels of quality, as well as discrepancies between firms' stated versus observed price-quality positions. These patterns remain even among firms that face higher levels of competition, as measured by their distance from the nearest competitor and baseline price dispersion in the market.

Once firms receive competitor information, they change their pricing in performance-enhancing ways, suggesting that this information may be valuable. Treated firms are 17% more likely to change their prices relative to control firms in the months following the canvasser visit. Firms that were over- or under-pricing relative to their quality respond most to treatment, and firms that were charging higher prices compared to their nearest competitors decrease prices, while those that were charging lower prices increase them. Receiving competitor information ultimately results in higher measures of firm performance: treatment firms have a 15% higher number of calls, page views, and map directions views on Yelp, and a 3% lower availability for an appointment the next day. These performance effects do not appear to be driven by firms' increased usage of the Yelp platform.

Treatment effects are larger for firms that face higher competition, as well as those without prior experience using price promotions, suggesting that a lack of competition or capabilities to use the information may not fully explain firms' lack of knowledge. This finding is consistent with the interpretation that while higher competition may not be sufficient to increase firms' awareness of competitors, competitive forces may increase the value of competitor information and hence firms'

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<sup>3</sup> Obtaining competitor prices that are provided as treatment takes less than 9 minutes of phone calls (less than a minute per competitor), and many managers state that they could easily obtain this information online, suggesting that the acquisition costs are fairly low.

<sup>4</sup> More elaborate nail services (e.g. nail art or pedicure) are priced in proportion to the regular manicure price, such that two salons with approximately similar regular manicure prices will have approximately similar prices across their other services. This is often not the case in even other simple markets: for example, among cafes, comparing prices of a cup of coffee may not map to their price positioning, as cafes have differing sizes of cups, and some may have cheaper coffee but more expensive pastries.

<sup>5</sup> SMEs are defined by the U.S. Small Business Administration as firms with fewer than 500 workers. Firms with fewer than 100 workers account for 98% of employer firms, and firms with fewer than 20 workers make up 89%. SMEs represent 47% of employment and 46% of GDP. (<https://sbecouncil.org/about-us/facts-and-data/>).

responses to becoming aware. Furthermore, firms without prior experience appear to be able to use this information to improve their decisions.

Given this large positive impact of competitor information, the natural question is why firms had not previously invested in this information on their own. Evidence from interviews and a follow-up experiment across control firms suggests that attentional costs may have been an important factor, consistent with research on the importance of managerial attention (Ocasio 1997, Helfat and Peteraf 2014, Hanna, Mullainathan, and Schwartzstein 2014, Golman, Hagmann, and Loewenstein 2017). One mechanism that appears to drive firms' inattention is that outdated knowledge of competitors leads firms to falsely believe that they are already aware and underestimate the value of paying attention, until they are triggered to explicitly reevaluate their knowledge. This suggests that firms may fail to update from even readily accessible information, and that they may not be able to realize the potential gains from data even as it becomes increasingly available.

This paper relates to several strands of literature. First, a large literature on firms' management practices has documented how firms' lack of knowledge and adoption of best practices may explain the dispersion in performance observed across firms (Bloom and Van Reenen 2007, Syverson 2011, Bloom et al 2013, Sadun et al 2017). This paper builds on this literature by providing evidence on how widespread firms' lack of competitor knowledge may be even for strategically important decisions like pricing, and how increased competitor information can improve these decisions by better aligning pricing to quality decisions. These findings suggest that operational effectiveness may be important for not only management practices, but also strategic choices like positioning.

Second, a growing literature on cognitive underpinnings of strategy has proposed the importance of firm capabilities for attention (Ocasio 1997, Kaplan, Murray, and Henderson 2003, Helfat and Peteraf 2014). But problems in measurement and identification have made it hard to confirm how attention might impact firm strategy, and why some firms may be inattentive has remained a question. This paper provides empirical evidence on how inattention might lead firms to overlook competitor information, and proposes that firms may become inattentive due to outdated information that leads them to be complacent to new information. Building on ideas proposed by Gavetti (2012), these findings suggest that even in competitive markets, managers may need to worry about inattention to the immediate competitive environment, and that attention may create opportunities for competitive advantage by exploiting the cognitive limitations of other firms.

Lastly, the growth of platform businesses has spurred a literature on how the design of platforms impacts the performance of firms in the marketplace, as well as the growth of the marketplace itself (Jansiti and Levien 2004, Parker and Van Alstyne 2005, Eisenmann 2007, Kapoor and Agarwal 2017, Piezunka, Katila, and Eisenhardt 2015, Rietveld, Schilling, and Bellavitis 2019). Many platforms are increasingly seeking to optimize the supplier side of their marketplaces by reducing frictions across sellers, such as businesses on Google or Bing that fail to update their bids for advertising when doing so could increase revenues, or Airbnb hosts that fail to adjust their pricing even as demand increases (Airbnb 2017). This paper suggests that one promising direction may be to introduce information on competitors, which may improve firm decisions as well as help optimize the marketplaces themselves.

## 2 Experimental Design

To isolate the value of competitor information on firm pricing, I run a field experiment across businesses in the personal care industry. All firms in the sample receive marketing visits from Yelp canvassers, during which treatment firms receive additional information on the prices of 9 geographically closest competitors. Canvassing visits result in a balanced experimental sample of 3,218

firms, which represent approximately 60% of each market across New York, Los Angeles, San Francisco, and Chicago. I observe low levels of attrition and non-compliance.

## 2.1 Study context and setting

Case studies have long provided valuable insights to uncover empirical facts. Studies of hotels have yielded numerous insights on firm positioning, location choices, learning, and competitor perception (Baum and Haveman 1997, Baum and Ingram 1998, Chung and Kalnins 2001, Baum and Lant 2003, Li and Netessine 2012). Pizza stores offered evidence on how organizations acquire and transfer knowledge (Darr, Argote, and Epple 1995). Taxicab companies enabled a detailed study of coordination costs and organizational rigidity (Rawley 2010). Careful studies of fishing boats in India, pineapple farms in Kenya, local gas stations, and ready-mix concrete have provided detailed insights on issues as diverse as firm productivity, learning, and pricing (Conley and Udry 2010, Jensen 2006, Lewis 2008, Syverson 2004). In each of these papers, grounding the question in a case study of a particular industry helps identify precise measures of concepts and uncover new hypotheses or puzzles from the richness of the context.

However, finding a market to study why firms might lack competitor knowledge and what its value might be for a strategic choice like price positioning is difficult, due to the many requirements it imposes. It requires a large number of firms across varying market conditions to statistically identify the extent to which the value of competitor information might vary across levels of market competition or firm attributes. Moreover, price positioning must be clear, measurable, and comparable across firms, which is challenging to find and often reduces the sample to an even smaller number of firms. For example, even in a relatively simple market like cafes, it is not straightforward to precisely measure firms' price positioning: cafes vary in their menus with some items that are more expensive than others, and even a seemingly comparable item like a cup of coffee does not provide comparable measures across establishments due to its varying size and quality, both of which are challenging to consistently measure. As a result, much prior research on positioning has been based on qualitative case studies of single organizations or limited by small sample sizes: 50 consulting firms in Semadeni (2006), 159 banks in Deephouse (1999), and 614 hotels in Baum and Haveman (1997).

After assessing many possible industries<sup>6</sup>, I chose to focus on personal care businesses that offer nail services, due to the extent to which I can isolate price positioning and how it changes. The market for nail salons is estimated to be approximately \$9.8 billion in the U.S. (IBIS 2019). As a point of comparison, the nail salon industry is slightly larger than the men's clothing store market in the U.S., estimated at \$8.5 billion, and slightly smaller than the egg production market, at \$10.5 billion (IBIS 2019). While the nail salon market is fairly competitive and fragmented, large chains also exist. For example, Regal Nails has over 800 salons across U.S., Canada, and Puerto Rico, with over 1.15 million in annual revenues. Many nail salons represent entrepreneurial endeavors, often founded by college-educated immigrants and women who pursue entrepreneurship as career alternatives (Nails Magazine 2013). A prominent example of an entrepreneurial salon is Miniluxe, a Boston-based chain of 25 salons, which recently received \$23 million in venture capital investments.

The nail salon industry has a number of attributes that make it an apt setting to study the value of competitor information on firm pricing. First, nail salons represent the largest vertical among local businesses and compete locally, as customers typically do not enabling a sample of thousands of firms across hundreds of local markets.<sup>7</sup> The large number of firms and local markets enables me to evaluate

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<sup>6</sup> I analyzed industry verticals across drycleaners, florists, and restaurants based on market (and sample) size, comparability and observability of price positioning, and competitor information accessibility.

<sup>7</sup> Potentially as a result of the level of competition, nail salons have recently come under regulatory scrutiny for labor rights violations.

competitor knowledge and the value of competitor information across different firm attributes and degrees of market competition. Second, they have standardized, comparable, and observable measures of pricing positioning. Every salon has a price for a regular manicure, which approximately represents its price positioning, as other services are priced proportionally to the regular manicure price. Regular manicure prices vary from \$5 to \$150 depending on quality,<sup>8</sup> which can be observed in the salon's polish brands, cleanliness of the interior, and luxuriousness of décor. These price and quality decisions and how they are made are generally similar to those of other retail businesses, as well as of small and medium enterprises (SMEs) more broadly, which make up 99.7% of all U.S. establishments and 46% of GDP.<sup>9</sup> Finally, information on competitor prices is easily accessible via phone calls or visits, enabling me to study why firms might lack competitor knowledge even when information is easily attainable.<sup>10</sup>

Within this context, I partner with Yelp, an online platform that crowdsources listings and reviews of local businesses. As of June 2018, Yelp listed over 4.6 million verified<sup>11</sup> businesses including restaurants, home services, beauty salons, and fitness centers, accumulating 163 million reviews and attracting 74 million unique desktop and 72 million mobile visitors on a monthly average basis (Yelp 2018). Yelp displays business listings with location information, which are continually sourced from Yelp's internal team, user reports, and partner acquisitions, and checked by an internal data quality team. Yelp also provides reviews and photos that detail business decisions, and tracks proxies of business performance, such as calls to the business, views of map directions to the business, and business pageviews. Furthermore, it has a free business dashboard for businesses to observe information about their reviews, where Yelp could in theory provide information about their competitive context.

I collaborate with Yelp to run a field experiment by scaling up existing efforts within the company that sent canvassers to physically visit local businesses. At the time, Yelp was making marketing visits to a handful of businesses each year to inform them about how to update their information on Yelp's free business page. I scale up these efforts and layer an information intervention on top of the standard marketing visit for businesses assigned to treatment. This setting provides an advantage over online platform settings, by enabling information to be verifiably delivered.

## 2.2 The competitor information intervention

All firms receive a marketing visit from a Yelp canvasser, and firms assigned to treatment receive additional information on competitor price positions during this visit. This information displays the relative price positions of their 9 geographically closest competitors, which canvassers explain based on a standardized script on which they are trained.

Within the experimental sample, all firms across control and treatment groups receive a physical visit from a Yelp canvasser. The canvasser provides a brochure with information on how to edit business details, add photos, and respond to reviews on Yelp's free business page (**Figure 1**) and offers assistance with claiming their page. For businesses who have already claimed their Yelp page, the canvasser offers assistance with verifying the information or logging into the account. Firms also receive a standard marketing postcard with free Yelp advertising credits on the front and a blank canvas on the back (**Figure 1**).

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<sup>8</sup> This range of manicure prices is observed across the entire set of 6,370 nail salons that I verified across the San Francisco Bay Area, New York City, Los Angeles, and Chicago.

<sup>9</sup> SMEs are defined by the U.S. Small Business Administration as firms with fewer than 500 workers. Firms with fewer than 100 workers account for 98% of employer firms, and firms with fewer than 20 workers make up 89%. SMEs represent 47% of employment. (<https://sbeccouncil.org/about-us/facts-and-data/>).

<sup>10</sup> Obtaining competitor prices that are provided as treatment takes less than 9 minutes of phone calls (less than a minute per competitor). Most firms are aware of Yelp, and many managers comment that they could easily obtain this information online, suggesting that the acquisition costs are fairly low.

<sup>11</sup> Verification means that the business claimed their free page on Yelp, verifying that the listing was a true business.

Businesses assigned to treatment additionally receive a personalized competitor pricing report on the back of the marketing postcard (**Figure 2**). The postcard displays the firm's regular manicure price compared to its nine geographically closest competitors.<sup>12</sup> It also lists the name of each competitor and the exact price it charges.<sup>13</sup> In order to further facilitate comprehension, the postcard displays the name of the business at the top with a summary description, which is algorithmically generated to take one of four versions: (1) You charge the lowest/highest price in the area. [If applicable:  $n$  businesses charge the same price.] (2) Most businesses nearby charge higher/lower prices than you.  $n$  businesses charge less/more. (3) Most businesses nearby charge the same or higher/lower prices as you.  $n$  businesses charge less/more. (4) Most/All businesses nearby charge the same price as you.

Every canvasser is trained using a standardized script. The team managers in the four cities and I trained each canvasser individually, guiding each canvasser through at least three hours of practice with the script and detailed data recording steps, followed by a few hours of canvassing visits together to confirm correct execution. A phone application records the canvasser's location and date stamp for the business visit. Canvassers are instructed to follow up with a business up to three times if they are not able to speak with a manager or owner. If they are still unable to do so by the third visit, canvassers leave the brochure and postcard, and provide a contact number for any questions. They record descriptions of each interaction they have with businesses, such as whether they are able to speak with someone or asked to come back another time.

Canvassers are not informed of the experiment or experimental conditions. Approximately two to five canvassers work in each metropolitan area at any given time. They are assigned to one form of canvassing (either control or treatment) to begin, and transition to the other canvassing type after a few weeks, with the explanation that Yelp is trying different ways to canvass. No canvasser performs both types of canvassing during the same period or switches more than once between canvassing types, in order to avoid the possibility that the canvasser may confuse the protocol.

### 2.3 Sample definition, randomization, and timing

To determine the eligible set of businesses for the experiment, all nail salon listings on Yelp across the San Francisco Bay Area, New York City, Los Angeles, and Chicago are verified via phone calls. Firms in the eligible set are randomly assigned to control or treatment, stratified on the metropolitan area, prior relationship with Yelp, and Yelp rating. Between June and November 2018, Yelp canvassers strive toward visiting all businesses in this set, sequencing visits by neighborhood such that a full neighborhood is finished out before moving to the next. Yelp canvassers reach 3,474 businesses, which results in an experimental sample of 3,218 firms.<sup>14</sup>

The San Francisco Bay Area, New York City, Los Angeles, and Chicago are chosen as the markets for intervention, based on (i) the presence of Yelp offices to leverage the canvassing effort; (ii) the number of nail salons in the area to allow for a sufficiently large sample; and (iii) coverage of Yelp to obtain robust data on businesses. I identify ZIP codes within these areas<sup>15</sup> and extract all nail salon listings on Yelp in these ZIP codes, which results in a set of 9,889 nail salons.

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<sup>12</sup> The nine geographically closest competitors are determined using the full sample of verified businesses in the area, based on longitude and latitude coordinates. This means that information on businesses not in the experimental sample are included in these postcards.

<sup>13</sup> This image was extensively piloted prior to the experiment on nail salons in Boston (outside of the experimental sample) to ensure that business owners and managers could easily understand the information.

<sup>14</sup> 256 were identified as duplicates or permanently closed by the time of visit.

<sup>15</sup> For the San Francisco Bay area, I identified ZIP codes in cities with more than 50,000 people across the greater Bay area.

I call every business in this set and use Google Maps Streetview to confirm they are open, offering nail services, correctly located, and not a duplicate business. Any business that is not listed in Yelp's sales database is dropped (302 salons, or 3% of the extracted list), which serves as an additional screen to ensure the business is open and has the contact information required for data collection. I also drop any salons that are not physically located in one of the four markets (including mobile businesses), as well as businesses located inside airports. This process results in a sample of 6,370 nail salons across these areas.

Any salons with Yelp ratings of 1 to 2.5 stars (out of 5) are excluded, in order to maximize the likelihood of compliance to treatments.<sup>16</sup> This sample restriction is imposed due to the complicated relationship Yelp has with local businesses: while some business owners have embraced Yelp, claiming that it helps acquire new customers and feedback for improvement, others have expressed frustration, especially on Yelp's controversial sales practices and algorithmic removal of false reviews. Within this context, businesses with ratings lower than three stars are especially likely to have antagonistic stances against Yelp, which can reduce the likelihood that the business complies to treatment by being receptive to a Yelp canvasser and any information that the canvasser delivers. This sample restriction results in an eligible set of 3,948 businesses, which represents 62% of the full set of salons.

The resulting eligible set of 3,948 businesses represents the goal that Yelp canvassers strive toward reaching, which is subject to a few constraints.<sup>17</sup> First, while all 3,948 businesses are verified to be open and unlikely to be a duplicate at the time of randomization in May 2018, canvassers may arrive at the business to discover that the business either no longer exists or is a duplicate of another listing. Second, Yelp has a fixed canvassing budget and timeline, by the end of which canvassing operations have to terminate even if all 3,948 businesses have not yet been visited.

Businesses in the eligible set are assigned to experimental groups through a stratified randomization process using its metropolitan area, prior relationship with Yelp, and Yelp rating rounded to the nearest multiple of 0.5. Stratified randomization ensures that treatment and control groups are similar not just in expectation, but also in practice in the sample along important observable dimensions. It can also improve precision to the extent that these variables explain the variation in the treatment of interest (Cox and Reid 2000, Duflo, Glennerster, and Kremer 2007). These variables are chosen based on a number of reasons. Metropolitan areas may have different dynamics of competition due to variation in business density as well as customer tastes, which could determine how the business responds to information on competitors. Prior relationship with Yelp, which defines whether a business has claimed its free business page on Yelp and/or previously advertised with Yelp, and prior Yelp rating are likely to be correlated with key firm attributes and determine the business's receptiveness to Yelp canvassers and any information that they might provide. Within each stratum, firms are randomly assigned to one of two experimental groups, control or treatment. 1,972 firms are assigned to treatment, and 1,976 firms are assigned to the control group (**Figure 3**).<sup>18</sup>

To ensure that the resulting experimental sample is approximately balanced in the timing of visits across experimental groups, canvassers are assigned to finish all visits across control and treatment firms within a neighborhood before moving on to their next neighborhoods.

Between June 18 and November 18 of 2018, canvassers reach 3,474 businesses. 256 are identified as duplicates or closed by the time that they visit, resulting in an experimental sample of 3,218 firms (**Figure 4**). All firms in Los Angeles and Chicago are reached, and most firms in New York and San

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<sup>16</sup> Treatment information on competitor pricing, as well as measures of competition, are not subject to this restriction. I take the full set of verified firms to determine the nearest competitors.

<sup>17</sup> Power calculations suggested that this sample size would be sufficient to detect standardized effect sizes of 0.09 for all treatment and control firms with 80% power.

<sup>18</sup> Stratified randomization was done using Stata.

Francisco are reached, excluding the farther out areas (Bronx and outer areas of Queens for New York and North Bay for San Francisco) (**Figure 5 and 6**).

## 2.4 Balance, attrition, and non-compliance

Firms are well balanced across experimental conditions. Control and treatment firms in the same neighborhood are visited approximately at the same time, but treatment firms appear to slightly lag behind control firms. Non-compliance and attrition rates are low.

**Table 1** shows the summary statistics across all baseline characteristics of firms in the experimental sample.<sup>19</sup> The average baseline price is \$13.88 and ranges from \$5.00 to \$60.00.<sup>20</sup> At the time of visit, data collectors observe an average of 4 employees and 4 customers, which range from 1 to 25 and 0 to 30, respectively. 75% of salons have availability between 4-5pm the next day, with a standard deviation of 0.27.

**Table 2** shows that across baseline variables, control and treatment firms are well-balanced. In two variables out of 16 variables, control and treatment firms appear to be statistically different, which may be spurious. The difference in luxuriousness is small, but the timing of canvassing appears to be delayed among treatment firms by approximately 1.4 weeks. While this difference may be spurious, due to the importance of this variable, I control for the week of the canvassing visit in all specifications, and further explore this potential issue in robustness.

Non-compliance rates are low. Fewer than 2% of firms (58) are marked as non-compliant, which manifests in the form of firms rejecting any conversations with Yelp canvassers when they arrive at the business (**Table 3**). In these cases, neither control nor treatment firms receive any information from the canvasser.

I observe similarly low levels of attrition. Attrition stems from both firm closures, which is unlikely to be influenced by treatment, as well as firms that cannot be reached after canvassing visits. Approximately 5% of firms in the sample permanently close during the 12-month period. 1% of firms (36) in the sample are unreachable for any data after canvassing visits. Neither type of attrition varies significantly across experimental groups.

## 3 Measuring firms' competitor knowledge, price positioning, and performance

I construct a data set of firm knowledge, price positioning relative to quality, and performance over a 12-month period between May 15, 2018, to September 15, 2019 (**Figure 7**). Firms' prior knowledge of competitors is collected by Yelp canvassers who ask questions to treatment firms prior to providing treatment. Measures of firms' price positioning are collected via phone calls and physical visits to all businesses by data collectors at baseline and endline. Data from the Yelp platform, supplemented by city government tax records, provide proxies of firm performance. In order to ensure accuracy, canvassers and data collectors remain blind to treatment assignment, and 5% of all hand-collected data is verified by an independent data collector, with any conflicts sent to a third data collector.

### 3.1 Measuring stated positions and knowledge of competitors

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<sup>19</sup> Data collectors were sometimes not able to visit the salon due to closure upon multiple tries, or due to security at reception, leading to varying numbers of observations across variables.

<sup>20</sup> Across the full set of verified salons, regular manicure prices range from \$5 to \$150.

Firms' own descriptions of their positioning and knowledge of competitors are collected by Yelp canvassers during their visits. Treatment businesses are asked a set of questions before and after treatment. Prior to information delivery, canvassers ask, (1) "What do you think sets you apart from your competitors?" followed by (2) "Who do you consider as your primary competitors?" and (3) "What do you think they charge for a regular manicure?". Canvassers then deliver the competitor information treatment and ask, "Would you like to continue receiving this information?" to determine whether businesses find the information valuable. Canvassers record answers to these questions as close to verbatim as possible.

In order to ensure accuracy, canvassers remain blind to experimental assignment and hypotheses, and managers are not aware that they were being assessed as part of an experiment. Furthermore, canvassers' data entry and performance are monitored on a daily basis.

All answers are read and coded by two independent research assistants. Both research assistants first independently read a few hundred responses to understand potential categories of answers, and compare notes to arrive at a list of categories. They then individually assign each answer to one of the categories. Any conflicts are sent to a third research assistant to resolve.

### 3.2 Measuring price positioning relative to quality

Data on price positioning are collected by a team of ~50 data collectors who make calls and visits to businesses.<sup>21</sup> All data collectors are blind to experimental assignments, and are assigned to collect data on control and treatment businesses by neighborhood in order to ensure balance between experimental groups. To ensure data validity and accuracy, data collectors are given detailed scripts and evaluation rubrics, have a subset of their data validated by another independent data collector, and in the case of visits, take photos of menus, interiors, and exteriors to validate their coding. Their performance in terms of accuracy and productivity is tracked on a weekly basis, as well as their location and time of visit.

Price positioning is measured by the price of a regular manicure, collected via calls made to all businesses on a monthly basis between May 2018 and May 2019. Data collectors ask for the price of a regular manicure without taxes or cash discounts. In a subset of the months, prices of other services (pedicure, manicure and pedicure combination) are also collected.<sup>22</sup>

These pricing data are validated in two steps. First, the full list of salons is divided among data collectors, where 5% of the data are additionally allocated to another data collector as a quality check. Second, once all data collectors submit their data, any observations with a business closure or unreachable flag, conflict in prices or open status across two data collectors, or a mismatch between the name and identifier for the are reassigned to data collectors. This second step is repeated up to three times in each month.

Quality is measured by coding the level of nail polish brands used, the cleanliness of the interior, and the luxuriousness of the décor, observed via physical visits to each business at baseline (May – August 2018) and endline (May – September 2019). While reviews and photos on Yelp may potentially provide a subset of these data points for some businesses, they are collected at different points in time and missing for a large percentage of businesses in the sample, so physically visiting businesses to collect this data within the a few months improves the collection of accurate and comparable measures.

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<sup>21</sup> Data collectors were undergraduates and Masters students recruited using job postings across every university in the four cities that were posted every 3-6 months. They were selected after an interview asking questions about data validity and collection methods. Over the course of the project, ~83 data collectors were hired.

<sup>22</sup> Data collectors also note whether the phone number is no longer in service, no one answers, nail services are no longer offered, business is permanently closed, or business refuses to provide prices over the phone. Due to these reasons, data collectors were not able to obtain a price every month for each salon, resulting in an unbalanced panel.

In order to ensure standardization and accuracy of scoring, data collectors use an evaluation rubric to code quality metrics, and their coding is validated through a number of validation checks. For nail polish brands, data collectors are given a list of nail polish brands classified into low, medium, and high according to their retail price per bottle (low: below \$10; medium: between \$10-\$20; high: above \$20). They are instructed to select the highest level of polish brand they observe, as most firms use some proportion of the lowest-cost brands. They record any brands they observe that are not present on this list, which are then coded ex-post using their retail prices. For cleanliness and luxuriousness, data collectors are given a rubric of metrics to guide their coding, detailed in **Table 4**. Data collectors are also required to take photos of the interior, polish brands, menu, and exterior to ensure accuracy, and 5% of each data collector's photos are checked every week. Approximately 5% of firms are assigned to an additional independent data collector to validate quality measures.<sup>23</sup> Data collectors' accuracy and productivity are tracked on a weekly basis, and the data entry application records their location and time of visit.

During these visits, data collectors also collect additional data on businesses' opening hours, promotions, and the number of employees and customers at the time of the visit.

### 3.3 Measuring performance

Firm performance is measured using a variety of proxies: purchase intentions from the Yelp platform, next-day availability between 4-5pm via phone calls, and sales in one city as measured by San Francisco government's sales tax data.

My main proxies of performance are collected on the Yelp platform, which measures purchase intentions for each business based on consumer search patterns. I construct monthly measures of business performance, based on the number of unique views of the business page, the number of calls made to the business, and the number of views of map directions to the business.

While these proxies are available for all firms on a monthly basis, they have two key limitations in capturing effects on performance. First, they capture consumers' purchase intentions, and do not reflect actual sales. Second, while these measures may reflect demand among customers who search, they are not as likely to capture demand among regular customers.

To overcome these limitations, I complement these measures with additional proxies of performance. During monthly phone calls, data collectors ask if there is availability for an appointment the next day between 4-5pm<sup>24</sup>, a peak hour for salons, and record a binary answer. This measure captures both searching customers as well as regular customers.

I also collect data from city government databases on business registration, licensing, and tax. Firm and owner attributes are extracted from city government databases on business registration and licensing data. I work with the government of San Francisco to analyze business sales data from tax records.<sup>25</sup>

## 4 The landscape of firms' competitor knowledge and price positioning

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<sup>23</sup> Any data collectors above a threshold accuracy level was replaced immediately, but discrepancies were extremely rare, and only two data collectors were dismissed.

<sup>24</sup> In order to prevent any suspicion across salons, the specific time was changed on a monthly basis (e.g. 4pm in January, 4:45pm in February).

<sup>25</sup> Due to the tax cycle, the data relevant for the experimental period will be available in summer 2020.

Baseline measures suggest that many firms lack competitor knowledge, including those that face higher levels of competition. Over 46% of firms are not able to state specific competitors and their prices prior to receiving information on competitor prices. Consistent with this evidence, firms' observed pricing positions display a large dispersion within each level of quality and exhibit discrepancies with firms' stated price-quality positions.

#### 4.1 Baseline competitor knowledge

When asked by canvassers prior to treatment who they consider as primary competitors, 46% of firms are not able to state their primary competitors (**Figure 8**). These firms respond that they do not know which businesses are their primary competitors, or that it has been a while since they looked at other businesses to be able to state specific competitors. Canvassers classify any answers that appear to be brush-offs as "did not answer" based on the firms' disinterest in answering follow-up questions or continuing the conversation, which constitutes 6% of responses.

Among firms who are able to answer, the largest category of firms (21%) consider all salons nearby to be competitors. This lends credence to geographical distance as a key factor determining competitors, consistent with findings across other industries (Baum and Lant 2003). The geographic distance considered varies across salons: 55% state that nearby salons in walking or driving distance are competitors, 21% consider all salons in the neighborhood or city as competitors, 15% refer to salons on the same block, and 15% state salons within a few blocks from them. 16% of firms mention specific salons. 2% mention a type of salon (e.g. Japanese nail art salons). 9% of salons state that they have no competitors.

Similarly, 58% of firms are not able to state the prices that their primary competitors charge (**Figure 9**). 21% of firms state that they believe competitors charge similar prices, while 8% and 6% state more or less, respectively. 1% state that they do not care what competitor prices are.

Surprisingly, firms that are not aware of their primary competitors and their prices remain across those that face higher market competition. The level of competition is measured by the firm's distance from its geographically nearest competitor, as well as the baseline price dispersion across its geographically nearest 9 competitors, across the full set of verified salons in the cities beyond the experimental sample.<sup>26</sup> These set of measures are robust to adjusting for variation across cities such as density. Across both of these indicators, fewer firms in more competitive markets with closer nearby competitors and lower market price dispersion appear to lack knowledge of their competitors or their prices, as expected (**Figure 10-11**).<sup>27</sup> However, the difference in percentage between firms facing above and below median competition is not large, and a substantial percentage of firms across more competitive markets still display a lack of awareness.

While these responses suggest that many firms may not be aware of their competitors even when facing higher levels of competition, they are based on stated responses, and may potentially overstate the percentage of firms that are not aware of primary competitors' positions. I explore additional evidence of baseline price positions to provide a more complete picture of the baseline landscape before analyzing experimental results on the impact of competitor information.<sup>28</sup>

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<sup>26</sup> The experimental sample excludes salons with 1-2.5 stars for Yelp ratings. However, both the treatment information and measures of competition are determined using the full sample of verified businesses in the area to identify the geographically closest competitors based on longitude and latitude coordinates.

<sup>27</sup> From this point onwards, I only show results for distance from the nearest competitor when referring to competition levels, but all results are robust to using the baseline price dispersion measure (which can be found in the appendix).

<sup>28</sup> I further explore measures of competitor knowledge using incentivized responses to questions on competitor knowledge at endline.

## 4.2 Dispersion in baseline price positioning

Consistent with the interpretation that firms lack knowledge of their competitors, firms display a large dispersion in their price positioning across the similar levels of quality. On average, firms with higher quality charge higher prices (**Figure 12**). Quality represents a sum of the firm's polish brand level, cleanliness, and luxuriousness, and ranges from 3 (lowest quality) to 11 (highest quality).<sup>29</sup> This positive correlation suggests that despite the inevitable noise present in the quality measures,<sup>30</sup> they capture some signal of offered quality, and is robust to using a standardized sum of polish brands, cleanliness, and luxuriousness, as well as each individual measure alone.

However, firms display a large dispersion in their pricing, which appears unlikely to be fully accounted for by noise in the quality measures. **Figure 13(a)** plots the same figure as **Figure 12**, but shows every firm observation within each quality level sorted by price, along with the interquartile range. The coefficient of variation in price across all observations is 37.8%. Within each quality level, the coefficient of variation in price ranges from 22.2% to 47%. Strikingly, at \$15 for a regular manicure, firms offer the entire range of quality. This dispersion persists when controlling for ZIP code fixed effects, as shown in **Figure 13(b)**.

The largest dispersion in price positioning can be observed in the middle of the quality distribution, relative to those offering the lowest or highest levels of quality.<sup>31</sup> In fact, many firms appear to be “stuck in the middle,” rather than in the bottom left and top right corners of the figure (low price and low quality; high price and high quality). This observation is supported by **Figure 14**, which shows that many firms are positioned between \$8 and \$20 in price and 5 and 8 in quality.

Consistent with results on baseline competitor knowledge, this dispersion remains across firms that face higher levels of competition (**Figure 15**).

## 4.3 Discrepancies between firms' observed and stated positions

Consistent with the interpretation that firms lack knowledge of their competitors and are dispersed in their positioning relative to other firms, many firms' observed positions do not match their stated positions. Firms provide varying descriptions of their positioning, which can be categorized into five broad types, loosely based on Porter's (1980) “generic strategies”: price, quality differentiation, horizontal differentiation, focus, and “stuck in the middle” (or according to firms' own descriptions, “nothing”). **Figure 16** shows the descriptions that treatment firms provide of their positioning prior to treatment, prompted by the question, “What sets you apart from your competitors?”.<sup>32</sup> The largest category of answers maps to quality differentiation: offering quality service and products (30%) or cleanliness (23%). The second largest category (13%) is “nothing”, which includes answers like “we haven't looked at other salons, so we don't know,” or “we offer the same services as other salons.” The third largest category is low price (8%). Other answers loosely map to horizontal differentiation (e.g. service variety or location), and focus (e.g. specific customer segment or service specialty).

Although firms generally mention only a few types of positions, there remains much dispersion in positioning within each stated type. **Figure 17** plots observed price-quality positions for all firms that

<sup>29</sup> As described in Section 3.2, polish brands range from 1 to 3 based on retail price per bottle, and cleanliness and luxuriousness are rated on a scale of 1 to 4.

<sup>30</sup> Noise may arise from variation in the date and time of the canvasser visit, as well as variation across canvassers – despite the measures taken using rubrics and data validation to increase accuracy. Furthermore, there may be measures of quality that are not captured in these, such as the level of customer service or friendliness.

<sup>31</sup> The same pattern can be observed when plotting by a standardized sum of each quality measure, or each individual measure of quality alone.

<sup>32</sup> As described in Section 3.4, each answer was coded by two independent research assistants. Any conflicts were sent to a third independent research assistant who resolved the conflict.

specify low price as their positioning. Even within this set, prices range from \$5 to \$18, and quality ranges from the lowest 3 to 8.

This variation remains within neighborhoods. **Figure 18** plots the observed price-quality positions of firms in a ZIP code in New York, located on the Upper East Side in Manhattan. Firms offer a range of prices, from \$9 to \$35, as well as range of quality levels from 4 to 9. Furthermore, even when focusing only on firms that offer quality-related positions within this ZIP code, much dispersion remains.

## 5 Empirical strategy: identifying the value of competitor information

Baseline measures of competitor knowledge and price positioning suggest that firms may lack knowledge of their competitors. To more precisely evaluate this and the value of competitor information, I analyze firm responses to the experimental treatment.

For all analyses, my base econometric specification leverages a difference-in-differences model to evaluate the difference in price changes after a canvassing visit across control and treatment firms.

Specifically, I run the following regression:

$$(1) \quad y_{iswt} = \beta_0 + \beta_1 Post_{iswt} * Treat_{isw} + \beta_2 Post_{iswt} + \beta_3 Treat_{isw} + \gamma_w + \delta_s + \eta_t + \varepsilon_{iswt}$$

where  $y_{iswt}$  is the outcome of interest for firm  $i$  in randomization strata  $s$  visited in week  $w$ , measured at month  $t$ . The primary outcome of interest is whether firms adjust their pricing, which is measured by a binary variable indicating whether a firm's regular manicure price in a given month is different from the price observed at baseline (May 2018). I decompose this price change into a price increase or decrease relative to baseline, and also examine percentage changes in price levels.

$Post_{iswt}$  is an indicator that takes value 1 for firms in either control or treatment starting the month they are visited by a Yelp canvasser until the end of the study and 0 otherwise.  $Treat_{isw}$  is an indicator that takes value for 1 for firms assigned to treatment and 0 otherwise.  $\gamma_w$  controls for canvasser visit week fixed effects,  $\delta_s$  controls for randomization strata fixed effects, and  $\eta_t$  controls for data collection survey month fixed effects.  $\varepsilon_{iswt}$  is an idiosyncratic error term. Since the unit of randomization is the firm, standard errors are clustered at the firm level (Abadie et al 2017).

$\beta_1$  identifies the treatment effect for treatment firms relative to control firms and is the main coefficient of interest.  $\beta_2$  captures the passing of time and any effect of a canvasser visit across all firms, and  $\beta_3$  identifies any pre-treatment differences between treatment and control firms. While fixed effects are not necessary for identification given that treatment is randomly assigned, I run this specification with and without fixed effects to account for any random differences across experimental groups.

## 6 The impact of competitor information on firm pricing

Once firms receive information on competitor prices, they change their pricing in performance-enhancing ways, suggesting that this information may be valuable. Treatment firms are 16.8% more likely to change their prices following the canvassing visit, relative to 17.3% of control firms that change their prices. At the time of the canvasser visit, 19% of firms mention that they plan to change their prices based on the competitor information they received, supporting the interpretation that the information drives these price changes. Firms change prices by both increasing and decreasing prices,

firms that were charging lower prices compared to their nearest competitor increasing prices. Firms that were over- or under-pricing relative to their quality respond most to treatment.

Firms display seasonality in when they change prices. They are more likely to use promotions in slower months (fall and winter)<sup>33</sup>, and generally change menu prices at the end of the year between December to January. These patterns are reflected in **Figure 19**, and are consistent with those documented in industry magazines and confirmed by salon managers and owners (Nails Magazine 2008, 2018).

Firms assigned to treatment show a higher likelihood of changing prices compared to control firms following the canvasser visit. **Figure 20** plots the raw percentage of control versus treatment firms that charge a different price compared to their baseline price in the spring of 2018,<sup>34</sup> in each month before and after the canvassing visit.<sup>35</sup> At the time of the canvassing visit, approximately 12% of firms have changed their prices relative to baseline, which mostly reflect firms that use promotions that may be captured at the time of the phone calls, as well as any firms that changed prices between baseline and the first month of data collection. At the time of the canvasser visit, there is little difference in the likelihood that a firm charges a different price from baseline between the control and treatment group, as expected by randomization and the balance of baseline variables. In the months following the canvasser visit, firms that are assigned to receive the competitor information treatment show a higher likelihood of changing prices by approximately 2-4 percentage points compared to control firms.

While these plots suggest that providing information on competitor positions leads firms to change their own price positioning, they do not isolate the precise effect of treatment. Estimating intention to treat effects using the econometric specification in **Section 5** provides a more systematic analysis, addressing the unbalanced panel, noise from any small pre-treatment differences, and the slight delay of canvasser visits across treatment firms, which are reflected in the raw data. I now turn to these regression results.

**Table 5** shows the intention to treat estimates of the competitor information on firms' likelihood of changing their price: treatment firms show a significantly higher likelihood of changing prices by 16.8% (3 percentage points) compared to control firms after the canvassing visit. Estimates of the treatment effect are stable across all specifications, which control for any pre-visit differences between control and treatment firms, the passing of time, and the week of the canvasser visit, with columns (2)-(4) additionally controlling for month and/or strata fixed effects to absorb noise from seasonality and location.<sup>36</sup> As shown in the last two rows of the table, 17.3% of control firms change their prices in the six to ten months following the canvasser visit.

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<sup>33</sup> As discussed in later sections, 24.7% of firms use promotions of any kind, and 10.1% of firms use demand-based promotions (based on hours of week, days of week).

<sup>34</sup> To ensure accuracy in baseline prices, these were collected between early February and mid-May of 2018, in order to allow for multiple validations of each price.

<sup>35</sup> Each month begins in the 15<sup>th</sup> of each month, in order to count months following canvasser visits, which began in June 18<sup>th</sup>. The table below the figure shows the percentage of observations reflected in each mean, which vary due to the variation in the number of observations collected in each month (due to some firms not answering their phones or having closed) and the staggered timeline of visits across the 12 months of data collection. This means that only firms that were visited in the first set of canvassing visits between June 15 and July 15 have observations 10 months after the canvassing visit. Similarly, only firms that were visited in the last set of canvassing visits between October 15 and November 15 have observations 4 months prior to the canvassing visit.

<sup>36</sup> Strata and month fixed effects are not necessary for identification given that treatment is randomly assigned, but help absorb noise. Given potential non-spurious imbalance between control and treatment groups in canvasser visit timing, I control for the week of the canvasser visit across all specifications. The estimate for "Treat" captures any pre-visit differences between control and treatment firms, which are small and statistically insignificant. The estimate for "Post" reflects control firms' likelihood of changing prices after the canvassing visit, but also captures a mechanical increase from the passing of time.

During the canvasser visit, 19% of treatment firms show interest in the competitor information and indicate that they intend to change their prices, proving supportive evidence that the increased likelihood of treated firms to change prices is driven by the competitor information treatment. **Figure 21** categorizes canvassers' notes on their visit, where firms show a diversity of responses. A majority (58%) of firms positively engage with Yelp canvassers, either showing active interest in the conversation or logging into their Yelp page. The 19% of firms who show interest in competitor information comment that they want to receive more pricing information over time or for their other services, show surprise in learning how their prices compare to their competitors, and indicate plans to change their pricing. For example, one note comments, "manager was surprised that her salon charges the lowest price in the area. She is thinking of raising her prices." Another salon owner expresses surprise that a nearby salon charged \$45 for a manicure, and notes that she will research what this salon offers to see how she might be able to also raise her prices. 16% of firms show no interest in Yelp or the pricing information.

**Table 6** shows that treatment firms change their prices by both increasing and decreasing prices.<sup>37</sup> Column (1) shows that 3.6% of observations among control firms show a price decrease relative to baseline in the months following the canvasser visit.<sup>38</sup> Treatment firms are 13.9% (0.5 percentage points) more likely to decrease their prices in the post-visit period, though the estimate is noisy. A larger percentage of firms increase their prices in the months following the canvasser visit, as shown in Column (2). Treatment firms are 16.8% (2.3 percentage points) more likely to increase their prices in the post-period, relative to 13.7% of observations among control firms. These changes result in a slight increase in price level among treatment firms of 2.3%, which represents an increase of approximately \$0.30 relative to the average price level among control firms of \$13.20 (Column 3).

Treatment firms increase or decrease prices depending on their relative price positioning to their nearest competitor at baseline. **Table 7** show treatment effects on price change, price levels, price increase and decrease by firms' baseline price position relative to their geographically nearest competitor. Firms with lower or higher baseline prices relative to their nearest competitor are more likely to change prices, compared to firms with the same baseline price relative to their nearest competitor. Firms with lower baseline prices are more likely to increase their price, while firms with higher baseline prices are more likely to decrease their price.

Furthermore, competitor information appears to lead firms to better align their pricing to their quality decisions, with firms that were over- or under-pricing relative to their quality responding most to treatment. **Table 8** show how treatment effects vary based on the baseline alignment between pricing and quality.<sup>39</sup> The degree of misalignment in baseline decisions is measured by the absolute error from the best-fit line regressing baseline price on quality and ZIP code fixed effects, with firms farther away from the best-fit line having higher misalignment. Treatment firms with higher misalignment are more likely to change prices – both increasing and decreasing prices.

## 7 The impact of competitor information on performance

Consistent with treatment effects that suggest competitor information improves firm pricing, treatment ultimately results in higher proxies of firm performance by 14-15%, as measured by the

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<sup>37</sup> For all results going forward, I report results from my base specification with canvasser visit week. Results are robust to adding strata and/or month fixed effects.

<sup>38</sup> 3.6% of months among control firms reflect a price decrease, which does not mean that 3.6% of firms are persistently decreasing prices, but that 3.6% of the monthly observations show a price decrease, which may reflect the use of promotions.

<sup>39</sup> These results are robust to different specifications (e.g. continuous, tertile, or quartile measures of misalignment).

number of calls, page views, and map directions views on Yelp. Additional measures on estimated revenue and next-day availability for an appointment provide further support for performance effects. These effects do not appear to be driven by firms' increased engagement with the Yelp platform.

## 7.1 Intention to treat estimates of competitor information on performance

Columns (1)-(3) in **Table 9** show that following canvasser visits, treatment firms ultimately receive 14.8% more calls, 14.6% more page views, and 14.5% more map directions views from customers on Yelp compared to control firms.<sup>40</sup> The magnitude of these estimates can be approximately compared to the magnitude of effects in another experiment run on the Yelp platform on the effect of online ads, where randomly assigning firms to receive three months of free ads on Yelp led to a 6.5% increase in calls, 19% increase in page views, and 14% increase in map directions views (Dai, Kim, and Luca 2018).

**Figure 22** shows that treatment increases the performance of the median firm, rather than shifting the full distribution of firms or only moving firms at the highest or lowest tails. These figures plot the distribution of the sum of calls, page views, and map views received between baseline and endline across control and treatment firms. Treatment firms at either tails of the distribution do not appear to show significant performance differences compared to control firms, but the median treatment firm appears to see a higher number of calls, page views, and map views gained during this period.

Yelp proxies of performance have two key limitations in capturing effects on performance. First, these capture consumers' purchase intentions and do not reflect actual sales. Second, while these measures may reflect demand among customers who search, they are not as likely to capture demand among regular customers. To explore these concerns, I am obtaining sales tax data from the City of San Francisco, where the data relevant for the experimental time period (2019) will be available in summer 2020 due to the timeline of tax collection. Additional measures also provide further support.

Back-of-the-envelope calculations mapping these purchase intentions to revenues suggest that treatment firms observe an increase in revenues from these searchers relative to control firms. One concern that stems from measures of purchase intentions is that firms that are decreasing prices may attract more purchase intentions, but in fact reduce firm revenues. To investigate, I construct proxies of revenues using the price that firms charge each month and the number of purchase intentions observed. Interpreting these measures as revenues requires the assumption (1) that each purchase intention leads to a sale – which likely overestimates the effect especially in the case of page views, and (2) that every customer purchases a regular manicure and not any other services – which likely underestimates the effect. Therefore, these estimates are useful mostly as a directional guide.

**Table 10** shows that treatment firms' estimated revenue is 19% higher from calls, 16% higher from page views, and 18% higher from map views, compared to control firms after canvassing visits. These estimates are fairly precisely estimated. Additionally, prior studies estimate positive correlations between purchase intentions and revenues. Using revenue data from the Washington State Department of revenue, Dai et al 2018 found that a 10% increase in quarterly page views is correlated with a 3.3% increase in quarterly revenue.<sup>41</sup> Based on this estimate, a back-of-the-envelope calculation suggests that treatment firms observe 4.8% higher revenues compared to control firms from pageviews.

Furthermore, treatment firms appear to be less likely to have availability for an appointment during a peak hour the next day, suggesting that they may not be losing revenue from regular customers while

<sup>40</sup> Due to restrictions in the data sharing agreement, I am not able to publicly share the base level of the number of calls, page views, or map directions views for the control firms.

<sup>41</sup> Using historical tax revenue data from 2015, Dai et al (2018) regress logged revenue change on logged change in page views, restaurant fixed effects, and quarterly dummies for a matched set of 835 restaurants, as a back-of-the-envelope calculation. Their estimate of the coefficient on change in pageviews is 32.54%, which was fairly precisely estimated (1% level) with standard errors clustered at the business level.

increasing revenue from searchers. Consistent with the interpretation that treatment firms see higher performance, column (4) in **Table 9** shows a 2.7% decrease in the likelihood of a next-day availability during a peak time (4-5pm) among treatment firms, relative to 77.2% of control firms that have availability, although the estimate is noisy. As shown in the section on robustness, this estimate is larger and more precise when restricting to a balanced sample of firms. This provides additional suggestive evidence that treatment results in improved performance.

## 7.2 Are performance effects driven by treatment firms increasing their engagement on Yelp?

One potential mechanism through which treatment might result in higher performance is by motivating firms to increase their engagement with the Yelp platform, since treatment is delivered by Yelp canvassers. However, analyzing the effect of treatment on firms' engagement indicators suggests that treatment firms do not increase their engagement on Yelp compared to control firms.

Columns (1) to (3) in **Table 11** show that in the months following the canvasser visit, treatment firms are not more likely than control firms to log in on Yelp, claim their Yelp page, or purchase advertising, as indicated by estimates that are close to zero with fairly large standard errors. The treatment effect on review comments in Column (5), which indicates firms' comments on reviews received from users, is also small and noisy. The estimate on direct responses is more precise, suggesting a 1.3% higher likelihood of treatment firms to send direct responses. However, this measure reflects an increase in customer interest more than business engagement metrics, as firms must first receive a request from a customer about a quote or an appointment to be able to send direct responses. These results suggest that observed performance effects do not appear to be driven by treatment firms' higher engagement with Yelp.

## 8 Why do firms lack knowledge of competitors?

Given this large positive impact of competitor information, the natural question is why many firms had not previously invested in this information on their own. I consider several possible explanations, such as limited competition reducing the value of competitor information and firms' lack of capabilities to use the information leading them to not invest. I find limited evidence that either can fully explain firms' lack of knowledge. Evidence from informal interviews and a follow-up experiment among control firms suggests that attentional costs may be an important factor, consistent with research on the importance of managerial attention (Ocasio 1997, Helfat and Peteraf 2014, Hanna, Mullainathan, and Schwartzstein 2014, Golman, Hagmann, and Loewenstein 2017). Managers appear to underestimate the value of paying attention to competitor information, because they hold out-of-date information that leads them to falsely believe that they are already aware until they are triggered to explicit reevaluate their knowledge.

### 8.1 Possible explanations

Several possible reasons could explain why firms did not know competitor positions prior to the experiment. I explore each in turn.

First, it may be the case that competitor information is not valuable for firms across many markets depending on the level of competition. One way to rationalize the high percentage of firms that lack competitor knowledge at baseline may be that unaware firms facing lower competition derive limited

value from competitor information, and unaware firms facing higher competition use other sources of knowledge such as observing residual market demand, which serve as sufficient statistics. This explanation would suggest that providing competitor information should lead to price changes by firms in less competitive markets, who do not gain sufficient value from competitor information to incur the cost themselves but benefit from information being fully freely delivered.

I find limited support for this explanation. **Table 12** show estimates of the treatment effect by the level of competition, as measured by the firm's distance from its nearest competitor. Treatment firms that face lower levels of competition (indicated by farther distance from the nearest competitor and higher price dispersion among its nearest nine competitors) do not appear to be more likely to change their prices after the canvassing visit compared to control firms. In contrast, treatment firms facing above-median levels of competition show a ~3 percentage point higher likelihood of changing prices compared to control firms.<sup>42</sup> This result is further supported by evidence that at baseline, firms facing lower competition do not appear to be substantially more dispersed in their pricing positions, as discussed in **Section 4.2** and shown in **Figure 15**. This suggests that while higher levels of competition may not be sufficient to substantially raise firms' awareness of competitors, competitive forces may increase the value of competitor information and the likelihood that it triggers responses from firms.

Another reason why firms lack competitor knowledge may be that some are unable to take advantage of it. Prior research has documented the importance of relevant capabilities in being able to recognize the value of new information and apply it (Cohen and Levinthal 1990, Henderson and Cockburn 1994). In this case, firms without relevant pricing capabilities may not know how they should take advantage of competitor information to improve their decisions, and thus not invest in acquiring the information. For example, firms may need a prior understanding of customer preferences across the market, or analytic skills to process optimal responses to many competitors, in order to use the information to their benefit (Dutta et al 2003, Zbaracki and Bergen 2010, Li and Netessine 2012). Given that treatment firms appear to change their pricing in performance-enhancing ways on average, this explanation would suggest that firms that respond to treatment are mostly those with relevant capabilities, who may be adjusting earlier than they might have otherwise.

To explore this possibility, I code whether firms used promotions at baseline by identifying those that offer special demand-based promotions for regular manicures, pedicures, or packages.<sup>43</sup> 10.1% of firms offer promotions based on expectations of customer demand, such as slower times of day (before 3pm), days of the week (Monday to Wednesday), or months of the year (winter promotions). The use of these promotions may be linked to sophistication in pricing, as it indicates an understanding of the distribution of customer preferences and how they fluctuate. Conversations with managers and owners support this interpretation: they explain that they base these promotions on when they knew customer demand would slow. I also observe similar trends in the pricing data across control firms, where firms appear to be more likely to change prices in the winter months.

However, I find little supportive evidence that firms lack competitor knowledge due to their lack of relevant pricing capabilities to take advantage of the information. Treatment firms that did not use demand-based promotions at baseline appear to be more likely to respond to competitor information,

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<sup>42</sup> This result that treatment firms that face higher levels of competition are more likely to respond is robust to using other cutoffs such as quartiles. This evidence raises the question: why do these firms survive? One explanation may be that I am observing short-run dynamics. Another explanation may be that there is some friction that limits competition. For example, quality firms may be capacity constrained, which reduces the strength of the selection mechanism in the market. My results likely do not generalize to perfectly competitive markets in the long run.

<sup>43</sup> Cash or credit card discounts are not included in this coding, as almost every firm uses these discounts. I also exclude promotions for new customers, repeat visits, and group- and birthday-based discounts, as these are also common and do not indicate sophistication with pricing based on knowledge of fluctuating customer demand. However, the results are robust to using this broader definition of promotions.

while treatment effect estimates are small and noisy for firms that used promotions at baseline (**Table 13**).

## 8.2 Evidence of managerial inattention

Evidence from informal interviews suggests that attentional costs may have been an important factor. Managers appear to underestimate the value of this information because they hold outdated information that leads them to believe that they already know it. I further explore the extent to which this mechanism might explain why firms are not aware of competitor positions, by running a follow-up experiment across control firms.

### 8.2.1. Informal interviews

Informal interviews with 25 pilot salons suggest that managers may be inattentive to competitor information because outdated information they observed at an earlier point in time leads them to underestimate the value of acquiring information again.<sup>44</sup>

When asked whether they would find information on competitor prices valuable, managers answered that this information would not be useful, explaining that they were already aware of what competitors are doing. Some explained that they can easily observe this information themselves on Yelp, while others emphasized that they have “competitive prices.”

However, when asked to specify who their primary competitors are and what they were charging, most managers could not answer precisely, explaining that they were not sure exactly what the price points may be. One salon owner responded, “I thought I knew, but I guess it’s now been a few years since I’ve checked who our competitors are.” Another manager explained, “now that I’m trying to answer these questions, it must have been about ten years ago that I last looked at competitors’ prices.” These comments suggest that managers may fail to pay attention to competitor information, due to the belief that outdated information is more recent.

Once given treatment postcards with competitor prices, a few of the managers expressed surprise and stated they would change their prices. For example, one salon manager commented, “wow, a lot has changed. I should think about how to change my prices. Maybe I can increase it by more than I planned -- I’ll keep it in mind at end of the year.”

Treatment firms in the experiment echoed many of these comments, suggesting that inattention may be a potential mechanism that explains their lack of knowledge.

### 8.2.2. Evidence from a follow-up experiment among control firms

I run a follow-up experiment to explore this explanation for why firms might be inattentive. At endline (between May – August 2019), all firms are visited by data collectors and asked a series of incentivized questions assessing their current knowledge of competitor positions: (1) “what salon is located closest to you?” (2) “what do you think they are charging for a regular manicure?” (3) “How do you think your price positioning compares to your two nearest nail salons?”. Once they finish answering all questions, they are provided with answers, based on data collected within the same week to ensure accuracy. If they answer all questions correctly, they receive a \$10 Amazon gift card.

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<sup>44</sup> These conversations were conducted with managers during piloting, across salons in Boston that were outside the experimental sample.

I randomly assign all 1,578 control firms to one of two experimental conditions, which vary in the sequence of asking managers if they are interested in signing up to receive information on competitors' pricing before or after answering the incentivized questions. Managers are shown a sample treatment postcard for a salon in a different city, and informed that this can be provided at no cost. Half of the control firms are assigned to be "Asked First" whether they would like to sign up to receive information on the prices of their nearest competitors, and then asked the incentivized questions assessing their knowledge. The other half of the control firms are assigned to be "Asked Last" whether they would like to sign up to receive competitor information, after reevaluating their knowledge by answering questions about their nearest competitors.

Randomizing the sequence of questions enables me to explore managers' demand for competitor information and whether they underestimate its value when they have not been prompted to reevaluate their knowledge. Data collectors record managers' answers to the three incentivized questions, their interest in signing up to receive competitor information, and their comments on follow-up questions on why they are (or are not) interested in signing up for the competitor information. These follow-up reasons can help explore the mechanisms driving managerial inattention, and unpack whether holding outdated information leads managers to underestimate the value of competitor information.

The experiment is currently ongoing, with approximately half of the control salons reached by data collectors.<sup>45</sup> Early results suggest that firms assigned to be asked first whether they are interested in signing up for competitor information before answering incentivized questions are less likely to show a demand for competitor information, consistent with the hypothesis that managers may be inattentive to competitor information until prompted to reassess their knowledge.

## 9 Conclusion

In this paper, I explore why firms may lack knowledge of competitors. I find that a large percentage of firms are not aware of competitor pricing prior to receiving this information, even in more competitive contexts. However, once firms receive competitor information, they change their pricing in performance-enhancing ways and observe higher proxies of firm performance. Early suggestive evidence points to the potential role of managerial inattention, which may be exacerbated when managers hold outdated information.

While the specific dimension of competitor knowledge considered in this paper – competitor prices – may not apply across many other contexts, there has been growing evidence that firms across varying sizes and industries lack knowledge of their competitors. Managerial inattention does not seem likely to be limited to small firms or specific industries, suggesting that it may be a mechanism that drives the lack of competitor knowledge across many other contexts. These findings highlight that as data on competitors and consumers become increasingly accessible in the digital economy, understanding how managers allocate attention and overcome issues of inattention may become increasingly important.

Furthermore, revisiting theories of strategic positioning in light of managerial inattention and the widespread lack of competitor knowledge may provide insight into how firms can adjust and improve their positioning and its value for competitive advantage. These findings suggest the importance of operational effectiveness even for strategic choices like positioning. Particularly among small and medium enterprises that constitute a large percentage of the economy, there may be firms – even across fairly competitive markets – that are far from the frontier in their positioning and may benefit from relatively simple interventions. One particularly relevant context may be across online platforms that

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<sup>45</sup> Conditional on being able to converse with 50% of my control salons, I should be sufficiently powered to detect a 10 percentage point difference in signup rates.

can optimize the seller side of their marketplaces by reducing these frictions. This paper takes a step in understanding the nature of these frictions and how the design of information on platforms might help firms improve.

These findings also point to new puzzles to unwrap in future work. One ongoing direction I am exploring evaluates whether and how firms that change their price positioning in the experiment also change their quality positioning in the longer run. Teasing apart changes in quality decisions and overall positioning more broadly may provide insights on firms' internal alignment and firm performance, a long-theorized question by scholars across a variety of literatures (Milgrom and Roberts 1990, Porter 1996, Ichinowski et al 1997, Levinthal 1997, Ghemawat 1999, Rivkin 2000, Siggelkow 2001, 2002). Observing how firms partially or fully shift their positioning may shed light on how firms arrive at internal alignment and whether improving external fit based on competitor information may also help firms evolve toward improved internal fit.

Another puzzle points to the underlying mechanisms that drive why or how firms become inattentive, which can provide insights on the extent to which attention may create opportunities for competitive advantage. While informal interviews and the follow-up experiment provides suggestive insights, more direct and precise tests of possible mechanisms may provide richer insights on how managers may be able to avoid inattention traps.

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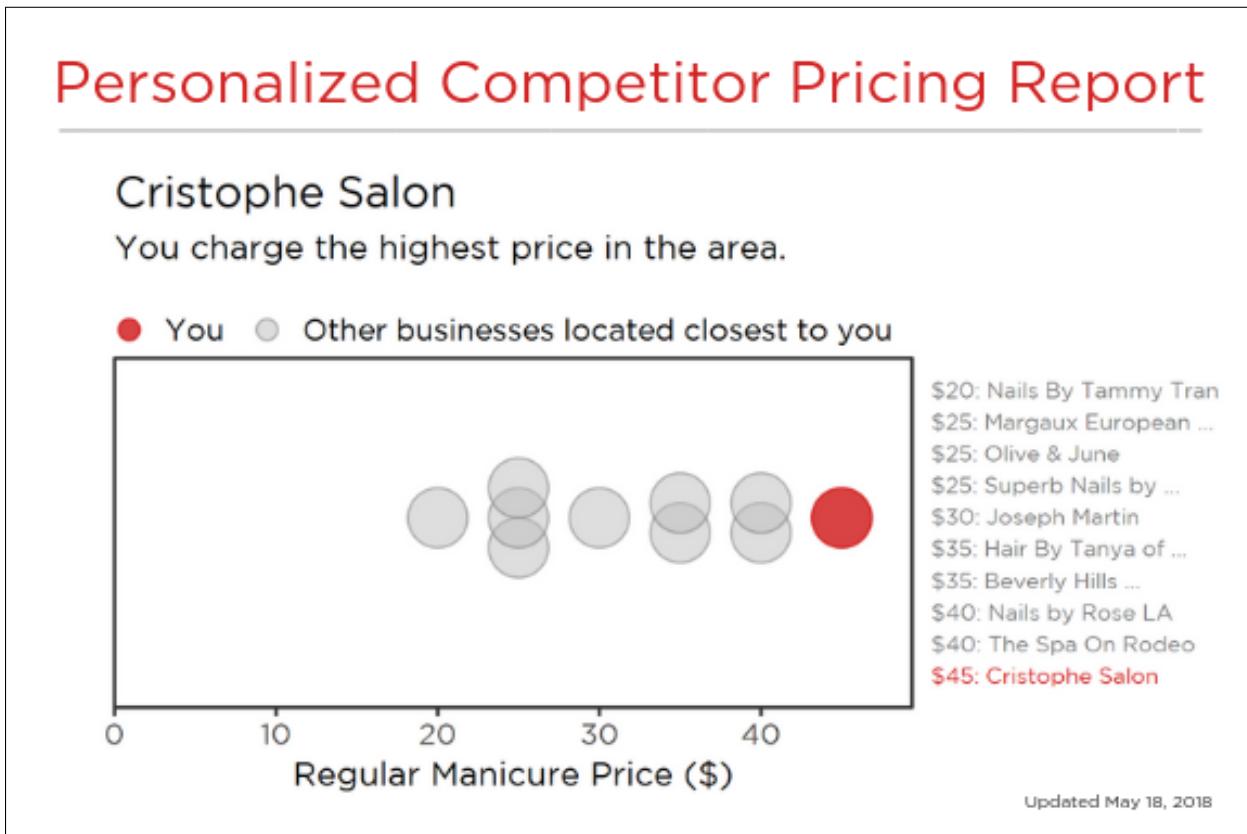
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Figure 1: Brochure and postcard provided to all firms



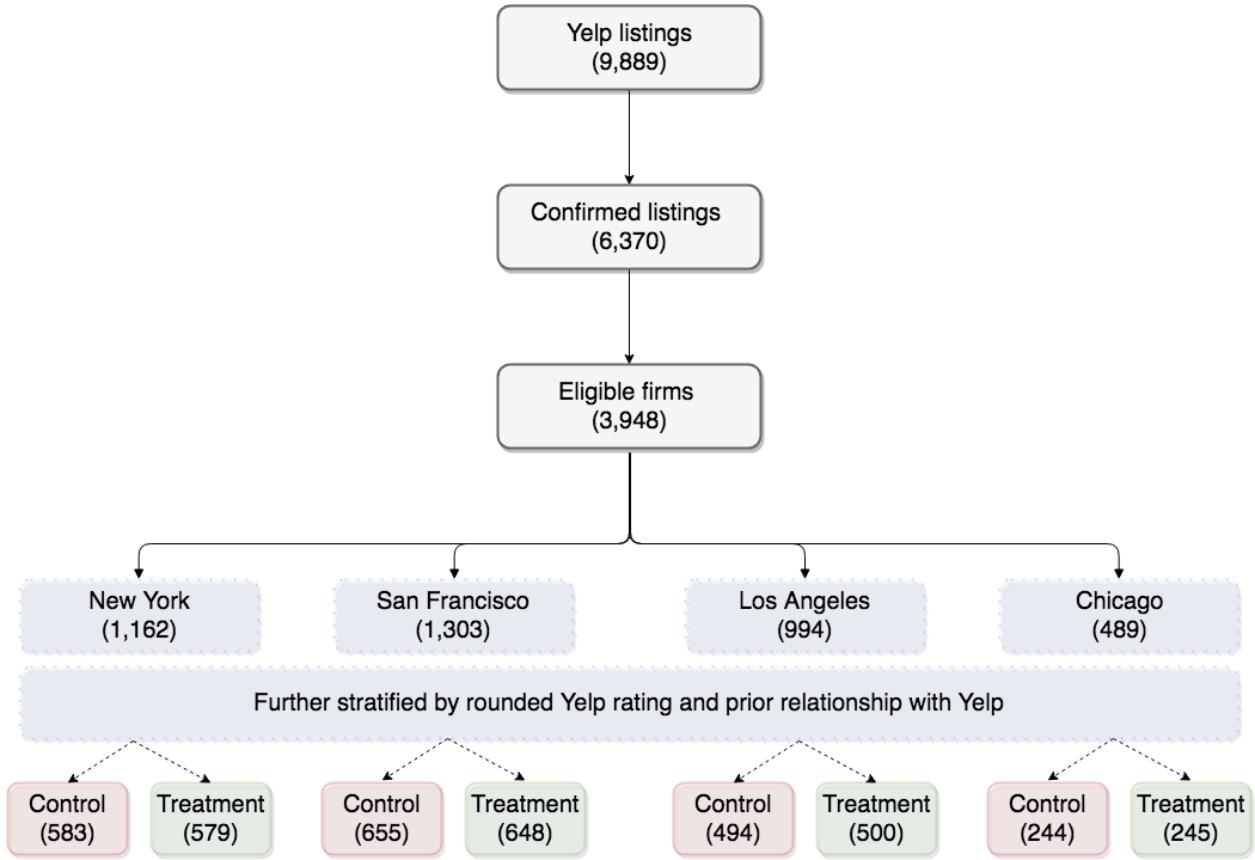
Notes: The top figure shows the brochure that Yelp canvassers provided to all businesses, which includes information on how to edit business details, add photos, and respond to reviews on Yelp's business page. The bottom figure shows a standard marketing postcard that Yelp additionally provided on their visits, which offers free Yelp advertising credits. The back of this postcard is blank for control businesses.

Figure 2: Sample treatment information



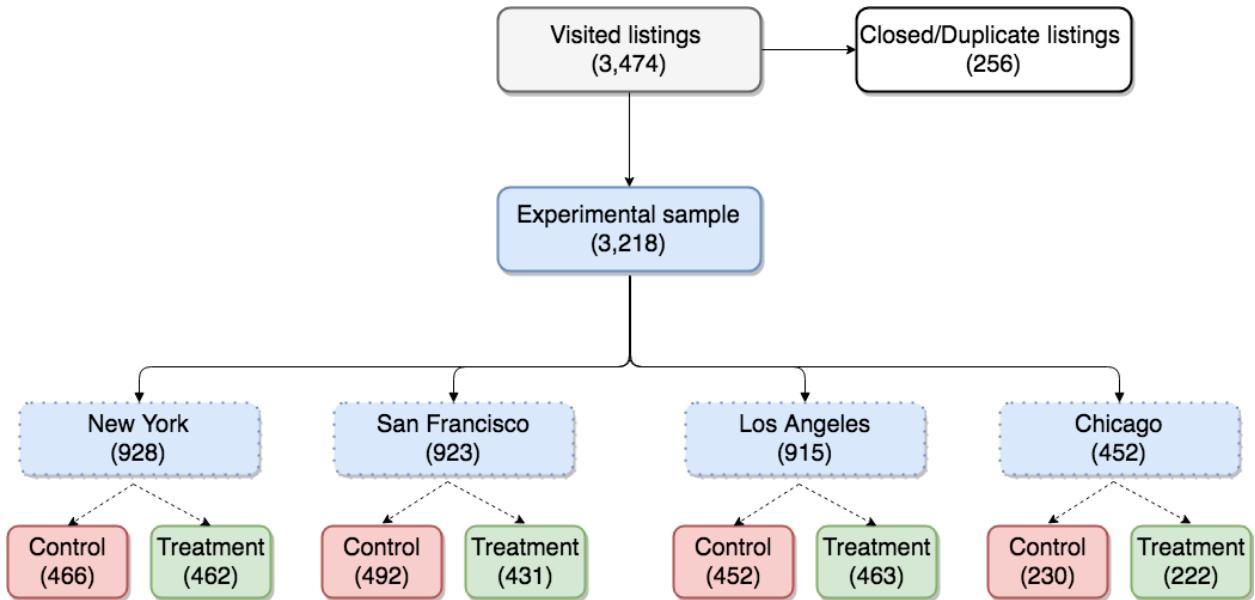
Notes: The back of the marketing postcard for treatment businesses includes a personalized competitor pricing report, a sample of which is shown above. It displays the firm's name, along with a line summarizing the firm's relative price positioning. The image shows the firm's regular manicure price compared to its nine geographically closest competitors. To the right of the postcard are the names of each competitor, along with the exact price it charges.

Figure 3: Randomization



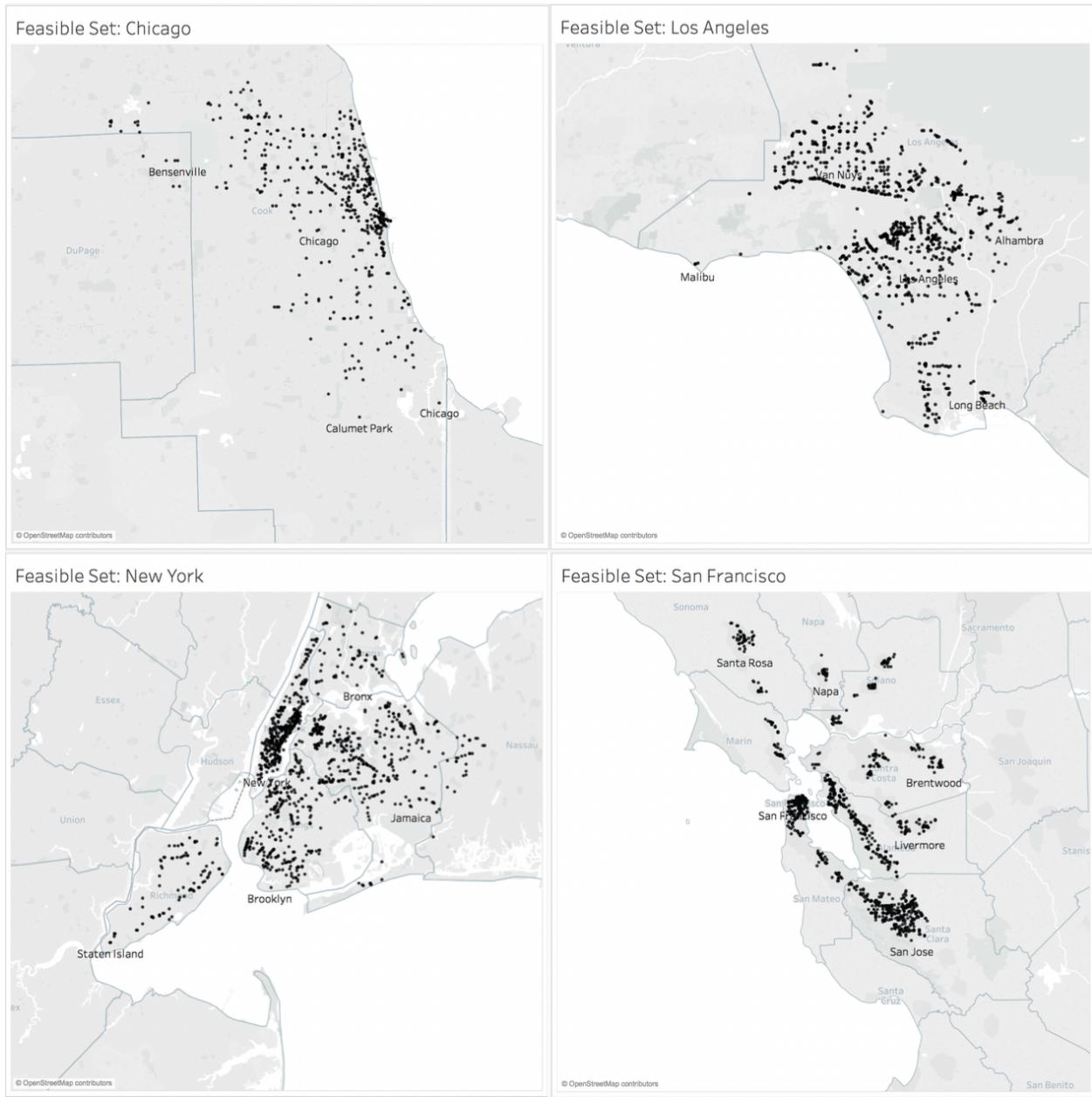
Notes: This figure shows the sample definition and randomization map. To determine the set of eligible firms for the experiment, all nail salon listings on Yelp across the San Francisco Bay Area, New York City, Los Angeles, and Chicago are verified via phone calls and Google Streetview, which results in 6,370 firms. This set is further restricted by excluding any salons with Yelp ratings of 1 to 2.5 stars (out of 5), in order to maximize the likelihood of compliance to treatment. This sample restriction results in an eligible set of 3,948 businesses, which represents 62% of the verified set of firms and the goal Yelp canvassers strived toward reaching, subject to the canvassing budget and timeline. Firms are randomly assigned to control or treatment groups, stratified on its metropolitan area, prior relationship with Yelp, and Yelp rating rounded to the nearest multiple of 0.5.

Figure 4: Experimental sample



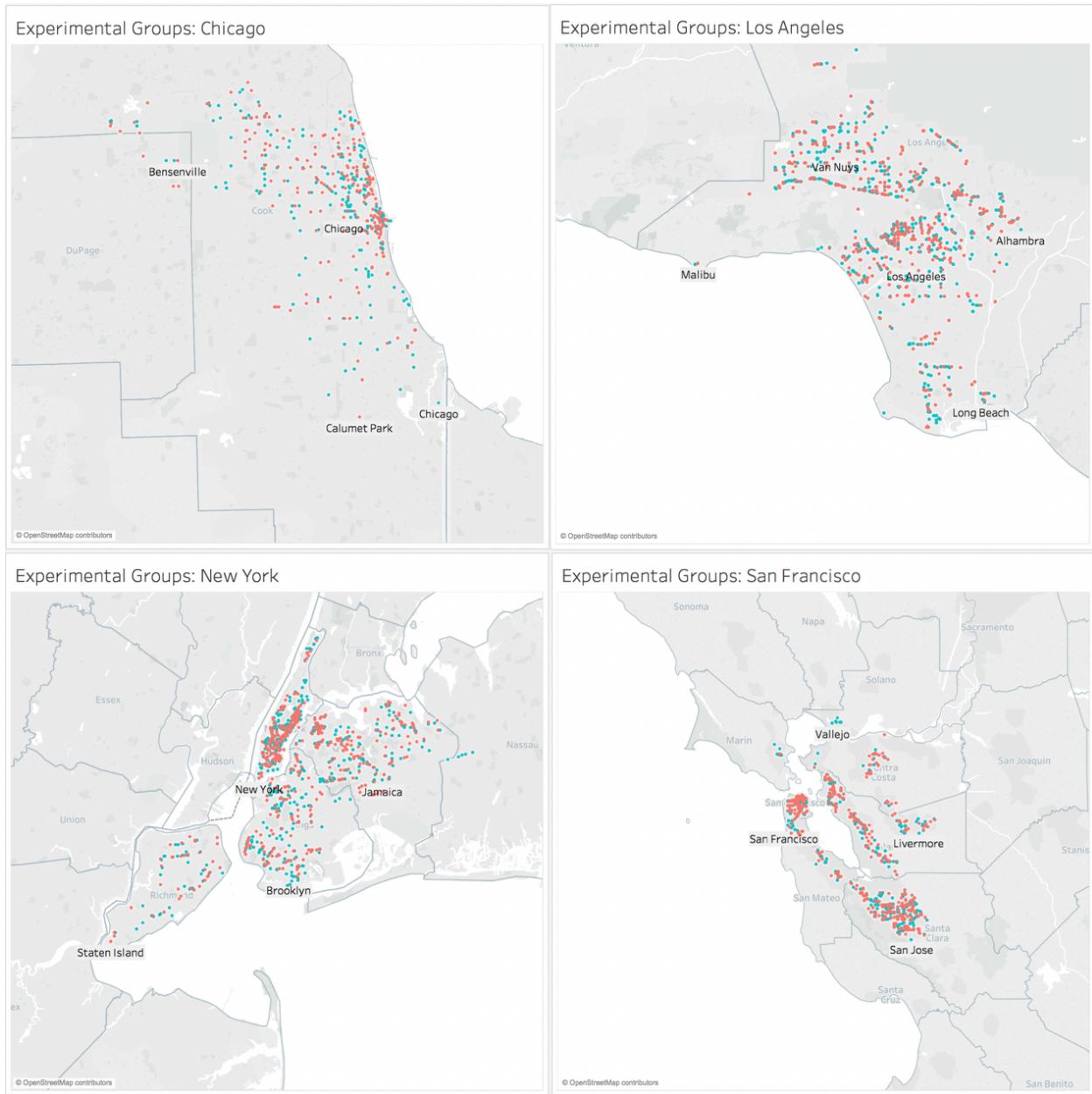
Notes: This figure shows the experimental sample, which results from visits canvassers are able to make among the eligible set within the canvassing timeline. Between June 18 and November 18 of 2018, canvassers are assigned to visit firms, where they are required to finish all visits across control and treatment firms within a neighborhood before moving on to the next neighborhood. Yelp canvassers reach 3,474 businesses. 256 are identified as duplicates or closed by the time that they visit, which results in an experimental sample of 3,218 firms. All firms in the eligible set in Los Angeles and Chicago are reached, and most firms in New York and the San Francisco Bay Area are reached (those that are not reached are in the farther out areas in the Bronx and Queens for New York and the North Bay for San Francisco).

Figure 5: Map of firms in the eligible set



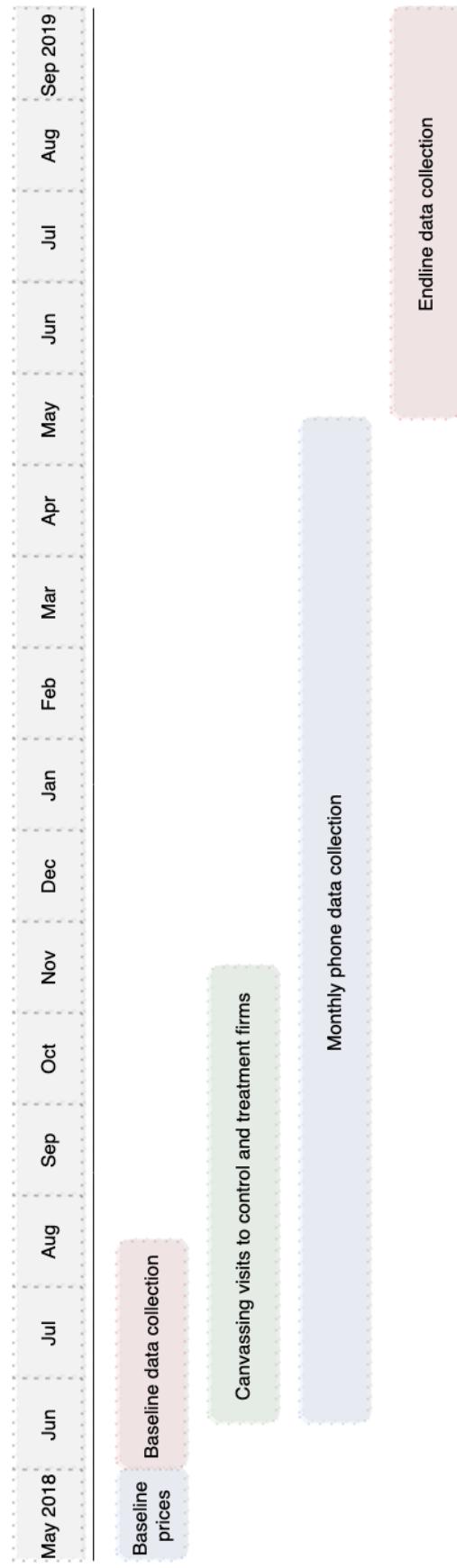
Notes: This map shows all firms in the eligible set across each of the four cities.

Figure 6: Map of firms in the experimental sample



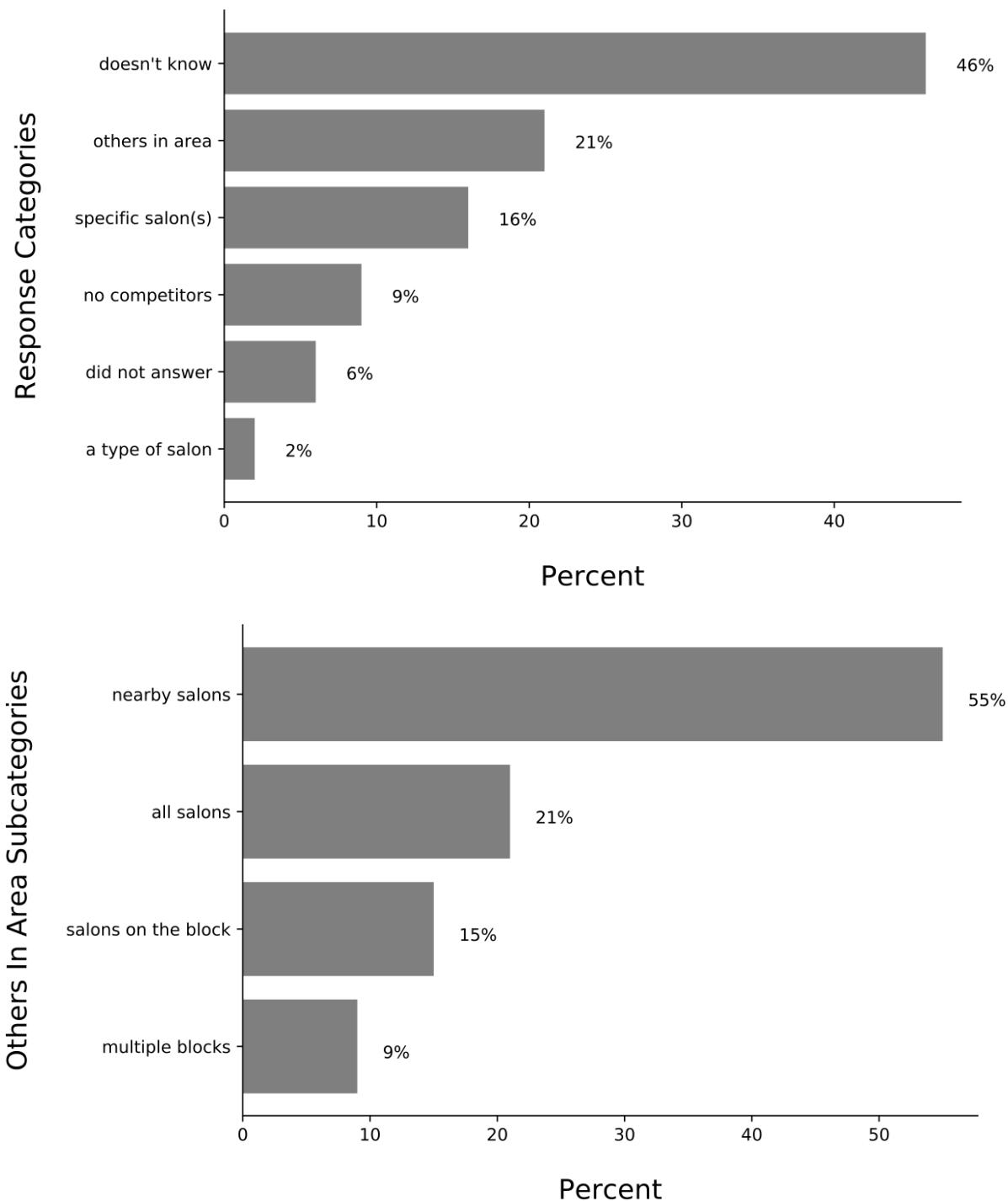
Notes: This map shows all firms in the experimental sample across each of the four cities. Firms in the Bronx and outer Queens area are missing in New York, and firms in the outer North Bay area are missing for San Francisco, compared to the eligible set.

Figure 7: Experimental Timeline



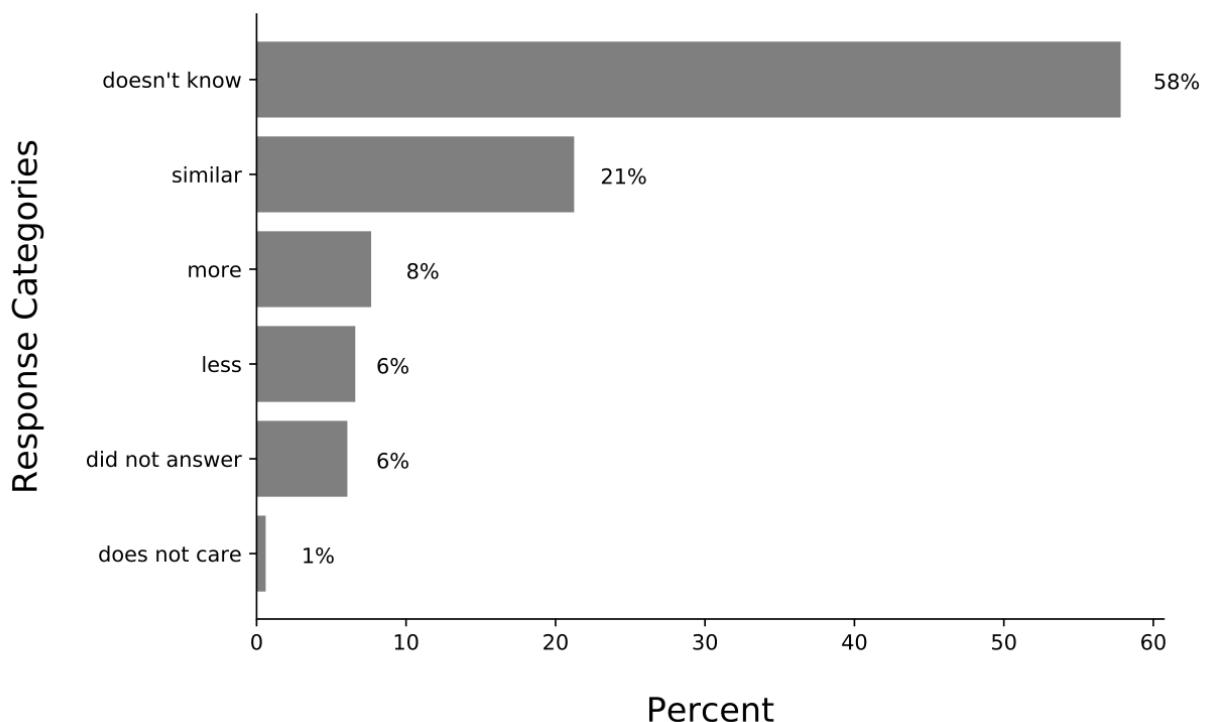
Notes: This figure shows the experimental timeline. Baseline prices are collected in May 2018, and continue to be collected on a monthly basis until May 2019. Baseline quality data are collected between June - August 2018, where it is staggered by neighborhoods to ensure that data are collected before canvassing visits. Endline data are collected between June and September 2019.

Figure 8: Knowledge of primary competitors across treatment firms



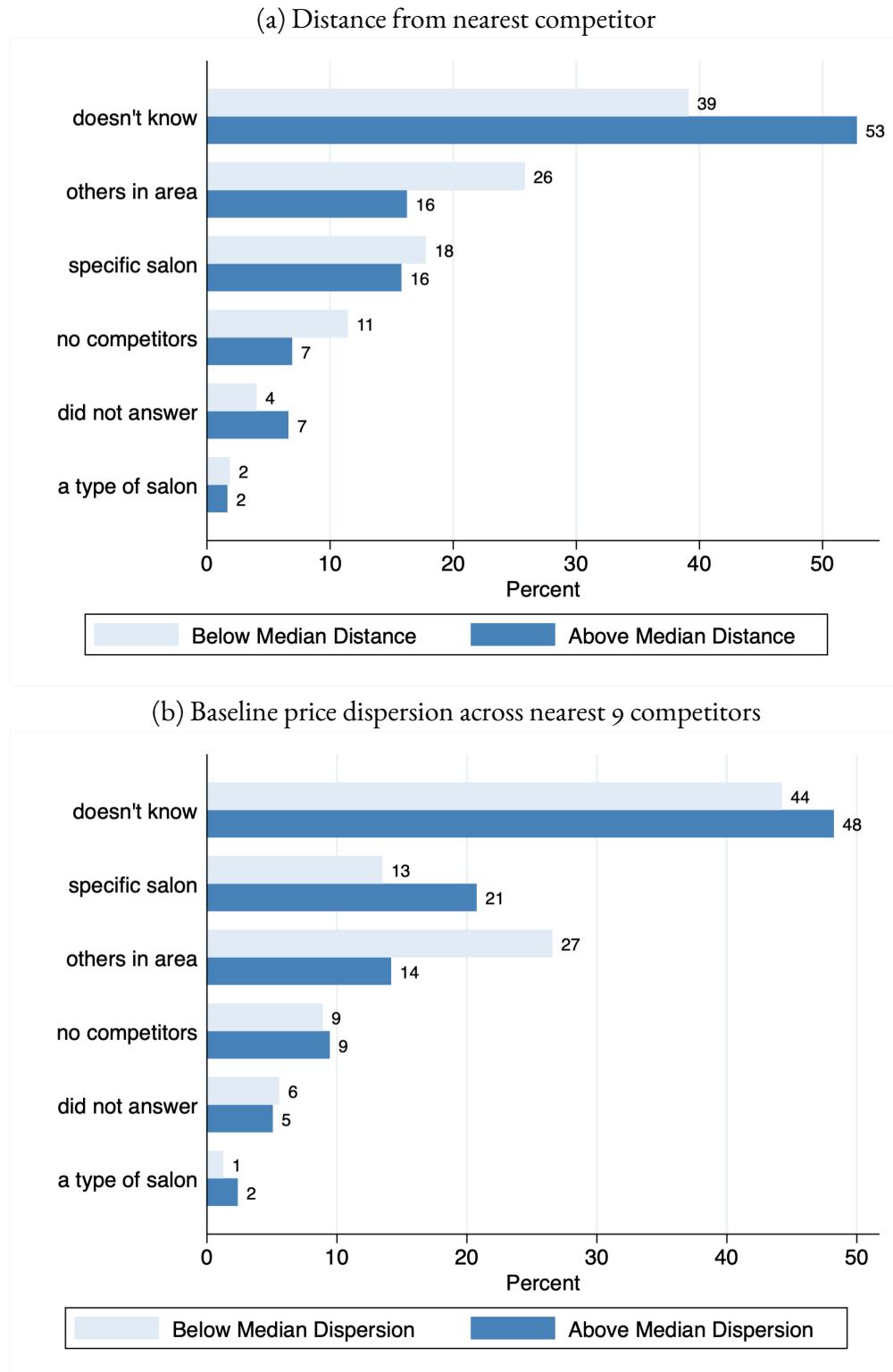
Notes: The top figure shows the breakdown of responses to the question “who do you consider as your primary competitors?” across 1,383 (out of 1,578) treatment firms with whom Yelp canvassers were able to have a conversation to deliver pricing information. Any salons unwilling or too busy to answer the question, or disinterested in answering follow-up questions or continuing the conversation, were counted as “did not answer”. The bottom figure shows the breakdown of 275 responses in “others in area”, based on the four types of phrasing used to describe other competitors in the area: all salons in the area, nearby salons, salons on the block, and multiple blocks.

Figure 9: Knowledge of competitor pricing across treatment firms



Notes: This figure shows the breakdown of responses to the question “what do you think [your primary competitor(s)] charge for a regular manicure?” asked by Yelp canvassers to treatment firms.

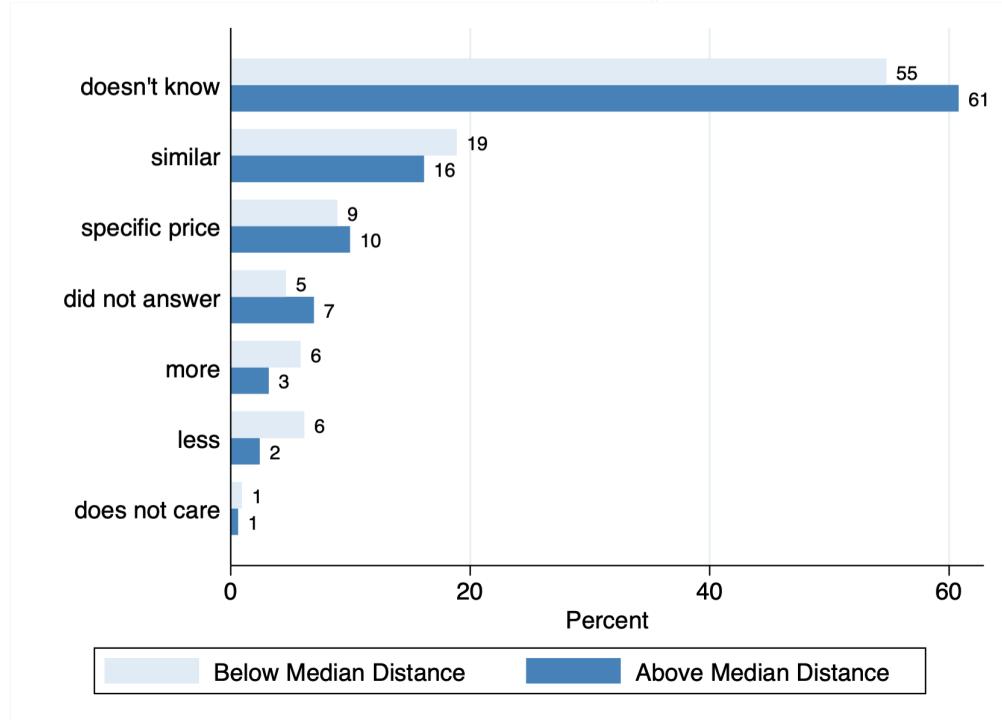
Figure 10: Knowledge of primary competitors by level of competition



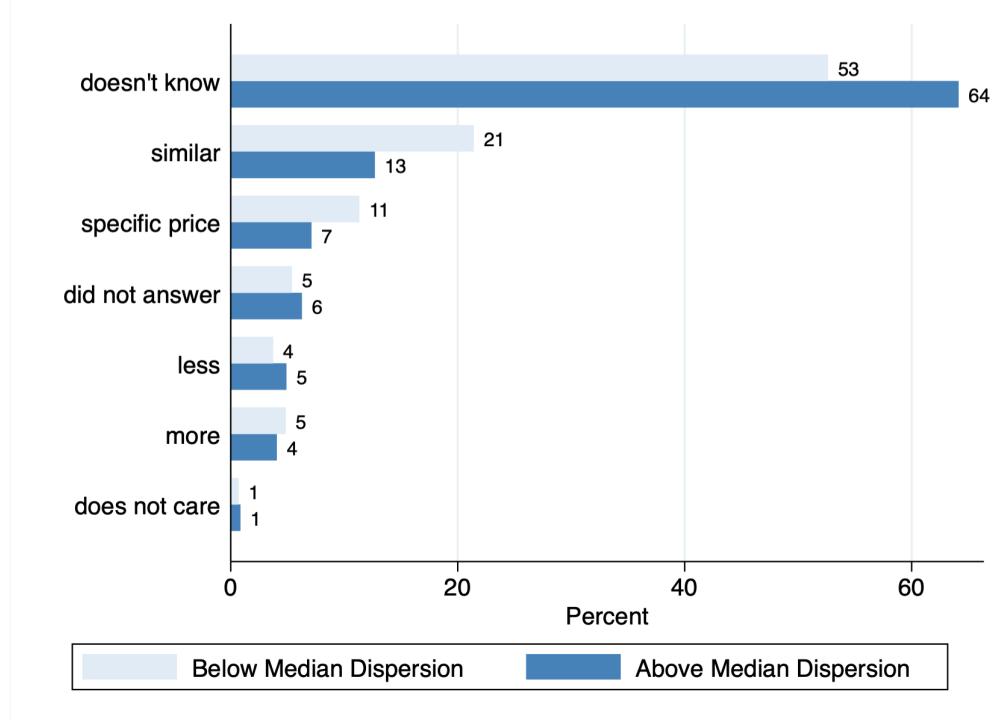
Notes: These figures break down firm responses reflecting their knowledge of competitors by two measures that proxy the level of competition. (a) uses the firm's distance from its nearest competitor as a measure of competition. (b) uses baseline price dispersion across its nearest 9 competitors as a measure of competition. For both of these measures, "below median" distance and dispersion map to higher levels of competition, as they suggest that competitors are closer by and less dispersed in prices.

Figure II: Knowledge of competitor pricing by level of competition

(a) Distance from nearest competitor

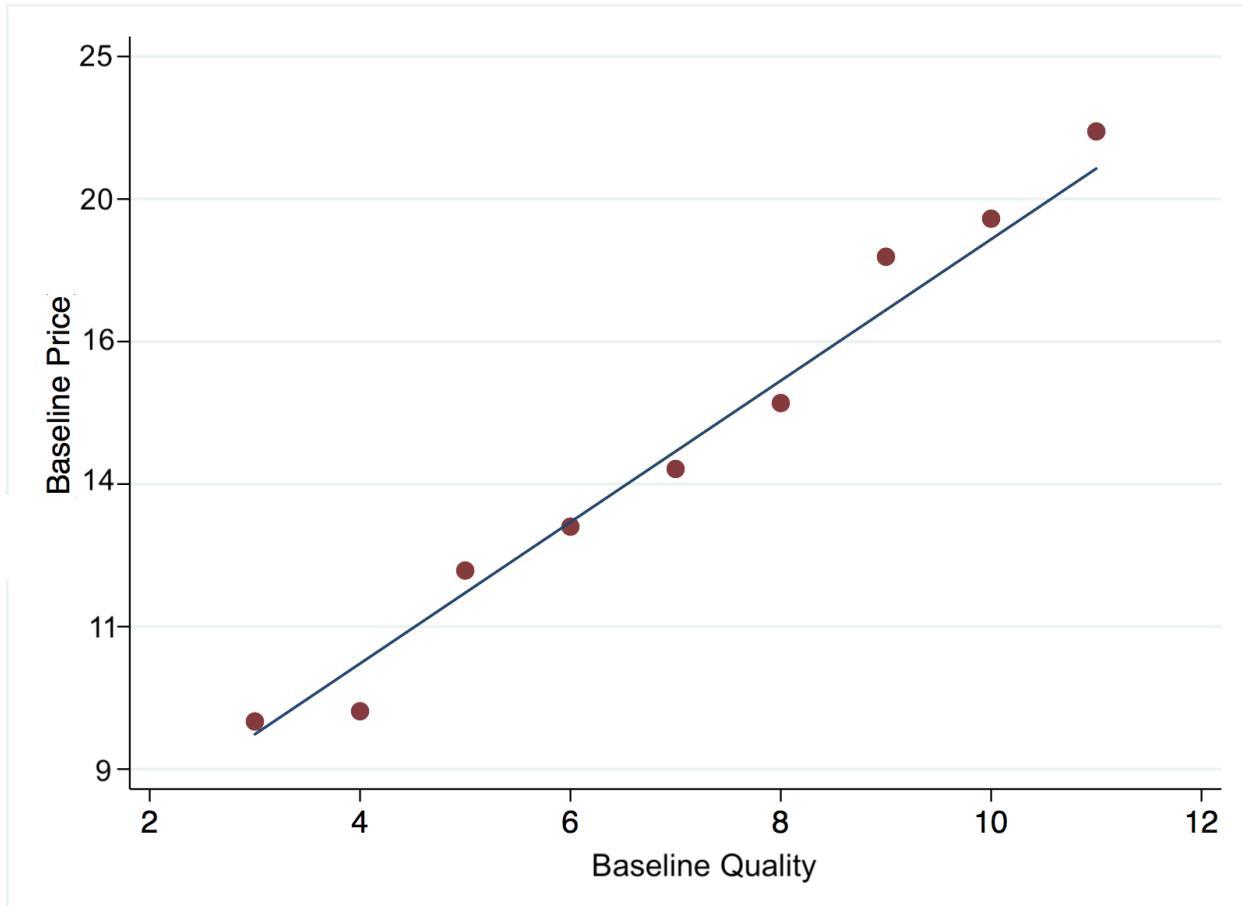


(b) Baseline price dispersion across nearest 9 competitors



Notes: These figures break down firm responses reflecting their knowledge of competitor prices by two measures that proxy the level of competition. (a) uses the firm's distance from its nearest competitor as a measure of competition. (b) uses baseline price dispersion across its nearest 9 competitors as a measure of competition. For both of these measures, "below median" distance and dispersion map to higher levels of competition, as they suggest that competitors are closer by and less dispersed in prices.

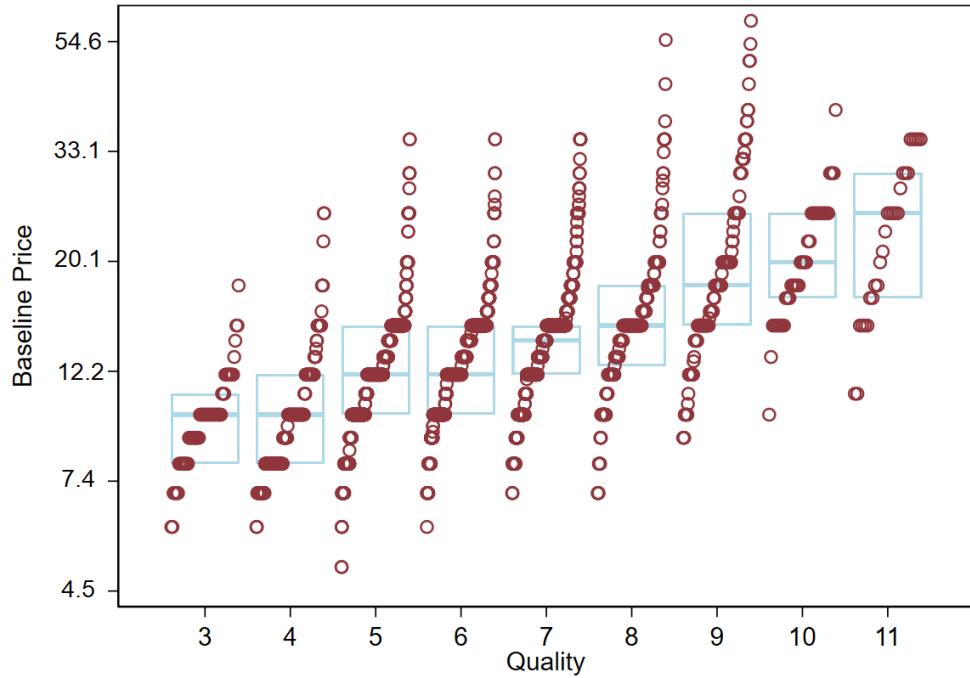
Figure 12: Average regular manicure price by quality



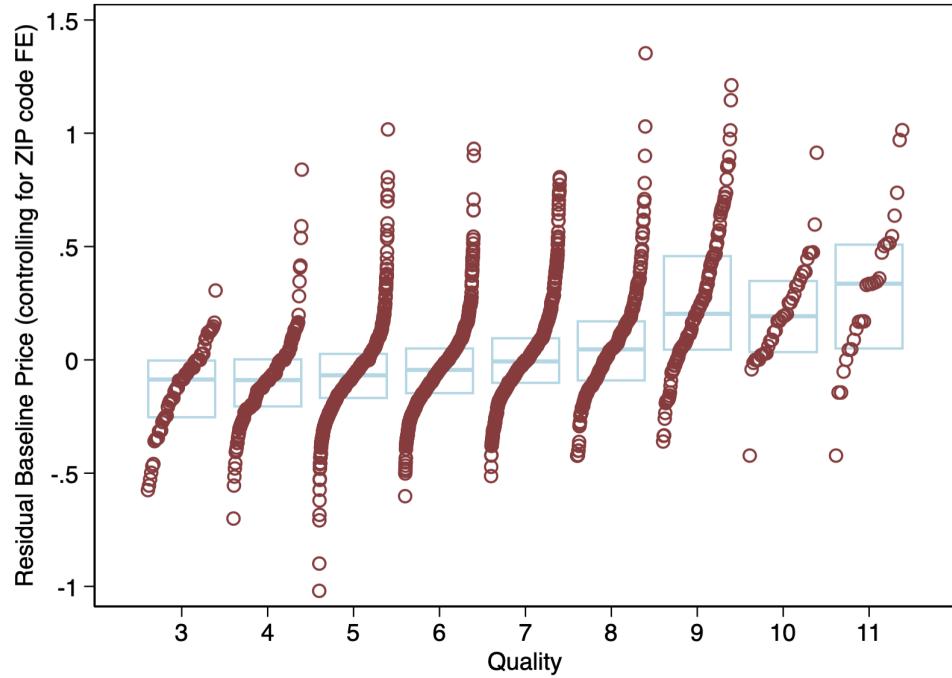
Notes: This figure plots a binscatter of logged baseline price on baseline quality. The y-axis masks logged values of baseline price with price levels for ease of interpretation. Quality represents a sum of the firm's polish brand level, cleanliness, and luxuriousness, and ranges from 3 (lowest) to 11 (highest). This is robust to using a standardized sum of polish brands, cleanliness, and luxuriousness, as well as each individual measure alone.

Figure 13: Dispersion in price-quality positions

(a) Dispersion in firm pricing by quality level

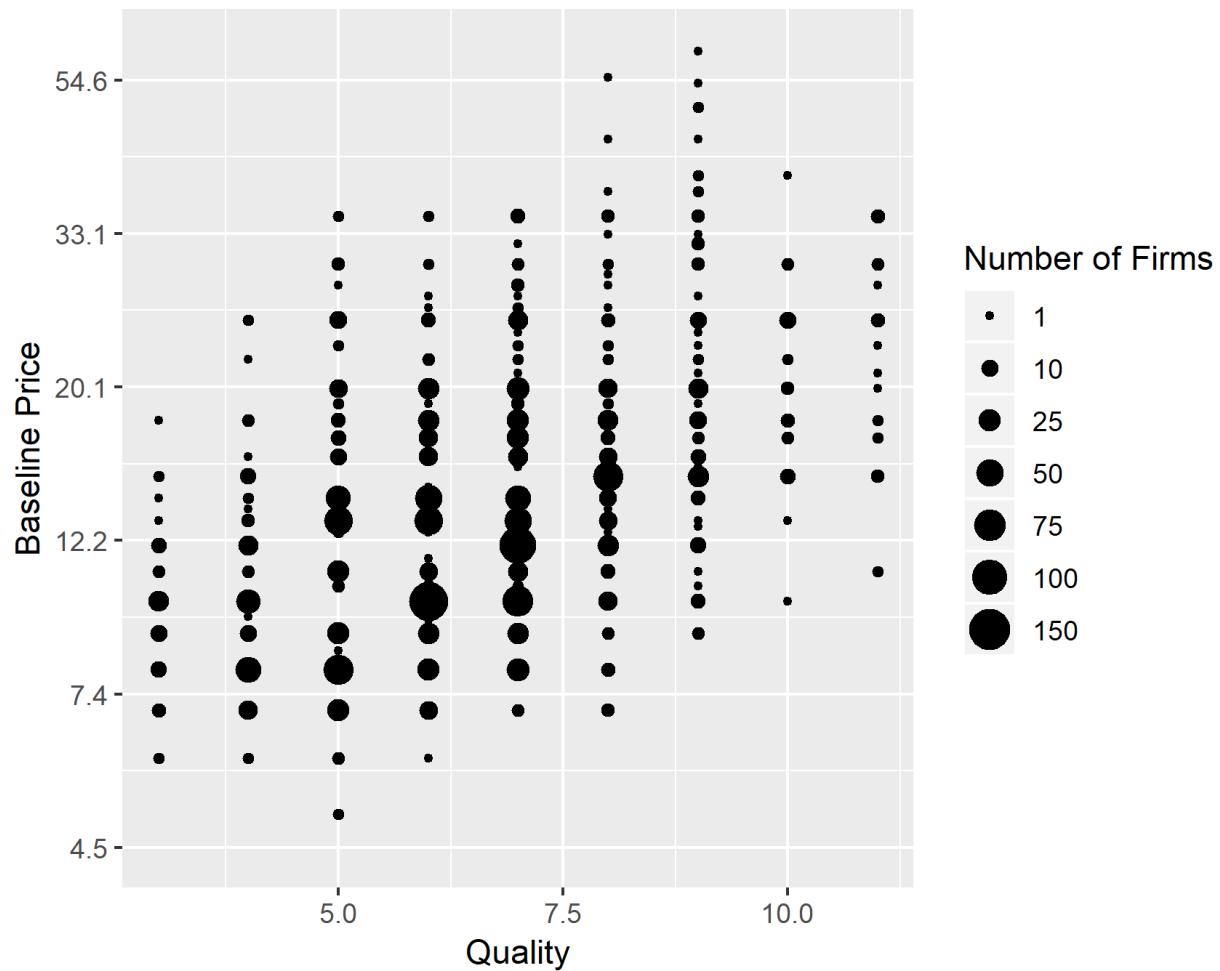


(b) Residual dispersion in firm pricing by quality level, controlling for ZIP code fixed effects



Notes: This figure plots baseline price on baseline quality, showing every firm observation (represented by a red circle) within each quality level sorted by price, along with the interquartile range (in blue). (b) plots the residual baseline price after controlling for ZIP code fixed effects. The coefficient of variation in price across all observations is 37.8%. Within each quality level, the coefficient of variation in price ranges from 22.2% to 47%.

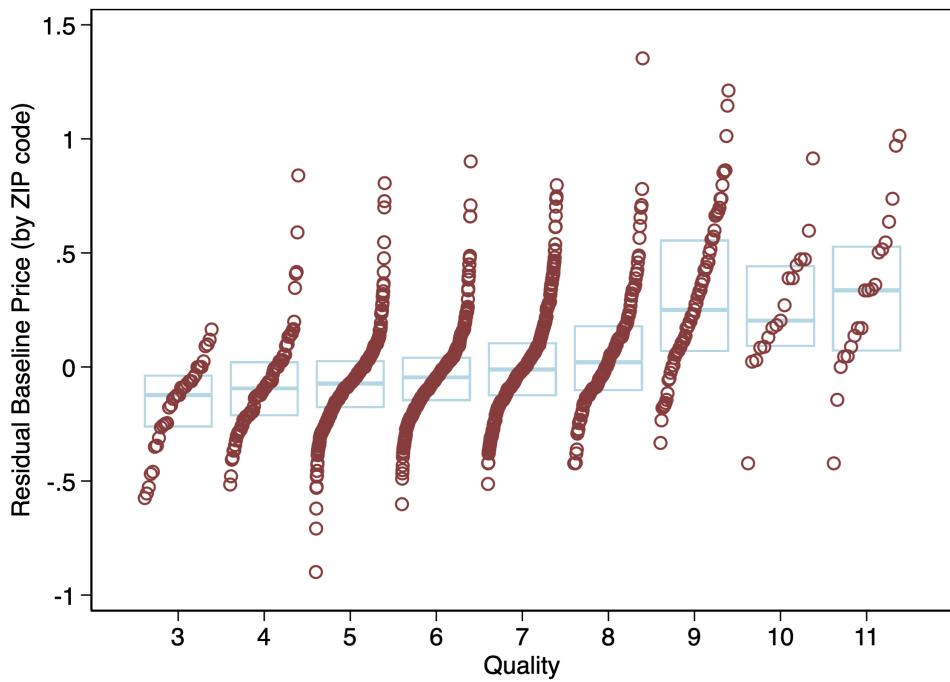
Figure 14: Frequency of firm positions



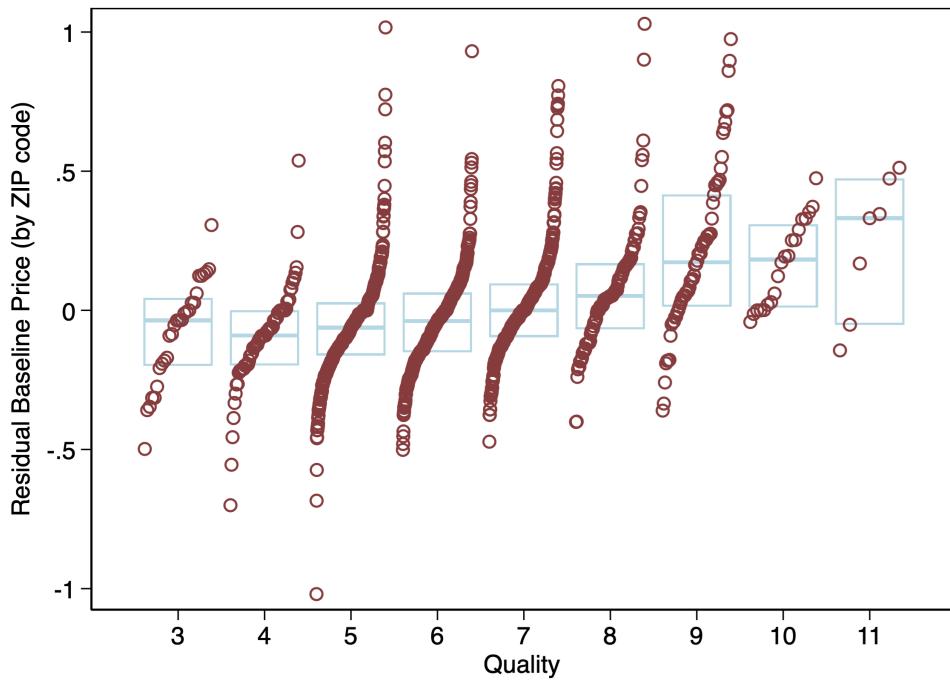
Notes: This figure shows the frequency of price-quality positions, where the size of the dot represents the number of firms at a given price-quality position.

Figure 15: Dispersion in price-quality positions by level of competition

(a) Below median distance from nearest competitor

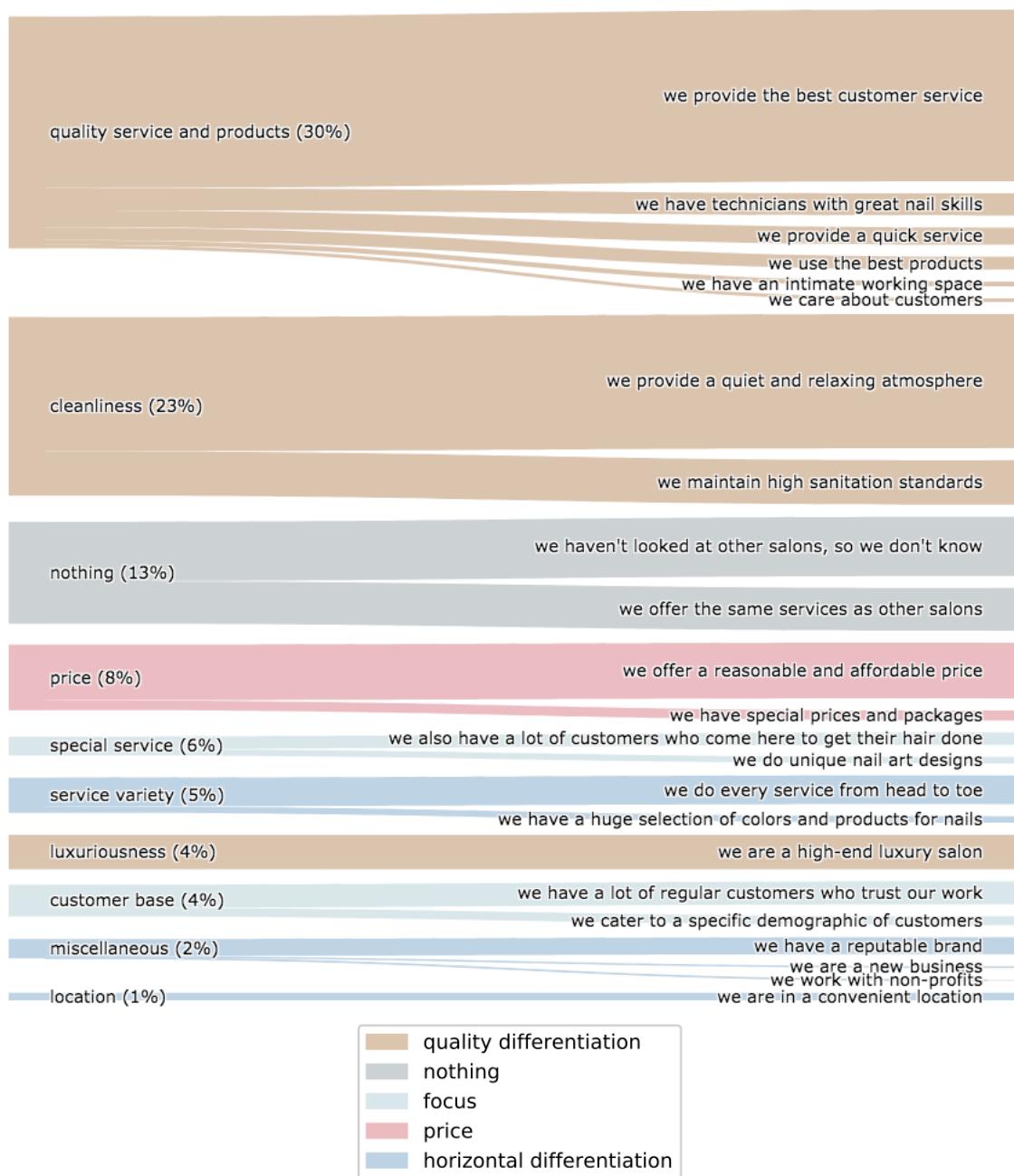


(b) Above median distance from nearest competitor



Notes: This figure separates Figure 13(b) into below and above median distance from the nearest competitor to show the level of dispersion in price-quality positions by competition level.

Figure 16: Firms' own descriptions of their positioning



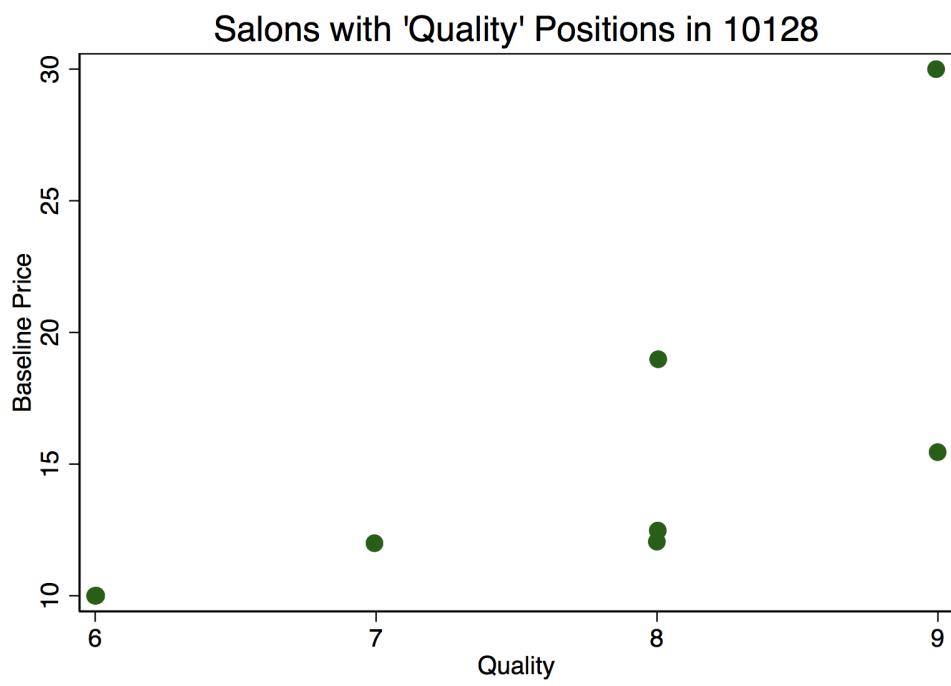
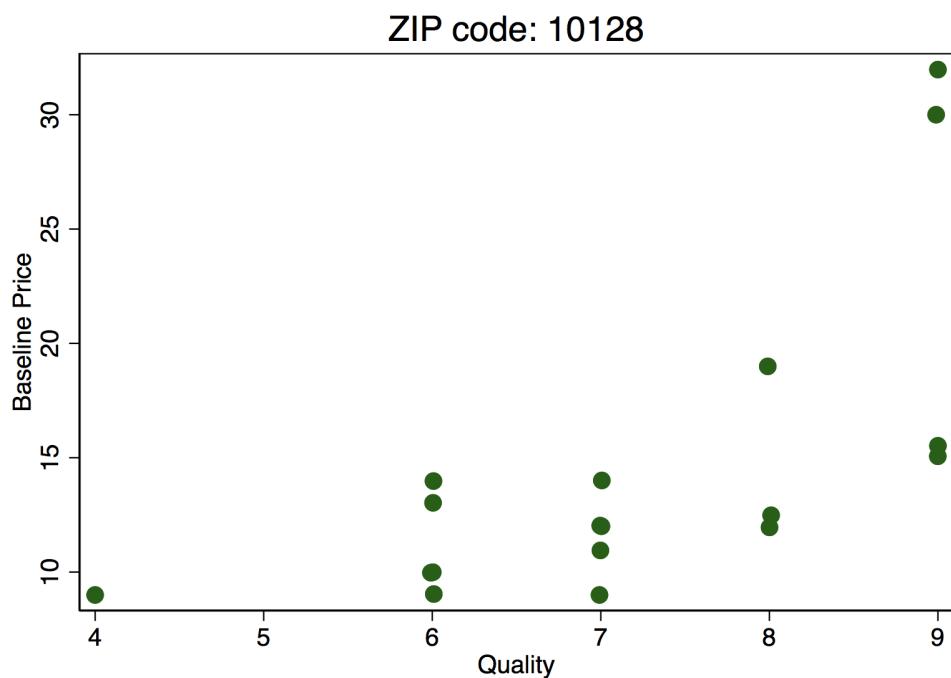
Notes: This figure shows a diagram of the self-descriptions that treatment firms provide of their positioning prior to treatment, prompted by the question, "What sets you apart from your competitors?". Each response was coded into categories by two independent research assistants, with any discrepancies sent to a third research assistant.

Figure 17: Dispersion in observed price-quality positions across firms describing their position as “low price”



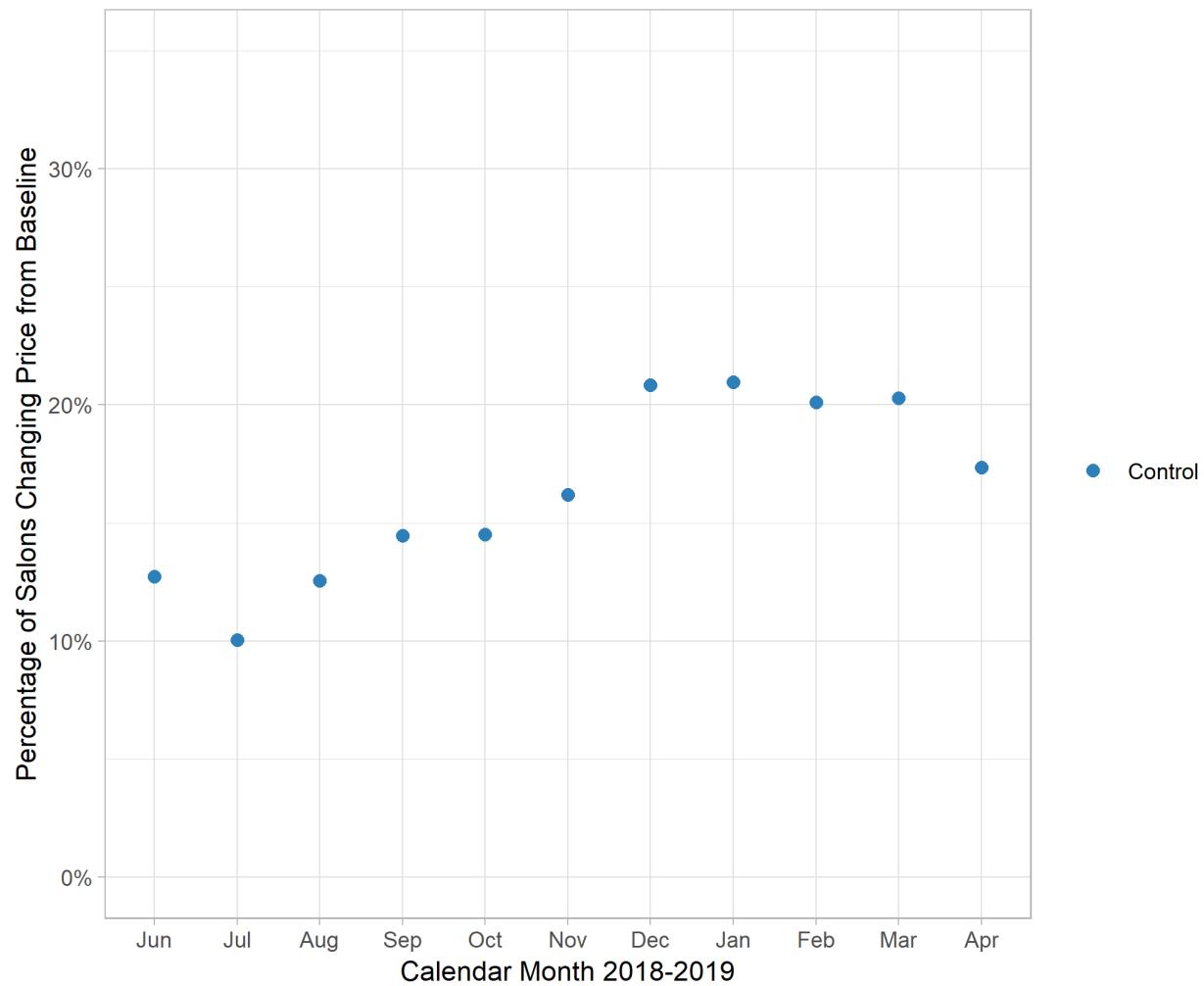
Notes: This figure plots observed price-quality positions for all firms that specify “low price” as their positioning.

Figure 18: Dispersion in price-quality positions across firms in ZIP code 10128



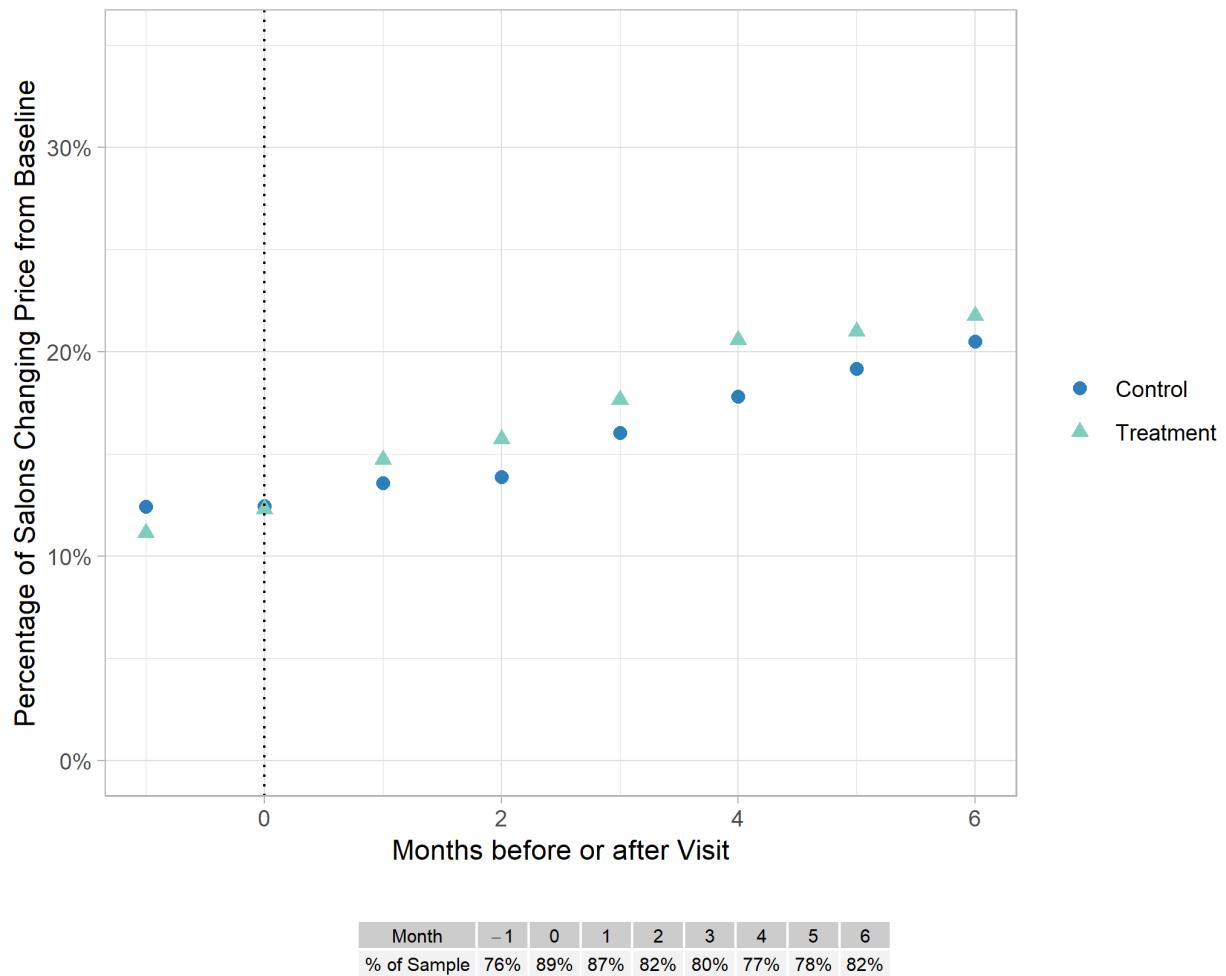
Notes: This figure plots the observed price-quality positions of firms in ZIP code 10128 in New York, which is located in the Upper East Side of Manhattan.

Figure 19: Seasonality in price changes



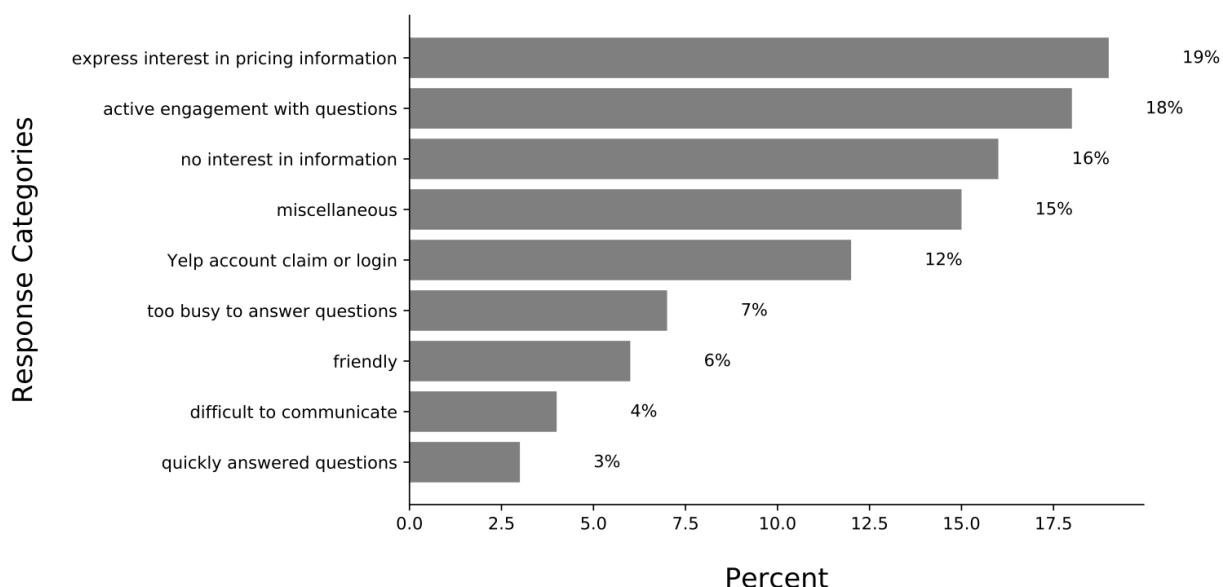
Notes: This figure plots the percentage of control firms with a different regular manicure price from their baseline price by calendar month. Firms appear to display seasonality in when they change prices, using more promotions in slower months (fall and winter) and changing menu prices at the end of the year. These patterns are consistent with those documented in industry magazines and confirmed by salon managers and owners.

Figure 20: Percentage of firms with a different price relative to baseline (by elapsed month)



Notes: This figure plots the raw percentage of control versus treatment firms that charge a different price compared to their baseline price in each month before and after the canvassing visit. Each month begins on the 15th of each calendar month in order to count months following the canvasser visit, which began June 18, 2018. The table below the figure shows the percentage of observations reflected in each mean, which varies due to the variation in the number of observations collected in each month (due to closures or firms not answering calls) and the staggered timeline of visits across the 12 months of data collection (e.g. firms visited between October 15 - November 15 have only 5 months of post-visit data).

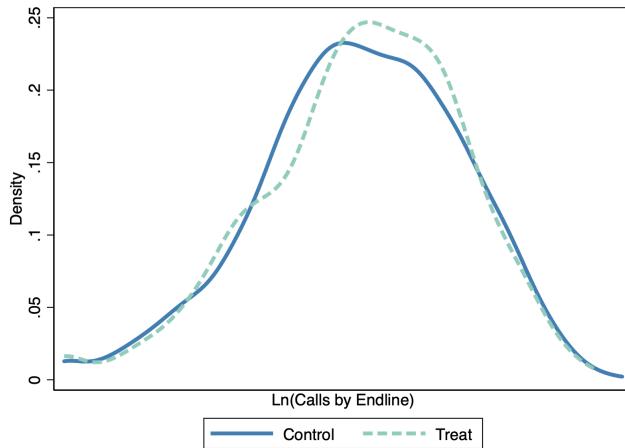
Figure 21: Canvasser notes on treatment firm responses



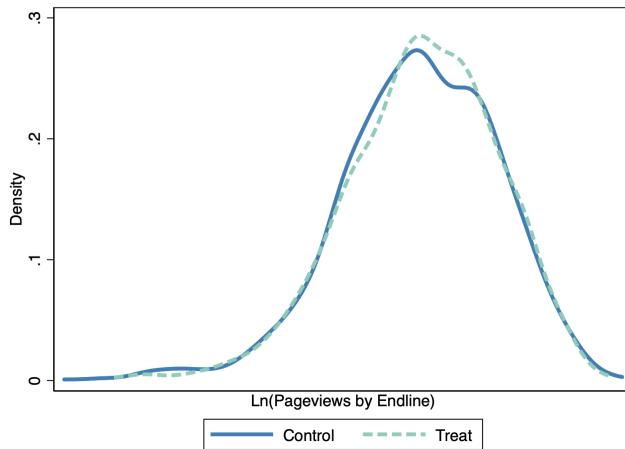
Notes: This figure categorizes canvassers' notes on their visit. Two independent research assistants coded each response, with any conflicts resolved by a third research assistant.

Figure 22: Distribution of firm performance

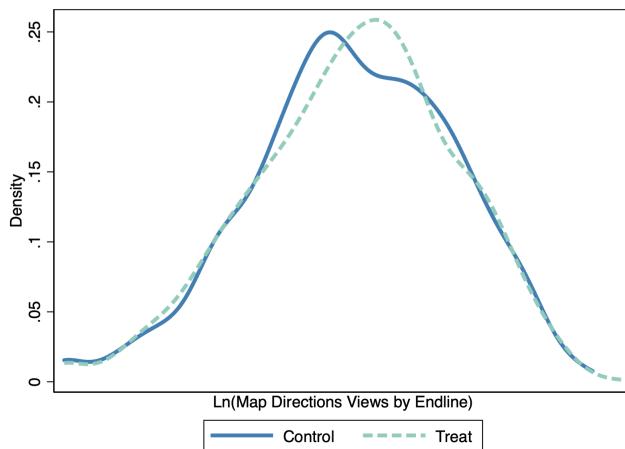
(a) Number of calls



(b) Number of page views



(c) Number of map directions views



Notes: These figures plot the distribution of the sum of calls, page views, and map directions views received between baseline and endline across control and treatment firms. Due to restrictions in the data sharing agreement, the levels of the number of calls, page views, or map directions views are masked.

Table 1: Summary Statistics

|                                     | (1)<br>All |       |       |       |         |       |
|-------------------------------------|------------|-------|-------|-------|---------|-------|
|                                     | mean       | sd    | min   | p50   | max     | count |
| Baseline Price                      | 13.88      | 5.24  | 5.00  | 13.00 | 60.00   | 3218  |
| Baseline Number Of Employees        | 4.26       | 2.53  | 1.00  | 4.00  | 25.00   | 2923  |
| Baseline Number Of Customers        | 3.75       | 3.23  | 0.00  | 3.00  | 30.00   | 2926  |
| Baseline Total Hours Open Weekly    | 62.06      | 10.25 | 8.00  | 63.00 | 115.50  | 3073  |
| Cleanlinessito4                     | 2.65       | 0.70  | 1.00  | 3.00  | 4.00    | 2964  |
| Luxuriousnessito4                   | 2.41       | 0.73  | 1.00  | 2.00  | 4.00    | 2969  |
| Polish Brand Level                  | 1.12       | 0.37  | 1.00  | 1.00  | 3.00    | 3018  |
| Price of Gel Manicure               | 29.32      | 8.06  | 10.00 | 28.00 | 105.00  | 2806  |
| Baseline Number of Services (Scope) | 2.09       | 1.24  | 0.00  | 2.00  | 7.00    | 3092  |
| Baseline Yelp Rating                | 3.88       | 0.61  | 3.00  | 4.00  | 5.00    | 3142  |
| Baseline Number of Yelp Reviews     | 69.01      | 84.68 | 0.00  | 41.00 | 1075.00 | 3218  |
| Availability Next Day 4-5pm         | 0.75       | 0.27  | 0.00  | 0.86  | 1.00    | 3209  |
| Baseline Average Daily Opening Hour | 09:44      | 00:31 | 06:00 | 09:51 | 14:00   | 3075  |
| Baseline Average Daily Closing Hour | 19:14      | 00:50 | 13:04 | 19:04 | 23:25   | 3074  |
| Yelp Canvass Week                   | 33.66      | 5.33  | 24.00 | 34.00 | 44.00   | 3218  |
| Number of Price Changes Pre-Visit   | 0.12       | 0.29  | 0.00  | 0.00  | 1.00    | 2609  |

Notes: This table provides summary statistics on all baseline characteristics of a salon, collected by data collectors via phone calls or physical visits to the business. Baseline price refers to the regular manicure price. Baseline number of employees and customers count the total number of employees and customers that are observed at the time of visit. Total hours open weekly counts the total number of hours that salons are open, based on their opening and closing times. Cleanliness and luxuriousness are coded on a scale of 1 to 4, detailed in Table 4. Polish brand level is coded on a scale of 1 to 3, based on the retail price of the most expensive nail polish brand observed. The number of services counts the total types of services that are offered by the firm (e.g. spa services, hair cuts, hair removal, make-up, tanning, and tattoos and piercings). Availability next-day is a binary variable collected by data collectors when inquiring for an appointment between 4-5pm, a peak hour for salon services. Yelp canvass week measures the week that canvassers visit each firm. The number of price changes pre-visit counts the total number of price changes between baseline and the canvasser visit.

Table 2: Balance of Baseline Variables Across Experimental Conditions

|                                     | Treatment Mean | Control Mean | Difference (p-value) |
|-------------------------------------|----------------|--------------|----------------------|
| Baseline Price                      | 13.98          | 13.79        | -0.19 (0.30)         |
| Baseline Number Of Employees        | 4.31           | 4.22         | -0.09 (0.31)         |
| Baseline Number Of Customers        | 3.82           | 3.68         | -0.13 (0.26)         |
| Baseline Total Hours Open Weekly    | 62.23          | 61.89        | -0.33 (0.37)         |
| Cleanlinessito4                     | 2.67           | 2.63         | -0.04 (0.13)         |
| Luxuriousnessito4                   | 2.46           | 2.37         | -0.10*** (0.00)      |
| Polish Brand Level                  | 1.12           | 1.12         | -0.00 (0.74)         |
| Price of Gel Manicure               | 29.35          | 29.29        | -0.05 (0.86)         |
| Baseline Number of Services (Scope) | 2.11           | 2.08         | -0.02 (0.59)         |
| Baseline Yelp Rating                | 3.88           | 3.89         | 0.01 (0.49)          |
| Baseline Number of Yelp Reviews     | 69.62          | 68.41        | -1.21 (0.69)         |
| Availability Next Day 4-5pm         | 0.75           | 0.75         | -0.00 (0.95)         |
| Baseline Average Daily Opening Hour | 09:43          | 09:44        | 00:01 (0.40)         |
| Baseline Average Daily Closing Hour | 19:15          | 19:14        | -00:01 (0.42)        |
| Yelp Canvass Week                   | 34.39          | 32.95        | -1.44*** (0.00)      |
| Number of Price Changes Pre-Visit   | 0.12           | 0.13         | 0.01 (0.32)          |
| Observations                        | 1578           | 1640         | 3218                 |

Notes: This table shows the balance of variables at baseline between control and treatment firms.

Table 3: Compliance and attrition across experimental conditions

|                | (1)<br>Treatment<br>Number of Firms | (2)<br>Treatment<br>% of Firms | (3)<br>Control<br>Number of Firms | (4)<br>Control<br>% of Firms | (5)<br>p-value |
|----------------|-------------------------------------|--------------------------------|-----------------------------------|------------------------------|----------------|
| Non-compliance | 25                                  | 1.58                           | 33                                | 2.01                         | 0.36           |
| Closed         | 88                                  | 5.58                           | 73                                | 4.45                         | 0.14           |
| No price data  | 20                                  | 1.27                           | 16                                | 0.98                         | 0.43           |
| Observations   | 1578                                | 1578                           | 1640                              | 1640                         | 3218           |

Notes: Non-compliance denotes firms that rejected any conversation with Yelp canvassers when they arrived. In these cases, the firm did not receive any information from the canvasser, including the brochure and postcard materials. “Closed” represents firms that were confirmed as closed or no longer offering nail services after the canvassing visit. “No price data” represents firms that were no longer reachable after the canvassing visit but were not confirmed as closed or no longer offering nail services.

Table 4: Rubric to code cleanliness and luxuriousness

|  |  |
|--|--|
| Instructions: Please rate the salon's cleanliness and luxuriousness, assigning the rating using the following guidelines. If you are in between categories and see any of what is listed for a lower rating, record the lower rating. If for any reason you cannot observe the salon interior, enter NA. |  |
| <b>Cleanliness</b>   |  |
| 1 Grime on countertops and/or nail clippings on floors, technicians are wearing their own outside clothing and no gloves, technicians are reusing tools after each customer, pedicure bath is reused after a customer finishes   |  |
| 2 General disarray or grime on countertops and floors, technicians are wearing their own outside clothing and no gloves, technicians are using some disinfection (e.g. UV lighting machine), pedicure bath is washed with water after a customer finishes  |  |
| 3 Generally clean countertops and floors, technicians are wearing some type of uniform but may not be wearing gloves, technicians are using liquid disinfection, pedicure bath appears to be disinfected after a customer finishes   |  |
| 4 The floor and surfaces are spotless, technicians are wearing neat clothing and gloves, tools are disposable and/or salon has an autoclave, pedicure area is being disinfected for at least 10min after a customer finishes   |  |
| <b>Luxuriousness</b>   |  |
| 1 Small and cramped service area, no waiting area, no investment into decor (furniture, upholstery, or art) with stained walls and/or broken fixtures, no amenities provided   |  |
| 2 Small but comfortable service areas, some reception area even if small and not clearly separate from the rest of the salon, no broken fixtures or wall stains but little investment into decor, basic amenities (e.g. candy) may be provided   |  |
| 3 Spacious service area, small but separate reception area, some investment into decor (furniture, upholstery, or art), some amenities provided (e.g. water, disposable slippers, reading material)  |  |
| 4 Spacious and private or luxurious service area, security and/or spacious waiting area, high investment into decor (furniture, upholstery, or art), many amenities provided (e.g. drinks of choice, snacks, diversity of reading material, slippers/gowns)  |  |

Notes: This table shows the rubric that data collectors use to code cleanliness and luxuriousness. Data collectors are required to take accompanying photos of the interior, polish brands, menu, and exterior to validate their codings. 5% of each data collector's photos are checked every week.

Table 5: Price Changes Across Control and Treatment Firms

|                                      | (1)<br>Price Change | (2)<br>Price Change | (3)<br>Price Change | (4)<br>Price Change |
|--------------------------------------|---------------------|---------------------|---------------------|---------------------|
| Post * Treat                         | 0.029**<br>(0.013)  | 0.028**<br>(0.013)  | 0.030**<br>(0.013)  | 0.030**<br>(0.013)  |
| Controls                             | Yes                 | Yes                 | Yes                 | Yes                 |
| Visit Week FE                        | Yes                 | Yes                 | Yes                 | Yes                 |
| Month FE                             | No                  | Yes                 | No                  | Yes                 |
| Strata FE                            | No                  | No                  | Yes                 | Yes                 |
| Observations                         | 30142               | 30142               | 29552               | 29552               |
| Mean (control in months after visit) | 0.173               |                     |                     |                     |
| SD (control in months after visit)   | 0.378               |                     |                     |                     |

Notes: This table shows intention to treat estimates of the competitor information treatment on firms' likelihood of changing prices. Observations are at the firm-month level. The dependent variable is a binary indicator of whether the firm's regular manicure price in a given month is different from its baseline price. All regressions control for any baseline differences between control and treatment groups, an indicator for months post-canvasser visits, and fixed effects for the week of the canvasser visit. Columns (2)-(4) additionally control for randomization strata fixed effects and/or month fixed effects. Standard errors are clustered at the firm level. \* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

Table 6: Directions of Price Changes Across Control and Treatment Firms

|                                      | (1)<br>Price Decrease | (2)<br>Price Increase | (3)<br>ln(Price)    |
|--------------------------------------|-----------------------|-----------------------|---------------------|
| Post * Treat                         | 0.005<br>(0.006)      | 0.023**<br>(0.011)    | 0.023***<br>(0.009) |
| Controls                             | Yes                   | Yes                   | Yes                 |
| Visit Week FE                        | Yes                   | Yes                   | Yes                 |
| Observations                         | 30142                 | 30142                 | 30142               |
| Mean (control in months after visit) | 0.036                 | 0.137                 | 2.580               |
| SD (control in months after visit)   | 0.185                 | 0.344                 | 0.304               |

Notes: This table shows intention to treat estimates of the competitor information treatment on firms' likelihood of decreasing or increasing prices (columns 1 and 2), as well as price levels (column 3). Observations are at the firm-month level. Price decrease (increase) is a binary indicator of whether the firm's regular manicure price in a given month is lower (higher) than its baseline price. All regressions control for any baseline differences between control and treatment groups, an indicator for months post-canvasser visits, and fixed effects for the week of the canvasser visit. Standard errors are clustered at the firm level. \* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

Table 7: Price Change Across Control and Treatment Firms by Baseline Price Position from Nearest Competitor

|                | Price Change       |                   |                  | Price Increase      |                  |                  | Price Decrease  |                   |                  |
|----------------|--------------------|-------------------|------------------|---------------------|------------------|------------------|-----------------|-------------------|------------------|
|                | (1) Lower Price    | (2) Same Price    | (3) Higher Price | (4) Lower Price     | (5) Same Price   | (6) Higher Price | (7) Lower Price | (8) Same Price    | (9) Higher Price |
| Post * Treat   | 0.056**<br>(0.022) | -0.002<br>(0.023) | 0.022<br>(0.021) | 0.058***<br>(0.021) | 0.004<br>(0.021) | -0.003<br>Yes    | -0.001<br>Yes   | -0.006<br>(0.008) | 0.025*           |
| Controls       | Yes                | Yes               | Yes              | Yes                 | Yes              | Yes              | Yes             | Yes               | (0.013)          |
| Visit Week FE  | Yes                | Yes               | Yes              | Yes                 | Yes              | Yes              | Yes             | Yes               | Yes              |
| Observations   | 1118               | 7302              | 11132            | 1118                | 7302             | 11132            | 1118            | 7302              | 11132            |
| Mean (control) | 0.177              | 0.159             | 0.178            | 0.158               | 0.141            | 0.114            | 0.019           | 0.017             | 0.064            |
| SD (control)   | 0.382              | 0.365             | 0.382            | 0.365               | 0.348            | 0.318            | 0.136           | 0.130             | 0.245            |

Notes: This table shows treatment effect estimates by subsamples based on firms' baseline relative price positioning compared to their nearest competitor (whether the firm charged lower, same, or higher prices compared to its nearest competitor). Observations are at the firm-month level. The dependent variable for columns (1)-(3) is price change, a binary indicator of whether the firm's regular manicure price in a given month is different from its baseline price. The dependent variable for columns (4)-(6) is price increase, and for columns (7)-(9) is price decrease – which are binary indicators of whether the firm's regular manicure price in a given month is higher or lower than its baseline price. All regressions control for any pre-visit differences between control and treatment groups, an indicator for months post-canvasser visits, and fixed effects for the week of the canvasser visit. The last two rows show the mean and standard deviation of the dependent variable for control firms across post-canvasser visit months. Standard errors are clustered at the firm level. \* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

Table 8: Price Change Across Control and Treatment Firms by Baseline Misalignment

|                | Price Change     |                     | Price Increase   |                     | Price Decrease    |                   |
|----------------|------------------|---------------------|------------------|---------------------|-------------------|-------------------|
|                | (1) Low Misalign | (2) High Misalign   | (3) Low Misalign | (4) High Misalign   | (5) Low Misalign  | (6) High Misalign |
| Post * Treat   | 0.009<br>(0.017) | 0.057***<br>(0.020) | 0.009<br>(0.016) | 0.044***<br>(0.017) | -0.001<br>(0.008) | 0.012<br>(0.010)  |
| Controls       | Yes              | Yes                 | Yes              | Yes                 | Yes               | Yes               |
| Visit Week FE  | Yes              | Yes                 | Yes              | Yes                 | Yes               | Yes               |
| Observations   | 14015            | 13663               | 14015            | 13663               | 14015             | 13663             |
| Mean (control) | 0.157            | 0.181               | 0.131            | 0.137               | 0.027             | 0.043             |
| SD (control)   | 0.364            | 0.385               | 0.337            | 0.344               | 0.161             | 0.203             |

Notes: This table shows treatment effect estimates by subsamples based on firms' baseline alignment in pricing and quality (measured by the absolute error from the best-fit line regressing baseline price on quality and ZIP code fixed effects). Observations are at the firm-month level. The dependent variable for columns (1)-(2) is price change, a binary indicator of whether the firm's regular manicure price in a given month is different from its baseline price. The dependent variable for columns (3)-(4) is price increase, and for columns (5)-(6) is price decrease – which are binary indicators of whether the firm's regular manicure price in a given month is higher or lower than its baseline price. All regressions control for any pre-visit differences between control and treatment groups, an indicator for months post-canvasser visits, and fixed effects for the week of the canvasser visit. The last two rows show the mean and standard deviation of the dependent variable for control firms across post-canvasser visit months. Standard errors are clustered at the firm level. \* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

Table 9: Performance Across Control and Treatment Firms

|                | (1)<br>ln(Calls)    | (2)<br>ln(Pageviews) | (3)<br>ln(Map Directions Views) | (4)<br>Next-day Availability |
|----------------|---------------------|----------------------|---------------------------------|------------------------------|
| Post * Treat   | 0.148***<br>(0.042) | 0.146***<br>(0.039)  | 0.145***<br>(0.040)             | -0.027<br>(0.018)            |
| Controls       | Yes                 | Yes                  | Yes                             | Yes                          |
| Visit Week FE  | Yes                 | Yes                  | Yes                             | Yes                          |
| Observations   | 35398               | 35398                | 35398                           | 25755                        |
| Mean (control) |                     |                      |                                 | 0.772                        |
| SD (control)   |                     |                      |                                 | 0.420                        |

Notes: This table shows intention to treat estimates of the competitor information treatment on proxies of firm performance: calls to the business, number of pageviews, and number of map directions views on Yelp, as well as a binary indicator of availability for an appointment next day during a peak hour. Observations are at the firm-month level. All regressions control for any baseline differences between control and treatment groups, an indicator for months post-canvasser visits, and fixed effects for the week of the canvasser visit. Standard errors are clustered at the firm level. \* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

Table 10: Estimated Revenue Across Control and Treatment Firms

|               | (1)<br>ln(Revenue Calls) | (2)<br>ln(Revenue Pageviews) | (3)<br>ln(Revenue Map Views) |
|---------------|--------------------------|------------------------------|------------------------------|
| Post * Treat  | 0.191***<br>(0.070)      | 0.162***<br>(0.046)          | 0.182***<br>(0.068)          |
| Controls      | Yes                      | Yes                          | Yes                          |
| Visit Week FE | Yes                      | Yes                          | Yes                          |
| Observations  | 30142                    | 30142                        | 30142                        |

Notes: This table shows intention to treat estimates of the competitor information treatment on estimated revenues based on Yelp purchase intentions. Dependent variables are constructed by multiplying the price firms charge each month and the number of purchase intentions (calls, pageviews, or map direction views) observed. Observations are at the firm-month level. All regressions control for any baseline differences between control and treatment groups, an indicator for months post-canvasser visits, and fixed effects for the week of the canvasser visit. Standard errors are clustered at the firm level. \* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

Table II: Platform Engagement Across Control and Treatment Firms

|               | (1)<br>ln(Login Days) | (2)<br>Account Claimed | (3)<br>Advertising | (4)<br>Responses   | (5)<br>ln(Review Comments) |
|---------------|-----------------------|------------------------|--------------------|--------------------|----------------------------|
| Post * Treat  | 0.026<br>(0.027)      | -0.002<br>(0.014)      | 0.006<br>(0.005)   | 0.013**<br>(0.005) | 0.009<br>(0.007)           |
| Controls      | Yes                   | Yes                    | Yes                | Yes                | Yes                        |
| Visit Week FE | Yes                   | Yes                    | Yes                | Yes                | Yes                        |
| Observations  | 35398                 | 35398                  | 35398              | 35398              | 35398                      |

Notes: This table shows intention to treat estimates of the competitor information treatment on firms' engagement with the Yelp platform. Dependent variables are the number of days a business logs in to Yelp (column 1), whether a business has claimed its page on Yelp (column 2), whether a business has purchased Yelp advertising (column 3), the number of responses the business has made to customer questions on quotes or appointments (column 4), and the number of comments the business has made on users' reviews (column 5). Observations are at the firm-month level. All regressions control for any baseline differences between control and treatment groups, an indicator for months post-canvasser visits, and fixed effects for the week of the canvasser visit. Standard errors are clustered at the firm level. \* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

Table 12: Price Changes Across Control and Treatment Firms by Distance from Nearest Competitor

|                                      | Price Change              |                           |
|--------------------------------------|---------------------------|---------------------------|
|                                      | (1) Below Median Distance | (2) Above Median Distance |
| Post * Treat                         | 0.045**<br>(0.018)        | 0.011<br>(0.018)          |
| Controls                             | Yes                       | Yes                       |
| Visit Week FE                        | Yes                       | Yes                       |
| Observations                         | 15050                     | 15092                     |
| Mean (control in months after visit) | 0.172                     | 0.174                     |
| SD (control in months after visit)   | 0.377                     | 0.379                     |

Notes: This table shows treatment effect estimates by subsamples based on firms' distance from their nearest competitor as a proxy of the level of competition it faces (below median distance represents higher levels of competition). Observations are at the firm-month level. The dependent variable is price change, a binary indicator of whether the firm's regular manicure price in a given month is different from its baseline price. All regressions control for any pre-visit differences between control and treatment groups, an indicator for months post-canvasser visits, and fixed effects for the week of the canvasser visit. The last two rows show the mean and standard deviation of the dependent variable for control firms in the subsample across post-canvasser visit months. Standard errors are clustered at the firm level. \* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

Table 13: Price Changes Across Control and Treatment Firms by Baseline Use of Promotions

|                                      | Price Change from Baseline |                     |
|--------------------------------------|----------------------------|---------------------|
|                                      | (1) No Promotions          | (2) Used Promotions |
| Post * Treat                         | 0.032**<br>(0.013)         | -0.002<br>(0.045)   |
| Controls                             | Yes                        | Yes                 |
| Visit Week FE                        | Yes                        | Yes                 |
| Observations                         | 27010                      | 3132                |
| Mean (control in months after visit) | 0.170                      | 0.191               |
| SD (control in months after visit)   | 0.376                      | 0.394               |

Notes: This table shows treatment effect estimates by subsamples based on firms' baseline use of demand-based promotions as a proxy of their pricing capabilities. Observations are at the firm-month level. The dependent variable is price change, a binary indicator of whether the firm's regular manicure price in a given month is different from its baseline price. All regressions control for any pre-visit differences between control and treatment groups, an indicator for months post-canvasser visits, and fixed effects for the week of the canvasser visit. The last two rows show the mean and standard deviation of the dependent variable for control firms in the subsample across post-canvasser visit months. Standard errors are clustered at the firm level. \* p<0.10, \*\* p<0.05, \*\*\* p<0.01.