Diagnosing Quality: Learning, Amenities, and the Demand for Health Care

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Abstract

We study the role of amenities in increasing demand for underutilized healthcare services. We randomized the price of a high-amenity diagnostic consultation for cataract surgery. Using this variation, we show that providing amenities doubles surgery take-up for patients diagnosed with operable cataracts. We then structurally estimate a model of patient demand to evaluate the importance of two mechanisms for this effect: amenities as quality signals versus sunk cost accounting. Results show that effects are largely driven by the former channel, suggesting that adoption of underutilized services may be increased by providing extra amenities at low prices in early patient interactions.

Keywords: health care demand, amenities, learning, health care quality, cataracts, surgery, Mexico

JEL Codes: D81, D83, I12, I15

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1 Introduction

Information frictions play a fundamental role in health care markets (Arrow, 1963). One oft-cited problem is consumers’ limited information when making choices related to health care services and insurance plans (Dranove and Satterthwaite, 1992, 2000; Handel and Kolstad, 2015; Kolstad, 2013; Kolstad and Chernew, 2009; Sofaer and Firminger, 2005). Yet, despite these substantial frictions, recent evidence suggests health care markets function relatively well, allocating greater market share to higher performing producers (Chandra et al., 2016). This indicates that consumers are indeed able to (at least partially) discern quality differentials and make choices accordingly.

One mechanism through which this differentiation might take place is through repeat interactions with providers, which are commonplace across a wide variety of health care settings; patients often rely on these interactions to reduce uncertainty regarding quality (Dranove et al., 2003; Leonard, 2007; Leonard et al., 2009). This process is most effective for nontechnical amenities – for example, whether a clinic appears to operate efficiently or whether a physician is respectful and speaks clearly – and, notably, not effective at revealing the technical quality of care, e.g., whether the physician uses evidence-based treatment protocols (Frank, 2004). This distinction is important because the quality of health care inputs is a key driver of differences in health outcomes across providers, but may be difficult to observe even after repeated interactions (Adhvaryu and Nyshadham, 2015; Chandra and Staiger, 2007; Doyle, 2011). Amenities, on the other hand, are relatively easily observed signals, but do not directly influence health outcomes (Manary et al., 2013).

What role can amenities play in stimulating the demand for health care? Specifically, can improving amenities increase demand for “underutilized” services? We study these questions in the context of elective surgery, which commonly involves initial interaction between patients and providers through diagnostic consultations (Hoffer Gittell et al., 2000; Kim et al., 2004). We hypothesize that higher amenities during the diagnostic consultation phase may generate higher beliefs about the quality of health care services, and thus increases patients’ demand for surgery conditional on a positive diagnosis. A positive association between amenities and technical health care quality may arise as an equilibrium outcome if amenities function as a costly signal of underlying quality, similar to, e.g., Ackerberg (2003); In and Wright (2017); Kihlstrom and Riordan (1984); Milgrom and Roberts (1986); Nelson (1974); and Wolinsky (1983).\(^1\)

\(^1\)This fact seems to be echoed to a certain extent in the literature on patient satisfaction and health care quality; see, e.g., Cleary and McNeil (1988); Manary et al. (2013).
We evaluate this hypothesis in the setting of cataract surgery in Mexico City. A cataract is a clouding of the eye’s lens. Cataracts are associated with aging, and if severe enough, can cause blurry vision, trouble with filtering light, and eventually blindness. Indeed, the majority of blindness in old age is attributed to cataracts in low-income countries (Flaxman and Bourne, 2017; Lewallen, 2008; Liu et al., 2017). The only recourse for severe cataracts is surgery to remove the clouded lens and replace it with an artificial lens. Cataract surgery dramatically improves vision, but despite high need in many low-income contexts, surgery take-up is low (Congdon and Thomas, 2014; Rabiu, 2001; Zhang et al., 2014). Given rising life expectancy across the developing world, the incidence of cataracts is expected to increase significantly, raising the latent demand for surgery.

To test whether greater access to amenities during initial interactions with the provider might increase surgery take up, we implemented a price experiment at a cataract surgery clinic in Mexico City. We helped create a “premium” (high-amenity) diagnostic consultation and randomized its price (at 3 price points) to patients. The consultation offered patients a chance to be seen immediately by a diagnostic specialist in an upgraded room with additional amenities. These additional amenities were essentially frills: a comfortable couch to sit on and beverages while they received their diagnosis.2

Demand for the premium consultation varied substantially and nonlinearly with the randomized price. About 12-13 percent of patients offered a price of 250 and 300 Mexican pesos (approximately 20-24 USD at the time) took up the premium consultation. But at 350 pesos (about 28 USD), there was effectively no demand. Across all patients, about a quarter received a positive diagnosis for cataracts.3 Those who had operable cataracts were offered the opportunity to schedule a surgery at the clinic. Cataract surgery in this setting is an order of magnitude more expensive than diagnosis. We use the variation in the take-up of the premium consultation induced by the price randomization to study the effect of improved access to amenities in the diagnostic stage on subsequent surgery adoption. We find large impacts of improved amenities: treatment on the treated estimates using randomized price as an instrument for premium consultation take-up show that patients who had improved access to amenities were nearly twice as likely to opt for cataract surgery at the clinic.

Finally, we estimate a structural model to gain insight into the mechanisms underlying the results

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2 There were two other types of diagnostic consultations: basic (50 pesos) and a “no wait time” consultation (200 pesos). The basic consultation involved a long wait (3.5 hours on average) and being evaluated in the standard quality room. The no wait time consultation allowed patients to skip the line but still involved the standard consultation room (and no additional amenities).

3 This did not vary across patients who chose versus who declined the premium consultation, suggesting that patients may not have had precise beliefs about the severity of their cataracts (otherwise, we might have observed that more patients who were ultimately diagnosed with cataracts took up the premium diagnostic consultation).
summarized above. Specifically, we evaluate two potential drivers of the impacts of the intervention on surgery take-up: sunk costs and amenity utility updating. Sunk costs have been shown in a large body of work spanning psychology and economics to factor into decision-making, both in laboratory and real-world contexts (Arkes and Blumer, 1985; Ashraf et al., 2010; Cohen and Dupas, 2010; Thaler, 1980). Since exposure to amenities in this experiment is driven by price randomization, it is possible that the additional costs of taking up the premium consultation, though they are sunk at the time of making the decision to take up surgery, do indeed affect surgery adoption.\footnote{The premium consultation was about 16 to 24 USD more expensive than the basic consultation.}

Amenity utility updating is relevant if exposure to improved amenities generates an increase in the evaluation of overall clinic quality, i.e., if individuals perceive amenities and overall service quality to be positively correlated. The results show very clearly that the driving mechanism in our setting was updating regarding the utility from amenities (32% larger in magnitude than the disutility from waiting). Sunk costs, on the other hand, play a negligible role in the link between amenities and subsequent surgery take-up (only 2% of the marginal effect of wait time). Taken together, these outputs of the structural model imply that providers can meaningfully drive up adoption of underutilized care like cataracts surgery by providing extra amenities in early interactions with patients at low prices.

This study is, to our knowledge, the first randomized assessment of the value of amenities in spurring subsequent health care demand. A rich descriptive literature has documented patients’ abilities to discern the quality of amenities (in contrast to technical aspects of the quality of care) (Frank, 2004). What is less clear is the extent to which patients value amenities, and how this value translates into future demand for health care services. The need for exogenous variation in the level of amenities in order to answer this question is clear: patients’ experiences regarding amenities and their subsequent health care utilization is likely jointly determined by unobserved factors like preferences and underlying health status (Dupas and Miguel, 2017). We answer this question using randomized variation in access to amenities in a setting that naturally lends itself to repeated interaction with the health care provider.

Our work also relates to studies on information provision in health care markets. Better information has the potential to shift out the demand for health care and significantly affect patient welfare (Dranove et al., 2003). Much of this literature has focused on quality revelation through report cards grading the performance of health care providers, surgeons, and hospitals. Interestingly, consistent with the idea that consumers do not revise beliefs markedly when it comes to technical aspects of care, this literature
generally finds little change in consumer demand even though actual quality measures improve as a result of report cards (Dranove and Sfekas, 2008; Epstein, 2010; Kolstad, 2013; Mukamel et al., 2004). A related literature examines how patients learn about quality through their repeated experiences with providers (Leonard, 2007; Leonard et al., 2009). We add to these strands of work by identifying the specific role of amenities, and by elucidating, via structural modeling, how amenity-related updating can drive provider demand. Our structural estimates confirm that the signaling value of amenities is an economically (and statistically) significant driver of surgery demand.

Finally, we contribute to the body of work on the nuanced role of pricing in determining healthcare demand, particularly in the developing world (Kremer and Holla, 2009). This literature has focused on the fact that while demand is downward sloping in price, often steeply so, behavioral factors may intervene to alter which pricing strategies can stimulate high demand for necessary products and services. Consistent with previous studies of pricing for health care products in low-income contexts, we find that demand for amenities is downward sloping and there is little evidence of sunk cost effects (Ashraf et al., 2010; Dupas, 2014). This study suggests that providing improvements in amenity levels in initial interactions as a signal of quality at little or no cost is ideal for stimulating significantly more usage of healthcare services.

The rest of the paper is organized as follows. Section 2 provides details on the context and the price experiment. Section 3 describes the data and balance checks. Section 4 presents the results of the experiment. Section 5 lays out a structural model to aid in the interpretation of the experiment and presents the resulting estimates. Finally, section 6 concludes.

2 Context and Description of Randomized Controlled Trial

2.1 Cataracts and Cataract Surgery

A cataract is an occlusion of the eye’s lens, typically manifesting at later ages (50 and older). If severe, cataracts can decrease visual acuity, cause difficulty in filtering light, and, if left untreated, eventually cause blindness. In low-income country contexts, where the vast majority of cataracts are untreated, cataracts are the leading cause of blindness in the elderly (Chao et al., 2014). The determinants of low take-up of cataract surgery are likely multifactorial. Access to high quality ophthalmic surgeons is limited in many part of the developing world; price is often prohibitively high for low-income households; and the costs and benefits of surgery are not widely known (Grimes et al., 2011).
2.2 Randomized Controlled Trial Setup

We implemented a randomized controlled trial (RCT) at a cataract surgery clinic serving mostly low-income elderly patients in Mexico City. The experiment took place from January to April 2013. During this period, each patient that arrived for a diagnostic consultation was enrolled with consent into the study. Due to consultation times and availability of diagnosticians, the maximum number of consecutive patients enrolled daily was approximately 150. The average daily number of patients was about 80. Expected waiting time for the consultation was calculated based on the consecutive number assigned to each patient (number of patients that arrived before) and the number of doctors available that given day. The average wait time, calculated in this manner, was sizable – about 3.5 hours.

We helped the clinic management evaluate the demand for and impacts of a new, high-amenity “premium” diagnostic consultation by randomizing its price at three price points to patients. The randomized price was 250, 300 or 350 pesos, all of which were below 400 pesos, the price at which the premium consultation had been piloted by the clinic prior to the study. The premium consultation offered patients a chance to be seen immediately by a diagnostic specialist in an upgraded room with additional amenities. Apart from the reduction in wait time, additional amenities were essentially frills: hot and cold beverages and a more comfortable couch to sit on while patients received their diagnoses.

The receptionist who greeted patients upon their arrival explained the variety of consultations available when patients entered. There were three types of diagnostic consultation available to patients:

- **Basic** (50 pesos): standard wait time, diagnosis in a standard room, no amenities
- **No wait time** (200 pesos): reduced wait time, diagnosis in a standard room, no amenities
- **Premium** (randomized price – 250, 300, or 350): reduced wait time, upgraded room, additional amenities

Once the options were made known, the receptionist handed a closed “ticket” to each patient from a previously randomly ordered stack. The ticket reported the randomized price of the premium consultation cost (250, 300 or 350 pesos). The patient was told that she was able to access the premium consultation at the price assigned by the ticket, and was also told the approximate wait time according to the pre-calculated estimation given the patient’s number. Each patient chose the consultation she wished to undergo, and made a payment to the receptionist accordingly. After the diagnosis was
determined, those who had operable cataracts were given the opportunity to schedule surgery at the clinic.

3 Data and Summary Statistics

3.1 RCT Data Description

We received data on the offered randomized price for the premium consultation, the estimated waiting time from the patient’s “ticket,” as well as her choice of consultation. We also have data on the diagnosis received following the consultation, and whether she decided to undergo surgery in cases when the diagnosis indicated the presence of operable cataracts. The total sample for the consultation is 2162 patients (see Appendix for details on constructing the sample).

Across all randomized prices, 10% of patients, or 216 out of 2162, chose the premium consultation (see Table 1). For patients who received a price of 250 pesos, around 81% chose the basic consultation, 5% chose the no wait time consultation, and 13.6% chose the premium consultation. These shares are similar for the patients who received a ticket with a price of 300 pesos: around 80% chose the basic consultation, 6% the no wait time consultation, and 13% the premium consultation. Demand for the premium consultation is substantially lower for those who received a ticket of 350 pesos; only 5 out of 579 patients (less than 1%) chose the premium consultation, while around 91% and 8% chose the basic and the no wait time consultations, respectively. Note that, as expected, demand for the no wait time consultation is increasing in the price of the premium consultation.

About a quarter of patients (474 out of 2162) were diagnosed with operable cataracts and were recommended surgery. The distribution between the three consultation types for the three randomized prices for patients diagnosed with cataracts is very similar to the distribution for the full sample (see Table 2). Particularly, among patients diagnosed with cataracts, 14%, 12.7% and 0.8% of those who received a ticket of 250, 300, and 350 pesos, respectively, chose the premium consultation.

For patients diagnosed with cataracts, 45 out of 474 (about 10%) decided to undergo cataract surgery at the clinic (See Table 3). Around two-thirds of these patients chose the basic consultation, 6.7% the no wait time consultation, and 26.7% the premium consultation. Table 4 shows that the share of surgery take-up for the patients diagnosed with cataracts is similar for those who received a ticket of 250 and 300 pesos, around 10.8%, and much lower for those who received a ticket of 350 pesos, around
Table 1: Premium Consultation Take-up by Randomized Premium Consultation Price

<table>
<thead>
<tr>
<th>Type of Diagnosis Consultation</th>
<th>Randomized Premium Consultation Price</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>250</td>
</tr>
<tr>
<td>Patient chose Basic Consultation</td>
<td>658</td>
</tr>
<tr>
<td>% within price assignment</td>
<td>81.2%</td>
</tr>
<tr>
<td>Patient chose No Wait Time Consultation</td>
<td>42</td>
</tr>
<tr>
<td>% within price assignment</td>
<td>5.2%</td>
</tr>
<tr>
<td>Patient chose Premium Consultation</td>
<td>110</td>
</tr>
<tr>
<td>% within price assignment</td>
<td>13.6%</td>
</tr>
</tbody>
</table>

Note: All prices are in 2013 Mexican pesos. Randomization is at individual level. Prices of premium consultation are randomized at 250, 300, and 350. The basic consultation price is fixed at 50. The no wait time consultation price is also fixed at 200. The premium consultation differs from the basic consultation in letting the patient skip the queue (no waiting time) and adding some auxiliary services, not related to the quality of medical diagnosis. The no wait time consultation differs from the basic consultation in letting the patient skip the queue (no waiting time). No auxiliary services are provided during no wait time consultation. The reported percentages represent the proportion of the patients randomly assigned to each price who selected each consult type.

5.7%.

3.2 Summary Statistics

Table 5 reports summary statistics by randomized price for the premium consultation for the full sample of patients who were enrolled in the experiment. We also present a balance test between the three groups defined by the randomized prices for each variable using ANOVA. The average wait time was 3.5 hours. The share of patients diagnosed with cataracts is around 22%. About 37% of patients were male, and were on average 58 years old. Means and standard deviations of these three variables are very similar across the three randomized prices. ANOVA shows that none of these means are statistically different across the three groups defined by the randomized prices.

Table 6 presents summary statistics for the sample of patients diagnosed with cataracts. Note that in general patients diagnosed with cataracts are around 11 years older than the average of the whole sample while the share of males and the average wait time are similar for both samples. As we mentioned before, around 9.5% of the patients diagnosed with cataracts received a surgery at the clinic, while 17.5% of the patients diagnosed with cataracts scheduled a surgery after the diagnosis even if
Table 2: Premium Consultation Take-up by Randomized Premium Consultation Price for Patients Diagnosed with Cataracts

<table>
<thead>
<tr>
<th>Type of Diagnosis Consultation</th>
<th>Randomized Premium Consultation Price</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>250</td>
</tr>
<tr>
<td>Patient chose Basic Consultation</td>
<td>151</td>
</tr>
<tr>
<td>% within price assignment</td>
<td>81.6%</td>
</tr>
<tr>
<td>Patient chose No Wait Time Consultation</td>
<td>8</td>
</tr>
<tr>
<td>% within price assignment</td>
<td>4.3%</td>
</tr>
<tr>
<td>Patient chose Premium Consultation</td>
<td>26</td>
</tr>
<tr>
<td>% within price assignment</td>
<td>14.1%</td>
</tr>
</tbody>
</table>

Note: All prices are in 2013 Mexican pesos. Randomization is at individual level. Prices of premium consultation are randomized at 250, 300, and 350. The basic consultation price is fixed at 50. The no wait time consultation price is also fixed at 200. The premium consultation differs from the basic consultation in letting the patient skip the queue (no waiting time) and adding some auxiliary services, not related to the quality of medical diagnosis. The no wait time consultation differs from the basic consultation in letting the patient skip the queue (no waiting time). No auxiliary services are provided during no wait time consultation. The reported percentages represent the proportion of the patients randomly assigned to each price who selected each consult type. Of the 2162 patients in the price experiment, 474 were diagnosed with operable cataracts. The reported percentages represent the proportion of the patients randomly assigned to each price who selected each consult type.

Table 3: Surgery Take-up by Consultation Type

<table>
<thead>
<tr>
<th>Surgery Implemented</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient chose Basic Consultation</td>
</tr>
<tr>
<td>% within price assignment</td>
</tr>
<tr>
<td>Patient chose No Wait Time Consultation</td>
</tr>
<tr>
<td>% within price assignment</td>
</tr>
<tr>
<td>Patient chose Premium Consultation</td>
</tr>
<tr>
<td>% within price assignment</td>
</tr>
</tbody>
</table>

Note: All prices are in 2013 Mexican pesos. Randomization is at individual level. Prices of premium consultation are randomized at 250, 300, and 350. The basic consultation price is fixed at 50. The no wait time consultation price is also fixed at 200. The premium consultation differs from the basic consultation in letting the patient skip the queue (no waiting time) and adding some auxiliary services, not related to the quality of medical diagnosis. The no wait time consultation differs from the basic consultation in letting the patient skip the queue (no waiting time). No auxiliary services are provided during no wait time consultation. Of the 474 patients diagnosed with operable cataracts, 45 chose to undergo surgery at the clinic. The reported percentages represent the proportion of the patients who underwent surgery who selected each consult type.
Table 4: Surgery Take-up by Randomized Premium Consultation Price for Patients Diagnosed with Cataracts

<table>
<thead>
<tr>
<th>Randomized Premium Consultation Price</th>
<th>Not Implemented</th>
<th>% within price assignment</th>
<th>Implemented</th>
<th>% within price assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>250</td>
<td>165</td>
<td>89.2%</td>
<td>20</td>
<td>10.8%</td>
</tr>
<tr>
<td>300</td>
<td>148</td>
<td>89.2%</td>
<td>18</td>
<td>10.8%</td>
</tr>
<tr>
<td>350</td>
<td>116</td>
<td>94.3%</td>
<td>7</td>
<td>5.7%</td>
</tr>
</tbody>
</table>

Note: All prices are in 2013 Mexican pesos. Randomization is at individual level. Prices of premium consultation are randomized at 250, 300, and 350. The basic consultation price is fixed at 50. The no wait time consultation price is also fixed at 200. The premium consultation differs from the basic consultation in letting the patient skip the queue (no waiting time) and adding some auxiliary services, not related to the quality of medical diagnosis. The no wait time consultation differs from the basic consultation in letting the patient skip the queue (no waiting time). No auxiliary services are provided during no wait time consultation. Of the 474 patients diagnosed with operable cataracts, 45 chose to undergo surgery at the clinic. The reported percentages represent the proportion of the patients randomly assigned to each price who selected each consult type.

Table 5: Summary Statistics

<table>
<thead>
<tr>
<th></th>
<th>Full Sample</th>
<th>Price 250</th>
<th>Price 300</th>
<th>Price 350</th>
<th>Anova</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Std. Dev.</td>
<td>Mean</td>
<td>Std. Dev.</td>
<td>Mean</td>
</tr>
<tr>
<td>Waiting time (hours)</td>
<td>3.487</td>
<td>1.625</td>
<td>3.480</td>
<td>1.616</td>
<td>3.470</td>
</tr>
<tr>
<td>Positive Diagnosis (cataract)</td>
<td>0.219</td>
<td>0.414</td>
<td>0.228</td>
<td>0.420</td>
<td>0.215</td>
</tr>
<tr>
<td>Male</td>
<td>0.371</td>
<td>0.483</td>
<td>0.356</td>
<td>0.479</td>
<td>0.384</td>
</tr>
<tr>
<td>Age</td>
<td>58.033</td>
<td>18.080</td>
<td>57.272</td>
<td>18.699</td>
<td>58.477</td>
</tr>
<tr>
<td>N</td>
<td>2162</td>
<td></td>
<td>810</td>
<td></td>
<td>773</td>
</tr>
</tbody>
</table>

Note: All prices are in 2013 Mexican pesos. Randomization is at individual level. Waiting time is the estimated waiting time in hours before the first available time slot for basic consultation. It is announced to the patient upon arrival at the clinic. Positive Diagnosis (cataract) is an indicator variable, which equals 1 if a patient was diagnosed with a cataract and 0 otherwise. Age refers to the age of a patient in years. Male is an indicator variable, which equals 1 if patient is male and 0 if patient is female. Balance Anova tests were estimated across the three groups defined by the randomized prices for each variable.

they did not receive the surgery before the end of data collection. Note that the share of patients that received a surgery (or scheduled a surgery) at the clinic varied nonlinearly with respect to the randomized price offered for the premium consultant (i.e., around 10.8% or 18% of the patients who were offered a price of 250 or 300 pesos received or scheduled a surgery, respectively, compared to 5.7% or 13% of those who were offered a price of 350 pesos.)
Table 6: Summary Statistics for Patients Diagnosed with Cataracts

<table>
<thead>
<tr>
<th></th>
<th>Full Sample</th>
<th>Price 250</th>
<th>Price 300</th>
<th>Price 350</th>
<th>Anova</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean Std. Dev.</td>
<td>Mean Std. Dev.</td>
<td>Mean Std. Dev.</td>
<td>Mean Std. Dev.</td>
<td>F-stat p-value</td>
</tr>
<tr>
<td>Waiting time (hours)</td>
<td>3.381 1.616</td>
<td>3.537 1.628</td>
<td>3.384 1.636</td>
<td>3.142 1.555</td>
<td>2.21 0.11</td>
</tr>
<tr>
<td>Surgery Implemented</td>
<td>0.095 0.293</td>
<td>0.108 0.311</td>
<td>0.108 0.312</td>
<td>0.057 0.233</td>
<td>1.4 0.2483</td>
</tr>
<tr>
<td>Surgery Scheduled</td>
<td>0.175 0.380</td>
<td>0.173 0.379</td>
<td>0.211 0.409</td>
<td>0.130 0.338</td>
<td>1.6 0.2029</td>
</tr>
<tr>
<td>Male</td>
<td>0.408 0.492</td>
<td>0.416 0.494</td>
<td>0.422 0.495</td>
<td>0.377 0.487</td>
<td>0.33 0.72</td>
</tr>
<tr>
<td>Age</td>
<td>69.726 11.732</td>
<td>69.957 11.452</td>
<td>69.789 11.838</td>
<td>69.293 12.086</td>
<td>0.12 0.89</td>
</tr>
<tr>
<td>N</td>
<td>474</td>
<td>185</td>
<td>166</td>
<td>123</td>
<td></td>
</tr>
</tbody>
</table>

Note: Sample consists of patients diagnosed with cataract. All prices are in 2013 Mexican pesos. Randomization is at individual level. Waiting time is the estimated waiting time in hours before the first available time slot for basic consultation. It is announced to the patient upon arrival at the clinic. Surgery Implemented is an indicator variable which equals 1 if after cataract diagnosis a patient received a surgery during the data observation period and 0 otherwise. Surgery Scheduled is an indicator variable which equals 1 if after cataract diagnosis a patient scheduled a surgery, irrespective if it was received during the observation period, and 0 otherwise. Male is an indicator variable, which equals 1 if patient is male and 0 if patient is female. Age refers to the age of a patient in years.

Figure 1A: Wait Time by Randomized Price

Figure 1B: Wait Time by Randomized Price for Patients with Cataracts

Note: Waiting time is estimated in hours before the first available time slot for basic consultation. It is announced to the patient upon arrival at the clinic. Randomization is at individual level. Figure 1A presents the wait time for the full sample across the three group defined by the randomized prices of 250, 300 and 350 and Figure 1B presents the wait time across the three for the sample of patients diagnosed with cataracts.

Figure 1A presents the wait time for the full sample across the three groups defined by the randomized prices of 250, 300 and 350 pesos. Note that the distributions are quite similar overall and share a common support. We provide some formal statistical proof for this assertion in the next subsection. For patients diagnosed with cataracts, the distributions for the wait time present more variation for these three groups due to a smaller sample, although the three again share a common support and a similar pattern (see Figure 1B).

Note that in addition to establishing that the price randomization was well executed, these figures
also demonstrate that the expected wait time, which prevailed at the time that each patient made decisions regarding which consult type to avail themselves of, provides an independent source of variation (confirmed below in Table 7) in the relative benefit of choosing one of the no wait time options. That is, in addition to the randomized price for the premium consult, the expected waiting time provides additional identifying variation to help separate the utility the patient received from choosing either of the two upgraded consult types rather than the baseline consult. We leverage this additional variation to identify the structural model below and provide richer interpretation of the effects of consult on subsequent surgery take up.

3.3 Defining “Treated” and “Control” groups

In order to explore the shape of the demand curve for the premium consultation, Figure 3 presents the probability of choosing the premium consultation for each randomized price group. Note that the probability for patients who received a ticket with a price of 250 pesos is very similar to the probability for those who received a price of 300. However, this probability is statistically significantly different for those who were offered a price of 350 pesos.

![Figure 3: Linear Probability Model of Premium Consultation by Randomized Premium Consultation Price](image)

Note: Figure 3 presents the estimates of the coefficients of the estimates of a linear probability model of choosing premium consultation for each randomized price group, with 5% (line) and 10% (bar) confidence intervals.

We thus group patients who received a price of 250 and 300 pesos together and label this group
as treated, and label the 350 peso group as control. Table 7 presents a Kolmogorov Smirnov test for the equality of distributions for descriptive variables (gender, age, and waiting time) using the empirical distribution functions of the two groups defined previously: treated and control. We cannot reject the hypothesis that the samples of the two groups are drawn from the same distribution for all three variables.

Table 7: Kolmogorov-Smirnov test for Patients with a Randomized Price of 250 and 300 and 350

<table>
<thead>
<tr>
<th>Waiting time</th>
<th>Group 1[Price 250 and 300]</th>
<th>Group 2[Price 350]</th>
<th>Combined K-S:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difference</td>
<td>0.020</td>
<td>-0.035</td>
<td>0.035</td>
</tr>
<tr>
<td>p-value</td>
<td>0.718</td>
<td>0.364</td>
<td>0.693</td>
</tr>
<tr>
<td>Corrected</td>
<td></td>
<td></td>
<td>0.671</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age</th>
<th>Group 1[Price 250 and 300]</th>
<th>Group 2[Price 350]</th>
<th>Combined K-S:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difference</td>
<td>0.024</td>
<td>-0.044</td>
<td>0.044</td>
</tr>
<tr>
<td>p-value</td>
<td>0.616</td>
<td>0.195</td>
<td>0.387</td>
</tr>
<tr>
<td>Corrected</td>
<td></td>
<td></td>
<td>0.363</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Male</th>
<th>Group 1[Price 250 and 300]</th>
<th>Group 2[Price 350]</th>
<th>Combined K-S:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difference</td>
<td>0.000</td>
<td>-0.004</td>
<td>0.004</td>
</tr>
<tr>
<td>p-value</td>
<td>1.000</td>
<td>0.988</td>
<td>1.000</td>
</tr>
<tr>
<td>Corrected</td>
<td></td>
<td></td>
<td>1.000</td>
</tr>
</tbody>
</table>

Note: Waiting time is the estimated waiting time in hours before the first available time slot for basic consultation. It is announced to the patient upon arrival at the clinic. Randomized Price is a price for premium consultation randomly assigned to a patient. Age refers to the age of a patient in years. Male is an indicator variable, which equals 1 if patient is male and 0 if patient is female.

4 Experimental Results

In this section we present the results of the experiment. We first explore first stage results of the effects of the randomized price (as well as expected wait time) on take up of both the premium and no wait time consultations. We then present results on the pass through effects of consultation choice on surgery implementation, using the randomized price to account for endogeneity in the consultation choice. Finally, in the next section, we enrich the interpretation of these second stage impacts by
developing and structurally estimating a model of two-stage patient-provider interactions in which the consultation choice in the first stage affects surgery decisions in the second stage through both updated expected utility from amenities (as well as disutility from waiting) and “sunk cost” effects of the nominal price paid for the consultation.

4.1 First Stage

Table 8 shows results of regressions of premium consultation take-up on treated and control groups defined by randomized prices. We find that being assigned a relatively low price for the premium consultation resulted in a 12.5 percentage point increase in the likelihood of take-up. Take-up in the “control” (highest price) group was essentially zero. The coefficient is unchanged when we control for waiting time, gender and age. Note that a higher expected waiting time increases the demand for the premium consultation as well. Each additional hour of expected wait time increases the likelihood of choosing the premium consultation by nearly 3 percentage points. Remember that expected waiting time was 3.5 hours on average and ranged up to nearly 7 hours at times.

Table 8: Premium Consultation Take-up

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Premium Consult.</th>
<th>Premium Consult.</th>
<th>Premium Consult.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1[Randomized Price = 250 or 300]</td>
<td>0.125***</td>
<td>0.126***</td>
<td>0.125***</td>
</tr>
<tr>
<td></td>
<td>(0.00937)</td>
<td>(0.00953)</td>
<td>(0.00955)</td>
</tr>
<tr>
<td>Waiting time (Hours)</td>
<td>0.0280***</td>
<td>0.0281***</td>
<td>0.0281***</td>
</tr>
<tr>
<td></td>
<td>(0.00390)</td>
<td>(0.00397)</td>
<td>(0.00397)</td>
</tr>
<tr>
<td>Male</td>
<td>0.0104</td>
<td></td>
<td>(0.0131)</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td>0.000132</td>
</tr>
<tr>
<td>Constant</td>
<td>0.00864**</td>
<td>-0.0898***</td>
<td>-0.101***</td>
</tr>
<tr>
<td></td>
<td>(0.00385)</td>
<td>(0.0146)</td>
<td>(0.0249)</td>
</tr>
<tr>
<td>Observations</td>
<td>2,162</td>
<td>2,162</td>
<td>2,151</td>
</tr>
<tr>
<td>Mean of Premium Consult.</td>
<td>0.0999</td>
<td>0.0999</td>
<td>0.0995</td>
</tr>
</tbody>
</table>

Note: Robust standard errors in parenthesis (**p < 0.01, *p < 0.05, *p < 0.1). Randomization is at individual level. Waiting time is the estimated waiting time in hours before the first available time slot for basic consultation. It is announced to the patient upon arrival at the clinic. Male is an indicator variable, which equals 1 if patient is male and 0 if patient is female. Age refers to the age of a patient in years. The premium consultation differs from the basic consultation in letting the patient skip the queue (no waiting time) and adding some auxiliary services, not related to the quality of medical diagnosis.
Table 9 shows results on take-up of the no wait time consultation, whose price was fixed at 200 pesos. Here, as predicted, we find that being in the treated group for the premium consultation resulted in a lower take-up of the no wait time consultation (about 2 percentage points lower). That is, when the relative incremental price for the additional amenities is lower, patients are more likely to select the premium consult and less likely to select the consultation involving no wait time alone. Note that here again a larger waiting time increased the probability of taking up the no wait time consultation and demographic controls do little to change these results.

Table 9: No Wait Time Consultation Take-up

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>No Wait Time Consultation</th>
<th>No Wait Time Consultation</th>
<th>No Wait Time Consultation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1[Randomized Price = 250 or 300]</td>
<td>-0.0232*</td>
<td>-0.0222*</td>
<td>-0.0205*</td>
</tr>
<tr>
<td></td>
<td>(0.0126)</td>
<td>(0.0125)</td>
<td>(0.0125)</td>
</tr>
<tr>
<td>Waiting time (Hours)</td>
<td></td>
<td>0.0221***</td>
<td>0.0225***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.00336)</td>
<td>(0.00342)</td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td>0.00392</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.0107)</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td>0.000111</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.00266)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.00864**</td>
<td>-0.0898***</td>
<td>-0.101***</td>
</tr>
<tr>
<td></td>
<td>(0.00385)</td>
<td>(0.0146)</td>
<td>(0.0249)</td>
</tr>
<tr>
<td>Observations</td>
<td>2,162</td>
<td>2,162</td>
<td>2,151</td>
</tr>
<tr>
<td>Mean of No Wait Time Consult.</td>
<td>0.0624</td>
<td>0.0624</td>
<td>0.0623</td>
</tr>
</tbody>
</table>

Note: Robust standard errors in parenthesis (***p < 0.01, **p < 0.05, * < 0.1). Randomization is at individual level. Waiting time is the estimated waiting time in hours before the first available time slot for basic consultation. It is announced to the patient upon arrival at the clinic. Male is an indicator variable, which equals 1 if patient is male and 0 if patient is female. Age refers to the age of a patient in years. The no wait time consultation differs from the basic consultation in letting the patient skip the queue (no waiting time). No auxiliary services are provided during no wait time consultation.

4.2 Second Stage

Having established that both the randomized price for the premium consultation and the expected waiting time impact consultation take up for both the premium and no wait time consultations, we now examine the impacts of premium consultation take-up on surgery implementation. We estimate the following biprobit model that accounts for the endogeneity of diagnostic consultation take-up by
leveraging the randomized price of the premium consultation:

\[
PC_i = \beta_0 + \beta_1 \mathbf{1}[Price_i = 250 \ or \ 300] + \beta_2 Wait_{ing \ time_i} + X_i \beta_3 + \varepsilon_{1,i},
\]

\[
SI_i = \alpha_1 Wait_{ing \ time_i} + \alpha_2 PC_i + X_i \alpha_3 + \varepsilon_{2,i},
\]

where

\[
\begin{pmatrix}
\varepsilon_1 \\
\varepsilon_2
\end{pmatrix} | WT, X \sim N
\begin{pmatrix}
0 \\
0
\end{pmatrix},
\begin{pmatrix}
1 & \rho \\
\rho & 1
\end{pmatrix}
\]

and \(PC_i\) is an indicator variable that is equal to 1 if patients choose premium consultation, \(1[Price_i = 250 \ or \ 300]\) is an indicator variable for the treated and control group defined by randomized prices, \(Wait_{ing \ time_i}\) is the estimated waiting time in hours before the first available time slot for basic consultation, \(X_i\) is a matrix of controls including Male which is an indicator variable equal 1 if patient is male and 0 if patient is female; and Age which refers to the age of a patient in years, \(SI_i\) is an indicator variable that equals 1 if a cataract surgery was implemented, for individual \(i\).

We find that taking up the premium consultation in the first stage more than doubles the probability of surgery implementation (an increase of about 13 percentage points in surgery take-up). These results are presented in Table 10. Columns 1 and 2 report results with no controls and waiting time, age, and gender added as controls, respectively. We see little substantive change in the coefficient on premium consultation across each specification.\(^5\)

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1) Surgery Implemented</th>
<th>(2) Surgery Implemented</th>
</tr>
</thead>
<tbody>
<tr>
<td>Premium Consultation</td>
<td>0.144* (0.0817)</td>
<td>0.130* (0.0732)</td>
</tr>
<tr>
<td>Observations</td>
<td>440</td>
<td>439</td>
</tr>
</tbody>
</table>

Note: Robust standard errors in parenthesis (*** \(p < 0.01\), ** \(p < 0.05\), * \(p < 0.1\)). Randomization is at individual level. Column (1) shows the marginal effects of the estimates of the biprobit model specified in equation (1) without controls and Column (2) includes the controls Male and Age. The premium consultation differs from the basic consultation in letting the patient skip the queue (no waiting time) and adding some auxiliary services, not related to the quality of medical diagnosis.

\(^5\)In the appendix, we present analogous results from specifications using a dummy for surgery scheduled as the outcome in place of surgery implemented. The pattern of results is qualitatively identical.
5 Interpretation

In this section, we develop a discrete choice model in order to better interpret the relationship between consultation choice and surgery take up.\textsuperscript{6} We model patients decisions in each stage and allow for the consultation choice to impact the surgery decision by way of updated expected utility from amenities, disutility from waiting, and the “sunk cost” of the price paid for the selected consultation type. We then estimate the model, report on fit, and calculate marginal effects of the utility of amenities and price paid for the consultation on surgery take up. We benchmark the size of each effect against the marginal effect of the disutility of waiting on surgery take up to interpret their importance.

5.1 Model

Our model begins at the point when a consumer enters the clinic. We assume that individuals derive (dis)utility from having cataracts; the wait time before consultation; amenities provided; and money. They maximize expected discounted utility. Each patient has a prior probability of having a cataract, $s_0$, which implies a disutility (a penalty health shock) of magnitude $v_0$ (similar to Vera-Hernandez, 2003). Patients arrive at the clinic and receive a randomized price $p_p$ for the premium consultation, and fixed prices, $p_w$ and $p_b$, for the no wait time consultation and the basic consultation, respectively. As we mentioned before, the premium consultation provides reduced waiting time and extra amenities that \textit{ex-ante} provide an incremental value, $u_{0,a}$. The no wait time consultation involves regular facilities and reduced waiting time that \textit{ex ante} provides an incremental value, $u_{0,w}$, and the basic consultation involves regular wait time with regular facilities.

Individuals thus potentially differ along four dimensions: the probability of having cataracts, $s_0$, their penalty health shock (value for being unhealthy or having a cataract), $v_0$, and their \textit{ex-ante} incremental value for waiting time, $u_{0,w}$, and extra amenities, $u_{0,a}$.\textsuperscript{7}

In the second period, individuals discover if they are diagnosed with a cataract, and conditional on this event, they decide whether to undergo cataract surgery or not. Let $\tilde{p}_p \equiv (p_p, p_s)$\textsuperscript{'} where $p_s$ is the price of the surgery. Thus, if the patients choose the premium consultation in period 1, and undergo cataract surgery, their utility is $u_{2|p} (\tilde{p}_p, 0) \equiv u (\tilde{p}_p \cdot 1_{[2,1]}, 0) + u_{1,p}$, where $u (\cdot, \cdot)$ is decreasing with respect to both arguments, $u_{1,p} \equiv u_{1,a} + u_{1,w}$, and $u_{1,a}$ and $u_{1,w}$ are the updated expected utilities provided by the extra amenities and no waiting time, respectively. If patients do not undergo the

\textsuperscript{6}The model draws on Vera-Hernandez (2003) and Einav et al. (2012) among others.

\textsuperscript{7}This is in addition to other characteristics like waiting time and socioeconomic variables.
surgery their utility is \( u_{2|p}(\tilde{p}_p, v_0) \equiv u(p_p, v_0) \). The analysis is similar if patients choose the no wait time consultation or the basic consultation in period 1.

Given a prior probability, \( s^* \), of having a cataract, patients expected utility from the premium consultation in period 1 depends on if they undergo cataract surgery or not, in period 2:

\[
\begin{align*}
    u_{1,p}(\tilde{p}_p, v_0) &\equiv s^* E_{u_{0,p}|s^*} \left[ \max \left\{ u(\tilde{p}_p', 1_{[2,1]}, 0) + u_{0,p}, u(p_p, v_0) \right\} \right] + (1 - s^*) u(p_p, 0) , \\
\end{align*}
\]

(2)

where \( u_{0,p} \equiv u_{0,a} + u_{0,w} \). \(^8\) Let \( \tilde{p}_w \equiv (p_w, p_s)' \), if patients take the no wait time consultation their expected utility would be

\[
\begin{align*}
    u_{1,w}(\tilde{p}_w, v_0) &\equiv s^* E_{u_{0,w}|s^*} \left[ \max \left\{ u(\tilde{p}_w', 1_{[2,1]}, 0) + u_{0,w}, u(p_w, v_0) \right\} \right] + (1 - s^*) u(p_w, 0) . \\
\end{align*}
\]

(3)

Finally, let \( \tilde{p}_b \equiv (p_b, p_s)' \), if patients choose the basic consultation, their utility would be

\[
\begin{align*}
    u_{1,b}(\tilde{p}_b, v_0) &\equiv s^* \max \left\{ u(\tilde{p}_b', 1_{[2,1]}, 0) , u(p_b, v_0) \right\} + (1 - s^*) u(p_b, 0) . \\
\end{align*}
\]

To solve the model we work backward from the second period. Given a positive cataract diagnosis and given that a patient chose the premium consultation, in period 2, individuals undergo cataract surgery if

\[
\begin{align*}
    u_{2|p}(\tilde{p}_p, 0) - u_{2|p}(\tilde{p}_p, v_0) \geq 0. \\
\end{align*}
\]

(4)

Note that the analysis is similar if patients chose the no wait time consultation or the basic consultation in period 1. In period 1, individuals choose the premium consultation if

\[
\begin{align*}
    u_{1,p}(\tilde{p}_p, v_0) \geq \max \left\{ u_{1,w}(\tilde{p}_w, v_0), u_{1,b}(\tilde{p}_b, v_0) \right\} . \\
\end{align*}
\]

(5)

and similarly for the no wait time consultation and the basic consultation. 

---

\(^8\)Note we assume that the utility (or disutility) from a high price for the consultation, having or not having cataract, wait time, and amenities provided are additively separable in \( u(\cdot, \cdot) \) and the incremental value provided by the no wait time and the amenities.
5.2 Econometric Specification: Linear Approximation

We now link the discrete choice model to the data. In the data, we observe the randomized price received by each patient, waiting time for the basic consultation, cataract diagnosis, characteristics of the patients (e.g., age, gender), and if patients undergo cataract surgery.

We make functional form assumptions that are closely related to the observed outcomes. In the model, the characteristics of the patients are related to observed outcomes by the consultation decision (equation 5) and the surgery take-up decision (equation 4) and by the probability of having a cataract. In particular, we assume that the utility functions are well approximated by linear relationships. We adopt this linear approximation for convenience, and we show later that it provides good fit to the observed data. That is, if patients chose the premium consultation in period 1, then the difference between undergoing cataract surgery or not in period 2 is well approximated by

\[
\begin{align*}
    u_{2|p}(\tilde{p}_p, 0) - u_{2|p}(\tilde{p}_p, v_0) \\
    \approx \beta_v v_0 + u_{1,p} + \beta_p p.
\end{align*}
\]

Similarly, if patients chose the no wait time consultation in period 1, then in period 2

\[
\begin{align*}
    u_{2|w}(\tilde{p}_w, 0) - u_{2|w}(\tilde{p}_w, v_0) \\
    \approx \beta_v v_0 + u_{1,w} + \beta_p p,
\end{align*}
\]

and if patients chose the basic consultation in period 1, then in period 2

\[
\begin{align*}
    u_{2|b}(\tilde{p}_b, 0) - u_{2|b}(\tilde{p}_b, v_0) \\
    \approx \beta_v v_0 + \beta_p p
\end{align*}
\]

In period 1, we assume that the differences between the expected utility of premium consultation and that of the no wait time or basic consultation (denoted by \(k\)) are well approximated by

\[
\begin{align*}
    u_{1|s^*}(\tilde{p}_p, v_0) - u_{1|s^*}(\tilde{p}_k, v_0) \\
    \approx \alpha_{v} v_0 + \alpha_{a} u_{0,a} + \alpha_{w} u_{0,w} + \alpha_{p} p + \alpha_{s}s^*
\end{align*}
\]

\(^9\)We follow a similar strategy as in Einav et al. (2012).
for \( k \neq p, k \in \{p, w, b\} \), where \( s^* \) is the probability of each patient of having a cataract, which we also assume is well approximated by a linear relationship.

### 5.2.1 Covariates

First, we incorporate individual characteristics into the model. We describe a patient by a vector of characteristics, \( \Xi = (x, \tilde{x}, p, \varepsilon_u, \varepsilon_w, \varepsilon_v) \) where \( x \) includes demographic characteristics (e.g., age, gender), \( \tilde{x} \) includes \( x \) plus the waiting time, and \( p \) is the price of premium consultation. The scalar characteristics \( \varepsilon_u, \varepsilon_w, \varepsilon_v \) are not observed. Moreover, we assume that \((\varepsilon_u, \varepsilon_w, \varepsilon_v)\) are drawn from a multivariate normal distribution \( N(0, \Sigma_0) \) independent of \((\tilde{x}, p)\). We parametrize type as

\[
v_0 = x' \xi_v + \varepsilon_v, \tag{10}
\]

\[
u_{w,0} = \tilde{x}' \xi_w + \varepsilon_w, \tag{11}
\]

\[
u_{a,0} = \tilde{x}' \xi_a + \varepsilon_a. \tag{12}
\]

Note that type is a linear combination of the observed and unobserved characteristics. We combine our parametric assumptions to obtain

\[
u_{2|p}(\tilde{p}_p, 0) - \nu_{2|p}(\tilde{p}_p, v_0) \approx x'(\beta_v \xi_v) + u_{1|p} + \beta_pp + \beta_v \varepsilon_v, \tag{13}
\]

if patients chose the premium consultation in period 1 and

\[
u_{2|w}(\tilde{p}_w, 0) - \nu_{2|w}(\tilde{p}_w, v_0) \approx x'(\beta_v \xi_v) + u_{1|w} + \beta_pp + \beta_v \varepsilon_v, \tag{14}
\]

if patients chose the no wait time consultation in period 1.\(^{10}\) Finally, if patients chose the basic consultation in period 1,

\[
u_{2|b}(\tilde{p}_b, 0) - \tilde{u}_{2|b}(\tilde{p}_b, v_0) \approx x'(\beta_v \xi_v) + \beta_pp + \beta_v \varepsilon_v. \tag{15}
\]

\(^{10}\)Remember that \( u_{1|p} \equiv u_{1|a} + u_{1|w} \).
Analogous to the functional forms assumed for period 2, we assume that the utility in period 1 is well approximated by

\[ u_{1,p|s^*}(\tilde{p}_p, v_0) - u_{1,k|s^*}(\tilde{p}_k, v_0) \approx x' (\alpha_v \xi_v + \alpha_w \xi_w + \alpha_a \xi_a) + \alpha_w w t + \alpha_p p + \alpha_s s^* + (\alpha_v \varepsilon_v + \alpha_w \varepsilon_w + \alpha_a \varepsilon_a). \]  

(16)

(17)

As we mentioned earlier, individuals arrive to the clinic and have a prior of having a cataract. We assume this is well approximated by a linear relationship:

\[ s^* \approx x' \gamma + \varepsilon_s. \]  

(18)

where \( \varepsilon_s \) is normally distributed, \( N(0, \sigma_s^2) \).\(^{11}\) We can define new parameters and random variables as:

\[ \alpha_x \equiv \alpha_v \xi_v + \alpha_w \xi_w + \alpha_a \xi_a, \ \varepsilon_u \equiv \alpha_v \varepsilon_v + \alpha_w \varepsilon_w + \alpha_a \varepsilon_a, \]

\[ \beta_x \equiv \beta_v \xi_v, \ \text{and} \ \varepsilon_q \equiv \beta_v \varepsilon_v. \]

5.3 Estimating Equations and Stochastic Assumptions

We have three estimating equations. The first is the probability of having cataract. The model implies that an individual will be diagnosed with cataract if and only if \( s^* > 0 \). Then

\[ s \equiv \begin{cases} 1 & s^* \geq 0 \\ 0 & \text{otherwise} \end{cases}. \]  

(19)

Based on their probability of having cataract, individuals will choose consultation \( k \in \{p, w, b\} \) as follows:

\[ u_{1|s} = \begin{cases} p & \text{if} \ x' \alpha_x + \alpha_w w t + \alpha_p p + \alpha_s s^* + \varepsilon_u > \mu_p \\ b & \text{if} \ x' \alpha_x + \alpha_w w t + \alpha_p p + \alpha_s s^* + \varepsilon_u < \mu_b \\ w & \text{otherwise} \end{cases}. \]  

(20)

Note that the parameters \( \alpha_w, \alpha_p \text{ and } \alpha_s \) measure the sensitivity of the consultation decision to changes in the waiting time, price of the premium consultation and the prior probability of being diagnosed with cataract, respectively. Finally, in the second period, if an individual chose consultation \( k \) in period

\(^{11}\)This assumption is not crucial to our conclusions.
1 and is diagnosed with cataract, she will undergo cataract surgery if

\[
    u_{2|k,s} = \begin{cases} 
        1 & x' \beta + 1[u_{1|s}=k]u_{1,k} + \beta_p p + \epsilon_q \geq 0 \\
        0 & \text{otherwise}
    \end{cases},
\]

(21)

where \( u_{1,k} \) is normalized to 0 (see equation 15). Here \( u_{1,k} \) means that the probability of undergoing cataract surgery increases as the additional utilities from no waiting time and extra amenities increase.

Remember that we initially assumed that \((\epsilon_u, \epsilon_w, \epsilon_v)\) are normally distributed with mean zero. We also assume that \(\epsilon_s\) is normally distributed so that \((\epsilon_s, \epsilon_u, \epsilon_q) \sim N(0, \Sigma)\) where

\[
    \Sigma = \begin{pmatrix} 
        \sigma^2_s & \rho_{su}\sigma_s\sigma_u & \rho_{sq}\sigma_s\sigma_q \\
        \rho_{su}\sigma_s\sigma_u & \sigma^2_u & \rho_{uq}\sigma_u\sigma_q \\
        \rho_{sq}\sigma_s\sigma_u & \rho_{uq}\sigma_u\sigma_q & \sigma^2_q
    \end{pmatrix}.
\]

(22)

5.4 Identification and Estimation

We take the model directly to the data observed from the experiment. The model can be thought of as a system of three equations: (i) a probit cataract equation, (ii) an ordered probit consultation equation, and (iii) a probit surgery decision equation. This system maps the observed and unobserved characteristics of each patient, along with the wait time and the randomizes price, into realizations of cataract diagnosis, type of consultation chosen and cataract surgery decision. The maximizations of these three equations are standard but cumbersome since we need to integrate over unobservables.\(^{12}\)

Recall that in the data, we observe demographic characteristics of each patient, the expected waiting time when they arrive at the clinic, the randomized price of the premium consultation, their corresponding selection of the type of consultation, the medical diagnosis (i.e., if the patient has a cataract or not), and their ultimate decision to schedule and undergo the surgery conditional on a positive diagnosis. These conditional probabilities provide all the information needed to estimate the model, subject to some additional assumptions.

In estimating the probit cataract equation, \(\gamma\) is only identified up to a scale, so we set \(\sigma^2_s = 1\).

Now consider how the variation in the data described above identifies the parameters of the ordered probit consultation equation. In the previous section, we showed that the price randomization was

\(^{12}\)In Appendix B we provide the details of the derivation of the estimating equations (19), (20), and (21). Using these estimating equations and the stochastic assumptions in (22), we compute the likelihood function of the observed decisions.
well executed and also demonstrated that the expected wait time provides an independent source of variation in the relative benefit of choosing the basic consultation. We need two identification constraints for the ordered probit consultation equation. First, we need to suppress the intercept to be able to recover \( \mu_p \) and \( \mu_b \). Second, we fix \( \sigma^2_u = 1 \).

Finally, for the probit surgery equation, note that in addition to the randomized price for the premium consult, which provides extra amenities and no waiting time, the expected waiting time provides additional identifying variation to help separate the utility the patient received from choosing either of the two upgraded consult types rather than the baseline consult in period 1. Thus, variation in the randomized price of the premium consult and in the expected waiting time allow us to recover \( u_a \) and \( u_w \). We need only one additional identifying restriction, \( \sigma^2_q = 1 \).

The remaining parameters are the correlations between the unobservables that affect the probability of having cataract, \( \varepsilon_s \), and the unobservables that affect type of consultation decision and surgery decision, \( \varepsilon_u \) and \( \varepsilon_q \), respectively.

5.5 Structural Estimates

Below we report results of the structural model estimation. In Table 11 we show that the model fit is remarkably good for all choice variables across both stages.

In Table 12 we report marginal effects of the impacts of utility from amenities and waiting time, as well as the “sunk cost” effects of the price of the premium consultation on surgery implementation. Note first that the marginal effect of the updated utility from amenities is economically and statistically significant. Using the marginal effect of the disutility of waiting, which has been well-established as an important determinant of healthcare utilization, as a benchmark we see that utility from amenities has a 32% larger marginal effect. On the other hand, no detectable “sunk cost” effect appears, with a magnitude only 2% the size of the disutility from waiting.

Taken together these results confirm that the updating in the utility from amenities is a strong determinant of ultimate surgery implementation and the primary mechanism linking experience in the initial diagnostic stage to later stage utilization. Our estimates indicate that providers can meaningfully drive up adoption of underutilized care like cataracts surgery by providing extra amenities in early interactions with patients at little to no nominal cost.
Table 11: Model Fit

<table>
<thead>
<tr>
<th></th>
<th>Model Fit</th>
<th>Raw Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cataract</td>
<td>0.229</td>
<td>0.220</td>
</tr>
<tr>
<td>Consulta Plus</td>
<td>0.090</td>
<td>0.103</td>
</tr>
<tr>
<td>Consulta Azul</td>
<td>0.059</td>
<td>0.065</td>
</tr>
<tr>
<td>Consulta Uno</td>
<td>0.851</td>
<td>0.832</td>
</tr>
<tr>
<td>Surgery / Consulta Plus</td>
<td>0.239</td>
<td>0.250</td>
</tr>
<tr>
<td>Surgery / Consulta Azul</td>
<td>0.103</td>
<td>0.110</td>
</tr>
<tr>
<td>Surgery / Consulta Uno</td>
<td>0.040</td>
<td>0.066</td>
</tr>
</tbody>
</table>

Note: The model fit moments are computed based on the econometric model described in sections 5.2 and 5.3 and the parameter estimates presented in Table 12. Raw data moments are computed from the estimating sample. The probability of surgery is computed for the patients diagnosed with cataract.

Table 12: Marginal Effects

<table>
<thead>
<tr>
<th></th>
<th>Cataract Diagnosed</th>
<th>Premium Consult.</th>
<th>Surgery Implemented</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.011***</td>
<td>0.0015</td>
<td>0.001***</td>
</tr>
<tr>
<td>Gender</td>
<td>0.036***</td>
<td>0.0041</td>
<td>0.012***</td>
</tr>
<tr>
<td>Premium Consult. Price</td>
<td>-0.001***</td>
<td>0.0004</td>
<td>0.001</td>
</tr>
<tr>
<td>Waiting Time</td>
<td>0.040***</td>
<td>0.0088</td>
<td>0.003***</td>
</tr>
<tr>
<td>Cataract</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utility (Waiting time)</td>
<td>0.035***</td>
<td>0.0087</td>
<td></td>
</tr>
<tr>
<td>Utility (Amenities)</td>
<td>0.046***</td>
<td>0.0067</td>
<td></td>
</tr>
</tbody>
</table>

Note: The model estimates are based on the econometric model described in sections 5.2 and 5.3. The sample for the probability of having cataract and the ordered probit consultation equation is 2,162 (see Table 5) and the sample for the probit surgery equation is 439 (see Table 6). Reported marginal effects present the effect of a unit change in each explanatory variable. For the dummy variables we follow Einav et al. (2012) and compute the marginal effect by taking the difference when the explanatory variable variable is equal 1 and when the variable is equal to 0. For continuous variables we use the numerical derivative with respect the explanatory variable.
6 Conclusion

Health care markets are prone to asymmetric information, which can have substantial implications for market functioning and as a result the choices and welfare of consumers. Patients often attempt to remedy lack of information about potential providers by learning from their own past experiences. This learning process seems particularly useful for nontechnical amenities, which patients can discern quite readily. This stands in contrast to learning about the technical quality of care, which ultimately is what matters for health outcomes. But these two may be correlated in equilibrium if amenities function as a signal of the underlying (technical) quality of care.

Under this premise, improving amenities in early stages of patient-provider interaction in health care services might be useful in spurring increased demand for “underutilized” health care services. We evaluate this hypothesis in the context of cataract surgery in Mexico City. We implemented a high-amenity premium consultation and randomized its price, and then evaluated both the demand for this consultation as well as the effects of its take-up on subsequent demand for surgery for those patients who ended up having operable cataracts.

We find that demand is sensitive to price in a highly nonlinear way. Moreover, take-up of the premium consultation increased surgery take-up quite substantially, providing reduced form evidence that increased amenities could improve the subsequent demand for health care in this context. We then set up and estimate a structural model that evaluates the roles of sunk costs versus the value of felt amenities in determining surgery demand. We find that, in keeping with the hypothesis laid out above, demand for cataract surgery is sensitive to amenities provided in the first stage of patient-provider interaction, and that sunk costs matter very little. This is to our knowledge the first rigorous evidence of the value of amenities in increasing health care demand.

This work has potentially important policy implications. In particular, preventative health care products and services are underutilized in many settings around the world, particularly in low-income countries. This work suggests that one way to raise the demand for such products and services is to increase the level of felt amenities in initial stages of patients’ interactions with service providers.
References


A Additional Figures

Figure 1A: Distribution of Age by Randomized Premium Consultation Price

Figure 1B: Distribution of Age by Randomized Premium Consultation Price for Patients Diagnosed with Cataracts

Note: Figure 1A presents the age for the full sample across the three groups defined by the randomized prices of 250, 300 and 350. Figure 1B presents the age across the three groups for the sample of patients diagnosed with cataracts.

B Details of the Estimation

B.1 Estimation

In this section we present the likelihood function used to estimate the parameters of the model. The model can be thought of as a system of three equations: (i) a probit cataract equation, (ii) an ordered probit consultation equation, and (iii) a probit undergo surgery equation. The model’s three equations are

\[
    s_i^* \equiv x_i' \gamma + \varepsilon_{si},
\]

\[
    u_{1i|s^*} \equiv x_i' \alpha_x + \alpha_w w_i + \alpha_p p_i + \alpha_s s_i^* + \varepsilon_{ui},
\]

\[
    u_{2i|k,s^*} \equiv x_i' \beta_x + \sum_{k \in \{p, w, b\}} 1 \left[ u_{1i|s^*} \in A_k \right] u_{1i,k} + \beta_p p_i + \varepsilon_q
\]

where \( A_p \equiv [\mu_p, \infty), A_p \equiv [\mu_b, \mu_p), \) and \( A \equiv (-\infty, \mu_b). \) The system’s endogenous variables are the prior probability of individual \( i \) of having cataract, \( s_i^* \), the latent purchase utility of consultation \( k \in \{p, w, b\} \), \( u_{1i|s^*} \), and the latent utility of undergo cataract surgery conditional on being diagnosed with cataract.
The system’s exogenous variables are the waiting time, $w_{ti}$, the randomize price, $p_i$, and a vector of characteristics of individual $i$, including age and gender. Note that $s^*_i$, $u^*_{1i|s^*}$, and $u^*_{2i|k,s^*}$ are not observed for all patients. Thus, we follow a similar strategy as in Einav et al. (2012).

Remember that we assume that $(\varepsilon_s, \varepsilon_u, \varepsilon_q) \sim N(0, \Sigma)$ where

$$
\Sigma = \begin{pmatrix}
\sigma^2_s & \rho_{su}\sigma_s\sigma_u & \rho_{sq}\sigma_s\sigma_u \\
\rho_{su}\sigma_s\sigma_u & \sigma^2_u & \rho_{uq}\sigma_u\sigma_q \\
\rho_{sq}\sigma_s\sigma_u & \rho_{uq}\sigma_u\sigma_q & \sigma^2_q
\end{pmatrix},
$$

which allow us to express the unconditional density of $(\varepsilon_s, \varepsilon_u, \varepsilon_q)$ as a function of

$$
f(\varepsilon_s, \varepsilon_u, \varepsilon_q) = f(\varepsilon_q|\varepsilon_s, \varepsilon_u) f(\varepsilon_u|\varepsilon_s) f(\varepsilon_s).
$$

Thus, the joint density of $(s^*_i, u^*_{1i|s^*}, u^*_{2i|k,s^*})$ can be expressed as

$$
f(s^*_i, u^*_{1i|s^*}, u^*_{2i|k,s^*}) = f\left( u^*_{2i|k,s^*} - x_i'\beta_x + \sum_{k \in p,w,b} 1[u^*_{1i|s^*} \in A_k] u_{1i,k} + \beta_p p_i | x_i, w_{ti}, p_i, s^*_i, u^*_{1i|s^*} \right)
\times f\left( x_i'\alpha_s + \alpha_w w_{ti} + \alpha_p p_i + \alpha_s s^*_i | x_i, w_{ti}, p_i, s^*_i \right)
\times f\left( s^*_i - x_i'\gamma | x_i \right).
$$

Next, we rewrite expression (27) in terms of the observable endogenous variables $(s_i, u_{1i|s}, u_{2i|k,s})$. First, we derive the likelihood of being diagnosed with cataract. The probability of observing individual $i$ diagnosed with cataract is

$$p_{si} = \Phi\left( x_i'\gamma \right)
$$

where $\Phi(\cdot)$ denotes the standard normal distribution function.

Second, conditional on being diagnosed with cataract, we can derive the likelihood of observing a patient chosen consultation type $k$. The likelihood of premium consultation conditional on having cataract can be computed from the covariance matrix $\Sigma$ and the properties of the multivariate distribution as

$$p_{u_{1i}=p|s_i=1} = \int_{-\infty}^{x_i'\gamma} F_{u_i|s_i} \left( -\mu_p + x_i'\alpha_x + \alpha_w w_{ti} + \alpha_p p_i + \alpha_s s_i \right) f(\varepsilon_s) ds,$$
for the no wait time consultation is

\[ p_{u_1=w|s=1} = \int_{-\infty}^{x'_i} F_{\varepsilon_u|\varepsilon_s} (-\mu_p + x'_i\alpha_x + \alpha_w w t_i + \alpha_p p_i + \alpha_s s_i) f(\varepsilon_s) \, ds - \int_{-\infty}^{x'_i} F_{\varepsilon_u|\varepsilon_s} (\mu_u - x'_i\alpha_x - \alpha_w w t_i - \alpha_p p_i - \alpha_s s_i) f(\varepsilon_s) \, ds, \]

and for the basic consultation is

\[ p_{u_1=b|s=1} = \int_{-\infty}^{x'_i} F_{\varepsilon_u|\varepsilon_s} (\mu_u - x'_i\alpha_x - \alpha_w w t_i - \alpha_p p_i - \alpha_s s_i) f(\varepsilon_s) \, ds. \]

We can derive analogously the likelihood for premium, no wait time and basic consultation conditional on not having cataract.

Third, we derive the likelihood of observing a patient’s decision to undergo cataract surgery. Conditional on being diagnosed with a cataract, the likelihood that an individual who chose premium consultation would undergo cataract surgery is

\[ p_{u_2=1|s=1, u_1=p} = \int_{-\infty}^{x'_i} \int_{-\infty}^{x'_i} F_{\varepsilon_p|\varepsilon_u, \varepsilon_s} \left( x'_i \beta_x + \beta_p p_i + \beta_u u_{1p} \right) f(\varepsilon_u, \varepsilon_s) \, duds \tag{29} \]

Similarly, conditional on being diagnosed with a cataract, the likelihood of an individual who chose the basic consultation would undergo cataract surgery is

\[ p_{u_2=1|s=1, u_1=b} = \int_{-\infty}^{x'_i} \int_{-\infty}^{x'_i} F_{\varepsilon_p|\varepsilon_u, \varepsilon_s} \left( x'_i \beta_x + \beta_p p_i \right) f(\varepsilon_u, \varepsilon_s) \, duds \tag{30} \]

Analogously, we can derive the likelihood of an individual who chose the basic consultation would undergo cataract surgery conditional on being diagnosed with a cataract. Note that conditional on not being diagnosed with a cataract, the likelihood that an individual who chose premium, no wait time and basic consultation would undergo cataract surgery is 0, for all three cases.

### B.2 Likelihood Function

Finally, we combine the probit cataract, ordered probit consultation, and the probit surgery equation, into a full likelihood function, \( L(s, u_1, u_2|x, w t, p) \). Before writing the likelihood function, we
define the possible outcomes observed in the data as:

- \( I_1 \): No cataracts and *premium consultation*.
- \( I_2 \): No cataracts and *no wait time consultation*.
- \( I_3 \): No cataracts and *basic consultation*.
- \( I_4 \): Cataracts, *premium consultation*, surgery.
- \( I_5 \): Cataracts, *no wait time consultation*, surgery.
- \( I_6 \): Cataracts, *basic consultation*, surgery.
- \( I_7 \): Cataracts, *premium consultation*, no surgery.
- \( I_8 \): Cataracts, *no wait time consultation*, no surgery.
- \( I_9 \): Cataracts, *basic consultation*, no surgery.

Then, the full likelihood is

\[
\log L = \sum_i \log (p_{s_i}) \\
\sum_{i \in I_1} \{ \log (p_{u_{1i}}=p|s_i=0) \} \\
\sum_{i \in I_2} \{ \log (p_{u_{1i}}=w|s_i=0) \} \\
\sum_{i \in I_3} \{ \log (p_{u_{1i}}=b|s_i=0) \} \\
\sum_{i \in I_4} \{ \log (p_{u_{1i}}=p|s_i=1) + \log (p_{u_{2i}}=1|s_i=1,u_{1i}=p) \} \\
\sum_{i \in I_5} \{ \log (p_{u_{1i}}=w|s_i=1) + \log (p_{u_{2i}}=1|s_i=1,u_{1i}=w) \} \\
\sum_{i \in I_6} \{ \log (p_{u_{1i}}=b|s_i=1) + \log (p_{u_{2i}}=1|s_i=1,u_{1i}=b) \} \\
\sum_{i \in I_7} \{ \log (p_{u_{1i}}=p|s_i=1) + \log (p_{u_{2i}}=0|s_i=1,u_{1i}=p) \} \\
\sum_{i \in I_8} \{ \log (p_{u_{1i}}=w|s_i=1) + \log (p_{u_{2i}}=0|s_i=1,u_{1i}=w) \}
\]
\[ \sum_{i \in I} \{ \log (p_{u_1=1, s_i=1}) + \log (p_{u_2=0, s_i=1, u_1=0}) \} \]

Our estimates of the parameters $\gamma, \alpha_x, \alpha_w, \alpha_p, \alpha_s, \mu_p, \mu_b, \beta_x, \beta_{1,p}, \beta_{1,w}, \beta_w, \beta_p$, and $\Sigma$ maximize this log-likelihood function.