Price Elasticity of Demand for Reproductive Health Services at an Ecuadorian Private Voluntary Organization

Final Report

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I. INTRODUCTION

Financial sustainability is becoming a priority among family planning and reproductive health (FP/RH) service providers in the developing world. Non-governmental organizations (NGOs), especially, need to recover program costs, often by charging **user fees** for services once offered at no charge or at heavily subsidized prices. Reliance on user fees, however, is controversial. Program managers and donors alike are concerned that fees may reduce access to services, especially among poor women. Furthermore, in many programs, the number of clients is an indicator of success. Hence, declines in utilization resulting from price increases may be unacceptable to program managers. Because of these concerns, service delivery organizations need to be aware of the likely impacts of price changes on utilization, and the tradeoffs between improving sustainability and serving low-income clients. A key parameter informing these types of decisions is the sensitivity of demand to price changes — the **price elasticity of demand (PED)**.

The "Law of Demand" states that price increases lead to lower demand. The **price elasticity of demand** for a good or service measures the magnitude of the decrease in quantity demanded associated with a given price increase. Mathematically, price elasticity of demand is defined as:

Price elasticity of demand = $e(Q^D,P)$ = (Percent change in Q^D/ Percent change in P)

Where: Q^D = quantity demanded
P = price

Usually, Q and P move in opposite directions, consequently $e(Q^D,P)$ is almost always negative. For ease of presentation, elasticity estimates are presented as positive numbers. A value of $e(Q^D,P)$ of 1 means that a 1 percent increase in price results in a 1 percent decrease in quantity demanded. Similarly, an $e(Q^D,P)$ of 2 means that a 1 percent price increase leads to a 2 percent decline in demand, etc.

Demand can be elastic, inelastic, or unitarily elastic. If the computed value is greater than 1, demand is said to be **elastic**. In such cases, raising the price of a good leads to a decline in total revenue because the price increase is offset by the reduction in quantity demanded. Conversely, if the computed value is less than 1, demand is said to be **inelastic**; and raising a price leads to higher revenues. Finally, if the computed value is exactly 1, demand is **unitarily elastic**; and raising prices produces no change in revenue. The price elasticity of demand is usually not constant at all points on the demand curve. Demand may be inelastic when prices are low and elastic when prices are high. For example, if the price of a cycle of pills is 20 cents, a 50% increase to 30 cents will probably not result in a 50% decline in sales. However, at an initial price of $2, a 50% increase represents a larger absolute increase in

resources needed to purchase the product, and the drop in demand would be greater than at the lower price.

Having a reliable and easy-to-apply methodology to determine price elasticity of demand would help program managers balance sustainability and concerns about access. Unfortunately, few, if any, PED methodologies of known predictive validity have been developed for family planning and reproductive health programs.[1] This study is a preliminary attempt at identifying and validating such a methodology.

The study described in this paper tests the predictive validity of **Willingness-to-Pay** (also known as Contingent Valuation) surveys in predicting price elasticity of demand. The study compares predicted changes in elasticities based on responses to WTP questions with actual elasticity changes observed during an experiment that increased the prices of NGO services in Ecuador.

The WTP methodology assesses consumer willingness to pay hypothetical prices for a good or service. This information can be used to estimate price elasticity of demand. Although new to FP/RH, the methodology has been utilized extensively in environmental damage assessment, to place a monetary value on non-market natural resources by asking individuals how much they would be willing to pay for the preservation of canyons, lakes, air quality, etc. Since consumer willingness to pay a wide range of different hypothetical price increments can be elicited directly through one survey questionnaire, the methodology can be administered expendiently and cheaply.

Program setting

The study was conducted between August 1996 and June 1997 by the Centros Medicos de Orientacion y Planificacion Familiar (CEMOPLAF), an Ecuadorian NGO. CEMOPLAF was created in 1974 to serve low-income couples; its clients consist primarily of working-class urban women, approximately 20% of whom live at or below the poverty line. The agency operates over 20 FP/RH clinics, as well as community-based distribution (CBD) and social marketing programs. Contraceptives provided by CEMOPLAF include the IUD (the most frequently accepted method), hormonal and barrier methods, and sterilization. Other reproductive health services such as obstetrics and gynecological care, pre- and post-natal care, and pediatric services are also available at the clinics. Many of these services are provided below cost, and are subsidized by for-profit activities and donor funds.

CEMOPLAF wanted to improve cost recovery while continuing to serve its target populations. In 1996, the organization recovered over 70% of costs through locally generated income. However, due to their heavy subsidization, the sale of clinic services only accounted for 6% of total agency income. For example, at $6.65 for an IUD insertion, and a little over $2 for a gynecological visit and IUD revisit, CEMOPLAF was

[1] Barbara Janowitz and John Bratt. "What Do We Really Know About the Impact of Price Changes on Contraceptive Use?" *International Family Planning Perspectives*, 22:1, March 1996.

recovering only 62 percent of visit costs. Furthermore, CEMOPLAF prices for one year of IUD services (insertion plus an average of 1.4 revisits) or a course of gynecology treatment (including diagnosis and cure) represent only 1.2 percent of annual income for even the poorest clients[2]. These facts suggested that CEMOPLAF could raise prices without limiting access to poor clients. However, rather than arbitrarily raising the subsidized prices of clinic services, program managers wanted to understand the impacts of such price increments on utilization. Consequently, this operations research study was designed with the following objectives:

- To understand the impact of higher prices on clinic utilization and revenues,
- To evaluate the impact of price increases on the access of low-income clients, and
- To determine if client responses to willingness-to-pay survey questions administered prior to increasing prices reliably predict the price elasticity of demand for FP/RH services.

II. Methodology

The study consisted of willingness-to-pay surveys and a true experiment. A baseline WTP survey predicted the demand for CEMOPLAF services at different price levels, and was used to set the price increases for the experiment that followed. The experiment was used to measure changes in utilization in response to price increases, which were then compared to changes predicted by the WTP survey. During the eleven-month experimental phase, two follow-up WTP surveys were administered to assess the effects of the price increases on client characteristics. Data on utilization and clinic revenue were collected for the entire eleven-month period of the study.

The Willingness-to-Pay Surveys: The first round of willingness-to-pay surveys was conducted two months prior to the experimental price increases in November 1996. The second and third surveys took place respectively three and seven months after the price increase.

In each round of surveys, clients at fifteen clinics answered questions about their willingness to accept hypothetical price increments for CEMOPLAF services. All clients entering the participating clinics during a one-month period, or the first 400 clients for that month, whichever was reached first, were interviewed. The willingness-to-pay questions in the survey instrument took the form of a "bidding game." A first "bid" (S./ 4,500) was quoted to the respondent, who accepted or rejected it; the amount was then raised (S./ 9,000) or lowered (S./ 2,500) depending on the response[3].

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[2] John Bratt, et. al. "An Assessment of Client "Ability to Pay" for Reproductive Health Services Provided by an Ecuadorian Family Planning Agency." Final Report. February, 1995. p. 9.

[3] See Appendix 1 for more details on the Willingness-to-Pay questionnaire used in Ecuador.

The WTP questionnaire was designed to avoid the major sources of error often associated with such instruments[4]: it (1) relied on personal interviews; (2) used close-ended questions that elicited the respondents willingness to pay a specified amount or increment for the service being valued; (3) reminded respondents that the price increment in question was a real one (not merely driven by inflation) and that paying more for the service in question would reduce the amount of money available to spend on other things; (4) included reminders to respondents that there were substitutes for the service in question; and, (5) questioned respondents about factors that might influence their preferences[5]. A substantial portion of the survey instrument consisted of questions on respondents' socioeconomic and demographic characteristics.

The Experiment: The experiment used a randomized block design and included 15 CEMOPLAF clinics serving clients with similar socio-economic profiles[6]. Clinics were first ranked on an index based on 1996 prices charged for IUD and gynecology services. The ranked clinics were then divided into five blocks of three clinics each, so that block one consisted of the three clinics with the highest prices (clinics ranking 1 -3), block two consisted of the three clinics with the next highest prices (clinics ranking 3 –6), etc. Within each block, clinics were randomly assigned to either the control or one of the two treatment conditions. Price increases were instituted in each of the clinic groups. In the control group, prices were increased by 20 percent only to keep pace with inflation. In the two treatment groups prices were raised by 40 and 60 percent, respectively.

III. Results

A. Adherence to the research design

Although the original research design called for identical price increments (20, 40, or 60 percent) for all clinics belonging to any one group, not all clinics implemented the full increase. This resulted in each group having a range of different price increments by clinic. The range in the control group was 10% -20%, in treatment group 1, 30%-40%, and in treatment group 2, 50%-60%. Ecuador has a high rate of inflation

[4] In the aftermath of the Exxon Valdez oil spill and the potentially massive loss of existence values, the U.S. Department of Commerce - acting through the National Oceanic and Atmospheric Administration (NOAA) - convened a panel of experts to determine whether estimates of lost existence values derived through the contingent valuation method were sufficiently reliable to be used in natural resource damage assessment. While the panel's conclusion was a qualified "yes," it established a "set of **guidelines** to which it felt future applications of the contingent valuation method should adhere, if the studies are to produce reliable estimates…." (Paul R. Portnoy, "The Contingent Valuation Debate: Why Economists Should Care," *Journal of Economic Perspectives*, Vol. 8, Number 4, Fall 1994, p. 9; Kathryn A, Phillips, et. Al., "Willingness to Pay for Poison Control Centers, *Journal of Health Economics*, Vol. 16, 1997, p. 347)

[5] One of the guidelines not adhered to in this study in the interest of time and brevity, but which would have added to the contingent valuation process, is the recommendation to include follow-up questions to ensure that respondents understood the choice they were being asked to make and discover the reason for their answer.

[6] A cluster analysis performed in 1994 to identify fifteen clinics serving clientele with similar socio-economic characteristics. The cluster analysis was based on four variables: the percentage of clients working for pay outside the home, the percentage that owned a refrigerator, the percentage that had consumed meat on at least two of the three previous days, and median family income. (Bratt et. Al. 1995)

and a concomitant shortage of small denomination bills. To be able to make change, clinics rounded (in most cases downwards) prices to facilitate cash transactions. Because initial prices for studied services were low in absolute terms – often less than U.S. $2 – small amounts of rounding in absolute terms resulted in fairly large percentage deviations from price increase targets. However, since there was no overlap in price ranges, the deviation from the design did not affect our ability to interpret the results of the study. A more important problem was that interviewers incorrectly explained the willingness to pay for IUD insertion questions to respondents during the first round of interviews. Although the problem was corrected in subsequent rounds, we were unable to make accurate estimates of the price elasticity of demand for IUD insertions, one of CEMOPLAF's most popular services.

B. Observed Price Elasticity of Demand: The Impact of Experimental Price Increases

Table 1 shows mean prices and mean number of visits, along with their standard deviations, for each service by clinic group for the quarters immediately preceeding and following the November 1996 price increases. Visit data are from service statistics.

All groups witnessed a decline in utilization after the price increase. Four factors contributed to the decline in visits: (1) long term downward trends in utilization (declining utilization of CEMOPLAF services since 1995); (2) seasonality (December is traditionally a "slow" month in CEMOPLAF clinics); (3) civil disturbances during the experimental period (street marches, strikes and barricades to force the resignation of Ecuador's President) and (4) price increases. The experimental design permits us to focus on the differences in behavior (the differential changes) between the control and treatment groups. Thus, it allows us to control for the effect of the first three contextual factors, and isolates the role of the price increases in utilization changes[7].

[7] Appendix 2 demonstrates the steps involved in deriving elasticity estimates with differential or incremental changes.

Table 1: Prices and Visits before and after the Experimental Price Increase

	Clinic Name	Mean Price (US $)			Mean number of visits		
		Oct '96	Nov '96	*% change*	Aug-Oct '96	Nov '96 - Jan '97	*% change*
OB-GYN	Control Group	2.53	2.97	*17.6*	311	247	*-20.5*
		(0.92)	(1.13)		(133)	(106)	
	Treatment Group 1	2.50	3.39	*35.6*	183	135	*-26.1*
		(0.64)	(0.63)		(80)	(75)	
	Treatment Group 2	2.28	3.50	*53.7*	94	64	*-32.0*
		(0.41)	(0.80)		(73)	(54)	
IUD Revisit	Control Group	1.77	2.08	*17.6*	185	174	*-6.3*
		(0.29)	(0.34)		(85)	(79)	
	Treatment Group 1	1.64	2.30	*40.7*	191	164	*-14.1*
		(0.32)	(0.50)		(111)	(84)	
	Treatment Group 2	2.04	3.12	*54.4*	160	119	*-25.7*
		(1,966)	(0.84)		(79)	(63)	
Prenatal	Control Group	2.59	3.00	*17.0*	71	65	*-7.7*
		(0.82)	(1.03)		(29)	(22)	
	Treatment Group 1	2.17	2.97	*37.2*	109	97	*-10.3*
		(0.25)	(0.33)		(41)	(34)	
	Treatment Group 2	1.83	2.83	*54.5*	74	61	*-17.0*
		(0.47	(0.83)		(44)	(23)	

Note: Standard deviations within parentheses. Exchange rate used for conversions, US $1 = S./3,600.

Observed price elasticity of demand for the three services are -0.32 for OB-GYN, -0.42 for IUD revisits, and -0.19 for prenatal services[8]. These estimates, which relate to the prices and price increments that prevailed at the time of the experiment, show that demand for CEMOPLAF services was inelastic. Analysis of Covariance shows that changes in utilization for the two treatment groups were not significantly different from changes in the control group.

C. Comparison of Predicted and Observed Price Elasticity of Demand

We applied a logistic regression model to data from the first round of WTP surveys to derive predicted elasticity estimates for *price increments equal to the differential price increases from the experiment*[9]. Hence, these predictions are fully comparable to the observed price elasticity of demand estimates presented in the previous section.

[8] See Appendix 2.

[9] Appendices 3 and 4 provide detailed descriptions on the estimation techniques used to derive price elasticity of demand estimates from WTP data

Table 2: *Observed* and *Predicted* Price Elasticity Estimates

	Observed	**Predicted**	**Difference**
OB-GYN	0.32	0.24	0.08
IUD Revisits	0.42	0.20	0.22
Prenatal	0.19	0.64	-0.45

WTP-based elasticity estimates predict that demand for all three CEMOPLAF services is inelastic. This is consistent with the observed results. The *differences* between the observed and predicted elasticities — the prediction errors — are small, and show no consistent patterns of over- or under-estimation. In the case of OB-GYN and IUD revisits, predicted elasticities are lower than observed elasticities (underestimation), while for prenatal care, the converse is true.

The question is whether or not predicted utilization and revenue estimates differ greatly from observed results. To address this question, we use two elasticity estimates — predicted and observed — to calculate changes in utilization and revenue resulting from a specified price increase. We then compare the results to assess the impact of prediction errors. The results are presented for the three services under consideration. They are the results obtained when we compare the differences in utilization and revenue between the control (20 percent price increase) and experimental 1 (40 percent price increase) conditions. The magnitude of the predicted and observed differences for the control – experimental 2 (60% increase) comparison (not shown) are similar to those reported in Table 3.

Table 3: Comparing Observed and Predicted Changes in Utilization and Revenues[10]

Initial price of a consultation in a hypothetical clinic = S./10,000 (US $2.77)
Initial # visits = 500 clients per month (for each service)
Initial revenue = S./5 million (US $1,388)

	Decline in number of visits		**Increase in revenue**	
	Predicted	Observed	*Predicted*	Observed
20% price change				
OB-GYN[11]	*-24*	-32	*+ $200*	+ $173
	(-4.8%)	(-6.4%)	*(+14.4%)*	(+12.4%)
IUD Revisits[12]	*-20*	-42	*+ $213*	+ $140
	(-4.0%)	(-8.4)	*(+15.4%)*	(+10.0%)
Prenatal[13]	*-64*	-19	*+ $67*	+ $217
	(-12.8%)	(-3.8%)	*(+5.0%)*	(+15.6%)

Note: exchange rate, US $1 = S./ 3,600.

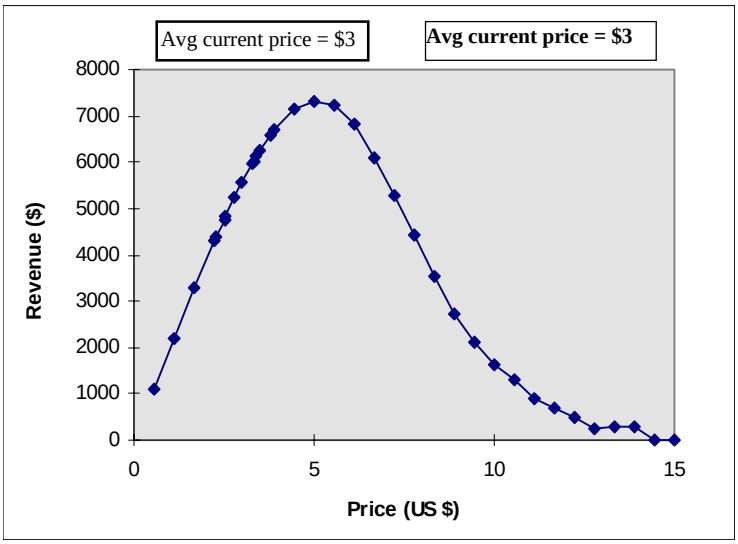
[10] See Appendix 5 for details on calculation process.
[11] Predicted price elasticity estimate used for calculations = 0.24; observed price elasticity estimate = 0.32.
[12] Predicted price elasticity estimate used for calculations = -0.2; observed price elasticity estimate = 0.42.
[13] Predicted price elasticity estimate used for calculations = 0.64; observed price elasticity estimate = 0.19.

Except for prenatal visits, the WTP methodology underestimates client loss and overestimates revenue gain. It should be stressed, however, that the *predicted* utilization and revenue changes differ only very slightly from the *observed* changes.

Program Applications of Willingness-to-Pay Data

In this section we demonstrate how WTP data can be used to formulate pricing policies that allow program managers to balance the twin goals of financial sustainability and service to low-income clients. Figure 1, a predicted price-revenue curve derived using the logistic function (see Appendix 3 and 4) demonstrates how the number of CEMOPLAF clients willing to pay for an OB-GYN consultation (a measure of clinic utilization) and revenues change with price.

Figure 1[14]: Predicted Price-Revenue Relationship: OB-GYN



The demand for obstetrics/gynecology services among CEMOPLAF clients is **inelastic** in the $ 0.50 - $5.00 price ranges. Within this range, **raising prices will yield higher revenues** because the price increment more than offsets any corresponding decline in utilization. The upward slope of the price-revenue curve in Figure 1 depicts this. Beyond $5 demand becomes elastic. At this juncture, raising prices would reduce revenue. For CEMOPLAF, the revenue-maximizing price was $5; a typical clinic serving 2,030 clients monthly would generate over $7000 per month in user fees. The tradeoff between change in revenue and change in utilization of Ob-gyn. services resulting from different price levels is shown in Table 4 which uses WTP data.

Table 4: The Tradeoff between Financial Sustainability and Utilization: Ob-gyn Services

Current Price	**New Price**		**% Change in Price**	**% Change in Utilization**	**% Change in Revenue**
	Sucres	**(US$)**			
$ 2.77 (S./10,000)	16,000	4.44	60	-15.0	+36
	14,000	3.89	40	-7.6	+29.4
	12,000	3.33	20	-4.8	+14.4

[14] This figure is derived using data from Table A3.

Staying within the inelastic portion of the demand curve, a clinic manager has several pricing options, three of which are shown in Table 4. For example, s/he could raise prices by 60 percent and increase revenue by 36 percent. However, the manager would have to accept a 15 percent decline in utilization. Alternatively, the same clinic could raise prices by 40 percent and increase revenues by 29 percent while utilization declines 8 percent; or raise them just 20 percent, increasing revenues by 15 percent and losing only 4 percent of clients.

E. Changes in Client Profile

One of the primary concerns about raising prices of FP/RH services in NGO and public sector is that the corresponding client loss will be concentrated disproportionately among the poorest clients. For an NGO such as CEMOPLAF, whose primary goal is to provide affordable services to low-income couples in a financially sustainable manner, this poses a real dilemma. In an effort to address this issue, we performed chi-square and t-tests on survey data to determine whether the experimental price increases did indeed shift the client mix away from low-income clients. We examine the changes in a range of socioeconomic characteristics between two periods in time: August/September 1996, before the experimental price increase, and May/June 1997. Table 5 presents these changes for CEMOPLAF clients, broken down by control and treatment groups.

Table 5: Changes in Client Profile: Pre- Versus Post-price Increase

Characteristic	**Percentage change (between baseline and endline surveys)**		
	Control Group	**Treatment Group 1**	**Treatment Group 2**
Price increments	10-20%	30-40%	50-60%
% w/ income <S.\200,000 ($55)	- 26 *	- 2	- 11
% w/ income >S.\900,000 ($250)	+ 15 *	+ 31*	+ 7
% clients working for pay	- 16	- 12 *	+ 6
% with car	- 0.2	- 6	- 12
% with bank account	- 10	- 13*	- 25 *
% with secondary education	+ 0.5	0	- 12.8

Note: * p< .05

If indeed, price has a negative effect on access of poor clients, we would expect a relatively greater shift in favor of wealthier clients among clinics that experienced larger price increments. However, this is not the case. For example, the control group with the lowest price increase experienced the largest percentage decline in number of low-income clients (those with income less than S./200,000), while the two groups with large *real* price increases do not show a statistically significant change in this indicator. Furthermore, although the number of employed users increased in treatment group 2, it decreased in treatment group 1, implying that the price increase did not have a consistent effect in ferreting out the unemployed and, hence, less well-off. Finally, asset ownership (possession of a car, bank account) in all three groups dropped despite the price increase. Since ownership of durable goods and assets is an indicator of wealth, it does not appear

that the higher prices in CEMOPLAF clinics shifted the client mix to a higher-income group of users. There is no clear impact of price increases on the profile of CEMOPLAF clients.

IV. DISCUSSION

This study set out to achieve two objectives: to (1) test the predictive validity of contingent valuation surveys and (2) help CEMOPLAF understand how it might achieve sustainability goals while continuing to serve low-income clients. We used an experiment and willingness-to-pay surveys to achieve these objectives.

Comparisons of results from the WTP surveys and the experiment show that predicted elasticity estimates closely match observed ones. Although errors exist, they do not greatly influence predictions of revenue and utilization changes that result from proposed price changes. The results of this study seem to imply that the WTP method has good predictive validity, and suggests that further exploration and use of this methodology is warranted.

WTP surveys could provide program managers with a powerful decision tool. They yield information about the range of prices within which demand for services is inelastic; the utilization and revenue outcomes of pricing alternatives within that range; and the tradeoffs between revenue and utilization. If future studies reinforce the conclusions of the Ecuador study, WTP could provide program managers with an instrument for making sound, goal-oriented pricing decisions. As a decision-making tool, the WTP methodology is efficient and can become routine if accompanied by training programs and a comprehensive instructional manual.

The results from this study show that demand for CEMOPLAF's Ob-gyn, prenatal, and IUD revisit services is inelastic at current prices in the majority of clinics. While current mean prices charged for the three services are between $2.39 and $3.19, demand is inelastic up to $5.00 for Ob-gyn. services and up to $3.89 for prenatal consultations and IUD revisits. There was ample opportunity for CEMOPLAF to raise prices and increase revenues without a dramatic client loss. Furthermore, results indicate that there is no clear link between higher prices and loss of low-income clients: raising prices, even by as much as 60%, does not appear to be incompatible with serving target clientele. CEMOPLAF used the results of this study to increase clinic prices throughout the system, in most cases to the highest level tested of 60%.

The present study is the first of its kind in the FP/RH field. More studies are necessary to further validate the WTP methodology and increase confidence in its use. Replicating this study in other countries where clients and programs have different characteristics, as well in non-clinic settings such as community-based distribution and social marketing programs would provide additional information about the predictive validity and applicability of the methodology in estimating price elasticity of demand.

APPENDIX 1
Contingent Valuation Questions from the CEMOPLAF Survey Instrument

			Skip to:
301	If the price of an OB/GYN consultation were to increase by S.4,500, would you continue to use CEMOPLAF services for this type of consultation?	Yes …… 1 No ……. 2 ------ ------ Don't know …… 9 ------ ------	304 304
302	If the price of an OB/GYN consultation were to increase by S.9,000 would you continue to use CEMOPLAF services for this type of consultation?	Yes …… 1 No ……. 2 ------ ------ Don't know …… 9 ------ ------	305 305
303	What is the maximum price you would pay for an OB/GYN consultation?	Maximum S./ _____	
304	If the price of an OB/GYN consultation were to increase by S.2,500, would you continue to use CEMOPLAF services for this type of consultation?	Yes …… 1 No ……. 2 Don't know …… 9	

S./ 4,500 or a little over $1 represented a 50% increase over the median of the mean service price (across all types of services) for a group of eight clinics that charged relatively high prices for all services. A second survey instrument which differed only in terms of the hypothetical increments was used for a group of seven clinics charging relatively low prices, where a 50% increase over the median of the mean service prices amounted to S./ 3,500. The bidding process for the low-priced clinics involved price increments of S./ 3,500, S./ 7,000, and S./ 1,500. The two questionnaires were identical in all other aspects.

APPENDIX 2

Using Service Statistics to Calculate *Observed* Price Elasticity of Demand Estimates

Table A1 demonstrates how differential changes in visits and price were used to calculate price elasticity of demand.

Table A1: Using Service Statistics to Calculate *Observed* Price Elasticity of Demand Estimates

	% Change in number visits	**% Change in price**	**Price Elasticity of Demand[2]**
Control Group (C)	-20.5	17.6	
Experimental Group 1 (E1)	-26.1	35.6	
E1 – C [1]	-5.6	18.0	
			-0.314
Experimental Group 2 (E2)	-32.0	53.7	
E2 – C	11.5	36.1	
			-0.318

(1) Differential changes are calculated simply by subtracting the treatment group value from the control group value. For example, the differential change in price between the control group and treatment group 1 is:

$$(-26.1) - (-20.5) = -26.1 + 20.5 = -5.6$$

(2) Price elasticity of demand calculation use differential change values. Hence, the price elasticity of demand for differential changes between the control group and treatment group 1 is: (-5.6/18) = -0.314.

(3) For ease of presentation, the observed price elasticities presented in the paper are averages of the two estimates calculated using the differential changes in price and visits between (1) the control group and treatment group 1; and (2) the control group and treatment group 2. For example, the observed price elasticity of demand for the experimental price increases for Ob-gyn services is: -0.32 = -[(-.314) +(-.318)]/2

APPENDIX 3

Using WTP Data to Estimate Price Elasticity of Demand:
Estimation Technique

We modeled respondents' willingness to pay using a logistic regression model. The dependent variable was the respondents' decision on whether or not to accept the proposed price increment for a service. The independent variables used in the regression were:

- *Price*: prevailing price at the time of the survey plus hypothetical price increment
- *Indirect cost of visit*: the cost of transportation and the opportunity cost of travel and waiting time.
- *Household income*: monthly family income.
- *First visit* (yes/no).
- *Education*: entered as dummy variables for some primary education, some secondary education, higher-than-secondary education, with no education as the omitted category.
- *Age*: entered as age brackets 15-29 and 30-49, with 45-80 as the omitted category.
- *Marital status*: entered as a dummy variable.

Table A2 reports the coefficients for the Ob-gyn WTP function[15]. Coefficients significant at the 95 percent confidence interval are indicated with an asterisk, "*".

Table A2: Parameter Estimates for the WTP Function: Obstetrics/Gynecology

Independent Variable	Coefficient Estimate	Standard Error
N = 5840[16]		
Price	-.0002*	.00000958
Household income	.000000451*	.000000086
Indirect cost	-.000002	.0000086
First visit	.6535*	.0822
Education:		
Primary	.0476	.1741
Secondary	.0993	.1763
Higher	.5225*	.1937
Married	-.2617*	.0766
Age:		
15-29	.0536	.1536
30-49	.1069	.1544
Constant	4.069*	.2465

These parameter estimates were then used to predict (1) for each respondent, the probability of accepting a range of hypothetical prices; (2) for the sample, the mean probability of accepting

[15] Similar results are available for IUD revisits and prenatal consultations.

[16] The actual number of obgyn clients interviewed was 2030. However, the Willingness-to-Pay questionnaire provides information on each respondents' willingness to accept (or not) 3 different prices: for example, the original price + S./4,500; original price + S./9,000; and original price + S./2,500. Hence, if individual A said yes to the S./4,500 increment, but no to higher increase, we know that she is willing to pay both original price + S./4,500 and original price + S./2,500, but unwilling to pay original price + S./9,000. This yields information about 3 distinct price points for individual A and every other respondent in the sample.

each specified price; and (3) the number of clients willing to accept each price[17]. Table 6 presents a sample of the type of data that calculations such as these produce.

Table A3: OBGYN

Price (Sucres)	**Price (US $)**	**Mean probability of accepting (% of sample)**	**Number clients WTP**	**Revenue (price x # clients) US $**
		100% = 2030		
2,000	0.56	98%	1,989	1105.22
4,000	1.11	98	1,989	2210.44
6,000	1.67	97	1969	3281.83
8,000	2.22	95	1,928	4285.56
10,000	2.78	93	1,888	5244.17
10,700	2.97	90	1,868	5550.92
12,000	3.33	89	1,807	6022.33
12600	3.50	86	1,786	6252.40
14,000	3.89	85	1,725	6710.28
14,500	4.00	84	1,705	6820.00
16,000	4.44	79	1,604	7127.78
18,000	5.00	72	1,462	7308.00
20,000	5.56	64	1,299	7217.78
22,000	6.11	56	1,116	6823.06

We can use this information to calculate WTP-predicated price elasticity estimates for any given price increase. For example, raising prices by 20 percent from $2.78 (or S./10,000) to $3.33 leads to a 4 percent decline in utilization and, hence, the elasticity is 0.2. Moreover, we can compare WTP-based predictions to the actual price elasticity of demand from the experiment. Table A4 uses WTP data to simulate the differential price increments between the control and treatment groups for obstetrics/gynecology services and predicts corresponding price elasticity estimates.

Table A4: Using WTP Data to Calculate *Predicted* Price Elasticity Estimates: OB-GYN

		% Change	**Predicted price elasticity of demand**
Simulating differential price increase between control group and treatment group 1			
Price increases from	$ 2.97 to $ 3.50	18	
Number visits declines from	1,868 to 1,786[18]	-4.4	
			-0.24[19]
Simulating differential price increase between control group and treatment group 2			
Price increases from	$ 2.97 to $. 4.00	36	
Number visits declines from	1,868 to 1,705	-8.7	
			-0.24

[17] See Appendix 4 for further details on the estimation techniques used.
[18] From Table A3.
[19] -0.24 = -4.44/18

(3) The predicted elasticities presented in this paper are simple averages of the two estimates calculated by simulating the differential price increases between (1) the control group and treatment group 1; and (2) the control group and treatment group 2. For example the observed price elasticity of demand for the experimental price increases for Ob-gyn. services is: $-0.24 = -[(-.24) + (-.24)]/2$

APPENDIX 4

Using Willingness-to-Pay Data to Assess Price Elasticity of Demand
Estimation Technique: Further details

The estimation techniques used to arrive at Table A3 in Appendix 4 are described below.

In order to estimate utilization (number of clients willing to pay) at a range of different prices, we:

(1) Predict, for each individual, the *probability* of a paying a range of specified prices.

$Prob_{ik}$, where i is the respondent # and k is the specified price.

Hence, the probability of respondent #12 paying a price of S./ 20,000 for an OB-GYN consultation = $Prob_{12,20000}$

(2) Calculate, for the sample, the *average probability* of accepting each specified price.

$P\text{-}bar_k = \Sigma\ P\text{-}bar_{ik} /N$ (where N is the number of decision-makers).

Hence, with a total of 2,000 decision-makers, the average probability of accepting paying a price S./ 20,000 for an OB-GYN consultation within the sample: $P\text{-}bar_{20000} = \Sigma\ Prob_{20000,i} /2000$

(3) Calculate the *number* of clients willing to pay each price.

Number of clients WTP each specified price = $P\text{-}bar_k$* Number of decision-makers

Hence, with 2000 decision-makers, the number of OB-GYN clients WTP S./ 20,000 for a consulation would = $P\text{-}bar_{20000}$ * 2,000

I. Estimating $Prob_{ik}$

$Prob_{ik} = F(Z_i) = F(\alpha + \beta X_i) = 1/ (1+e^{-z})$

Z_i is a theoretical continuous index, which is determined by explanatory variables X_i. In this study, Z_i represents how much the user/client values the CEMOPLAF service in questions. Although observations on Z_i are not available, they may be estimated in the following manner:

Estimating Z_i:

Step 1

We first estimated a WTP function:

- Regression type - logistic
- Dependent variable - clients' willingness to pay current price plus proposed increment (either S./ 4,500 or S./ 3,500). This is a binary choice variable, i.e. a (0,1) or (yes, no) variable.
- Independent variables -

(i) *Price*: prevailing price at the time of the survey plus hypothetical price increment
(ii) *Indirect cost of visit*: the cost of transportation and the opportunity cost of travel and waiting time.
(iii) *Household income*: monthly family income.
(iv) *First visit* (yes/no).
(v) *Education*: entered as dummy variables for some primary education, some secondary education, higher-than-secondary education, with no education as the omitted category.
(vi) *Age*: entered as age brackets 15-29 and 30-49, with 45-80 as the omitted category.
(vii) *Marital status*: entered as a dummy variable.

Here, by controlling for the effects of the users' socioeconomic and demographic characteristics, we isolate the effects of price on WTP.

Step 2

Using the coefficients derived from Step 1 (Table 5 presents coefficient values), we estimated Z_i at a range of different prices for each user:

$$Z_{ik} = \alpha_i + \beta_{1i}(\text{price}) + \beta_{2i}(\text{hhold income}) + \beta_{3i}(\text{primary}) + \beta_{4i}(\text{secondary}) + \beta_{5i}(\text{higher}) + \beta_{6i}(\text{married}) + \beta_{7i}(\text{first visit}) + \beta_{8i}(\text{age15-29}) + \beta_{9i}(\text{age30-49}).$$

For any given individual, all explanatory variables except price are constant.
The price variable was made to vary between S./ 2,000 - 50,000 in 2,000 sucre increments. Hence, each user had Z_i observations for 25 different prices.

Using Z_i to predict $Prob_{ik}$

Step 3

$$Prob_{ik} = F(Z_{ik}) = 1/ (1+e^{-z})$$

II. Using $Prob_{ik}$ to calculate the number of clients willing to pay different prices for a consultation

Step 4

We then calculated average sample probabilities for each price:

$P\text{-}bar_k = \Sigma\ Prob_{ik} / N$

For example, the average sample probability of paying S./ 20,000 for an ob-gyn consultation is:

$P\text{-}bar_{20000} = \Sigma\ Prob_{i,20000} / 1{,}288$

Step 5

#Number of clients WTP each specified price = $P\text{-}bar_k$* # decision makers

Example:

Price (sucres)	**Mean probability of accepting:** $P\text{-}bar_k$	**Number clients WTP:** $P\text{-}bar_k$* # decision makers	**Revenue:** Price x # clients
Assume N= 2030			
8,000	95%	1,928	4285.56
10,000	93%	1,888	5244.17

APPENDIX 5

Calculating the Impact of Prediction Errors on Estimated Utilization and Revenues

The table below depicts the first row of Table 3 in the main body of this paper. This appendix details the calculations used to arrive at the numbers in the two shaded cells.

Initial price of a consultation = S./10,000 (US $2.77)
New price, after 20% price increase = S/12,000 (US $3.33)
Initial # visits = 500 clients per month (for each service)
Initial revenue = S./5 million (US $1,385)

	Decline in number of visits		**Increase in revenue**	
	Predicted	Observed	*Predicted*	Observed
For 20% price increase				
OB-GYN	*-24 (-4.8%)*	-32 (-6.4%)	*+ $200 (+14.4%)*	+ $173 (+12.4%)

The predicted price elasticity of demand = - 0.24, implying that a 1% increase in price would lead to a 0.24% decline in number of visits.

Hence, a 20% price increase would lead to a decline in visits that = (.24 x 20)% = 4.8%

= (500 x .038) visits = 24 visits

Post-price increase revenue = (500-24) x US $3.33 = $1,585

Absolute change in revenue = (1,585- 1,385) = $200

Percentage change in revenue = (200/1,385)x100 = 14.4%