The Role of Waiting Time in Perception of Service Quality in Health Care

JEL Classifications: D12, I10

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Abstract

This paper includes a discussion of the way patients may perceive waiting at medical practices. As Becker argues for other services such as restaurants, plays, and sport events; a patient’s behavior is likely to be positively influenced by the total demand by other patients for a medical practice. Statistical analyses, based on a survey instrument using the least squares, ordered probit and mixed models as alternative estimation techniques, provide encouraging results with respect to a theory of perceived service quality. Also, there was some support for physician fees as a measure of service quality.

Key Words: Consumer Behavior, Service Quality, Medical Services, Waiting Time

JEL Classification: D1, I1, L8
I. Introduction

The primary objective in this paper is to examine perception of service quality in medical practices based on the length of office waiting time. Waiting to receive services is a typical feature of our society especially when the arrival or the service time (or both) is random. In the medical services industry, office waiting imposes an opportunity cost on patients and reduces their welfare. On the other hand, medical practices reduce their idle capacity by making patients wait. Several theoretical and empirical analyses of the demand and pricing of medical services consider the importance of waiting time by including non-monetary factors such as the opportunity cost of patients’ time (Holtmann, 1972; Acton, 1975; Phelps and Newhouse, 1975; DeVany et al, 1983; Cauley, 1987; Headen, 1991; and Vistnes and Hamilton, 1995). In the analyses of consumer behavior, increases in waiting time, because of its opportunity costs, is typically assumed to signal an inferior service quality and is to be avoided. Feldman (1979) considers the opportunity cost argument in his estimation of a hedonic price function for physicians’ office and hospital visits where office waiting time is used to signal quality. However, Feldman’s expected negative sign for the coefficient of office waiting time is not realized. In fact, the coefficient of waiting time turns out to be not only positive and large, but also statistically highly significant.

The negative relationship between waiting time and product quality is applicable to industries that sell homogeneous products. However, the social influence argument applied to the economic analyses of consumer behavior by Becker (1991) and others suggests that in certain businesses, producers do not raise prices to eliminate excess demand because they recognize indirect social influences on behavior. While, unlike providers of other services, physicians may not be as conscious of the impact of social influences on patients’ behavior, a ‘reasonable’ waiting period to receive medical services is likely to impress patients. In other words, since quality of medical services varies, consumers may use the length of waiting time as a source of information on the demand for physicians, and thereby the quality of the services. However, none of the existing empirical studies in health care has tested the impact of office waiting on the patient's satisfaction.

In this paper, Becker’s social influences argument is applied to examine whether patients use office waiting as an indication of the quality of the medical services offered. Here, the length of waiting time is treated as a signal to represent quantity of demand by other consumers. Although, patients are likely to show a positive reaction to waiting time up to a certain point, they are aware of and eventually respond to the increasing opportunity cost involved. The remainder of the paper will
continue as follows. A theoretical model of consumer behavior is presented in Section II. In Section III, the data set and the empirical model are explained. The statistical results of the analysis of the impact of waiting time on patient satisfaction are presented in Section IV. Conclusions are made in Section V.

II. Demand for Medical Services

Patient's utility function is assumed to be dependent upon both the quantity and the perceived quality of medical care such that the objective function can be written as:

$$\text{Max } U = U [Y - F(T)\cdot Q + v(L - T\cdot Q) + H(Q, Z)]$$

where $Y$ refers to patient income, $T$ is the length of waiting time per visit, $F(T)$ is nominal fees for medical care, $Q$ is the quantity of medical care received in terms of number of visits, $(L - T\cdot Q)$ is leisure time left for the patient considering the time spent at the medical practice, $v$ is the market value or the opportunity cost of one unit of time and $H(Q, Z)$ is the individual's health status which is influenced by both the quantity ($Q$) of medical care and the perceived quality ($Z$). Waiting time increases the real or full price of medical care ($P$) for the patient where $P = F + v\cdot T$. The derivatives of the objective function with respect to $Q$ yield:

$$U_q = -F - v\cdot T + H_q = 0$$

$$U_{qq} = H_{qq} < 0$$

(2)
(3)

Thus, the demand for medical care can be written as:

$$Q_d = f(F, Y, Z, T, v).$$

(4)

The effect of waiting time on patient demand can be further explored by examining its impact on patient satisfaction. Waiting time has two separate impacts on a patient's satisfaction ($W$). The conventional effect of waiting time on welfare is negative because it recognizes the opportunity cost of waiting time. This relationship is depicted by Figure 1- line (a). On the other hand, it can be
argued that a patient's perception of the quality of medical care, thereby the demand, is dependent upon waiting time, that is:

\[ Z = h(T). \]  \hspace{1cm} (5)

Since service quality improves patient satisfaction, holding fees (F) constant, satisfaction would be an increasing function of waiting time with an upper limit such as \( \alpha \), i.e. \( \frac{dZ}{dT} > 0 \ \{ T | \alpha < T > 0 \} \) (Figure 1- line b). Such a phenomenon is also observed among the consumers of many other services such as concerts, movies, restaurants, and sport events. Consumers use the popularity of the service as a signal or a source of information on service quality, particularly when other sources of information are absent. Interdependency in consumer utility functions and use of prices to convey information with respect to product quality are well established in the economic literature (e.g., Shapiro, 1983; Martin, 1986; and Becker 1974 and 1991). In the medical services industry, where prices are often regulated by insurance companies, Medicare, and Medicaid, waiting time tends to increase in response to a high demand for reputable physicians.

Although the service quality argument favors limited delays, since waiting time is also associated with an opportunity cost, consumer reaction to waiting time reflects the summation of the opposing reactions to waiting time. Therefore, the curvature of the satisfaction function with respect to waiting time could take any shape depending upon the strength of the opportunity cost effect as compared with the perception of service quality effect. Overall, at low levels of waiting time, increases in waiting time are likely to improve patients’ satisfaction; but, beyond certain point, rising waiting time diminishes patient satisfaction.

Considering the dependency of perceived service quality (Z) on waiting time (T), demand function in equation (4) can be rewritten as:

\[ Q_d = f(F, Y, Z) \]  \hspace{1cm} (6)
where the following partial derivatives can be expected \( \frac{dQ_+}{dF} < 0 \), \( \frac{dQ_+}{dY} > 0 \) (assuming that medical care is a normal good), and \( \frac{dQ_d}{dZ} > 0 \).

To examine the impact of change in waiting time on the optimum demand for medical care, we take the partial derivative of the first-order condition, equation (2), with respect to \( T \) as:

\[
\frac{\partial U_q}{\partial T} = -F_Z h_T - F_T - v + H QZ Z \quad (7)
\]

If fees are regulated so that \( F \) is constant with respect to perceived quality and waiting time, i.e. \( F_Z = 0 \) and \( F_T = 0 \), then \( \frac{\partial U_q}{\partial T} = -v + H QZ Z \). Assuming that patients judge quality by waiting, i.e. \( Z > 0 \), then increases in waiting time can increase demand only if increases in perceived quality increase the marginal utility from units of medical care, i.e. \( H QZ > 0 \).

To analyze the impact of changes in waiting on the demand for medical care, the full price of medical care is considered in Figure 2. Increases in the full price of medical care, particularly increases in waiting time when prices are regulated, signal higher quality of care. However, as it was demonstrated earlier in Figure 1, beyond a certain point the opportunity cost of waiting time becomes unacceptable and, as a result, satisfaction level and demand for medical care decline. In other words, if waiting time becomes excessive, an increase in the full price of medical care due to a longer waiting time would create a traditional reaction in customers, and demand becomes downward sloping.

Figure 2 also shows that, for a monopolistically competitive supplier of medical services, increases in waiting time help the firm reduce its excess capacity and achieve higher output levels up to the point where full capacity is reached. As for the equilibrium, since marginal cost is zero for a given capacity, a monopolistically competitive firm chooses the maximum price at \( P_m \), where the quantity demanded would be \( Q_m \). However, the location of supply curve determines whether this demand would be fully satisfied. If the capacity level is on the left of the maximum demand, such as \( S \), an excess demand of \( Q_1 Q_m \) will exist. At capacity levels on the right of the maximum demand, such as \( S' \), there will be an excess capacity measured by \( Q_m Q_1 \). Since waiting time (within limits) signals quality, waiting time persists even in the presence of excess supply of physicians. For example, physicians are likely to make patients wait even if there are no other patients at the office.
at the time, in order to create an impression of being busy. If the firm is operating at $S$, a capacity expansion to $S_1$ would give the firm two options, assuming that the nominal fee ($F$) is held constant. The firm has the option to reduce its waiting time and keep the number of patients served constant. In this case, the full price of medical care ($P$) would fall but firm revenues are left unchanged. Obviously, the firm has no financial incentive to choose this option. Alternatively, the firm can keep waiting time constant and increase the number of visits which means that full price of medical care ($P$) would remain constant. However, if the waiting time has been excessive prior to the expansion, the firm may choose a middle ground where by some reduction in the waiting time it attracts additional patients. Theoretically, the relevance of the upward segment of the demand curve in Figure 2 could be debated for some services such as health care. The empirical analysis that follows, however, explores the possibility of a positive correlation between waiting time and patient satisfaction in a limited domain of waiting time.

III. Data and Empirical Model

Data- The data used in this study is based on a survey of 1100 patients in Houston, Texas. In 1993, 100 questionnaires were randomly distributed among the patients of eleven medical practices. To make sure that various medical practices were represented in the sample, a mixture of quota and convenient sampling was used in selecting medical practices. Each specialty was represented by one medical practice in the sample. Patients were assured of anonymity. Office managers of each medical practice also received a separate questionnaire about the characteristics of the medical practice. The survey resulted in 247 completed patient questionnaires. Therefore, the response rate for the patient questionnaire was 23 percent.

For a descriptive analysis, mean and standard deviation of the variables extracted from patients and physician questionnaires are listed in Table I. Some of the highlights of this table are as follows. The patient ratings of their overall experience indicate that most patients were highly satisfied with their visits. Mean total waiting time was approximately 32 minutes. Ninety four percent of the patients visited with an advanced appointment. Clearly, a very small fraction of patients are emergency cases. Appointments were rather evenly distributed between morning and afternoon visits. Patients traveled approximately 27 miles to get to the medical practice. Females made 54 percent of the patients in the sample. Patient average age was in the mid-forties. On the average, more than half of the patients work outside of the home with the mean salary of more than
forty nine thousand dollars. The overwhelming majority of patients had health insurance. The percentage of Medicare and Medicaid patients was 27 and 8, respectively. On the average, eight percent of the patients in the samples came for an emergency visit, according to the physicians. The physicians, on the average, had nearly 16 years of experience since completion of internship. Although not all seriously ill patients visit their physicians without an appointment, the lack of an appointment could be interpreted as a proxy for the severity of illness for some patients.

Model- The empirical model to be estimated here is specified as:

\[
RO_{ij} = \beta_0 + \beta_1 PRP_{ij} + \beta_2 WT_{ij} + \beta_3 WTS_{ij} + \beta_4 AG_{ij} + \beta_5 I_{ij} + \beta_6 S_{ij} + \beta_7 AP_{ij} + \beta_8 TV_{ij} + \\
\beta_9 ED_{ij} + \beta_{10} INS_{ij} + \beta_{11} MC_{ij} + \beta_{12} MD_{ij} + \beta_{13} F_j + \beta_{14} EX_j + \beta_{15} EXS_j + \beta_{16} WK_{ij} + \\
\beta_{17} EM_j + \epsilon_{ij}
\] (8)

The dependent variable in this equation is the overall rating of patient i experience at medical practice j, which is an ordinal utility index for patients. Since arbitrary monotonic transformation of RO_{ij} across individuals can change the results, equation (8) will be estimated with the actual ratings by patients as well as their transformed values. PRP_{ij} is the interaction variable between medical practice and patient. No particular sign is expected for the coefficient of this variable. WT_{ij} is total waiting time which includes waiting times in the reception area and in the examination room combined. To deal with a potential causality problem between RO_{ij} and WT_{ij}, the Hausman test is performed with the null hypothesis that WT_{ij} is an exogeneous variable in equation 8. The explanatory variables for the reduced-form equation are AG_{ij}, I_{ij}, S_{ij}, AP_{ij}, APH_{ij}, TV_{ij}, ED_{ij}, INS_{ij}, MC_{ij}, MD_{ij}, F_j, WK_{ij}, EM_{ij}, ET_{ij}, NP_{ij}, V_{ij}, K_{ij}, I_{ij}. The t-statistic for the residuals from the reduced-form equation turns out to be 0.09. Therefore, the null hypothesis of exogeneity could not be rejected at the 5 percent level. Consequently, RO_{ij} will be estimated in a single equation model.

The sign of the coefficients for total waiting time signifies the importance of the opportunity cost factor as opposed to the perception of quality factor. A positive and negative coefficients for WT_{ij} and WTS_{ij}, respectively, demonstrate the existence of a concave patient rating of his experience with respect to waiting time. This result would show the importance of quality signals at low levels of waiting time and the strength of opportunity cost argument at high levels of waiting time. Among other explanatory variables, no a priori sign for the coefficient of the socioeconomic characteristics of patients is expected. This view also applies to variables such as whether an
appointment was made ($AP_{ij}$) and distance traveled ($TV_{ij}$). Following Martin's price dependent expectations of quality argument, patients are likely to rate their satisfaction higher for physicians with high fees (Martin, 1986). Of course, physicians who charge more are typically skilled specialists. Also, since high-fee physicians are less pressured to see a large number of patients per hour, they are likely to spend more time examining their patients which typically pleases the patients. Finally, number of years of experience since completion of internship ($EX_j$) is expected to have a positive effect at the beginning. This effect could become negative since a physician's knowledge often becomes outdated with the passage of time. Therefore, expected signs for $EX_j$ and $EXS_j$ are positive and negative, respectively.

Three alternative regression techniques are employed. First, the original values of the dependent variable, identified as $RO_{ij}$, are used to estimate parameters of equation (8) with the least squares regression method. This approach could be justified based on the existence of fractions in some patient ratings, which can support the continuity assumption required for using the least squares method. In the second approach, the ordinal nature of the dependent variable is reconsidered by rounding up the fractional ratings to make sure that all observations are discrete. The use of an ordered model also requires actual observations for each rating to exist. Since ratings of two, three, and four were not assigned by any respondent in the sample, empty cells existed. The coding of the dependent variable was adjusted to ensure that at least one observation exist for each stratification. As a result, a new rating system, named $RO_{ij}^1$, was created with values ranging from zero to six. The dependent variable is also censored because of the upper limit imposed on the values that patient rating could assume. Then, the appropriate statistical method to estimate the patient rating function using the $RO_{ij}^1$ series is the ordered probit (Greene, 2000), which is specified as follows:

$$ Y^* = \beta'X + \varepsilon, $$

(9)

where $Y^*$ is the patient’s unrestricted rating based on his feeling intensity, $X$ is a vector of measurable explanatory factors such as duration of waiting, socio-income characteristics of the patient, and physician skill, and $\varepsilon$ is the error term assumed to be normally distributed. While $Y^*$ is unobserved, its values are censored in the survey to obtain the observed $Y$ as following:
\[ Y = 0 \text{ if } Y^* \leq 0, \]
\[ 1 \text{ if } 0 < Y^* \leq \mu_1, \]
\[ 2 \text{ if } \mu_1 < Y^* \leq \mu_2, \]
\[ \ldots \]
\[ J \text{ if } \mu_{J-1} \leq Y^*, \]

where \( \mu \) is the rating intervals. Using \( \beta'X \) in equation (8) as the conditional expectation, i.e. \( \beta'X = \text{E}[Y \mid X_i] \), and \( \phi \) as the cumulative normal distribution function, the predicted probabilities for patient rating would be:

\[
\text{Prob ( } Y=0 \text{ ) } = \phi(-\beta'X),
\]
\[
\text{Prob ( } Y=1 \text{ ) } = \phi(\mu_1 - \beta'X) - \phi(-\beta'X),
\]
\[
\text{Prob ( } Y=2 \text{ ) } = \phi(\mu_2 - \beta'X) - \phi(\mu_1 - \beta'X),
\]
\[ \ldots \]
\[
\text{Prob ( } Y=j \text{ ) } = 1 - \phi(\mu_{J-1} - \beta'X),
\]

where \( j = 6 \).

The third approach for estimating the patients’ satisfaction function is a mixed model, which attempts to correct for the correlation of the residuals. Here, we consider the argument that \( RO_{ij} \) is treated as if a rank of 10 is ten times better than a rank of one and all respondents know about the meaning of each level of rating consistently. To solve this problem, distribution of sample is normalized by dividing the \( RO_{ij} \) by its mean to arrive at \( RO_{ij}^2 \) as another alternative measure of patient satisfaction. The mixed model is an extension of the general linear model where a more flexible specification of the covariance matrix of the error term is allowed. The following is the general format of such a model as applied here:

\[
Y_{ij} = \sum_k X_{ij} \beta_k + \varepsilon_{ij}, \quad (10)
\]

where \( Y_{ij} \) is a vector of the patient rating of his/her experience at a particular practice. Other components of this model include \( X_{ij} \) as a known matrix of independent variables, \( \beta_k \) as a vector of
unknown fixed effects related to both medical practice and patient characteristics, and \( \epsilon_{ij} \) as an unknown random error vector whose elements are no longer required to be independent. Then, the error component of equation (8) is decomposed into two statistically independent segments as follows:

\[
\epsilon_{ij} = \mu_{ij} + e_{ij}
\]  

Here, \( \mu_{ij} \) is treated as a random variable which represents medical practices and \( e_{ij} \) is assumed to be normally distributed with a mean of zero and variance of \( \delta^2 \).

IV. Results

Estimated parameters of the patient satisfaction function using the least squares, ordered probit, and mixed models, as alternatives, are presented in Table II. Model 1 contains the linear regression estimate for the best fit using the least squares method. An advantage of the least squares over the two other statistical methods applied here is the ease of interpreting the coefficients. To examine the assumption of constant variances across observations, regression disturbances are checked for the presence of heteroskedasticity. The White test statistic turns out to be 29.23. Given the critical value of 28.9 for \( \chi^2 \) with 18 degrees of freedom, at the 5% level, the null hypothesis of no heteroskedasticity is rejected. Accordingly, the standard errors reported are corrected for heteroskedasticity. The coefficients of both waiting time and its squared value are statistically significant with correct signs, though \( \beta_2 \) is only significant at the 10% level. The results also show that patients without an appointment were more satisfied with their experience than those who had made an appointment. The size of the coefficient for this variable suggests that it has an important influence on patients. Perhaps not having an appointment is playing the role of a proxy for the severity of illness and reflects the gratitude more seriously ill patients feel when they visit with their physician. In fact, the mean of RO\(_{ij}\) rating is 8.94 for patients with an appointment whereas it stands a bit higher at 9.83 for patients without an appointment, with respective standard deviations of 1.50 and 0.41. However, regression of a sub-sample that excludes patients without an appointment generated similar results for \( \beta_2 \) and \( \beta_3 \). Among other statistically significant result,
males were more satisfied than females. Also, Medicaid patients were more satisfied than patients without Medicaid while working patients were less happy with their experience.

The quasi-maximum likelihood method, which is more suitable for the data than the standard maximum likelihood method because of the observed abnormality in the residuals, is used to estimate the ordered probit model-- the Jarque-Bera statistic is 12.67 compared with the critical value of 5.99 for the $\chi^2$ with two degrees of freedom. As a result of using quasi-maximum likelihood method, the estimated covariance matrix is consistent and the standard errors are correct. However, the coefficients of the ordered probit model should be treated with caution because they are not the marginal effects. Nevertheless, the results reveal the direction of the impact of waiting time on patient rating which is the primary concern here. While $\beta_2$ and $\beta_3$ maintain their expected signs, they both have lost statistical significance. There are very few changes in the coefficients of other explanatory variables. For example, $\beta_5$ has gained some statistical significance showing that higher income patients tend to feel more satisfied with their experience at the medical practice than lower income patients. Of course, the small size of the income coefficient is due to the relative scale of the patient rating to the level of income. It must be noted that RO$_{1ij}$ has gone through both rounding up and recoding transformations, perhaps making it a less reliable source of information.

Finally, the linear mixed model is a likelihood-based approach used to estimate the determinants of a patient's overall rating of his/her experience at the medical practice as measured by the RO$_{2ij}$. The covariance parameters estimate for the residual is 0.0176 and for the medical practice is 0.0295, with the Z-values of 9.11 and 1.72, respectively. Therefore, the Wald Z-statistics indicate that the medical practice parameter is not significantly different from zero. Of course, medical practice is merely a control variable. The transformation of RO$_{2ij}$ has also reduced the value of the dependent variable and, as a result, has made the size of the coefficients for the explanatory variables smaller. The solution for the fixed effects in Model 3 shows that the interaction variable between medical practice and patients is statistically significant. More importantly, $\beta_2$ and $\beta_3$ are statistically significant with correct signs. Thus, the results of the statistical analysis in Model 3 show that waiting time has a positive effect on a patient’s rating of his experience at the medical practice when waiting time is low. But, the opportunity cost concern outweighs the quality perception concern when waiting time is high. The coefficient of income suggests that patients with high income are more satisfied than the low income patients. Similarly, patients who pay higher fees are more satisfied that the patients who are subject to lower fees. This result seems to prove the
notion of price dependence expectation of quality (Martin, 1986). Among other variables having coefficients statistically significant, the results for the gender variable shows that the males were more satisfied than the females. Patients’ satisfaction with their experience was lower among patients with an appointment than patients without an appointment, which is consistent with the findings from the other models. The effect of physician experience, however, is not consistent with our expectation. The Medicaid patients were more satisfied than patients without Medicaid, but patients who worked were more skeptical of their experience at the medical practice.

V. Conclusions

It is argued in this paper that patients may use office waiting time as a sign of the popularity of the physician and a source of information on the quality of medical care. This perception of service quality among patients is examined through statistical analysis of data. While several independent variables such as patient socio-economic characteristics are included in the empirical model, curvature of waiting time variable has been the primary concern. The results from the least squares regression and mixed models provide support for the theory advanced here that waiting time as a measure of perception of service quality (within limits) and the opportunity cost of waiting time are likely to generate opposing reactions in customers service industries such as health care. In this study, another potential measure of perceived service quality, physician fees, also proved to be statistically significant in the mixed model.

It is conceivable that variation in patient reaction to the length of waiting time exists depending upon the need for information on service quality under various conditions. For example, in small cities, patients are likely to have more information about quality of physician services through word-of-mouth. On the other hand, in large cities where direct exchange of information among patients is more limited, the length of waiting time as well as appointment delay may signal service quality to some patients. In other words, there may be a greater need to find proxies for information on the quality of physician services in large cities due to lack of sufficient social interaction among patients. Of course, separately, the typical clustering of physicians in large cities as opposed to small towns, which implies more competition, in itself may cause variations in waiting time. Finally, it might be argued that waiting time may not affect choice of physicians, but it may affect patient satisfaction and number of visits.
Endnotes

1. Following the initial works by economists such as Reinhardt (1972), DeVany et al. (1982) have used office waiting time as a variable in the estimation of the production function for medical services. Office waiting time in this model positively affects capacity utilization. Headen (1991) estimates that a five-minute increase in patient waiting time improves physician's productivity by 2.3 visits per week.

2. Of course, according to queuing theories, other factors besides the level of demand for services determine the length of waiting time in medical services.

3. Clearly this perception of service quality has limitations. For example, a patient may consider a very long waiting time as an indication of inefficiency of the medical practice and the physician rather than the quality of the services. Of course, appointment delay could also be used as a sign of service quality; but, for simplicity, it is ignored in the theoretical model of this paper.

4. The literature in health care marketing might shed some light on the topic of patient’s satisfaction. In health care services, quality is a cognitive belief about the experience. Although the process of achieving a cure is characterized by the delivery of the service experience and patients ultimately respond to the conceptualization of cure, satisfied patients are likely to develop a more positive perception of the health care delivered (Clemes, et al., 2001). De Man et al. (2002) believe that relationship between cure and care is complex. They identify several service quality dimensions in heath care, but patients with different characteristics attribute differing levels of importance to different service quality measures. Their research shows that patients perceive the core product, such as outcome and reliability, as more significant than peripheral product, such as access and food. According to De Man et al., there are various components of service satisfaction including human capital, such as skill and experience, personal characteristics of the provider, and physical and process components. De Man et al. believe that patients often lack sufficient knowledge to judge technological quality and are likely to use proxies for it.

5. The list of the medical practices in this study includes the following specialties: Cardiology, Dentistry, Family Practice, Internal Medicine, Obstetrics and Gynecology, Orthopedics, Ophthalmology, Otorhinolaryngology, Pediatrics, Plastic Surgery, and Urology. Copies of the questionnaires are available upon request.
6. Due to the exclusion of non-users, potential bias exists in sampling. Another source of bias in the sampling, which is rather typical in survey methodology, is caused by non-respondents.

7. It should be pointed out that questionnaires were randomly distributed in the medical practices which agreed to participate in the study. Consequently, medical practices performing poorly may not have been well represented in the samples.

8. The higher number of females in the sample is consistent with the national statistics which show that females typically visit more frequently with physicians than males.
References


<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Mean (Standard Deviation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RO</td>
<td>Original patient rating of his/her overall experience on a zero-to-ten scale (ten being the best)</td>
<td>8.99 (1.36)</td>
</tr>
<tr>
<td>RO&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Recoded patient’s rating of his/her overall experience on a zero-to-six scale (six being the best)</td>
<td>5.02 (1.26)</td>
</tr>
<tr>
<td>RO&lt;sup&gt;2&lt;/sup&gt;</td>
<td>Normalized patient rating of his/her overall experience (RO/8.95)</td>
<td>1.00 (0.15)</td>
</tr>
<tr>
<td>WT</td>
<td>Total waiting time in minutes (including the reception area and the examination room)</td>
<td>31.80 (36.35)</td>
</tr>
<tr>
<td>AP</td>
<td>Appointment made (1 = yes, 0 = no)</td>
<td>0.96 (0.20)</td>
</tr>
<tr>
<td>APH</td>
<td>Appointment hour (in military terms)</td>
<td>11.75 (2.71)</td>
</tr>
<tr>
<td>ET</td>
<td>Ethnicity of the patient (1 = Caucasian, 2 = African American, 3 = Hispanic, 4 = Asian/Pacific Islander, …)</td>
<td>1.42 (1.08)</td>
</tr>
<tr>
<td>TV</td>
<td>Miles traveled to see the physician</td>
<td>26.84 (47.82)</td>
</tr>
<tr>
<td>S</td>
<td>Sex (1 = male, 0 = female)</td>
<td>0.46 (0.92)</td>
</tr>
<tr>
<td>AG</td>
<td>Mid-point of age group of the patient or the adult accompanying the patient (10-20, 21-30, …, and 61 or older)</td>
<td>45.69 (17.98)</td>
</tr>
<tr>
<td>WK</td>
<td>Patient or the adult accompanying the patient working outside home (1 = yes, 0 = no)</td>
<td>0.57 (0.63)</td>
</tr>
<tr>
<td>I</td>
<td>Mid-point of income category of the patient or the adult accompanying the patient (less than $10,000, $10,000-$19,999, …, and $1000,000 or more)</td>
<td>$49,796.75 (29,584.87)</td>
</tr>
<tr>
<td>ED</td>
<td>Patient’s years of formal education completed</td>
<td>14.64 (2.86)</td>
</tr>
<tr>
<td>MC</td>
<td>Medicare recipient (1 = yes, 0 = no)</td>
<td>0.28 (0.57)</td>
</tr>
<tr>
<td>MD</td>
<td>Medicaid recipient (1 = yes, 0 = no)</td>
<td>0.08 (0.27)</td>
</tr>
<tr>
<td>INS</td>
<td>Health insurance (1 = yes, 0 = no)</td>
<td>0.90 (0.30)</td>
</tr>
<tr>
<td>EM</td>
<td>Percentage of emergency patients</td>
<td>8.18 (10.21)</td>
</tr>
<tr>
<td>EX</td>
<td>Physician’s number of years since completion of internship</td>
<td>15.95 (8.28)</td>
</tr>
<tr>
<td>F</td>
<td>Fees for an intermediate visit with an established patient</td>
<td>66.80 (30.15)</td>
</tr>
<tr>
<td>K</td>
<td>Total value of the medical equipment used in the medical practice (in dollars)</td>
<td>$241,480.50 ($335,723.60)</td>
</tr>
<tr>
<td>NP</td>
<td>Number of appointments per hour</td>
<td>4.52 (1.74)</td>
</tr>
<tr>
<td>V</td>
<td>Legal structure of the medical practice (1 = private, 0 = public)</td>
<td>0.76 (0.43)</td>
</tr>
</tbody>
</table>
### Table II. Parameter Estimates of the Patients’ Overall Rating

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Definition</th>
<th>Model 1 OLS- RO</th>
<th>Model 2 Ordered- RO¹</th>
<th>Model 3 Mixed- RO²</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \beta_1 )</td>
<td>Interaction of medical practice and patient</td>
<td>-0.00012</td>
<td>-0.00011</td>
<td>-0.00001b</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.00009)</td>
<td>(0.00009)</td>
<td>(0.00001)</td>
</tr>
<tr>
<td>( \beta_2 )</td>
<td>Waiting time in minutes</td>
<td>0.01196c</td>
<td>0.00247</td>
<td>0.00134a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.00829)</td>
<td>(0.00623)</td>
<td>(0.00075)</td>
</tr>
<tr>
<td>( \beta_3 )</td>
<td>Waiting time squared</td>
<td>-0.00016a</td>
<td>-0.00007b</td>
<td>-0.00002c</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.00005)</td>
<td>(0.00003)</td>
<td>(0.00000)</td>
</tr>
<tr>
<td>( \beta_4 )</td>
<td>Age group of the patient or the adult accompanying the patient</td>
<td>0.00332</td>
<td>0.00514</td>
<td>0.00037</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.00755)</td>
<td>(0.00745)</td>
<td>(0.00081)</td>
</tr>
<tr>
<td>( \beta_5 )</td>
<td>Income category of the patient or the adult accompanying the patient</td>
<td>0.00000</td>
<td>0.00001c</td>
<td>0.00000d</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.00000)</td>
<td>(0.00000)</td>
<td>(0.00000)</td>
</tr>
<tr>
<td>( \beta_7 )</td>
<td>Appointment made (1 = yes, 0 = no)</td>
<td>-0.94687a</td>
<td>-1.29457a</td>
<td>-0.10580b</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.25023)</td>
<td>(0.50170)</td>
<td>(0.05914)</td>
</tr>
<tr>
<td>( B_{7} )</td>
<td>Sex (1 = mail, 0 = female)</td>
<td>-0.53274a</td>
<td>-0.59558a</td>
<td>-0.05952a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.21722)</td>
<td>(0.21382)</td>
<td>(0.02291)</td>
</tr>
<tr>
<td>( \beta_8 )</td>
<td>Miles traveled to see the physician</td>
<td>-0.00214e</td>
<td>-0.00163e</td>
<td>0.00024</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.00137)</td>
<td>(0.00128)</td>
<td>(0.00019)</td>
</tr>
<tr>
<td>( \beta_9 )</td>
<td>Patient’s Years of formal education completed</td>
<td>-0.00713</td>
<td>-0.02440</td>
<td>-0.00080</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.04189)</td>
<td>(0.04130)</td>
<td>(0.000433)</td>
</tr>
<tr>
<td>( \beta_{10} )</td>
<td>Health insurance (1 = yes, 0 = no)</td>
<td>0.54314</td>
<td>0.61220c</td>
<td>0.06069</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.42698)</td>
<td>(0.38162)</td>
<td>(0.05088)</td>
</tr>
<tr>
<td>( \beta_{11} )</td>
<td>Medicare recipient (1 = yes, 0 = no)</td>
<td>-0.15874</td>
<td>-0.13074</td>
<td>-0.01774</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.26655)</td>
<td>(0.27658)</td>
<td>(0.02831)</td>
</tr>
<tr>
<td>( \beta_{12} )</td>
<td>Medicaid recipient (1 = yes, 0 = no)</td>
<td>0.77029b</td>
<td>0.62816c</td>
<td>0.08607c</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.40980)</td>
<td>(0.45143)</td>
<td>(0.05502)</td>
</tr>
<tr>
<td>( \beta_{13} )</td>
<td>Fees for an intermediate visit with an established patient</td>
<td>0.00195</td>
<td>0.00309</td>
<td>0.00022a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.00340)</td>
<td>(0.00366)</td>
<td>(0.00040)</td>
</tr>
<tr>
<td>( \beta_{14} )</td>
<td>Number of years since completion of internship</td>
<td>-0.00704</td>
<td>0.00262</td>
<td>-0.00079</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.00448)</td>
<td>(0.04579)</td>
<td>(0.00072)</td>
</tr>
<tr>
<td>( \beta_{15} )</td>
<td>Square of years of physician experience</td>
<td>0.00001</td>
<td>-0.00010</td>
<td>-0.00001a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.00094)</td>
<td>(0.00092)</td>
<td>(0.00011)</td>
</tr>
<tr>
<td>( \beta_{16} )</td>
<td>Patient or the adult accompanying the patient working outside home (1 = yes, 0 = no)</td>
<td>-0.36894b</td>
<td>-0.35423c</td>
<td>-0.04122b</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.21818)</td>
<td>(0.22278)</td>
<td>(0.02322)</td>
</tr>
<tr>
<td>( \beta_{17} )</td>
<td>Percentage of emergency patients</td>
<td>0.01043</td>
<td>0.00847</td>
<td>0.00117</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.01590)</td>
<td>(0.01591)</td>
<td>(0.00164)</td>
</tr>
<tr>
<td>( \beta_{0} )</td>
<td>Constant</td>
<td>9.64509a</td>
<td>-</td>
<td>1.07770c</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.88157)</td>
<td></td>
<td>(0.11790)</td>
</tr>
</tbody>
</table>

Adj. R² 0.24
F Statistic 4.42
AIC 3.27 2.75 -202.30
LR Statistic 51.86 (probability)
Log Likelihood -283.10 -230.24 -240.30

Heteroskedasticity-consistent standard errors are in parenthesis

- \(^a\) Significant at the 0.01 level.
- \(^b\) Significant at the 0.05 level.
- \(^c\) Significant at the 0.10 level.