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MEASURING IGNORANCE IN THE MARKET: A NEW METHOD WITH AN APPLICATION TO PHYSICIAN SERVICES

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ABSTRACT

Ever since Stigler's seminal piece on the economics of information, a great deal of research has been done investigating equilibrium in markets with imperfect information. While most of this research has been concerned with theoretically establishing the conditions under which there exists a distribution of prices in equilibrium, there is a small, but growing, body of empirical research in this area.

This work has followed the suggestion of Stigler and utilized the dispersion of prices (usually the variance) as a measure of ignorance about price. There are two disadvantages to using the variance (or another measure of dispersion, such as the range) of prices as a measure of ignorance about price. The first reason, recognized by Stigler and others, is that price can vary for many reasons other than ignorance. Thus dispersion is not a pure measure of ignorance about prices. The second reason, which has not been commonly considered in the empirical literature, is that price dispersion can occur due to ignorance on the part of both buyers and of sellers.

In this paper we propose a method for measuring ignorance about price in a market which builds on Stigler's original suggestion to use dispersion as a measure of ignorance. The innovation is to use a new frontier estimation technique containing a three component error term to separate observed price dispersion into purely random variation, variation due to buyer ignorance, and variation due to seller ignorance . We apply the technique to the physicians' service market. This supplies us with quantitative indices of price ignorance for different services and how the level of ignorance varies by buyer, seller, and market area characteristics. The results are striking. Buyer ignorance exceeds seller ignorance by roughly a factor of two in this market, and this gap is greater for services which are less frequently purchased, more heavily insured, or accompanied by greater severity of illness, as predicted by search theory.

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I. INTRODUCTION

A. Background

Ever since Stigler's (1961) seminal piece on the economics of information, there has been a great deal of research investigating equilibrium in markets with imperfect information. While most of this research has been concerned with theoretically establishing the conditions under which there exists a distribution of prices in equilibrium, there is a small, but growing, body of empirical research in this area.

This work has followed the suggestion of Stigler and utilized the dispersion of prices (usually the variance) as a measure of ignorance about price (see e.g., Stigler, 1961; Stigler and Kindahl, 1970; Pratt, Wise, and Zeckhauser, 1979; Carlson and Pescatrice, 1980; Marvel, 1976; Mathewson, 1983; Cox, DeSerpa, and Canby, 1982; Dahlby and West, 1986; and Van Hoommissen, 1988). There are two disadvantages to using the variance (or another measure of dispersion, such as the range) of prices as a measure of ignorance about price. The first reason, recognized by Stigler and others, is that price can vary for many reasons other than ignorance. Thus dispersion is not a pure measure of ignorance about prices. The second reason, which has not been commonly recognized in the empirical literature, is that price dispersion can occur due to ignorance on the part of both buyers and of sellers (Rothschild, 1974; Axell, 1977; Butters, 1977; Telser, 1978).

In this paper we propose a method for measuring ignorance about price which builds on Stigler's original suggestion to use dispersion as a measure of ignorance. We use a generalized frontier estimation technique (Polachek and Yoon, 1987) to separate observed price dispersion into purely random variation, variation due to buyer ignorance, and variation due to seller ignorance, and apply it to the physicians' services market. This yields price ignorance indices for different services and illustrates how ignorance levels vary by buyer, seller, and market area characteristics.

We define buyer ignorance as the difference between the lowest price at which the product is offered and the price which the consumer pays. This is the money cost to the consumer of ignorance about price. Analogously, seller ignorance is the difference between the highest price at which the product could be sold and the price the seller accepts for the product. Seller ignorance is the seller's money cost of ignorance about price. Thus, these measures provide money metrics for the amount of buyer and seller information in a market.

B. The Market For Physician Services

The health care market in general, but especially the physicians' services market, is commonly viewed as one in which market forces fail to work effectively (e.g., Arrow, 1963; Newhouse, 1978; Pauly, 1978; Pauly, 1986). Consumer price ignorance (i.e., lack of consumer information about price) has been viewed as an important reason for this market failure (Cantwell, 1981; Folland, 1985).[1] If consumer ignorance is substantial, policies failing to address this problem will not prove effective in strengthening the role of market forces (Marquis et al. 1985; Varner and Christy, 1986).

Despite universal agreement that information deficiencies are important causes of failure in the physician services market, there are no direct

[1] The Supreme Court viewed this as of enough importance to uphold an FTC ruling forcing the AMA to drop member restrictions on advertising (Federal Reporter, 1980).

estimates of the extent of consumer ignorance in this market.[2] This is not surprising, given that information is difficult to observe and quantify. Pauly (1978, 1986) points out that, while consumer information is perhaps the most important feature of the health services marketplace, nearly absolute consumer ignorance has been accepted as fact with very little empirical evidence.

The existing empirical work examines the link between information and the price level.[3] These studies attribute higher prices to consumer ignorance, using advertising or other variables as proxies for information. As Pauly (1978, 1986) indicates, consumer ignorance alone is not sufficient to reduce consumer welfare relative to the full information equilibrium. An informational asymmetry favoring the seller must also be present for ignorance to present a problem in the aggregate. This study devises a way to measure price ignorance as well as disentangle buyer and seller ignorance so that one can make such inferences.

In the rest of the paper we describe the theoretical and econometric models (sections II and III, respectively), generate hypotheses (section IV), discuss the data sources and the variables employed (section V) and present the empirical results (section VI). Section VII contains a summary and conclusions.

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[2] Newhouse and Sloan (1972), Hsiao (1980), Marquis et al. (1985), and White-Means (1989) have documented the dispersion in physician fees. Beazoglou and Heffley (1987) have done the same for dentists.

[3] E.g., studies relating advertising bans to eyeglass and retail drug prices (Benham, 1972; Cady, 1976; Feldman and Begun, 1978; Kwoka, 1984) and a study relating proxies for search costs to physician fees (Pauly and Satterthwaite, 1981).

II. THE MODEL

The approach taken here is based on results from the extensive literature on search theory. Price dispersion is possible in an otherwise competitive market if informational imperfections are present. For instance, buyers are motivated to purchase the product for the lowest possible price. They know the distribution of prices in the market, but not the price charged by any given seller. Buyers choose an optimal amount of search based on a weighing of the expected savings from search versus its associated costs. Since buyers do not have perfect information, on average they will pay more than the lowest price at which the product is offered for sale.[4] We define the gap between the lowest possible acceptance price and the price the consumer pays as consumer ignorance. This is a measure of the pecuniary cost to the consumer of his ignorance about price.[5]

Seller ignorance is defined in the same manner. The seller seeks to sell his product at the highest possible price. The seller also knows the distribution of prices, but does not know any given price.[6] Since sellers do not have perfect information they will, on average, receive less than the highest price at which the product is offered.[7] The difference between the

[4] Some ignorant buyers may serendipitously stumble on the lowest priced seller and will thus not incur any cost due to their ignorance. This is, however, a cost to the seller due to his ignorance.

[5] This ignorance is optimal from the individual's viewpoint, given the expected costs and benefits of search.

[6] Telser (1978) explicitly models search on the part of sellers. Rothschild (1974), Axell (1977), Butters (1977), and Burdett and Judd (1983) assume that sellers know their demand functions in only a probabilistic sense.

[7] Some ignorant sellers will randomly receive the highest price, but some will not, thus the average will be below the maximum.

price received and the highest price at which the product is sold is defined as seller ignorance.[8] This is the pecuniary cost to the seller of price ignorance.

Let there exist an equilibrium distribution of prices G(P), where

$$P = f(Z, \eta). \tag{1}$$

The function f describes price as a function of demand and supply shifters such as income and factor prices (Z), and of ignorance (η), where ignorance is defined as buyer ignorance relative to seller ignorance. If buyers are relatively more ignorant than sellers (on average), then $E(\eta)$ is positive, and vice versa. Rewriting (1) in the notation of a regression model, one obtains

$$P = \theta' Z + \eta. \tag{2}$$

Since not all of the elements of z will generally be observable, the expression for price is

$$P = \beta' X + u + \eta, \tag{3}$$

where u is a purely random error consisting of the unobservable elements of Z plus other stochastic factors and x consists of the observable elements of Z. Hence, u is assumed two-sided with $E(u)=0$, and u and X are assumed orthogonal. Since X is a sub-matrix of Z, the parameter vector β consists of the relevant

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[8] This ignorance is optimal, as it is for buyers, given the expected benefits and costs of search.

elements of θ from equation (2). In addition, the ignorance parameter η can be separated into its constituent components of buyer ignorance (w) and seller ignorance (v), so that the complete model may be written as

$$P = \beta' X + u + v + w. \tag{4}$$

We now turn to the econometric specification of the model.

III. ECONOMETRICS

Consider equation (4). Let the price observed for observation i, P_i, be determined by a vector X_i, a parameter vector β, ignorance, η_i, and random noise. Then P_i can be written as

$$P_i = \beta' X_i + \varepsilon_i, \ i = 1, 2, \ldots, n \tag{5}$$

where ε_i is an error term such that

$$\varepsilon_i = u_i + \eta_i = u_i + v_i + w_i \tag{6}$$

and where the density of u_i has support $(-\infty,\infty)$, the density of v_i has support $(-\infty, 0]$, and the density of w_i has support $[0,\infty)$.

Equations (5) and (6) represent a three-error component model which allows for both systematically positive and negative error components in addition to the usual random error component. u_i is a symmetric, purely random, error, and v_i and w_i are systematically negative and positive errors, representing seller and buyer ignorance, respectively.

The interpretation of v and w as measures of ignorance implies one-sided errors of differing signs such that $E(v) = \mu_v < 0$ and $E(w) = \mu_w > 0$. As explained in Section I, μ_v represents the average difference between the price received by sellers and the highest price at which the good is sold, thus μ_v is negative. μ_v can then be interpreted as seller ignorance. μ_w represents the average difference between the actual sale price and the lowest price at which the good is sold, and hence can be interpreted as buyer ignorance. Thus, μ_w is positive.

To obtain a form suitable for estimation which allows the identification of the one-sided error components v_i and w_i, assume that u_i has a normal distribution with mean and variance $(0, \sigma_u^2)$; that v_i is exponentially distributed with mean and variance (μ_v, σ_v^2), and that w_i has an exponential distribution with mean and variance (μ_w, σ_w^2).[9] In addition, for tractability, assume u_i, v_i and w_i are independent.

Following Yoon and Polachek (1987), the marginal density of ε_i is (suppressing the subscript i)

$$g(\varepsilon) = \frac{1}{\mu_v+\mu_w} \cdot \exp\left(\frac{\varepsilon}{\mu_v} + \frac{\sigma_u^2}{2\mu_v^2}\right) \cdot \{1-\Phi\left(\frac{\varepsilon}{\sigma_u} + \frac{\sigma_u}{\mu_v}\right) + (1-\Phi\left(\frac{-\varepsilon}{\sigma_u} + \frac{\sigma_u}{\mu_w}\right))$$

$$\cdot \exp\left[\frac{-1}{2}\left(\frac{2\varepsilon}{\sigma_u} + \sigma_u\left(\frac{1}{\mu_v} - \frac{1}{\mu_w}\right)\right) \cdot \sigma_u\left(\frac{1}{\mu_v} + \frac{1}{\mu_w}\right)\right]\} \qquad (7)$$

[9] These specific distributional assumptions are not required, but v_i and w_i must be distributed differently from u_i over their ranges in order to achieve identification.

where Φ denotes the standard normal distribution function.

The parameters of the buyer and seller ignorance model (β, σ_u, μ_v and, μ_w) can be estimated by maximizing the likelihood function:

$$L(y|\beta, \sigma_u, \mu_v, \mu_w) = \prod_{i=1}^{n} g(\varepsilon_i) \leq \prod_{i=1}^{n} g(P_i - \beta' X_i)$$

where the density g(.) is as given in (7).

The log-likelihood function can be written as

$$\log L = n \cdot \log \left(\frac{\theta_u \theta_v \theta_w}{\theta_v + \theta_w}\right) [\theta_u \theta_v \Sigma_i \varepsilon_i + (n/2) . \theta^2_v]$$

$$+\Sigma_i \log \{1 - \Phi(\theta_u \varepsilon_i + \theta_v) + [1 - \Phi(\theta_u \varepsilon_i + \theta_w)]$$

$$. \exp [-\frac{1}{2}(2\theta_u \varepsilon_i + \theta_v - \theta_w) . (\theta_v + \theta_w)\} \qquad (8)$$

where

$\theta_u = 1/\sigma_u$,

$\theta_v = \sigma_u/\mu_v$,

and $\theta_w = \sigma_u/\mu_w$.

The parameter θ_u is the inverse of the dispersion (σ_u), i.e., the precision, of the two-sided error component u, and the parameters θ_v and θ_w measure the inverses of the relative magnitudes (with respect to σ_u) of the mean negative-sided error component v and the mean positive-sided error component w.

IV. HYPOTHESES

The econometric method described in the preceding section allows us to identify and estimate the terms associated with buyer and seller ignorance. To complete the model we consider some established hypotheses from search theory. For example, it is well known that the net benefits of search are less, and hence consumer ignorance is greater, for: goods which are cheaper, goods which are purchased infrequently (Pratt, Wise, and Zeckhauser, 1979), and (for health care) more heavily insured services, and treatments associated with more severe illnesses (Newhouse, 1978; Dionne, 1984; Marquis, 1985).

We therefore estimate the model using the prices of eight different physician services as a means of testing these hypotheses. The services are: office visits to any physician; office visits to general practitioners (G.P.'s); office visits to pediatricians; office visits to general surgeons; hospital follow-up visits, dilation and curettage (D&C) by obstetricians; blood counts; and chest x-rays. We expect the information gap between buyers and sellers to be smaller for office visits than for hospital follow-up visits, D&C's, blood counts, or chest x-rays. Hospital care and D&C's are purchased less frequently than office visits, are associated with more severe illness, and are more heavily insured. Blood counts and chest x-rays are not necessarily infrequent nor associated with severe illness, but both are generally fully covered by insurance. In addition, hospital follow-up visits and blood counts and chest x-rays are usually tied to the purchase of another service, e.g., a hospital inpatient stay in the case of hospital follow-up visits. Similarly, the ignorance of buyers relative to sellers is expected to be larger for office visits to general surgeons than for office visits to G.P.'s or pediatricians, since the services of the former are purchased less frequently and are associated with more severe illness.

We also hypothesize that patients who are referred from another physician substitute the referral for search, and are thus more ignorant. To test this, we stratify physicians into those who have a high proportion of their practice from referrals and those who have a low proportion from referrals. The magnitude of buyer relative to seller ignorance should be greater for the high referral stratum than for the low referral stratum.

Last, we hypothesize that the opportunity cost of search is higher for both patients and physicians with higher incomes. Thus, the measures of both buyer and seller ignorance should be higher in areas with high per capita income than with low per capita income.

V. DATA

A. Sources

The data utilized for this study are from a national sample of physicians practicing in medical group practices.[10] The data were assembled by Mathematica Policy Research, Inc., under contract to the National Center for Health Services Research, Department of Health and Human Services, U.S. Government. The bulk of the data set is composed of surveys conducted by Mathematica from March to June of 1978, although some secondary data sources have been included. The final sample included 957 groups and 6353 physicians practicing in those groups. Five medical practice specialties were sampled:

[10] Since not all physicians practice in groups, the data are not necessarily representative of the physician services market, consequently the empirical results in this paper should be regarded as illustrative.

general practice, internal medicine, pediatrics, general surgery, and obstetrics/gynecology. Approximately 60 percent of all office-based physicians practice in these specialties.

This data set also includes data measuring characteristics of the area in which the group practiced as well as data on the hospital with which the group is affiliated. The area characteristics data were obtained from many sources, including the American Medical Association, and The County and City Data Book. For a full listing of all these data sources see Boldin, Carcagno, Held, Jamieson, and Woolridge (1979). The hospital data were obtained from the American Hospital Association Guide for 1978.

B. Variables

We estimated the three-error component model of the price function (equation (4)). Eight different prices were used as dependent variables: the usual fee for an office visit for all physicians, the usual fee for an office visit for general practitioners, the usual fee for an office visit for pediatricians, the usual fee for an office visit for general surgeons, the fee for a hospital follow-up visit for all physicians, the fee for a dilation and curettage (D&C) for obstetrician/gynecologists, the fee for a complete blood count, and the fee for a chest x-ray.[11]

The independent variables represent exogenous factors affecting the demand and supply of physician services: measures of insurance coverage, fee collection, market area characteristics, input prices, and physician

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[11] All money variables are deflated by the consumer price index (four person family, intermediate budget) for the county in which the physician is located.

characteristics.[12] The measures of insurance coverage are the proportion of the physician's patients who are covered by Medicare, Medicaid, and who have no insurance coverage. The proportion covered by Medicare is expected to have a positive impact on price, since Medicare provided generous reimbursement to physicians in 1978. The proportion on Medicaid is expected to have a negative effect on price, since Medicaid has been penurious in its reimbursement to physicians. The proportion without insurance should also be negatively related to price, since those without insurance pay the full cost of services provided. Fee collection is measured by the proportion of bills collected by the physician's practice. This provides a truer measure of the average transaction price, and may also proxy for price discrimination, to the extent that it is practiced by forgiving fees.[13]

Market area characteristics are per capita income, percent of the area that is urban, percent of the population on AFDC, and median gross rent. The first three variables are demand shifters controlling for income, population density, and poverty. Median gross rent is a proxy for the price of office space.

The wage paid to registered nurses by the physician's practice is a measure of the input price of labor.

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[12] We considered employing a number of other variables which could be hypothesized to determine price: patient waiting time, length of a follow-up office visit, physicians per capita, number of physicians in the group, and physician compensation method, but specification tests rejected the exogeneity of these variables.

[13] For an interesting discussion of this point, see Lachs, Sindelar, and Horwitz (1990).

Physician characteristics are: the experience of the physician, whether they practice in a subspecialty, whether they are female, whether they graduated from a foreign medical school, and the physician's specialty. The physician's experience, whether they practice in a subspecialty, and whether they are a foreign medical graduate are characteristics which may be associated with quality or productivity differences. They may either determine quality, and thus be valued indirectly, or they may be valued directly by patients (as in an hedonic model, e.g., Goldman and Grossman, 1974). The physician's sex may also be directly valued by patients, or may be related to productivity. Dummies for the physician's specialty were included in regressions which pooled physicians across specialties. Table 1 lists the definitions of these variables and Table 2 provides descriptive statistics.

VI. ESTIMATION RESULTS

Table 3 reports the complete set of parameter estimates for all physicians' fees. Tables 4 and 5 report the estimates of the ignorance indices by the various services and strata. The estimation results are striking. They reflect the common wisdom concerning information asymmetries. For all the specifications, the patient ignorance estimates are greater than the estimates of physician ignorance.[14] For example, in Table 3, the estimate of patient ignorance is 2.04 and of physician ignorance is 1.39. Thus, on

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[14] As a preliminary test we examined the distribution of the OLS residuals (ε) to the price function. Since ε is the sum of a normally distributed random variable and two exponentially distributed random variables, it is not normally distributed. A Kolmogorov-Smirnov test and a Jarque-Bera (Jarque and Bera, 1980) test on the OLS residuals both rejected normality at the 1% confidence level. In addition, the residuals were positively skewed.

average, patients pay a premium of almost 15 percent due to their ignorance. This is almost twice as great as the cost to physicians of their ignorance.

The parameter estimates are consistent with prior expectations. We report the parameter estimates for office visit fees pooling all physicians, since they did not differ much for the various strata. Table 3 contains two columns: one for the maximum likelihood estimates, and one containing least squares estimates for purposes of comparison.[15] Since the estimates are very simi`ar, we only discuss the maximum likelihood estimates.

The insurance variables are all significant and have the expected effects. The proportion of patients with Medicare coverage is positively related to price, and the proportion with Medicaid or no insurance have negative effects on price. The percent of bills collected by the practice has a negative, but insignificant, effect on the price charged. The negative sign implies that price increases as the collection percent falls, a way of compensating for lost revenue. This is also consistent with price discrimination by means of bill forgiveness.

The market area variables are mostly consistent with expectations. Per capita income and percent urban both have positive and significant coefficients. Median gross rent has an estimated positive effect on price, as hypothesized, but is not statistically significant. A puzzling result is that the percent of the population on AFDC has a positive and significant effect on

[15] Since theory provides no guide to the functional form of the price equation, we tested the validity of the two most common functional forms: linear and logarithmic, using the P_E test of MacKinnon, White, and Davidson (1983). The test failed to reject linearity, while the logarithmic form was rejected at the 1% level, therefore we employed the linear functional form.

price, rather than the hypothesized negative one. Perhaps percent AFDC is associated with omitted factors which have a positive effect on demand.

Registered nurse wages have a positive effect on price. This is as expected, since an increase in input prices will increase the marginal cost of production.

We hypothesized that physician experience would have a positive effect on price through patients valuing experience or through greater efficiency in producing quality. However, we find that experience of the physician has a negative and significant impact on price. This is not consistent with the hypothesis that experience represents quality, however it is consistent with a hypothesis that experience is associated with productivity, thus translating into lower price through decreased costs. Physicians who practice in a subspecialty charge higher fees, consistent with the story that this represents quality. Neither the physician's sex (whether they are female) nor whether they are a foreign medical graduate has a significant effect on price. Last, the physician specialty dummies are consistent with observed pricing patterns: G.P.'s and pediatricians charge less than general surgeons, and internists and obstetricians charge more.

Table 4 contains the maximum likelihood estimates for each of the three components of the error term for the seven other services: office visits by G.P.'s, office visits by pediatricians, office visits by general surgeons, hospital follow-up visits, D&C's by obstetricians, blood counts, and chest x-rays. Patients are found to be more ignorant than doctors. The measure of patient ignorance ranges from 5.212 for D&C's to 1.959 for pediatric office visits, and the difference between patient and physician ignorance varies from 4.084 for D&C's to 1.24 for G.P. office visits. In addition, the measures of patient ignorance and the differences between patient and physician ignorance are greater for those services which are purchased less frequently, associated with greater severity of illness, or are more heavily insured. The largest measures of patient ignorance, and the largest differences between the two ignorance measures, are for D&C's and hospital follow-up visits. These are both services which are purchased infrequently, are associated with greater severity of illness, and are heavily insured. The smallest estimates of patient ignorance and the smallest differences between patient and physician ignorance are for office visits to G.P.'s and pediatricians. These services are used relatively more frequently, are associated with lesser severity of illness, and are lightly insured. Intermediate values of these measures are found for blood counts and chest x-rays, services which are heavily insured, but are not purchased frequently and are not associated with severe illness. These findings, combined with the findings from Table 3, provide strong empirical support for the notion that information, and especially asymmetry in information, plays an important role in price determination in this market.

We also hypothesized that the proportion of a physician's practice drawn from referrals and per capita income in the market area are related to the cost of search. Referrals substitute for patient search. Since patients are searching less, they will pay a higher price. Physicians also likely know more about referred patients. Consequently, we expect the estimate of patient ignorance to be higher and the estimate of physician ignorance to be lower for physicians in the subsample with high referral practices. This is precisely the case. Examining the estimates in Table 5, the measure of patient ignorance is 2.361 when the percent of practice from referrals is 0-3%, and 2.855 when referrals make up 20% or more of the physician's practice.

Physician ignorance is estimated to be 1.765 for the low referral subsample, and 1.169 for the high referral physicians. Even more telling is the difference between patient and physician ignorance estimates for the two subsamples. The gap equals 0.6 for the low referral subsample and is equal to 1.69, or almost triple that, for the high referral subsample.

Per capita income is positively related to the opportunity cost of time, therefore search should be more costly (on average) in high than in low per capita income areas. This should be true both for patients and physicians. Thus, the estimates of both patient and physician ignorance should be higher in areas where the per capita income is higher. This is indeed the case. Again, using the estimates for office visit price for all physicians, we see that the estimate of patient ignorance is 2.839 where per capita income is $5,567 or greater, and 2.031 where per capita income is $4,455 or lower. Physician ignorance is estimated as 1.989 for the high per capita income subsample, and 0.711 for the low per capita income subsample.

Both of these results are consistent with hypotheses about how these variables affect search costs. They provide further support for interpreting the one-sided residual estimates components as measures of ignorance.

One problem with these as well as Stigler type ignorance estimates is that they are not based on actual measures of information, but are inferred from price data alone. Given that, it is useful to question the interpretation of the results as measuring ignorance. In particular, there are undoubtedly unmeasured quality differences which are captured in the total residual, ε. Recall that the measures of ignorance are essentially estimates of the dispersion in price. Therefore quality differences can only account for the observed pattern of the ignorance measures across the various strata if the dispersion in quality is greater for those strata with greater measured patient ignorance. Consider the findings for the patient referral strata. It could be argued that the larger measure of patient ignorance for the high referral stratum actually reflects the fact that higher quality physicians receive more referrals. Since the measure of patient ignorance is an estimate of dispersion, however, for this to be true there must not only be greater quality among high referral physicians, but greater dispersion in quality. There is no obvious reason to believe this is true. Of course, the overwhelming number of estimates following the same pattern of asymmetry between patient and physician provide evidence in favor of interpreting these estimates as measures of information.

VII. SUMMARY AND CONCLUSIONS

In this paper a new method for measuring ignorance is proposed which extends the Stiglerian measure of price ignorance. This method controls for the effects of supply and demand on price and uses a new econometric method to separate price dispersion into measures of buyer ignorance, seller ignorance, and random noise.

The method is applied to data from the market for physician services, a market which is commonly thought of as being characterized by ignorance about price. The empirical results accord with intuition: the measure of patient ignorance exceeds the measure of physician ignorance by approximately a factor of two. Patient ignorance is also measured as being relatively larger than physician ignorance for smaller ticket items, less frequently purchased items, more heavily insured items, and treatments associated with severe illness, as has been hypothesized. Last, measured ignorance is higher when proxies for search costs are higher. These results are striking and suggest that this method has promise in obtaining estimates of money metrics for price ignorance.

This does not necessarily imply large welfare gains from informing consumers about price, however. First, gains are only possible if some public or market institution could gather and disseminate this information more cheaply than individuals. Second, due to the numerous imperfections in the physicians services market, it is not obvious what the welfare effects of correcting only one of these imperfections would be.

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TABLE 1

Variable Definitions

Variable	Definition
Office Visit Fee: All Physicians	The usual fee charged for an office visit: all physicians pooled.
Office Visit Fee: G.P.'s	The usual fee for an office visit charged by genereral practitioners.
Office Visit Fee: Pediatricians	The usual fee for an office visit charged by pediatricians.
Follow-Up Hospital Visit Fee	The usual fee charged for a follow-up visit in the hospital: all physicians.
Office Visit Fee: General Surgeons	The usual fee for an office visit charged by general surgeons.
D & C Fee	The usual fee charged for a dilation and curettage by obstetrician/genecologists.
Blood Count Fee	The usual fee for a blood count.
Chest X-Ray Fee	The usual fee for a chest x-ray.
Collection Percent	The percent of all billings collected by the physician's practice.
Percent Medicare	The percent of the physician's patients covered by Medicare.
Percent Medicaid	The percent of the physician's patients covered by Medicaid.
Percent No Insurance	The percent of the physician's patients without insurance.
Female Physician	Dummy variable taking on the value one if the physician is female.
Foreign Medical Graduate	Dummy variable taking on the value one if the physician graduated from a non-U.S. medical school.
Experience	Number of years since graduation from medical school.

TABLE 1 (continued)

Variable Definitions

Variable	Definition
Sub-Specialty	Dummy variable taking on the value one if the physician practices in a sub-specialty.
Registered Nurse Wage	The wage paid registered nurses by the physician's practice.
Internist, General Practitioner, Pediatrician, Obstetrician	Dummy variables taking on the value one for the relevant specialty. Excluded specialty is general surgery.
Per Capita Income	Per capita income in the county in which the physician is located.
Percent Urban	Percentage of the population in the physician's county who live in an urban area.
Median Gross Rent	Median gross rent in the physician's county.
Percent AFDC	Percent of the population in the physician's county who are on AFDC.
Percent of Practice From Referrals	The percent of practice derived from referrals.

TABLE 2

Variable Means and Standard Errors

Variable	Mean	Standard Error
Office Visit Fee: All Physicians	13.94	3.88
Office Visit Fee: G.P.'s	12.61	2.94
Office Visit Fee: Pediatricians	13.76	3.14
Office Visit Fee: General Surgeons	14.23	4.46
Hospital Follow-Up Visit Fee	16.25	5.20
D & C Fee	191.45	71.02
Blood Count Fee	9.10	4.23
Chest X-Ray Fee	21.70	8.09
Collection Percent	91.86	9.09
Percent Medicare	21.96	14.82
Percent Medicaid	10.46	10.86
Percent No Insurance	10.39	10.84
Female Physician	0.05	0.21
Foreign Medical Graduate	0.06	0.24
Experience	20.29	10.85
Subspecialty	0.28	0.45
Registered Nurse Wage	4.87	0.99
Internist	0.35	0.48
General Practitioner	0.33	0.47
Pediatrician	0.14	0.35
Obstetrician	0.15	0.36
Per Capita Income	4752.99	1162.91
Percent Urban	72.88	28.19
Median Gross Rent	104.77	22.77
Percent AFDC	3.94	2.52
Percent of Practice From Referrals	20.12	26.52

TABLE 3

Estimates of the Three-Error Term Price Function[a,b]

Dependent Variable: Office Visit Fee: All Physicians

Independent Variables	MLE	OLS
Constant	12.18***	10.48
	(2.15)	(1.62)
Collection Percent	-3.58	-4.41***
	(2.89)	(1.35)
Percent Medicare	0.03***	0.0275***
	(0.0085)	(0.008)
Percent Medicaid	-0.061***	-0.056***
	(0.012)	(0.012)
Percent No Insurance	-0.0057***	-0.0017***
	(0.012)	(0.010)
Female Physician	0.0311	0.139
	(0.135)	(0.61)
Foreign Medical Graduate	-0.055	-0.306
	(0.197)	(0.33)
Experience	-0.071**	-0.093***
	(0.03)	(0.04)
Subspecialty	0.7797***	0.726***
	(0.203)	(0.21)
Wage of a Registered Nurse	0.915***	0.795***
	(0.171)	(0.122)
Internist	1.158***	1.065***
	(0.357)	(0.362)
General Practitioner	-1.785***	-1.796***
	(0.273)	(0.285)
Pediatrician	-2.276**	-2.58*
	(1.14)	(1.52)
Obstetrician	3.113***	3.636***
	(0.585)	(0.50)
Per Capita Income	0.447 X 10-3***	0.0003***
	(0.12X10-3)	(0.00015)
Percent Urban	0.015**	0.0134**
	(0.0047)	(0.005)
Median Gross Rent	0.0016	0.002
	(0.003)	(0.004)
Percent AFDC	0.325***	0.414***
	(0.049)	(0.04)
θ_u	0.574***	
	(0.067)	
θ_v	1.255***	
	(0.29)	
θ_w	0.853***	
	(0.166)	
σ_u	1.74	
μ_v	1.39	
μ_w	2.04	
Number of Observations		1,046

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[a] Standard errors reported in parentheses below the parameter estimates.
[b] *: significant at the 10% confidence level, **: significant at the 5% confidenc level, ***: significant at the 1% confidence level.

TABLE 4

Estimates of Patient and Physician Ignorance for Various Services[a]

Dependent Variable	Patient Ignorance μ_w	Physician Ignorance μ_v	Random Error σ_u
Office Visit Fee; General Practitioners	2.293	1.053	0.947
Office Visit Fee; Pediatricians	1.959	0.425	1.387
Office Visit Fee; General Surgeons	2.744	1.354	1.139
Hospital Follow-Up Visit Fee	4.235	1.550	1.808
Blood Count Fee	2.722	0.484	1.712
Chest X-Ray Fee	2.844	1.124	3.831
D&C Fee; OB/GYNs	5.212	1.128	1.845

[a] The set of explanatory variables employed was not identical to those employed in Table 3 in all cases.

TABLE 5

Estimates of Patient and Physician Ignorance for Various Strata

		Strata			
		Percent of Practice From Referrals		Per Capita Income	
Prices	Ignorance Measure	0-3%	20+%	0-$4,455	$5,567+
Office Visit Fee: All Physicians					
	Patient	2.361	2.855	2.031	2.839
	Physician	1.765	1.169	0.711	1.989
Pediatric Office Visit Fee					
	Patient	2.095	2.594	1.791	2.412
	Physician	1.826	0.153	0.323	1.691
General Practitioner Office Visit Fee					
	Patient	2.219	0.324	2.109	1.707
	Physician	2.418	0.815	0.679	2.581