

PRICE VARIATION AND ITS DETERMINANTS ACROSS DENTAL MARKETS

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I. Introduction

Dental services are heterogeneous. In addition, they vary across practices in terms of scope, mix, volume and quality. Furthermore, dental services cannot be stored or transferred, but rather must be produced on demand. Due to travel costs, both direct and indirect (e.g. value of time), the geographic area defining the market for a dental service is probably limited. In other words, most dental services are "locally" produced and consumed. In empirical research, variations in service, practice and market characteristics impose methodological restrictions which, if ignored, may lead to serious estimation inaccuracies and erroneous inferences. These problems are exacerbated if practice and service characteristics are systematically related to market characteristics. The use of aggregate data and inappropriate geographic areas to define markets for medical services, for example, has lent support erroneously to notions such as unnecessary surgery and induced demand[1].

The purpose of this paper is twofold. First, to provide estimates of market prices for specific (not aggregate) dental services using relatively proper geographic areas (markets). Second, to demonstrate the usefulness and power of a simple neoclassical competitive model to explain consistently the intermarket price variation for each dental service utilized. For this purpose, an extensive and accurate data base covering many dental services and markets will be utilized.

The following section presents the conceptual framework of this paper. Section III describes the data sources, definitions and measures. Finally, Sections IV and V provide the results and conclusions of this effort, respectively. II. Conceptual Framework

The economic model utilized in this paper is a simple neoclassical competitive one. For each specific dental service and market, a demand function with its usual arguments and properties is assumed to prevail. The incorporation of dental insurance in the demand function does not affect its usual properties. The supply of a dental service in a market is assumed to be perfectly elastic (available evidence makes this assumption plausible)[2]. These conditions are depicted in Figure 1.

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The demand conditions for a dental service may vary across markets. Income level, dental insurance coverage, age distribution and other sociodemographic consumer characteristics, as well as the price of substitute and complementary services, do differ by market areas[3]. According to the model described above, shifts in the demand for a dental service will affect the utilization of that service but not its price, other things being equal.

Similarly, the supply conditions for a dental service may vary across markets. Differences in input prices, for example, across market areas will imply variation in the position of the supply curve, other things being equal. Shifts in the supply curve, however, affect both the utilization and price of a dental service.

The model described above suggests the following relationship (price function):

$$P_i = f(I; S), \quad dP_i/dI > 0$$

where P_i is the price of dental service i ;
 I is the set of input prices; and
 S is a set of other factors determining the position of the supply function (e.g. level of quality).

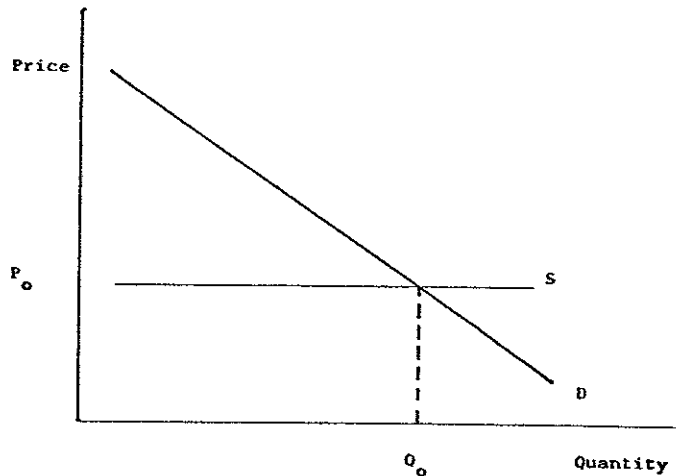


Figure 1. Demand and Supply Conditions in a Market for a Specific Dental Service.

This price function will be estimated and tested for each of six specific dental services across 64 dental markets in the State of Michigan.

III. Data Sources, Definitions and Measures

1. Data Sources

The primary source of data consists of all Blue Cross/Blue Shield of Michigan (BC/BSM) dental insurance claims filed by dentists in the State of Michigan during a 12-month period (May 1979 - April 1980). These claims represent a total of over 1.9 million services, 500 different types of services/procedures, and 4,273 dentists or dental practices. The number of dentists who filed at least one with BC/BSM constitutes over 60 percent of all active dentists in the State of Michigan. In addition, 82 of the 83 counties, well over 350 cities/towns and 496 zip code areas in the State of Michigan are represented in the data base.

Each insurance claim submitted to BC/BSM contains information on the dental service or procedure, the dentist's total fee, and the amount paid by BC/BSM. Several services are usually included in a claim. Each specific service/procedure and its corresponding price are reported separately. The availability of this information eliminates the problems associated with the use of measures of dental services in the aggregate, such as visits or categories of services. Thus, the variation in the scope of services and service-mix across dental practices not only is accounted for, but its effects can be measured.

Another important advantage of the BC/BSM dental insurance claim data is the documentation of the location of dentists and patients. This information makes feasible not only the identification of the relevant market area for a dental service, but also the utilization of additional sources of data (e.g. census data)[4].

Although the claims data have many unique features, they also have some potential limitations. For example, they contain no information regarding the technical quality of each service, or the "amenities" associated with each practice, such as scheduling, waiting and visit time.

A second limitation may arise from the use of insurance claims as a data source. It is possible that BC/BS of Michigan exerts some direct or indirect influence on dental prices and their variation. This influence may arise from two sources: a) extent and comprehensiveness of dental insurance coverage, and b) the pricing policy of the carrier (e.g. limits imposed on the level and range of dental fees).

These data limitations may not be severe, however. First, dental insurance is not as widespread as coverage for hospital and physician services. Second, the fees utilized in this study represent the charges filed by each dentist and not what is "approved" by BC/BSM. In addition, there is no available evidence indicating that dentists use a different fee system for insured patients, as compared with those without coverage.

2. Definitions and Measures

Dental Services:

The coding and nomenclature of dental services follows the American Dental Association's (ADA) four-digit classification system[5]. This scheme provides the most detailed categorization of dental procedures that is available.

Six specific dental services were selected for study. Table 1 indicates these services, their mean price in the State of Michigan and the percentage of total BC/BSM dental insurance claims they represent. Clearly, these services are common and well-defined, and they vary significantly in price.

Market for Dental Services:

Theoretically the notion of a market for a service is simple - the geographic area in which consumers and providers interact. The empirical application of this concept, however, is more complex. The extent of the market may vary by dental service and may differ for general practitioners and specialists. For the purpose of this study, the relevant market for a dental service will be approximated by the geographic area defined by one of the following: zip code area, town/city, county, state or the United States as a whole. The criterion for selecting the appropriate area for a service will be the proportion of the total number of claims for which the patient's and dentist's location is the same. The geographic area with the highest proportion will be considered the best approximation of the relevant market. Given the area covered by the claim data (Michigan) and the characteristics of dental services, the United States as a whole and the State of Michigan are considered too large to geographically define the relevant market for most dental services. Accordingly, the above criterion will be applied to the remaining three geographic areas.

Market Price: The market price of a specific dental service (P) is estimated according to the following formula:

$$P = \frac{\sum \bar{C}_i}{D} \text{ where } \bar{C}_i = \frac{\sum C_j}{N_i};$$

where D stands for the number of dentists in the market;

\bar{C}_i is the average price of the service charged by dentist i;

C_j stands for the individual charge of the service, and

N_i stands for the number of services provided by dentist i.

Input Prices: Since no direct measures of input prices are available, two proxy variables will be employed. The mean manufacturing wage rate (1980 census) will be used as a substitute for wages and salaries of dental auxiliaries. The median gross rent (1980 census) for the appropriate geographical area will be used to approximate the cost of dental space utilized.

IV. Results

Table 2 indicates the proportion of claims for which patient's and dentist's location is the same for three different geographic areas and six specific dental services. It is evident from this table that zip code areas are too small to be considered good approximations of the relevant markets for any of the six services. On the other hand, Table 2 shows that the county areas in Michigan provide the best overall approximation of the relevant markets for the services considered. Consequently, Michigan county areas will be employed as markets in the analysis that follows.

Table 3 provides the mean, standard deviation and coefficient of variation (standard deviation/mean) of market prices across 64 markets (Michigan counties) for each of six dental services. This table demonstrates clearly the heterogeneous nature of dental services. The effects of using distinct relevant market areas for each of the six services are shown in Table 4. This table indicates that differences in mean price for a service across markets are not only considerable but systematic. These results support the conclusion that the United States and the State of Michigan are too large geographically to be considered as single markets. Further, differences in mean price between cities and counties imply systematic variation in price between urban and rural areas. These differences become even more prominent when it is considered that BC/BSM treats the entire state as one market, in that only one maximum rate for each dental service is allowed.

Table 5 shows the regression results on the relationship between the market price of each dental service and input prices. All six regressions are significant and explain from 27 to 46 percent of the intermarket price variation. All coefficients have the expected sign and they are statistically significant ($\alpha=.06$), with one exception. In the case of Porcelain Crown with Gold, the regression coefficient for Rent is not significant at acceptable levels.

In an effort to test the strength of the simple model utilized above, a more comprehensive version was specified and estimated. Table 6 describes the additional variables incorporated into this model. Table 7 provides the results of the comparison between the simple and expanded model. As indicated by the last column of this table the contribution of the additional variables, taken as a group, to the simple model is not statistically significant ($\alpha=.05$) for four of the six dental services. Even in the remaining two dental services (Amalgam Restoration, Crown) the contribution is only marginally significant. Finally, the relationship between the market price of each of the six dental services and the dentist/population ratio across the 64 market areas was estimated (Table 8). Clearly, there is no relationship.

V. Conclusions

Several points can be made regarding the results presented above. First, the market area for the dental services considered is smaller than the State of Michi-

gan. Second, systematic variation in market prices occurs across the geographic areas defined as markets. Third, the variation in input prices explains consistently a significant part of the intermarket price variation. Fourth, the incorporation of additional variables did not increase significantly the explanatory power of the model. Finally, the use of specific services and proper markets indicates no correlation between the market price of a service and the dentist/ population ratio.

In conclusion, a simple neoclassical competitive model appears to be consistent with the intermarket variation in dental prices. Consequently, the use of other models and/or theories (e.g. target income) with limited applicability becomes "unnecessary."

Table 1. Services Utilized in the Estimation of Price Equations

Dental Service	ADA Code	Mean Price	Percent of Total Number of Claims
Initial Oral Examination	110	\$12.04	4.14
Prophylaxis, Adult	1110	18.82	12.06
Amalgam Restoration Two-Surface	2150	23.21	6.58
Porcelain Crown with Gold	2750	247.25	1.20
Complete Dentures Upper/Lower	5110/5120	322.96	.35
Single Extraction	7110	19.80	2.35

Table 2. Proportion of Total Number of Services for Which Patient's and Dentist's Location is the Same for Selected Dental Services and Geographic Areas. (Standard Deviations in Parentheses)

Dental Services	Mean Proportion of Services for Which Patient and Dentist are Located in Same:			Total Number of Services
	Zip Code Area	Town/City	County	
Initial Oral Exam	.39 (.49)	.71 (.45)	.86 (.35)	61,982
Prophylaxis, Adult	.34 (.47)	.65 (.48)	.72 (.45)	224,253
Amalgam Restoration Two-Surfaces	.33 (.47)	.67 (.47)	.72 (.45)	122,848
Porcelain Crown With Gold	.30 (.46)	.61 (.49)	.71 (.45)	22,244
Complete Dentures Upper/Lower	.30 (.46)	.63 (.48)	.68 (.47)	6,281
Single Tooth Extraction	.33 (.47)	.67 (.47)	.70 (.46)	36,403
Total Number of Areas:	372	23	71	---

Table 3. Mean, Standard Deviation and Coefficient of Variation of Market Prices for Six Dental Services Across 64 Michigan Counties.

Dental Services	Mean Price	Standard Deviation	Coefficient of Variation
Initial Oral Exam	\$ 10.26	1.42	.138
Prophylaxis, Adult	16.22	1.80	.111
Amalgam Restoration Two-Surfaces	21.00	1.91	.091
Porcelain Crown with Gold	225.52	18.19	.081
Complete Dentures Upper/Lower	283.46	30.21	.107
Single Tooth Extraction	16.88	2.51	.149

Table 4. Mean Prices of Six Dental Services Across Michigan County, City and Zip Code Areas.

Dental Service	Mean Price by Geographic Area		
	County	City	Zip Code
Initial Oral Exam	\$10.26	\$12.20	\$11.03
Prophylaxis, Adult	16.22	19.18	17.30
Amalgam Restoration Two-Surfaces	21.00	23.88	21.99
Porcelain Crown with Gold	225.52	251.50	238.35
Complete Dentures Upper/Lower	283.46	331.69	303.77
Single Tooth Extraction	16.88	20.57	18.23

Table 5. Estimated Price Equation for Selected Dental Services Across Michigan Counties (Market)
(Standard Errors in Parentheses)

	Initial Oral Examination	Prophylaxis, Adult	Amalgam Restoration Two-Surfaces	Porcelain Crown with Gold	Complete Dentures Upper/Lower	Single Tooth Extraction
CONSTANT	3.566 (1.392)	6.883 (1.351)	12.599 (1.868)	156.763 (17.387)	163.040 (30.193)	5.589 (2.372)
WAGE RATE	.485 (0.218)	1.122 (0.243)	.898 (0.293)	11.738 (2.727)	14.407 (4.735)	1.395 (0.372)
RENT	.014 (0.004)	.014 (0.005)	.014 (0.006)	.066* (0.056)	.186 (0.097)	.017 (0.008)
R-SQUARE	.298	.457	.304	.332	.269	.350
F-RATIO	12.95	25.66	13.30	15.15	11.24	16.38

* a = .24

Table 6. Definitions of Eight Additional Variables Incorporated into the Simple Model.

1. Percent of Population Living in Urban Area	*
2. Percent of Population Over 5 Years Old who have Lived in Same House, 1975-1980	*
3. Mean Family Size	*
4. Percent of Farm Population	*
5. Percent High School Graduates, 1980	*
6. Total Number of Active Dentists, 1979	**
7. Ratio of Population (1980) to Total Number of Active Dentists (1979)	*, **
8. Amount Paid by Patient (Deductables Plus Co-insurance)	***

Source: * 1980 U.S. Population Census
 ** ADA, Distribution of Dentists in the United States (1)
 *** BC/BSM Dental Insurance Claims

Table 7. Statistical Evaluation of the Contribution of Eight Additional Variables into the Simple Model.

Dental Services	R-Square of:			F-Value for added 8 Variables
	Simple Model	Expanded Model	Change in R-Square	
Initial Oral Examination	.298	.445	.147	1.76
Prophylaxis, Adult	.457	.534	.077	1.10
Amalgam Restoration Two-Surfaces	.304	.482	.178	2.28*
Porcelain Crown With Gold	.332	.497	.165	2.17*
Complete Dentures Upper/Lower	.269	.443	.174	2.07
Single Tooth Extraction	.350	.473	.123	1.55

*Statistically significant at $\alpha=.05$ (Critical value: $F=2.13$).

Table 8. Simple Correlation Coefficients Between Market Price and Dentist/Population Ratio for Six Dental Services.

Dental Services	Correlation Coefficient (R)
Initial Oral Examination	-.05
Prophylaxis, Adult	.11
Amalgam Restoration Two-Surfaces	.04
Porcelain Crown with Gold	-.03
Complete Dentures Upper/Lower	.02
Single Tooth Extraction	.00

All coefficients are not statistically significant at $\alpha=.05$.

ENDNOTES

- [1] Tryfon Beazoglou, Theory and Application in the Demand for Surgical Treatments. Working Paper #47, Center for Health Services and Policy Research, Northwestern University, (1980).
- [2] Tryfon Beazoglou, Peter Milgrom and Douglas Conrad. "Productivity and economies of scale in dentistry: Review and new evidence," unpublished mimeo, University of Connecticut Health Center, (1982).
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- [5] Council on Dental Care Programs, "Code on Dental Procedures and Nomenclature," Journal of the American Dental Association, 92 (1976), 647-652.

NEOCLASSICAL ECONOMICS AND THE SEXUAL DIVISION OF LABOR

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Within mainstream economics, the body of work which consists of theoretical and empirical analyses of labor supply comprises what may be called a "research program." [1] This program is part of a more comprehensive neoclassical research tradition and it intersects with other research programs. Specifically, it is intertwined with, and has implications for, consumer theory, human capital theory, theories of labor market discrimination, and the "new home economics." [2]

This paper is an outline of a larger project in progress [3], the goal of which is to analyze and evaluate the labor supply research program, specifically as it relates to women's labor supply. It has some similarity to the "methodology of scientific research programmes" formulated by Imre Lakatos (1978) and advocated by Mark Blaug (1980).

In the first section of the paper, the rationale for the method of analysis and its divergence from Lakatos's methodology is presented. This includes a brief recap of the contributions of Lakatos and two other major philosophers of science. Also, the relationship of this analysis to the emerging feminist research tradition is presented. In the second section, the analysis itself is outlined, and specific examples are given of its content.

I

Many economists today would probably admit that their knowledge of the epistemological and methodological underpinnings of their discipline goes scarcely beyond Milton Friedman's (1953) defense of positivism, which, in fact, is more appropriately labeled instrumentalism [4].

Major exceptions to this tendency are Marxists and economists of the Institutional school who explicitly reject the orthodox assumptions and methodology. Of course, the relative lack of concern with methodology on the part of the orthodox is appropriate if Friedman's arguments are accepted. It has been argued elsewhere that they should not be, but those arguments will not be replicated here [5].

Philosophers of science are having some impact on mainstream economics, however, as evidenced by the increased use of concepts such as "paradigm," "falsificationism" and "research program." [6] These terms are attributable to Thomas Kuhn, Karl Popper, and Imre Lakatos, respectively.

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