Implications of Reimbursement Policies for the Location of Physicians

by James R. Cantwell*

A simple model of physician migration predicts a positive relationship between physician fees and the number of physicians in an area and a negative relationship between physician fees and area population-physician ratios. The strong empirical support for this model suggests that Government health insurance programs could be used to encourage physicians to locate in scarcity areas.

Keywords:

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The two major Federal health insurance programs which began in the midsixties—Medicare for the elderly and Medicaid for some of the Nation's poor—may have contributed to a more uneven spatial distribution of physicians in the United States. First, the programs have increased total demand for physician services, while fixed labor and capital (in the short run) have constrained supply. As a result, the programs have increased quasi-rents to physicians and contributed to high physician incomes in adequately served and perhaps overly served areas. These changes have thus contributed to a more uneven distribution of physicians. (This argument was first advanced by DeVise (*6*)).[1]

A second and potentially more serious spatial impact of the programs may have occurred because of the substantially lower third-party reimbursement levels in rural areas than in urban areas. Differential reimbursement rates appear to represent statistically significant determinants of the availability of physicians (as measured by physician-population ratios (*9*, *1*, *11*).

OBJECTIVES

How reimbursement restrictions influence physicians' decisions on their location has not been examined in the literature. Investigation of this impact represents the primary objective of this article. In fiscal year 1977 alone, Medicare and Medicaid programs accounted for $5.4 billion in Federal expenditures for physician services (*8*).

The secondary objective is to examine characteristics of reimbursement areas used by Medicare Part B carriers.[2] The examination will focus on how low physician fees in rural areas affect the availability of physician services. Results for these objectives are important for evaluating third-party reimbursement practices, especially Medicare-Medicaid prevailing charge policies.[3] Contrary to the finding of most recent research on the determinants of the location of physicians (*4*), economic factors will be shown to have considerable impact on the distribution of physicians.

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[1] Italicized numbers in parentheses refer to items in References at the end of this article.

[2] A Medicare Part B (Supplemental Medical Insurance) carrier is an agency or organization (perhaps a Blue Shield plan or commercial health insurer) which has contracted to administer various aspects of the program, including claims payment.

[3] The prevailing charge is one key determinant to Medicare maximum reimbursement levels. Program benefits cannot exceed 80 percent of the reasonable charge (after a $60 deductible is met), which, in turn, is limited by the prevailing charge in the locality. In *A Discursive Dictionary of Health Care*, "prevailing charge" is defined as:

> A charge which falls within the range of charges most frequently used in a locality for a particular medical service or procedures. . . . Current Medicare rules state that the limit of an area's prevailing charge is to be the 75th percentile of the customary charges for a given service by the physicians in a given area.

The "customary charge" is defined as:

> Generally, the amount which a physician normally or usually charges the majority of his patients. Under Medicare, it is the median charge used by a particular physician for a specified type of services during the calendar year preceding the fiscal year in which a claim is processed.

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DATA SOURCES

Supporting data come from the American Medical Association's Ninth Periodic Survey of Physicians, fall 1974, the latest year for which such information was available to the author. The questionnaire was mailed to 10,169 randomly selected, nonfederal, office-based physicians in the United States—AMA members and nonmembers. A usable sample size of approximately 5,000 was achieved after several mailings. Data were used to estimate Standard Metropolitan Statistical Area (SMSA) and county medical characteristics. Two separate files were created—one for SMSAs and one for nonmetropolitan counties.

REIMBURSEMENT AREAS

The various Medicare Part B carriers have options in drawing geographic boundaries within a State for purposes of calculating prevailing charges. Different carriers use different approaches. For example, in California, the two carriers established 28 localities, each composed of contiguous areas. In Massachusetts, two localities were formed—urban and suburban/rural. In Colorado, the carrier has made the State the prevailing charge locality.

Two alternative philosophies might guide persons trying to decide whether geographic (and specialty) differentials are to be incorporated in a fee-for-service reimbursement system. Reimbursement might be structured to reflect physician fees in the private market. This approach will be called *passive*. Or, the reimbursement structure could be used to influence physician location (and specialty) choices. This second approach will be called *active*.

A strong case has recently been developed that current Federal programs to finance health care contain substantial bias against rural residents (*5*). This bias stems partly from (1) eligibility requirements which insure broad coverage of poor, central-city residents and (2) a passive reimbursement fee structure.

A passive reimbursement structure would maintain urban-rural fee differentials. Whether any such differentials should be maintained in an active reimbursement structure is not clear, as these differentials may be largely attributable to differences in patients' incomes and extent of insurance coverage between the areas (*12*).

A MODEL OF PHYSICIAN LOCATION

To better understand the implications of Medicare reimbursement differentials on physician location, the relationship between physicians' fees and population-physician ratios will be explored. First, however, let us briefly review "price" and "quantity" in the market for physician services.

In their work on income from professional practice, Friedman and Kuznets argue that:

> In an analysis of medical and dental services, however, it is not obvious even what the relevant unit of service supplied or demanded is. And no matter how this 'unit' is defined, there is clearly no single price at which it sells; rather, there is a frequency distribution of prices. . . .
>
> *i The supply curve.* On the side of supply, the relevant 'unit' seems to be the individual practitioner . . . The total amount of service the profession stands ready to offer depends primarily on the number of practitioners. . . .
>
> The "price" that determines the "supply" of entrants is clearly the income or returns that individuals count on receiving. . . .
>
> If we abstract from all factors affecting the choice of a profession other than actuarial ones, the supply of new entrants depends solely on the relative arithmetic mean returns and costs. . . .
>
> *ii The demand curve.* On the side of demand as well as supply there is no easily specified 'unit' or single 'price'. . . . The only thing that seems relevant is the total sum that consumers as a whole are willing to spend for medical services. . . .
>
> We may, therefore, conceive of a demand curve for 'physicians' in which the 'price' is the average gross income per physician and the 'quantity', the number of physicians. But we cannot use this demand curve for our purposes. It is the average *net* rather than *gross* income that is the relevant figure to the prospective

practitioner. However, to each possible value of total gross income corresponds a fairly determinant value of total net income. We can therefore pass from a demand curve in which the 'price' is the average gross income to one in which the 'price' is the average net income (7).

One may reasonably assume that physicians will distribute themselves spatially so that their rate of return on their skills and abilities will be equalized, except for differences attributed to their transportation costs and differences which reflect differing amenities between regions. Therefore, no significant empirical relationship should be expected between physicians' net incomes and the stock of physicians in a geographic area if adjustments are made for skill and amenity differentials. However, a significant relationship should be expected between the stock of physicians and the determinants of (1) total payments to physicians, namely fees and number of visits by patients, and (2) costs of maintaining a medical practice.

Following Rimlinger and Steele (R-S), assume initially that physicians attempt to maximize net incomes (*13*). Although it provides the foundation for the following analysis, the R-S model did not include explicitly the role of physicians' fees and costs in determining area population-physician ratios. The following analysis does include this role explicitly.

After beginning with an identity relationship, we move to an equilibrium condition by imposing the assumption that physicians migrate until net incomes are equalized.

The following notation will be used:

POP_i = population of area i.
P_i = average fee per visit by patient in area i.
V_i = number of visits by patients per capita per year in area i.
MD_i = number of physicians in area i.
Y_i = physicians' average net income in area i.
C_i = average total costs of conducting business in area i.

With capital letters representing national variables, gross expenditures for physicians' services equal gross income to physicians:

$$POP\ (PV) \equiv MD\ (Y+C) \qquad (1)$$

In area i,

$$POP_i\ (P_iV_i) \equiv MD_i\ (Y_i+C_i) \qquad (2)$$

If, for equilibrium, physicians' net incomes are to be equal across space, the following equality must hold:

$$Y_i = \bar{Y} \qquad (3)$$

where $\bar{Y}$ is physicians' average net income in the Nation. This equality implies that the number of physicians which area i can support in equilibrium is:

$$MD_i = \frac{POP_i\ (P_iV_i)}{\bar{Y} + C_i} \qquad (4)$$

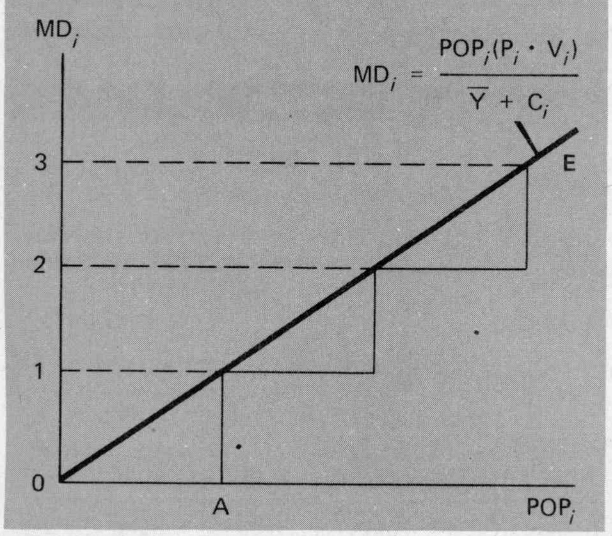
Assume initially that P_i, V_i, and C_i are invariant with location. Because MD_i is restricted to integer values (unless areas share physicians on a part-time basis), the supply of physicians, given by a step function, appears under line OE in the figure. Area i would require a population of OA to support a physician. With less population, area i's supply and demand for physician services would not intersect; physician services would be available only with a subsidy.

A Government insurance program, such as an idealized Medicare-Medicaid program, would have at least two effects on equation (4). First, some cases previously treated on a charity basis would now contribute to physicians' revenues, which increases area i's ability to support a physician. But if the market for physician services were initially in equilibrium, the excess demand would cause prices of services to rise, which would lead to higher average income for physicians. Whether a given area gains or loses physicians in the new equilibrium allocation depends on the amount of the area's Medicare-Medicaid receipts compared with the increase in physicians' average income.

Let M_i represent the area's Medicare-Medicaid receipts, which would depend on the number of Medicare-Medicaid eligibles, their utilization patterns, and the average allowable reimbursement per visit to a

The population-physician ratio in an area relates directly to physicians' average net income in the Nation and expenses of their practices in the area, but the ratio relates inversely to physicians' fees in the area and visits per capita.

FIGURE 1
Equilibrium Number of Physicians



physician. With P_i as price net of Medicare-Medicaid outlays, equation (4) will become:

$$MD_i = \frac{POP_i\,(P_iV_i) + M_i}{\bar{Y} + C_i} \qquad (5)$$

If Medicare-Medicaid expenditures and price net of Medicare-Medicaid outlay were available by region, estimates of the quantitative impact of these programs could be obtained. Data are not available for urban or rural areas; thus, empirical testing of the determinants of physician location must rest on the simpler equation (4):

$$\ln MD_i = \ln POP_i + \ln P_i + \ln V_i - \ln(\bar{Y}+C_i) \qquad (6)$$

or:

$$\ln (POP_i/MD_i) = \ln (\bar{Y}+C_i) - \ln P_i - \ln V_i \qquad (6')$$

The population-physician ratio in an area relates directly to physicians' average net income in the Nation and expenses of their practices in the area but the ratio relates inversely to physicians' fees in the area and visits per capita.[4]

EMPIRICAL RESULTS

Data are available for variables in equations (6) and (6′) for 1974. The values for population-physician ratios range from 414 for the largest SMSAs to 2,438 for the smallest nonmetropolitan counties (table 1). Physicians' mean net incomes and total expenses for practices vary little across counties and SMSAs (table 2). However, their fees and number of visits from patients per week differ considerably (table 2).[5]

The null hypothesis of a negative or zero relationship between the stock of physicians and their fees was tested against the hypothesis of a positive relationship. Cross sectional, single-equation estimates of (1) the stock of physicians equation and (2) the population-physician equation were obtained. Observations were restricted first to SMSAs (tables 3-5)[6] and second to nonmetropolitan counties, aggregated and by State (table 6). The SMSA results are reported separately for all SMSA physicians (table 3), all SMSA specialist physicians (table 4), and all SMSA general-practice physicians (table 5). In all four tables, the first column of results gives estimates from equation 6. The second column reports results when the estimates are for quality of life in the area, the number of graduates of the State's medical schools, and the amount of hospital capital in the area. The final column presents estimates of the impact of physicians' fees on the population-physician ratio (equation 6′).

[4] Population-physician ratios rather than the reciprocal are used because they convey physicians' work load better than the more usual statistic, physicians per 100,000 population. In addition, physicians per 100,000 population is an artificial construct when the area to which the statistic applies has fewer than 100,000 people.

[5] Spatial variation in physicians' fees is discussed in (*3, 2*).

[6] Tables 3 through 6 appear at the end of the article to avoid breaking up the text.

In sum, these results demonstrate that the number of physicians in an area is strongly influenced by the determinants of their net income.

Table 1—Population-physician ratios, by SMSA and county size, 1974

SMSA and county classification	Population		Nonfederal physicians		Population-physician ratio
	No.	*Pct.*	*No.*	*Pct.*	
United States total	211,392	100.0	321,089	100.0	658.4
SMSAs	153,893	72.8	277,553	86.4	554.5
Greater than 5 million	23,466	11.1	56,740	17.7	413.6
1 million to 5 million	62,726	29.7	121,500	37.8	516.3
500,000 to 1 million	27,953	13.2	44,360	13.8	630.1
50,000 to 500,000	39,748	18.8	54,953	17.1	723.3
Other than SMSAs	57,499	27.2	43,536	13.6	1,320.7
Greater than 50,000	4,279	2.0	4,299	1.3	995.3
Potential SMSA*	16,517	7.8	16,925	5.3	975.9
25,000 to 50,000	16,337	7.7	12,240	3.8	1,334.7
10,000 to 25,000	15,504	7.3	8,078	2.5	1,919.3
Under 10,000	4,862	2.3	1,994	.6	2,438.3

*Potential SMSA is a Sales Management term. See Roback, G. *Distribution of Physicians in the U.S., 1973.* Am. Medical Assoc., Chicago, 1974.

Source: Calculation using the Area Resource File, U.S. Dept. Health, Educ., and Welfare.

Equations (6) and (6′) are each based on an identity if (3) holds. We could use physicians' income in the area rather than physicians' average income in the Nation ($\bar{Y}$). With the constant suppressed, the estimated coefficients in column one would then all be "1" except the coefficient $\bar{Y} + C_i$, which would be "–1". Using $\bar{Y}$ rather than Y_i allows incorporating the behavioral assumption that physicians migrate until net incomes are equalized. This approach permits examination of pricing policies as determinants of the number of physicians in an area. The estimated coefficient of P_i in column one is positive and highly significant at the 1-percent level in all four tables. The other three estimated coefficients for the variables POP, V_i, and $\bar{Y} + C_i$ also differ significantly from zero at the 1-percent level, each with the expected sign. In sum, these results demonstrate that the number of physicians in an area is strongly influenced by the determinants of their net income.

In the second column three other variables are added. MDOUTPUT tests the effect of increasing the number of physicians who graduate from medical schools within a State on the supply of physicians to that State. If increasing the number of graduates is an effective policy, a positive coefficient would be expected in the stock of physicians equations (column two). INDEX and the associated dummy variables DSIZE1 and DSIZE2 test the effect of "quality of life" on the supply of physicians. A positive coefficient for INDEX would be expected in the stock of physicians equations. BEDS tests the effect of the stock of hospital equipment, as

If prevailing charge levels are established at higher levels in urban than in rural areas, we can expect availability of physicians' services in rural areas to be affected adversely.

Table 2—Physicians' net income, expenses of practices, visits by patients, 1974

SMSA and county classification	Mean estimated net income	Mean estimated expenses of practices	Mean total visits by patients per week
	Dollars		*Number*
United States	51,224	35,351	125.8
SMSAs			
Greater than 1 million	49,964	33,162	104.8
50,000 to 1 million	53,520	37,522	128.4
Non-SMSAs:	50,380	37,423	166.2

Source: Cantwell, J. R., ed. *Profile of Medical Practice, 1975-76 Edition*, Am. Medical Assoc., 1976, tables 43, 57, and 63.

reflected by the number of beds, on the supply of physicians. A positive coefficient for BEDS would be expected in the stock of physicians equation.

The estimates for MDOUTPUT suggest that increasing the number of physicians graduating from a State's medical schools will not increase the number of physicians serving that State. Indeed the sign of the coefficient in all stock of physicians equations is negatively related with a coefficient which is not significantly different from zero. Similarly, the population-physician ratio is not significantly related to the level of output from medical schools located in the State.

The coefficients for INDEX indicate that physicians are strongly attracted to areas which have a high index on Liu's quality-of-life scale (*10*). This finding holds true for physicians who locate in SMSAs and for those who locate in rural areas. The two size variables, DSIZE1 and DSIZE2, are required, as Liu has separate indexes for small, medium-sized, and large SMSAs. The estimated coefficient for BEDS in the stock of physicians equation is positive in three of the tables (3, 4, and 6) but statistically different from zero only in the first two tables.

Except for the size dummy variables and the BEDS coefficient in table 5, the expected reversal of signs occurs with all variables, when comparing the physician stock equation (6) with the population-physician equation (6′). Note especially the negative and highly significant coefficient of price in all four equations.

CONCLUSIONS

Population size, fees, visits per capita by patients, costs of practices, quality of life in the area, and quantity of hospital capital (measured by the number of beds), all help determine the number of physicians serving the geographic areas studied. Fees have been singled out for special emphasis because of the need to devise reimbursement criteria under Medicare-Medicaid (and NHI in the future) which will not worsen the poor distribution of physicians.

If prevailing charge levels are established at higher levels in urban than in rural areas, we can expect availability of physicians' services in rural areas to be affected adversely. One policy which merits consideration is to actively use the reimbursement system to encourage physicians to locate in areas lacking them. A first step in implementing this policy within the Medicare program would be for the carrier to set limits on prevailing charges which would make them uniform throughout a State.

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Table 3—SMSA physician location equations
(log-log form)

Explanatory variables	*Ln* (MD)	*Ln* (MD)	*Ln* (POPMD)
Ln (POP)	1.0376** (0.0211)	0.7058** (0.0683)	
Ln (P_i)	0.5198** (0.0756)	0.4414** (0.0692)	−0.4286** (0.0722)
Ln (V_i)	0.3879** (0.0429)	0.2736** (0.0420)	−0.3253** (0.0420)
Ln ($\bar{Y} + C_i$)	−0.3682** (0.1018)	−0.2771** (0.0935)	0.3089** (0.0474)
INDEX		0.1874** (0.0455)	−0.2028** (0.0474)
DSIZE1		0.1199 (0.0860)	0.0632 (0.0780)
DSIZE2		0.0779* (0.0510)	0.0082 (0.0491)
Ln (MDOUTPUT)		−0.0062 (0.0052)	0.0063 (0.0055)
Ln (BEDS)		0.3488** (0.0631)	−0.1184** (0.0349)
(CONSTANT)	−9.91	−8.11	9.96
R^2	.95	.96	.56
$\bar{R}^2$	.95	.96	.55
F	F(4,197) = 957.8**	F(9,192) = 534.4**	F(8,193) = 31.3**

*Significant at the 5-percent level (one-tail).
**Significant at the 1-percent level (one-tail).

Numbers in parentheses are standard errors of the parameter estimates.

- MD is the total number of nonfederal, patient care physicians in the SMSA,
- POPMD is POP ÷ MD,
- POP is the SMSA population,
- P_i is the mean price in cents of a followup office visit in the SMSA,
- V_i is mean total visits per capita, in the SMSA,
- $\bar{Y} + C_i$ is 51 plus mean practice expenses (in $1,000) in the SMSA,
- INDEX is the value of the Liu quality-of-life index for the SMSA,
- DSIZE1=1 if the SMSA population is greater than 500,000, 0 otherwise,
- DSIZE2=1 if the SMSA population is greater than 200,000 but less than 500,000, 0 otherwise,
- MDOUTPUT is the total number of surviving graduates of medical schools located in the State, and
- BEDS is the number of hospital beds in the SMSA.

". . . much unclear writing is based on unclear or incomplete thought. It is possible with safety to be technically obscure about something you haven't thought through. It is impossible to be wholly clear on something you do not understand. Clarity thus exposes flaws in the thought. The person who undertakes to make difficult matters clear is infringing on the sovereign right of numerous economists, sociologists, and political scientists to make bad writing the disguise for sloppy, imprecise, or incomplete thought . . .

Table 4—SMSA Specialist location equations
(log-log form)

Explanatory variables	*Ln* (SPEC)	*Ln* (SPEC)	*Ln* (POPSPEC)
Ln (POP)	1.0363** (0.0230)	0.7007** (0.0769)	
Ln (P_i)	0.5696** (0.0823)	0.5075** (0.0770)	−0.4900** (0.0796)
Ln (V_i)	0.4724** (0.0442)	0.3587** (0.0450)	−0.4134** (0.0443)
Ln ($\bar{Y} + C_i$)	−0.4218** (0.1140)	−0.3296** (0.1074)	0.3628** (0.1109)
INDEX		0.1722** (0.0507)	−0.1877** (0.0523)
DSIZE1		0.1246 (0.0960)	0.0608 (0.0863)
DSIZE2		0.0682 (0.0569)	0.0186 (0.0543)
Ln (MDOUTPUT)		−0.0077 (0.0058)	0.0077 (0.0061)
Ln (BEDS)		0.3499** (0.0712)	−0.1138** (0.0387)
(CONSTANT)	−10.24	−8.51	10.35
R^2	.95	.96	.60
$\bar{R}^2$	.94	.95	.58
F	F(4,197) = 860.6**	F(9,192) = 456.0**	F(8,193) = 36.4**

**Significant at the 1-percent level (one-tail)

Numbers in parentheses are standard errors of the parameter estimates.

- SPEC is the total number of nonfederal, patient care specialist physicians in the SMSA,
- POPSPEC is POP ÷ SPEC,
- POP is the SMSA population,
- P_i is the mean price in cents of a followup office visit in the SMSA,
- V_i is mean total visits per capita in the SMSA,
- $\bar{Y} + C_i$ is 54 plus specialist mean practice expenses (in $1,000) in the SMSA.
- INDEX is the value of the Liu quality-of-life index for the SMSA,
- DSIZE1=1 if the SMSA population is greater than 500,000, 0 otherwise,
- DSIZE2=1 if the SMSA population is greater than 200,000 but less than 500,000, 0 otherwise,
- MDOUTPUT is the total number of surviving graduates of medical schools located in the State, and
- BEDS is the number of hospital beds in the SMSA.

". . . In the case of economics there are no important propositions that cannot be stated in plain language. Qualifications and refinements are numerous and of great technical complexity. These are important for separating the good students from the dolts. But in economics the refinements rarely, if ever, modify the essential and practical point."

John Kenneth Galbraith
The Atlantic Magazine
March 1978

Table 5—SMSA general practitioner location equations (log-log form)

Explanatory variables	*Ln* (GP)	*Ln* (GP)	*Ln* (POPGP)
Ln (POP)	1.0100** (0.0174)	1.0672** (0.0584)	
Ln (P_i)	0.1752** (0.0659)	0.1181** (0.0644)	−0.1228** (0.0643)
Ln (V_i)	0.3840** (0.0320)	0.3644** (0.0309)	−0.3651** (0.0309)
Ln ($\bar{Y} + C_i$)	−0.2219** (0.0798)	−0.1936** (0.0774)	0.1917** (0.0774)
INDEX		0.2001** (0.0406)	−0.1946** (0.0404)
DSIZE1		−0.0032 (0.0764)	−0.0399 (0.0666)
DSIZE2		0.0422 (0.0453)	−0.0618* (0.0421)
Ln (MDOUTPUT)		−0.0006 (0.0047)	0.0005 (0.0047)
Ln (BEDS)		−0.0355 (0.0522)	−0.0145 (0.0289)
(CONSTANT)	−8.96	−9.38	8.94
R^2	.96	.96	.49
$\bar{R}^2$	.96	.96	.47
F	F(4,197) = 1,101.7**	F(9,192) = 542.3**	F(8,193) = 23.2**

*Significant at the 5-percent level (one-tail)
**Significant at the 1-percent level (one-tail)

Numbers in parentheses are standard errors of the parameter estimates.

- GP is the total number of nonfederal, patient care general-practice physicians in the SMSA,
- POPGP is POP ÷ GP,
- POP is the SMSA population,
- P_i is the mean price in cents of a followup office visit in the SMSA,
- V_i is mean total visits per capita in the SMSA,
- $\bar{Y} + C_i$ is 44 plus GP mean practice expenses (in $1,000) in the SMSA,
- INDEX is the value of the Liu quality-of-life index for the SMSA,
- DSIZE1=1 if the SMSA population is greater than 500,000, 0 otherwise,
- DSIZE2=1 if the SMSA population is greater than 200,000 but less than 500,000, 0 otherwise,
- MDOUTPUT is the total number of surviving graduates of medical schools located in the State, and
- BEDS is the number of hospital beds in the SMSA.

$$MD_i = \frac{POP_i(P_i \cdot V_i)}{\overline{Y} + C_i}$$

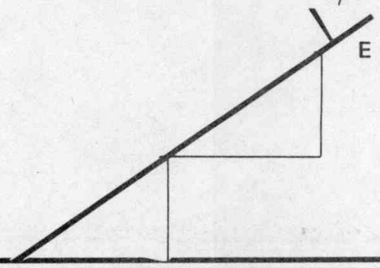

Table 6—Rural physician location equations
(log-log form)

Explanatory variables	*Ln* (MD)	*Ln* (MD)	*Ln* (POPMD)
Ln (POP)	1.1419** (0.0600)	1.0706** (0.0972)	
Ln (P_i)	0.5504** (0.1673)	0.4322** (0.1730)	−0.4554** (0.1691)
Ln (V_i)	0.4608** (0.0869)	0.4843** (0.0919)	−0.4572** (0.0835)
Ln ($\bar{Y} + C_i$)	−0.4216** (0.2077)	−0.4093** (0.2052)	0.3808** (0.2003)
INDEX		0.4383** (0.1760)	−0.2808** (0.1751)
Ln (MDOUTPUT)		−0.0102 (0.0091)	0.0101 (0.0091)
Ln (BEDS)		0.1188 (0.1033)	−0.1790** (0.0624)
(CONSTANT)	−11.8	−10.70	10.50
R^2	.90	.92	.55
$\bar{R}^2$	.89	.91	.49
F	$F(4,45) = 105.2$**	$F(7,42) = 69.4$**	$F(6,43) = 8.8$**

**Significant at the 1-percent level (one-tail)

Numbers in parentheses are standard errors of the parameter estimates.

- MD is the total number of nonfederal, patient care physicians in the county,
- POPMD is POP ÷ MD,
- POP is the county population,
- P_i is the mean price in cents of a followup office visit in the county,
- V_i is mean total visits per capita in the county,
- $\bar{Y} + C_i$ is 51 plus mean practice expenses (in $1,000) in the county.
- INDEX is the value of the Liu quality-of-life index for the State in which the county is located,
- MDOUTPUT is the total number of surviving graduates of medical schools located in the State, and
- BEDS is the number of hospital beds in the county.

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In Earlier Issues

In general, demand curves for farm products that are perishable and that have a single major use can be approximated by single-equation methods. Most livestock products and fresh fruits and vegetables (and, pragmatically, feed grains and hay) fall in this category. Such products contribute more than half of total cash receipts from farm marketings. With other farm products—as wheat, cotton, tobacco, and fruits and vegetables for processing—two or more simultaneous relationships are involved in the determination of free-market prices. The multiple-equation approach of the Cowles Commission may be fruitful in dealing with such commodities. Even in the case of wheat or cotton, however, it is possible to approximate certain elements of the total demand structure by means of single equations.

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