THE REGIONAL DISTRIBUTION OF PHYSICIANS AND SPECIALISTS*

R. M. Scheffler**

University of North Carolina at Chapel Hill

There have been several attempts to analyze the regional distribution of physicians in the United States using the physician population ratio. Some of the criticisms of using the physician population ratio to measure the adequacy of health care available are that it overlooks the organization and utilization of physicians' services and the ability of the population to purchase the services they require, and that it does not attempt to make any adjustment for quality and productivity. Even if we overlook these criticisms this measure still neglects the rapid pace of specialization in medicine.

This paper begins by analyzing the regional distribution of physicians where the total stock of physicians is broken down into medical specialists, surgical specialists, other specialists and general practitioners. (See Table #1) Changes in the regional per capita distribution of the above categories are analyzed for the 1963 and 1969 period. In addition, the relationship between population and income changes as they affect the location of physicians is examined. Furthermore, the regional distribution of hospital and medical school facilities is also considered as a causal factor.

The second part of the paper develops and estimates a multivariate regression model which explains the per capita distribution of physicians. The model uses cross-sectional statewide data to measure the economic demographic and institutional variables such as hospital facilities, medical schools, population, per capita income, and state licensing laws. Policy recommendations are suggested to alter and improve the regional distribution of physicians and specialists.

PART I

Table #1 shows the regional distribution of physicians and specialists using various breakdowns. The total physicians per capita (column #1) indicates that North East and West have a larger number of physicians per capita than the North Central and South. However, it seems to make more sense from the point of view of assessing the amount of health services actually available to consider column #4 - (Non-Federal Physicians Providing Care).

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The distribution pattern is still the same but the changes between the 1963 and 1969 period indicate that the South has had the greatest increase in this category. The rate of increase for the South was approximately 5.3 percent while the North Central has actually experienced an absolute decline. By comparison the North East in 1963 was 37.5 percent above the national average and in 1969 it was only 26.8 percent above it.

The rapid increase in the specialization of medicine is reflected in the fact that the per capita number of general practitioners has declined in every region (column #6, Table #1). This is indicative of the national trend which has been evident for many years.

In 1931 eighty-four percent of all physicians in private practice reported themselves to be general practitioners. In 1960, the corresponding percentage was forty-five, and in 1965, thirty-seven. The percentage is sure to decline further, for all the general practitioners in private practice in 1965, eighteen percent was over sixty-five years of age, a proportion of oldsters much higher than in any other area of practice, and in recent classes of medical school graduates, only some fifteen percent have planned to enter general practice.¹

The national decline and that of the North Central region was 37 percent while the decline was 51.6 in the North East and only 27.2 percent in the West as compared to 29 percent in the South during the period under study. As specialization continues, the regional distribution of various types of medical specialists becomes more important. A regional distribution which treats all physicians as identical units, using the physician population ratio, may suggest inadequate medical care because of the different services that are provided by different kinds of specialists.

We now turn to the regional distribution of medical specialists, surgical specialists, and other specialists. For a detailed breakdown of the type of specialist in each category see the key to Table #1. The South in 1969 had the lowest per capita number of non-federal medical and other specialists, whereas the North Central ranked at the bottom in the category of non-federal surgical specialists (see Table #1, columns #6, #7, and #8). In each of the above categories for every region there has been a significant increase during the 1963 and 1969 period. The largest increase has been for non-federal other specialists which increased over 25 percent for the whole nation and about 30 percent for the South. (Psychiatry, Anesthesiology, Radiology and Pathology compose over 60 percent of this category.)

POPULATION ELASTICITY OF MOBILITY

An increase in the per capita number of physicians or specialists may be the result of any of the following: a decrease in population, an increase in physicians at a faster rate than an increase in population. Table #2 shows the average annual percentage change in physicians divided by the average annual change in the population in each region during the 1963 to 1969 period. This is similar to an elasticity coefficient; however, it is not intended to indicate a causal relationship. Except for general practitioners the aggregate and disaggregate ratio show the number of physicians tends to increase at a faster rate than the population. This confirms alternative three above and is, of course, consistent with the increased physician population ratio we have already discussed.

Table #2 indicates that in the South the number of non-federal physicians providing care increased 2.7 times as fast as the population (column #5). The corresponding figures are 3.1 for the North East, 1.8 for the North Central and 1.7 for the West. The largest increase for the nation as a whole is for non-federal other specialists (column #8) followed by non-federal medical specialists. The South's performance in the non-federal surgical specialists category was excellent; it was about 33 percent above the national figure. In comparison the West had the smallest increase in each category. The North Central region was roughly on par with the national figures in every category. Furthermore, the rate of decline of non-federal general practitioners in relation to the population was the largest in the North East (-3.9) and the smallest for the West (-0.6). (See column #5).

INCOME ELASTICITY OF LOCATION

In this section we will analyze the location response of physicians to changes in per capita income. This is being used as a proxy for the demand for health services although,

"The major determinants of the use of physicians services are income, sex, race, education, place of residence and possession of health insurance. We need not bother with use of services as related to sex in a regional analysis. All the other factors tend to be correlated with income".²

Table #3 shows the percentage change in physician manpower as it relates to the percentage change of per capita income in each region for the period under study.³ Except for general practitioners the average per capita income elasticity of physician's location was positive. The West has the highest elasticity; a one percent increase in per capita income is associated with a .55 percent increase in the per capita number of physicians providing care. The highest coefficient of elasticity is for non-federal other specialists in all regions, then medical specialists are next followed by surgical specialists (columns #6, #7, #8). Only for the other specialists category in the West is the percentage increase greater than the percentage increase in per capita income.

REGIONAL PER CAPITA DISTRIBUTION OF HOSPITAL AND MEDICAL SCHOOL FACILITIES

Although changes in population and per capita income are two of the key variables in explaining the regional distribution of physicians, other factors such as hospital facilities and medical schools should be considered. However, no clear pattern is evidenced in Table #4 between hospital beds and location of physicians except that the total number of hospital beds have declined in every region. The West has the second highest number of physicians per capita while it has the least number of hospital beds per capita and seats in the freshman class of medical school per capita. In comparison the North East has the largest per capita number of hospital beds and seats in medical school as well as the highest number of physicians per capita.

A PHYSICIAN LOCATION MODEL

In this section we will consider a multiple regression model using statewide data to analyze the major factors that determine the per capita distribution of physicians. Cross-sectional statewide observations are used because adequate time series data are not available for the large number of variables which are used. It should be noted at the outset that this model has

the problem of multi-collinearity that is common to most aggregate models of this type; thus the estimates of the parameters may be biased. Furthermore, a single equation model overlooks interactions and feedbacks which are part of the system. There are some obvious interactions between hospital facilities and medical schools, and both these variables are also related to per capita income and urbanization. Therefore, this model must be considered a preliminary attempt which will lead to a rigorous multi-equation system.

Variables x_1 through x_4 have already been discussed in part one of this paper. Variable x_5 is an attempt to measure the effect of state licensing regulations on the movement of physicians. The variable is defined as the failure of the state licensing examination; if it is significant as a barrier, the parameter should have a negative sign. A proxy variable for urbanization (x_6) is used since it has been shown to be an important factor in the location choice of physicians.⁴ However, this variable is difficult to analyze because it also measures some of the effects of variables that have already been included such as per capita income.

An attempt is made to measure the quality of internships and residencies that were offered in each state (x_7, x_8). There is a shortage of doctors available to fill the number of internships and residencies available. Hence a physician is almost certain of receiving many offers which have almost no salary differential. Therefore, the physician will make his decision on other criteria -- one of the more important being the quality of training. It is expected that the higher the percentage filled of internships and residencies the better quality the hospital. The number of internships and residencies offered could not be included because it is highly collinear with hospital beds. Furthermore, an equivalent measure could not be used for medical schools since the shortage of such training insures that all seats will be filled. The omission of the income of physicians is due to data problems as well as one of specification. Many of the variables already included are related to the income of physicians. The specification of the model is as follows: the per capita number of physicians (x_{10}), general practitioners (x_{11}), medical specialists (x_{12}), surgical specialists (x_{13}), interns (x_{14}), and residents (x_{15}), were made a function of variables x_2 through x_8 . Thus:

$$x_i = f(x_2, \dots, x_8)$$

Where:

$$i = 10 \dots 15$$

x_2 = demand for physician services. (This is measured by the per capita income of each state.)

x_3 = production of physicians by medical schools. (This is measured by the number of seats in the freshman class in medical school divided by the population of each state.)

x_4 = measured medical facilities in hospitals. (This is measured by the total number of hospital beds, long and short term, divided by the population of each state.)

x_5 = a barrier to the mobility of physicians. (This is measured by the failure rate of the state licensing examination. The failure rate is defined as the number of physicians who are not granted licenses divided by the total number who take the examination.)

x_6 = urbanization. (This is the percentage of the population living in urban areas as defined by the 1960 census.)

x_7 = quality of internships. (This is measured by the percentage of internships which are filled in each state.)

x_8 = quality of residencies. (This is measured by the percentage of residencies which are filled in each state.)

EMPIRICAL RESULTS

Table #5 presents the results of the multivariate regression analysis which was estimated using cross-sectional statewide observations. The data were pooled for the period from 1963 to 1967 and a single equation was estimated for each of the dependent variables. Estimates were made for the specialty breakdown already discussed, e.g., x_1 , ... x_{12} , and x_{13} , plus two additional dependent variables, the number of interns (x_{14}), and the number of residents (x_{15}) per capita.

The overall fits of the regression are quite good as indicated by the high $\bar{R}^2$ (corrected for degrees of freedom). Variables x_7 and x_8 the quality measures of interns and residents were deleted from the equation because of low "t" values found for these parameters. In analyzing the results, we will only discuss the coefficients which have some particular significance. Furthermore, in order to make comparison between coefficients, elasticities at the mean for each independent variable were computed.⁵ We will now discuss each variable and compare its effect on each dependent variable.

URBANIZATION AND PER CAPITA INCOME

The effect of the income variable (x_2) and the urbanization variable (x_6) could not be separated. The serious problem of multi-collinearity is evidenced by the .78 correlation between those two variables. This produces a statistically unreliable income variable as shown by its low "t" value. However, the urbanization variable was significant and reliable for each health manpower classification.

Residents and interns seem to be affected the strongest by the degree of urbanization, having an elasticity coefficient of 1.49 and 1.67 respectively. They are followed by medical specialists and surgical specialists, but general practitioners have a negative relationship to urbanization. This indicates that they are located for the most part in rural areas and probably have difficulty competing with specialists in urban areas.

MEDICAL SCHOOLS

As would be expected, residents and interns are most concerned about the availability of medical schools as shown by the elasticity coefficients of .43 and .44. Except for general practitioners all coefficients relating to medical schools are significant at the .01 level (each has a "t" value of greater than 2.70). Assuming that these parameters estimates indicate the structural coefficients, we can expect that a 10 percent increase of medical schools per capita will on the average produce a 4.3 and 4.4 percent increase in residencies and internships respectively. Medical specialists and surgical specialists have a smaller elasticity coefficient, and as might be expected general practitioners have a coefficient which is statistically unreliable.

HOSPITAL FACILITIES

The empirical results confirm our prior expectation of a positive relationship between the per capita number of physicians and hospital facilities per capita. The elasticity coefficients indicate that medical and surgical specialists are quite responsive to differences in hospital facilities. The elasticity coefficient for the total stock of physicians indicates that on the average a 10 percent increase of hospital facilities per capita will increase the number of physicians per capita, *ceteris paribus*, by two percent.

LICENSING

The licensing variable which is defined as the failure rate on the licensing examination did not produce reliable results. The negative sign indicates state licensing of physicians may act as a barrier to mobility, however, this has not been statistically verified by our analysis (i.e., the "t" are low). In any event, it seems likely that the variable is not significant in determining the per capita distribution of physicians, specialists, interns, and residents. The pull of the other variables in our model (x_2 , x_3 , x_4 , and x_6) easily outweigh any effect the x_5 variable might have on the physician. Furthermore, as the increased use of reciprocity between states has weakened the effect of licensing regulations. For example in 1967 only 37.1 percent of the total licenses granted were by state examination as compared to 49.7 percent in 1955.

CONCLUSION

We have seen that the specialization in medicine intensifies the problem of region distribution.

The problem has grown more severe, too, because as prestige is accorded the specialist and as specialty practice comes to be defined as the best and most challenging medical practice, perhaps with a higher monetary return, fewer physicians select general practice. Yet, some markets are not large enough to support the specialist -- and certainly not a range of specialist.⁶

According to our analysis the degree of urbanization is the most important factor in determining the location of physicians. The per capita income of the population is also quite significant but it is difficult, because of multicollinearity, to separate its effect from that of urbanization. The total effect has been to create a medical crisis for the poor segment of the population living in rural areas.

The choice of policy variables in our model was limited to three: hospital facilities, medical school facilities, and state licensing regulations. Unfortunately, the licensing variable produced uncertain results and therefore was not helpful as far as policy is concerned. Building new hospitals in various geographic locations will certainly attract more physicians but at a tremendous cost and commitment of resources.

One possible use of the medical school variable would suggest that; additional medical schools be built keeping in mind the empirical relationship between it and the geographic distribution of physicians. However, the process is a slow one: "...the leadtime required to set up a training institution and for this institution's first entering class to qualify for practice may extend from eight to twelve years."⁷

Thus there seems to be a strong justification for regional health manpower planning. Unfortunately, past attempts such as the passage of the Regional Medical Program legislation (1965) and the comprehensive Health Planning legislation (1966), have been unsuccessful. There is in the United States a strong resistance to regionalization in general. Furthermore, physicians will not voluntarily cooperate because they are fearful that regionalization will effect their income and freedom of movement. Thus, regional planning on a voluntary basis seems to be unworkable.

Perhaps the physicians income supplement program proposed by Congressman Nick Galifianakis from North Carolina might be helpful. This bill would provide an income supplement to those physicians who moved and practiced in deprived rural areas. The Congressman's Community Health Act of 1971 was recently incorporated into the comprehensive Health Manpower Training Bill which is presently pending before the full house.

Key To Table #1
BREAKDOWN OF PHYSICIAN MANPOWER (1969)

Total - 247,508

Medical Specialities - 22.9 percent of total

allergy	pediatrics
cardiovascular diseases	pediatric allergy
dermatology	pediatric cardiology
gastroenterology	pulmonary disease
internal medicine	

Surgical Specialties - 29.5 percent of total

general surgery	otolaryngology
neurological surgery	plastic surgery
obstetrics and gynecology	colon and rectal surgery
ophthalmology	thoracic surgery
orthopedic surgery	urology

Other Specialties - 25.6 percent of total

aviation medicine	psychiatry
anesthesiology	pathology
child psychiatry	physical medicine and rehabilitation
diagnostic radiology	general preventive medicine
forensic pathology	public health
neurology	radiology
occupational medicine	therapeutic radiology

General Practitioners - 22.2 percent of total

Source: American Medical Association. Distribution of Physicians, Hospitals, and Hospital Beds in the United States. Chicago: American Medical Association, 1969.

TABLE 1. REGIONAL PHYSICIAN MANPOWER PER 100,000 POPULATION
(1963-1969)

		Total Physicians	Total Non- Federal Physicians	Total Physicians Providing Care	Non-Federal Physicians Providing Care	Non-Federal General Practitioners	Non-Federal Medical Specialists	Non-Federal Surgical Specialists	Non-Federal Other Specialists
		1	2	3	4	5	6	7	8
Total	1963	147	134	131	120	37	25	34	25
	1969	161	146	134	123	27	28	36	31
North	1963	177	170	160	153	41	34	42	36
	1969	197	187	164	156	27	40	44	45
North Central	1963	126	120	114	109	37	21	30	22
	1969	132	124	113	107	27	23	31	27
South	1963	121	107	107	94	31	18	28	17
	1969	136	118	112	99	24	22	32	22
West	1963	166	152	148	135	42	27	37	28
	1969	182	165	153	139	33	30	40	36

Source: American Medical Association. Distribution of Physicians, Hospital, and Hospital Beds in the United States. Chicago: American Medical Association, yearly issues 1963 through 1969.

TABLE 2. POPULATION ELASTICITY OF LOCATION (1963-1969)*

	Total Physicians	Total Non-Federal Physicians	Total Physicians Providing Care	Total Non- Federal Providing Care	Non-Federal General Practitioners	Non-Federal Medical Specialists	Non-Federal Surgical Specialists	Non-Federal Other Specialists
	1	2	3	4	5	6	7	8
Total	2.3	2.1	2.3	2.2	-1.8	3.7	2.8	4.9
North East	3.1	2.8	3.1	3.1	-3.9	5.1	3.8	7.3
North Central	1.7	1.5	2.0	1.8	-2.2	3.8	2.4	4.9
South	2.7	2.5	2.4	2.7	-1.6	4.5	3.7	5.9
West	1.7	1.7	1.8	1.7	-0.6	2.5	2.1	3.4

*This is defined as the average yearly percentage change in each physician category divided by the average yearly percent change in population.

TABLE 3. 1963-1969 INCOME ELASTICITY OF LOCATION*

	Total Physicians	Total Non- Federal	Total Providing Care	Total Non-Federal Providing Care	Non-Federal General Practitioners	Non-Federal Medical Specialists	Non-Federal Surgical Specialists	Non-Federal Other Specialists
Total	.39	.35	.40	.37	-.30	.63	.47	.84
North East	.37	.34	.37	.37	-.45	.60	.44	.85
North Central	.24	.21	.29	.26	-.26	.54	.34	.70
South	.38	.35	.32	.38	-.23	.62	.52	.82
West	.56	.53	.57	.55	-.18	.80	.67	1.08

*This is defined as the average yearly percentage change in each physician category divided by the average yearly percentage change in per capita income.

TABLE 4. HOSPITAL BEDS AND SEATS IN THE FIRST YEAR OF
MEDICAL SCHOOL PER 100,000 OF POPULATION
(1963 AND 1967)

		Total Number of Hospital Beds	Number of Seats in Freshman Class of Medical School
Total	1963	902	4.5
	1967	846	4.7
North East	1963	1141	5.0
	1967	1035	5.3
North Central	1963	908	4.8
	1967	869	5.1
South	1963	781	4.8
	1967	762	5.0
West	1963	760	2.5
	1967	690	2.7

Source: American Medical Association. Distribution of Physicians, Hospitals, and Hospital Beds in the United States. Chicago: American Medical Association, yearly issues 1964 through 1967.

American Medical Association, "Medical Education," Journal of American Medical Association. Volumes 182-206, yearly issues 1963-1967.

TABLE 5. CROSS-SECTIONAL MULTIPLE REGRESSIONS OF POOLED DATA (1963-1967) FOR THE PER CAPITA NUMBER OF SPECIALISTS, INTERNS, AND RESIDENTS: PARAMETER - ("t" VALUE IN PARENTHESES) AND ELASTICITY AT THE MEAN

Health Manpower Classification	Constant	Per Capita Income (x_2)	Medical Schools (x_3)	Hospital Facili- ties (x_4)	License Examin- tion (x_5)	Urbani- zation (x_6)	$\bar{R}^{2*}$
Surgical Specialists	-0.11153	0.00001 (0.19) .09	0.73381 (3.66) .12	0.01336 (2.03) .33	-0.00370 (-0.69) -.17	0.00444 (5.52) .85	.83
Medical Specialists	-0.29272	0.00001 (0.28) .12	0.63625 (2.96) .15	0.01958 (2.77) .69	-0.00017 (-0.30) -.01	0.00488 (5.65) 1.19	.84
General Practitioners	0.18025	0.00010 (0.28) .12	0.17687 (0.99) .02	-0.00241 (-0.41) -.06	-0.00027 (-0.57) -.01	-0.00201 (-2.83) -0.39	.31
Residents	-0.34081	0.0002 (0.54) .33	1.45976 (6.12) .43	0.02437 (3.11) 1.12	-0.00101 (-1.57) -.09	0.00479 (5.01) 1.67	.88
Interns	-0.06501	-0.00001 (0.62) .45	0.52964 (7.82) .44	0.00243 (1.09) .31	-0.00005 (-0.25) -.01	0.00152 (5.16) 1.49	.88

TABLE 5. CROSS-SECTIONAL MULTIPLE REGRESSIONS OF POOLED
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INTERNS, AND RESIDENTS: PARAMETER - ("t" VALUE IN
PARENTHESES) AND ELASTICITY AT THE MEAN
(Continued)

Health Manpower Classification	Constant	Per Capita Income (x_2)	Medical Schools (x_3)	Hospital Facilities (x_4)	License Examin- tion(x_5)	Urbani- zation (x_6)	$\bar{R}^2$ *
	-0.61504	0.00012 (1.16) .26	2.66758 (3.36) .10	0.06859 (2.63) .41	0.00026 (.12) -.00	0.01422 (4.46) .65	.85

* $\bar{R}^2$ are corrected for degrees of freedom.

FOOTNOTES

¹American Medical Association, The Graduate Education of Physicians (The Report of the Citizens Commission on Graduate Medical Education) (Chicago: American Medical Association, 1966), page 34.

²G. V. Rimlinger and H. B. Steele, "An Economic Interpretation of the Spatial Distribution of Physicians in the U.S.," Southern Economic Journal, July 1963, page 8.

³We are assuming that there are no lags involved.

⁴See: Steele, Henry B. and Rimlinger, Gasten V. "Income Opportunities and Physician Location Trends in the United States," Western Economic Journal, Spring 1965.

⁵For example, the elasticity at the mean for the equation $Y = a + bx$ is equal to $b \frac{\bar{Y}}{\bar{X}}$. A logarithmic transformation was not possible because of the negative values of some of the observations.

⁶Fein, Rashi, The Doctor Shortage (An Economic Diagnosis). Washington, D.C., The Brookings Institution, 1967.

⁷Manpower Report of the President, op. cit., page 175.

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