Pakistan Journal of Applied Economics (1982) vol.I, no.2 (223–235).

THE ECONOMICS OF PRIVATE MEDICAL PRACTICE IN KARACHI

Sabihuddin BUTT*

We use data from a survey conducted in Karachi to estimate production functions for private medical services. Separate production functions have been estimated for the services of general practitioners and specialists. Some interesting preliminary results are obtained.

I. Introduction

The economics of health has been drawing increasing attention in developing countries in recent years. Health should be an important part of any basic needs package and poverty alleviation strategy since it is widely asserted that the poor in these countries suffer disproportionately from ill-health and malnutrition. One of the many issues involved in the economics of health is that of physician productivity. The proper planning of manpower and equipment supply issues in health programmes requires information on the technical and economic determinants of physician productivity so as to discover which factors increase (or decrease), and to what extent, the level of provision of medical services.

This study investigates the economics of private medical practice in Pakistan's largest city, Karachi, with a view to providing a preliminary set of estimates of the determinants of urban medical services. It is the first of its kind in Pakistan and, as such, should provide some useful guidelines for health sector programmes in the country.

In Pakistan, knowledge regarding the technology of producing medical services is very limited. It is widely claimed that the nation suffers from a shortage of doctors. Are doctors the only bottleneck in the system? What other inputs go into the production of medical services? Are they complementary to or substitutive of the services of doctors? For example, what is

* The author wishes to express his sincere appreciation to Dr. Farrukh Iqbal, for his intensive editorial help in perparing the final draft of this paper. Thanks are also due to Dr. James C. Knowles and Mr. Hafiz A. Pasha, visiting Research Professor and the Joint Director at AERC, respectively, for their valuable comments on an earlier draft. The author is also grateful to the referees of the journal, who made numerous suggestions and comments that led to improvements in all aspects of this paper. Errors remaining in the paper are still the author's responsibility.

the role of medical aides (compounders, nurses etc)? Do they provide the bulk of actual medical services with doctors only providing overall consultation and advice? Or do doctors themselves provide the possibly wide range of services that are of concern here? How important is the availability of clinic and hospital space? Of medical and surgical equipment? Little is known, finally, about the relationship between physician characteristics (e.g. age, sex, foreign training) and physician productivity.

II. Data

The characteristics of our data limit both the scope of our inquiry and the degree to which our results can be generalised.

One may distinguish broadly between three sources of the provision of medical services in Pakistan: private allopathic practice, private homeopathic and hakim (i.e. traditional) practice, and government hospitals and dispensaries.[1] The present study is based on data pertaining only to private allopathic practice. This means that our results cannot be readily generalised to cover the availability of medical services to the poor and to rural areas. The urban poor obtain medical care largely through government sources and rural residents largely through traditional practitioners. This impression, it must be pointed out, rests on casual empiricism: there is no rigorous study of the access of different groups to different sources of medical services in Pakistan; this is clearly an area that begs for research. The scope of our present inquiry is limited to the provision of medical services in urban areas by private physicians. It is to be hoped that future studies will allow an evaluation of the other two sources of medical services also.

Our data are drawn from a city-wide survey of a random sample of private physicians in Karachi. Since no updated list of such physicians was available, the technique of cluster sampling was used. The city of Karachi was divided into 138 areas of approximately equal population. From these areas a 10% sample of 14 areas was drawn randomly. An attempt was made to enumerate and interview all solo allopathic medical practitioners located in the sample areas. The total number of such doctors in the sample was 369. An attempt was also made to cover clinic (group) practice. Eighteen clinics were randomly drawn from various parts of the city and all the doctors practicing there were to be interviewed. Finally, a mail survey was administered on an experimental basis to 122 physicians.

The overall response rate was as follows. Only 166 solo-practitioners

[1] One study [A. Ahmed (1976)] estimates the distribution of private practitioners as follows: Registered allopathic doctors (10,000); hakims (40,000); registered homeopathic doctors (13,361) and unregistered practitioners (24,000). Clearly, private allopathic doctors account for only a small percentage (11%) of the people providing medical services in Pakistan.

out of the 369 found in the sample clusters replied; only 9 out of 18 clinics cooperated thereby providing another 37 doctors (out of 89) to our sample; only 15 out of 122 doctors responded in the mail survey. This gives us a working sample of 218 respondents.

Our survey sought data on income and expenditure, weekly rates of office, hospital, surgical, home and other visits, fees charged, patient waiting time, the number of hours per week worked by the physician in various professional activities, practice expenses, the number of aides employed (including salaries and hours worked), the market value of medical equipment used by physicians, together with information on the amount of office space utilised, the physicians' behaviour in terms of delegating various functions to aides, and a range of background information on the physicians e.g. age, sex, speciality, experience, training and the characteristics of their practice. Since not all respondents answered every pertinent question the regression analysis report in the following section is based on the 138 doctors for whom all the relevant information was available.

III. The determinants of physician output

The conventional method of analysing output is via a production function. This approach allows a straightforward evaluation of input contribution to output, returns to scale, substitutability among inputs, and efficiency of production. In the case of medical services two kinds of inputs can be distinguished: standard physical inputs such as doctor's time, medical assistants' time, office space, and amount of clinical equipment; and non-standard inputs such as sex of doctor, size of doctor's practice (i.e. solo, small group or large group), training (i.e. foreign or local) and so on. The existence of these different kinds of inputs makes it necessary to modify the specification of the production function somewhat. The standard Cobb-Douglas specification cannot be used because all inputs enter this function multiplicatively. Hence if any input takes the value zero the output level is constrained to be zero. This means that such non-standard variables as the sex of the physician which have to be recorded in binary form (0,1) cannot be included in the analysis. Since such variables may be important it is necessary to modify the specification somewhat.[2] An easy way around

[2] We could, of course, have tried other production function specifications where such a distinction between standard and non-standard inputs might not have been necessary. The Cobb-Douglas form, however, is retained because it is widely used in the health literature and is computationally convenient. Kimbell and Lorant (1974) discourage experimentation with other functions by noting that the transcendental function gives implausible results for group practices and the CES function does not exhibit much sensitivity of the R^2 statistic to variations in the elasticity of substitution. They conclude that "insignificant explanatory power is lost by maintaining that the elasticity of substitution is one." (1974, p.3).

the problem is to entei all standard inputs multiplicatively and all non-standard inputs additively as in the following expression:

$$Q = \alpha . x_i^{\beta_i} \exp (r_j z_j + a) \tag{1}$$

or after taking logarithms, as

$$\log Q = \log\alpha + \beta_i \log x_i + r_j z_j + \mu$$

where Q = output
x_i = vector of standard inputs
z_j = vector of non-standard inputs

and the remaining symbols have standard econometric interpretations as intercept, coefficient vectors and random disturbance.

The actual variables used are defined in Table 1. Most definitions are self-explanatory. However, the definition of output needs further clarification.

According to previous studies [e.g. Reinhardt (1972), Kimbell and Lorant (1974), (1976), (1977)], standard measures of the output of phyician services include total visits, office visits, gross revenue and office revenue. Each measure is subject to criticism and the choice of measures should therefore carefully reflect the problem at hand. The first two measures capture physician activity but do not distinguish between the qualitatively wide range of services provided [Baily (1970)]. Thus total visits refer to the sum of office visits, hospital visits, surgical visits and homecalls. Each one of these could, theoretically, involve a different kind of medical service for which a different fee is possibly charged. Two considerations make this problem less severe in our case. If we distinguish broadly between general practitioners (GPs) and specialists[3] it appears (see Table 2) that 94% of the total visits reported by the former and 97% of those reported by the latter are office visits. Hence quality differences across types of visits should not mar our analysis. Output heterogeneity can be further circumvented by using the revenue measure of output. It would appear from Table 2 that the distinction we need worry about is that between GPs and specialists, rather than that among types of visits.

Output levels appear to vary considerably across physician type. GPs report a greater number of visits (297 versus 168) but lower revenue (Rs.1931 versus Rs.9760) per week as compared to specialists. This reflects the fact that the product provided by each type of physician is very different: the spe-

[3] All doctors who have qualifications in addition to the basic medical degree (M.B.B.S.) are classified as specialists here.

TABLE 1

LIST OF VARIABLES USED

TVISTS	:	Natural logarithm of weekly total visits (the sum of office visits, hospital visits, surgical visits and homecalls).
REVENUE	:	Natural logarithm of weekly gross revenue from all patient visits.
OFFVIS	:	Natural logarithm of weekly office visits (the sum of office visits and homecalls).
OFFREV	:	Natural logarithm of weekly revenue from office visits.

The above four variables are treated as measures of physician output. The following are standard and non-standard input measures.

DOC	:	Natural logarithm of weekly total hours worked by the physician.
AIDS	:	Natural logarithm of weekly total hours worked by non-physician personnel (both medical and non-medical employed by the physician in his private practice).
DISPHRS	:	Natural logarithm of weekly total hours worked by dispensers/compounders employed by the physician in his private practice.
AREA	:	Natural logarithm of the total area (square feet) of office space used by the physician in his private practice.
EQUIPS	:	Natural logarithm of the estimated market value of the physician's medical equipment and furniture in his private practice.
MEDICINE	:	Natural logarithm of the approximate value of non-patent drugs provided by the physicians in his private practice.
GROUP 1	:	Binary variable (one when number of physicians is greater than one but less than or equal to 5, zero otherwise).
GROUP 2	:	Binary variable (one when number of physicians is greater than 5, zero otherwise).
NDOCS	:	Alternative measure for group size in case of specialist's production function, measured in terms of number of full-time physicians in private medical practice.
SEX	:	Binary variable (one for female physician, zero otherwise).
EXP	:	Years of experience in primary speciality.
OUT	:	Binary variable [one if overseas training in primary speciality (excluding India and Bangladesh), zero otherwise].

cialist provides a more expensive form of medical service whose production requires higher quality inputs (e.g. specialist skill) and which commands a higher price. On the basis of this information separate production functions have been estimated for GP's and specialist's services. These are reported in Tables 3 and 4[4]. Means and standard deviations pertaining to the data used for Tables 3 and 4 are reported in the appendix.

TABLE 2

Weekly measure of physician output by physician type

Physician type	Weekly output measures			
	Total visits	Office visits	Total revenue	Office revenue
General practitioners	297 (309)	278 (262)	1931 (2153)	1772 (1792)
Specialists	168 (147)	163 (164)	9760 (7463)	2890 (2868)

Note: Standard deviations in parentheses

According to the results shown in Table 3, the level of GP services is positively and significantly affected by the amount of time put in by the doctor, by the value of the medical equipment at his disposal and by the value of the medicines he dispenses. A 10% increase in each of these inputs increases the number of visits held by the doctor by 3.3%, 1.4% and 3.4% respectively. When office revenue is used as the output measure, the size of practice appears to increase output also. None of the other variables are significant. In particular, sex, experience and foreign training do not seem to matter. The result for experience is a little surprising since one would have expected more experienced doctors to have a larger, more successful practice. The utilisation of medical aides (DISPHRS) appears not to be a good economic strategy for the average GP. While having more assistant labour at his disposal enables him to see more patients, it also appears to reduce his office revenue. However, both effects are statistically insignificant.

[4] All four measures of output were tried in each case. The results were broadly similar to the ones actually reported here. We have presented results for the two output variables in each case which produced higher R^2

The results in Table 4 taken by themselves as well as in comparison with Table 3 offer some rather interesting information.

Apparently, specialists can increase their output a great deal by increasing the amount of their own time. A 10% increase in own time raises the number of cases handled by 7.8% and office revenue generated by 9.6%,

TABLE 3

Estimates of Cobb-Douglas coefficients for two measures of output for general practitioners (t ratios in parentheses)

ESTIMATE	OFFVIS	OFFREV
DOC	0.332	0.3270
	(1.860)*	(1.582)*
AREA	0.074	−0.0005
	(0.700)	(0.000)
EQUIPS	0.143	0.2090
	(1.520)*	(1.926)**
DISPHRS[a]	0.050	−0.0030
	(1.078)	(0.050)
MEDICINE[b]	0.345	0.3990
	(3.245)**	(3.244)**
GROUP 1	0.077	0.6920
	(0.339)	(2.608)**
GROUP 2	0.226	0.7170
	(0.371)	(1.016)
SEX	0.035	0.0350
	(0.220)	(0.220)
EXP	0.002	−0.0050
	(0.030)	(0.476)
OUT	−0.035	0.0080
	(0.936)	(0.187)
CONSTANT	1.1173	2.9185
R^2	0.358	0.345
$\bar{R}^2$	0.283	0.269
F	4.797**	4.532**
N	97	97

a) Includes only dispensers and compounders

b) Rs. Value/Physician of medicine supplied to the outdoor patients

* Significant at. 05 level

** Significant at .10 level

as compared to 3.3% and 3.2% for GPs. This clearly reflects the higher "wage" commanded by specialists and the relatively higher demand (in relation to supply) for their services.

Specialists also appear to be constrained by office space. More office space would allow them to handle more cases (a 10% increase in AREA allows a 2.15% increase in TVISITS) but would not add to office revenue. The same is true of medical aides. Medical assistants increase patient-handling ability and do not appear to affect revenue. This is also what was found to be true for GPs.

The value of equipment employed adds to revenue but, unlike the case for GPs, reduces the number of visits handled by the average specialist. This result, if taken at face value, suggests that there might be a quantity-quality trade-off. Specialists employing more expensive equipment can be thought of as providing higher quality services but to fewer people. This is a matter that needs to be explored further since the quantity-quality tradeoff that is hinted at may, in fact, involve considerable social costs.

The value of medicines provided increases both measures of output. A 10% increase in this variable increases visits by 2.6% and revenue by 3.6%. These results are similar to those encountered earlier for GPs. Apparently, patients are attracted to doctors who not only dispense advice but also prescribe and sell medicines. While this effect is not surprising in the case of GPs it is somewhat surprising in the case of specialists whose main function is thought to involve consultation and/or surgery rather than the dispensing of medicines. The attraction in this for doctors is quite obvious. Selling medicines brings both customers and cash.

Another surprising result is the insignificance of the variable measuring experience. Casual empiricism has it that the older and more experienced the specialist the larger his practice. Our results indicate the opposite may be true since the sign on the experience variable is negative although insignificant. There is one possible explanation for this counter intitutive result: younger, recently graduated specialists may be perceived to have greater familiarity with advanced techniques in their fields, a perception which may negate the premium otherwise to be placed on age. The rapid pace of innovation in sophisticated surgical techniques suggests that such an explanation is not implausible. Furthermore, it tends to be supported by the positive (though insignificant) experience-output relationship found for GPs, a category for whom knowledge of the latest techniques is not as necessary and in whose area relatively few innovations have been made.

The effect of size of practice is measured in the case of specialists by the variable NDOCS, which is simply a headcount of the number of doctors associated with the respondent in his group practice. While size of practice enhances the patient handling capacity of GPs it appears to reduce that of specialists. At the same time it appears to increase office revenue for specialists. A uniformly positive effect could have been explained on the basis of economies of scale; the negative effect on visits handled does not fit with such an explanation.

Foreign experience is positively and significantly associated with both measures of specialist's output. Foreign trained specialists handle more patients and earn more revenue than their locally trained counterparts. There is clearly evidence of a premium on foreign training for specialists although none for GPs.

TABLE 4

Estimates of Cobb-Douglas coefficients for two measures of output for specialists
(t ratios in parentheses)

ESTIMATES	TVISTS	REVENUE
DOC	0.785	0.959
	(3.500)*	(2.593)*
AREA	0.215	−0.138
	(1.911)**	(0.748)
EQUIPS	−0.188	0.348
	(2.099)*	(2.348)*
AIDS[a]	0.291	−0.133
	(2.185)*	(0.606)
MEDICINE[b]	0.217	0.363
	(2.473)*	(2.509)*
NDOCS	−0.0217	0.054
	(1.647)**	(2.482)*
SEX	0.169	−0.199
	(0.655)	(0.466)
EXP	−0.014	−0.007
	(1.475)	(0.439)
OUT	0.059	0.068
	(2.980)*	(2.042)
CONSTANT	−0.0288	1.931
R^2	0.714	0.651
$\bar{R}^2$	0.631	0.549
F	8.602	6.415
N	41	41

a – Includes all kinds of non-physician personnel
b – Rs. value/physician of non-patient drugs supplied to outdoor patients
* – Significant at 0.05 level.
**– Significant at 0.10 level.

What is the scope for substitution in the provision of medical services? Can medical assistants such as dispensers, compounders and nurses substitute for a large fraction of doctors' time? This is an important question and it would be useful to obtain relevant estimates. Our results, however, offer only partial and tentative answers to these questions.

Table 3 suggests that dispenser's and compounder's time (DISPHRS) could substitute for GP's time – the coefficient on DISPHRS while insignificant, is positive. For specialists, Table 4 confirms that medical aides (including nurses now) can substitute for the doctor's time – the coefficient on AIDS is both positive and significant.[5] In this case a 10% increase in time provided by aides results in a 2.9% increase in number of visits handled. Thus a 30% increase in aides time would be required to compensate for a 10% decrease in specialist's own time.

TABLE 5

Average percent of physicians delegating tasks to a typical non-physician in private practice

Types of tasks	Physician(%)	Dispenser/ Compounder (%)	Nurse (%)	Other type of N.P.P.(%)	Total
Bandaging	30.0	56.3	13.7	1.00	100
Skin prepration for minor surgery	83.4	9.8	6.1	0.70	100
Immunizations	82.8	13.5	3.1	0.60	100
Cast application or removal	93.3	4.3	1.8	0.60	100
Instructions to patients	66.7	27.7	5.0	0.60	100
Minor sutures	88.8	9.3	1.9	0.80	100
Taking temperatures	63.7	25.0	10.0	1.30	100
Reading pulses	79.9	11.9	8.2	0.00	100
Taking blood pressure	85.7	6.2	8.1	0.00	100

[5] The reason DISPHRS is used in the regression for GPs, rather than AIDS, as a measure of the amount of assistance provided by aides is because GPs employ mostly dispensers and compounders and not nurses. Nurses are important in assisting specialists and their contribution is included in AIDS.

These results are too aggregative in nature to allow an assessment of the tasks in which health manpower substitution is possible. An attempt is made below to provide more information on the delegation of tasks by doctors. Table 5 presents the relevant data. The following pattern seems to emerge.

By and large a small percentage of most tasks is delegated to medical assistants. Bandaging appears to be the only task in which such personnel appear to be heavily used; the taking of temperatures and the issuing of instructions to patients (i.e. explaining the prescription) are tasks in which such personnel appear to be used moderately. Nurses are not heavily used. This is partly because GPs form a substantial part of our sample and they typically do not employ nurses.

On the basis of the foregoing it seems reasonable to conclude that the scope for health-manpower substitution, while present, appears to be small. It is important to emphasize the tentativeness of these results. They should be viewed as preliminary indicators of possibilities rather than as definitive estimates of effects. Such a conclusion, in fact, is appropriate for the study as a whole.

Applied Economics Research Centre
University of Karachi.

Appendix

TABLE A-1

Mean and standard deviation of variables used in general practitioner's production functions

ESTIMATE	MEAN[a]	STANDARD DEVIATION	MEAN[b]	STANDARD DEVIATION
OFFVIS	290.784	269.116	5.334	0.865
OFFREV	1844.340	1763.540	7.089	0.993
DOC	36.371	14.618	3.492	0.498
AREA	441.278	387.172	5.778	0.782
EQUIPS	97.289	211.013	3.886	0.990
DISPHRS	56.093	47.628	3.433	1.981
MEDICINE	339.899	269.397	5.517	0.876
GROUP 1	0.144	0.353	—	—
GROUP 2	0.021	0.143	—	—
SEX	0.155	0.507	—	—
EXP	16.155	9.447	—	—
OUT	0.691	2.417	—	—
CASE NO.	97			

a – Estimated in linear
b – Estimated in logarithm

TABLE A-2

Mean and standard deviation of variables used in specialist's production functions

ESTIMATE	MEAN[a]	STANDARD DEVIATION[a]	MEAN[b]	STANDARD DEVIATION[b]
TVISITS	201.512	210.292	4.874	.938
REVENUE	9418.122	14118.876	8.244	1.400
DOC	39.195	20.704	3.521	.578
AREA	611.707	638.458	5.953	.972
EQUIPS	585.024	730.539	5.664	1.310
DISPHRS	11.590	21.059	—	—
MEDICINE	357.867	455.862	4.915	1.546
AID	94.632	2.954	4.550	1.083
GROUP 1	.122	.331	—	—
GROUP 2	.537	.505	—	—
SEX	.293	.461	—	—
EXP	19.756	11.691	—	—
OUT	4.122	5.797	—	—
CASE NO.	41			

a – Estimated in linear
b – Estimated in logarithm

References

Ahmed, A., 1976, A critical study of health manpower training programme in Pakistan, Armed Forces Medical College, Rawalpindi, Islamabad.

Bailey, Richard N., 1970, Economies of scale in medical practice in : H. E. Klarman (ed.), Empirical studies in health economics, Baltimore: Johns Hopkins University Press.

Kimbell, J., and J. H. Lorant, 1974, Physician productivity and returns to scale, National Centre for Health Services Research and Development, U.S. Department of H.E.W.

Kimbell, J., and J.H. Lorant, 1976, Determinants of output in group and solo practices, Journal of Health Services Research, II no. 1.

Kimbell, J., and J.H. Lorant, 1977, Physician productivity and returns to scale, Journal of Health Services Research, Winter.

Reinhardt, U., 1972, A production function for physicians' services, Review of Economics and Statistics, IV no. 1.

Butt, Sabihuddin, 1981, Economics of private medical practice in Karachi, Discussion paper no. 46, Applied Economics Research Centre, University of Karachi.