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# Appendix A. Time Series: Sources and Methods

*Expenditures:* Data on national expenditures for physicians' services are published periodically by the Social Security Administration in the *Social Security Bulletin* and in *Research and Statistics Note.* See, for example, [11] and [8]. The series used in this paper (Table 1) represents the most recent official revision of these figures [12].

The principal component of this expenditures series is gross business receipts of physicians in private practice (sole proprietorships, partnerships, and corporations) reported to the Internal Revenue Service. Also included are the estimated gross receipts of osteopaths, a share of the gross of medical and dental laboratories (estimated to represent patient payments to them), and estimated expenses of group-practice prepayment plans in providing physicians' services (to the extent that these are not included in physicians' gross self-employment income). Estimated receipts of physicians for making life insurance examinations are deducted from the above. It should be noted that the expenditures series so obtained does not represent the market value of the services of *all* practicing physicians. Excluded are the salaries of public and private hospital staff physicians (considered a component of hospital care); salaries of physicians in public health departments (classed with government public health expenditures); and salaries of physicians in the Armed Forces and Indian Health Service (classed as expenditures for "medical activities in Federal units other than hospitals") [35].

*Public expenditures:* Federal, state, and local payments for the services of private practice physicians. These data are published regularly by the Social Security Administration, along with the data on total expenditures. We have used the most recent revision of these figures [12].

*Customary price:* Average annual level of the index of physicians' fees of the Consumer Price Index [60].

*Average price:* See Appendix B.

*Insurance:* Private health insurance benefit payments for surgical and regular medical expenses (including major medical payments for these purposes). Annual data are published by the Health Insurance Institute [23]. For 1952-60, see [23, 1961 edition, p. 41]; for 1960-68, see [23, 1969 edition, p. 35]. For 1948-51, data published in [23] only apply to commercial insurance companies and Blue Shield–they do not include benefits paid by Blue Cross or by independent hospital-medical plans. We therefore estimate a total for these years by assuming that the ratio of Blue Shield benefits to payments made by all noncommercial insurers was the same in 1948-51 as in the average of the two succeeding years (71.4 per cent in 1952, 71.8 per cent in 1953). This gives us an estimate of benefits paid by noncommercial sources. Adding this to the benefit figure for insurance companies, we have total private insurance benefits for physicians' services for these four years.

*Third-party payments:* The sum of public expenditures and private insurance benefits.

*Net price:* The sum payable by the patient himself for one standard visit. Net price is computed as average price multiplied by the ratio of direct expenditures (total expenditures less third-party payments) to total expenditures.

*Persons insured:* The number of individuals with at least one form of private insurance coverage for physician expenses. This is estimated as the number of persons covered by surgical insurance policies plus 2 per cent of those with regular medical policies plus 2 per cent of those with major medical policies [23]. An explanation of this formula is included in Appendix B, under variable $I_t$.

*Quantity:* Expenditures divided by the average price index.

*Population series:* U.S. civilian resident population, July 1 of each year. Alaska and Hawaii are included beginning 1959. For 1948-58, see [46]; for 1959-67, see [47]; and for 1968, see [45].

*Real disposable personal income:* [14].

*Demographic index–visits:* For 1948, 1956, 1966, and 1968, the percentage of the total population in each of twelve age-sex classes [47: 1949, 1957, 1967, and 1969 editions] was weighted by average per capita physician visits for that class, July 1963-June 1964 [56, Table 7], to arrive at a predicted per capita visit figure for each year.

*Demographic Index–expenditures:* For 1948, 1956, 1966, and 1968, the percentage of the total population in each of twelve age-sex classes was weighted by average per capita expenditures for physicians' services for that class, 1962 [55, Table 1], to arrive at a predicted per capita expenditures figure for each year.

*Real gross national product (GNP):* GNP [14, p. 177] divided by GNP implicit price deflator [14, p. 180].

*Persons engaged (total economy):* For 1948-65, [48, pp. 112-13]; for 1966-68, [50].

*Crude death rate:* A three-year average, centered on the given year, of the number of deaths per 1,000 population. For 1949-67, see [47]; for 1968, see [32].

*Crude death rate, cancer and heart disease:* A three-year moving average. For 1949-67, see [47].

*Average length of stay (days):* For nonfederal, short-term general hospitals and other special hospitals [25, various issues].

*Hospital days:* Product of admissions and average length of stay, for nonfederal, short-term general hospitals and other special hospitals [25, various issues].

*Physicians:* The basic series used in the computation of expenditures per physician and of quantity per physician (Tables 7 and 9) refers to physicians in private practice. Prior to 1959 the figures apply to the forty-eight states and the District of Columbia; beginning with that year the data are for fifty states and the District of Columbia. The sources for this series, as well as for the complete categorization of all U.S. physicians by activity, are [31, p. 3] for 1949, 1955, 1957, and 1959, and [2] for 1963, 1966, and 1967.

*Specialists:* Private practice physicians who are full-time specialists [31], [2]. Prior to 1963 the number of private practice physicians with a part-time specialty was steadily shrinking relative to the number with full-time specialty. Since then the AMA statistics only distinguish "specialists" and general practitioners, with no explanation given as to the current classification of those physicians who formerly would have fallen into the part-time specialist category.

*General practitioners:* [31], [2]. Prior to 1963 the figure includes part-time specialists.

*Per cent partners:* Number of physicians filing partnership returns as a per cent of all physicians filing business income tax returns for medical practice [33, p. 74].

*Visits per physician:* Applies to self-employed physicians under sixty-five years of age. In 1947, the average physician had 25.1 visits per day and worked 6 days a week, 48.75 weeks per year, giving a total of 7,342 visits per year. By 1968, the median number of visits per week had fallen to 131 and the median number of weeks worked to 47.9 (1967), for a total of 6,275 visits per year. [29, issues of February 1948, March 1948, May 1949, April 1, 1968, and December 8, 1969].

*Quantity per visit:* The increase in the quantity of physicians' services per visit which has occurred over time can be decomposed into an increase in quantity attributable to the shift toward specialization—analogous to an increase in quality insofar as specialists are higher-quality physicians—and a residual representing the pure productivity increase for physicians of a given level of training. The quality of the average visit in a given year is computed by determining the per cent of total visits performed by each kind of practitioner, and then weighting specialists' visits according to their higher average receipts, in this case 1.93 (see Appendix C, variable a). Thus

$$QL = \frac{V_g G + aV_s S}{V_g G + V_s S}$$

where QL = quality of the average visit; $V_g$, $V_s$ = visits per G. P., visits per specialist; G, S = number of G. P.'s, number of specialists; a = "quality" of a specialist's visit relative to one by a G. P. (measured by ratio of average gross receipts per visit). In 1947, G. P.'s (67.7 per cent of the total) made 27 visits per day, while specialists made only 22 [29, May 1949]; in 1966, G. P.'s (34.2 per cent of total) were making 154 visits per week, specialists, 91 per week [29, Feb. 6, 1967]. These data cover solo practitioners only. Thus, the average quality of a visit rose from 1.26 to 1.49 over this nineteen-year period (a rate of 0.9 per cent per year) as a result of the shift to specialization.

*Average business expenses per physician:* Average gross business receipts per physician minus average net profit per physician, as reported to the Internal Revenue Service [33, p. 75].

*Expenditures for dental services:* [28].

*Fee index for dental services:* [28].

*Dentists:* [33].

Table A-1

Public Expenditures and Insurance, 1948-68

| Year | Public Expenditures for Physicians' Services (Millions of $) | Private Medical Insurance Benefits (Millions of $) | Persons with Private Medical Insurance Coverage (Millions) |
|---|---|---|---|
| 1948 | $116 | $158 | 34.3 |
| 1949 | 126 | 196 | 41.5 |
| 1950 | 143 | 294 | 54.6 |
| 1951 | 164 | 413 | 65.4 |
| 1952 | 184 | 537 | 73.2 |
| 1953 | 207 | 655 | 81.9 |
| 1954 | 230 | 735 | 86.9 |
| 1955 | 248 | 840 | 90.1 |
| 1956 | 272 | 955 | 99.5 |
| 1957 | 310 | 1,178 | 106.9 |
| 1958 | 348 | 1,315 | 109.4 |
| 1959 | 371 | 1,474 | 114.9 |
| 1960 | 366 | 1,642 | 119.6 |
| 1961 | 407 | 1,878 | 125.5 |
| 1962 | 446 | 2,084 | 129.6 |
| 1963 | 475 | 2,311 | 134.8 |
| 1964 | 511 | 2,577 | 138.5 |
| 1965 | 552 | 2,876 | 143.8 |
| 1966 | 785 | 3,086 | 148.2 |
| 1967 | 1,989 | 3,535 | 154.1 |
| 1968 | 2,638 | 3,761 | 159.6 |

Table A-2

Physicians, by Type of Practice, 1947-68

| Year | Physicians in Private Practice | Specialists in Private Practice | Per Cent in Partnership Practice | Average Business Expenses per Physician |
|---|---|---|---|---|
| 1947 | 148,627[a] | 47,943 | 5.8 | $6,443 |
| 1948 | 149,519[a] | 51,300[a] | | |
| 1949 | 150,417 | 54,891 | | |
| 1950 | | | | |
| 1951 | | | | |
| 1952 | | | | |
| 1953 | | | 9.5 | 8,755 |
| 1954 | | | | |
| 1955 | 152,305 | 67,114 | | |
| 1956 | 153,825[a] | | 14.0[b] | |
| 1957 | 155,827 | 74,384 | 12.1[b] | 11,113 |
| 1958 | | | 15.5[b] | 12,139 |
| 1959 | 160,592 | 78,635 | 12.6 | 12,707 |
| 1960 | 164,847[a] | | 16.8 | 12,768 |
| 1961 | | | 16.0[b] | 13,038 |
| 1962 | | | 15.1 | 13,405 |
| 1963 | 178,295 | 110,204 | 16.3 | 14,379 |
| 1964 | | | 22.4 | 15,794 |
| 1965 | | | 22.2 | 16,480 |
| 1966 | 185,847 | 122,270 | 22.7 | 17,450 |
| 1967 | 188,772 | 126,508 | | |
| 1968 | 191,037[a] | | | |

[a] Interpolated or extrapolated.
[b] Estimated by Louis S. Reed, [33].

# Appendix B. Time Series: Derivation of Average Price

Since we have neither time series data on the average price actually received per visit nor the means to obtain such a series in dollar terms,[1] an indirect approach must be adopted in the construction of an average price index. The method followed here consists of estimating the ratio of *AP* to *CP* in each year and then multiplying this by the known *CP* index to obtain an index of average price.

By definition, $AP_t/CP_t$ equals the ratio of expenditures for physicians services to the total *value* of those services, valuing services at their customary price. By assumption, this ratio is entirely dependent upon the extent of insurance coverage in the population, and must equal 1 if all services are fully reimbursed. Thus

$$\frac{AP_t}{CP_t} = \frac{U_{It} I_t K_t CP_t + U_{Nt} N_t k CP_t}{U_{It} I_t CP_t + U_{Nt} N_t CP_t}$$

$$= \frac{U_t I_t K_t + N_t k}{U_t I_t + N_t} \qquad (1)$$

where $U_{It}$, $U_{Nt}$ = utilization of services per insured, and per uninsured, in year $t$;

$U_t$ = $U_{It}/U_{Nt}$, the utilization ratio;

$I_t, N_t$ = number of insured, and of uninsured, persons in year $t$;

$K_t$ = fraction of *CP* paid by insured persons, year $t$; and

$k$ = fraction of *CP* paid by uninsured persons (assumed constant).

The basic formula for computation of an *AP* index was first proposed by Martin Feldstein [16], and we owe much to his work in this area. However, in the assumptions and methods used to develop the requisite series our approach differs from his in several important respects. In particular:

1. Feldstein assumes $U_t$ to be constant over time, unaffected by the extent to which insured persons are reimbursed for their expenditures. We assume, rather, that the relative utilization of insured persons is directly proportional to the real amount of insurance benefits they receive.

2. Since $U_t$ is derived by comparing actual utilization patterns of insured and uninsured persons (in Feldstein's paper as well as in ours), the appropriate $I_t$ series should be the number of persons with any private insurance coverage for physician expenses. Feldstein, however, employs a weighted average of the number of persons covered under the three different kinds of policies, surgical (S), regular medical (RM), and major medical (MM), using as weights the benefits paid under each kind of policy. Consequently, his measure of $I_t$ is necessarily understated, and the degree of understatement may vary from year to year.

3. Feldstein assumes that insured persons pay the full customary price for all services received, regardless of whether or not a particular service is covered under their insurance policy (i.e., $K_t = 1$, every year). We, on the other hand, assume insured persons to have a payment ratio of 1 only to the extent that the services they purchase are reimbursed; on uninsured services we assume their payments ratio to be less than 1, though greater than that of uninsured persons.

What follows below is a detailed discussion of the manner in which each of the component series of equation (1) is constructed.

$I_t$: Ideally, we would like $I_t$ to be the per cent of the population with any physician expense protection. Unfortunately, the published statistics [23] do not include annual data on the extent of duplication among persons covered under the three kinds of policies. To estimate this duplication, we consider the findings of two nationwide surveys of health services conducted in 1963, one by the Health Information Foundation and National Opinion Research Center [3], the other by the National Health Survey of the U.S. Public Health Service [54]. We know from [3] that 66 per cent of the population has S and/or RM coverage, and from [23] and [3] that 65 per cent had S. Since 55 per cent of the population had RM in that year [54], only about 2 per cent of persons with RM (1/55) were not also covered by S.

[1] Dividing expenditures by the total number of visits, adjusted for variations in the nature of the average visit, is the method used to obtain price in the cross section and theoretically would be equally applicable for the time series as well. Unfortunately, data regarding the total number of physician visits are available for very few years in the period under consideration, and these come from several different sources (some sampling physicians, others sampling patients).

We know further from [3] that 22 per cent of the population had MM coverage, while only 69 per cent of the population had health insurance of any kind, including hospital expense protection. Thus, a maximum of 3 per cent (69-66) of the population had MM as their sole form of physician expense coverage. However, it is most unreasonable to assume the minimum amount of overlap possible between the MM and S-RM categories, particularly since the former is generally regarded as supplementary to other forms of health insurance. Most likely, fewer than ½ per cent of the population, or about 2 per cent of those with MM, had MM but *not* S or RM. Thus, we estimate an annual $I_t$ series by summing the number of persons with S + 2 per cent of the number with RM + 2 per cent of the number with MM.

Government insurance programs should have the same impact on *AP/CP* as private insurance. Prior to the institution of Medicare and Medicaid in 1966, however, public expenditures for physicians' services were relatively small in amount and widely dispersed through the population by a multiplicity of programs; there are no figures on the number of persons affected by one or more of these programs.[2] Since 1966 most public expenditures for physicians' services have been directed towards two well-defined population groups, the elderly and the medically indigent. We have expanded our $I_t$ figure for these years to include the number of persons covered by Medicare Part B (physician insurance) but *not* also covered by private insurance, in keeping with the concept of $I_t$ defined above (persons covered under *any* policy). Annual data on private insurance coverage of the elderly, by type of policy, are from [23]. Statistics on enrollment in Medicare Part B are from [36]; we assume that all elderly persons with private coverage have Medicare as well. Unfortunately, it has not been possible to account for the Medicaid population in a similar fashion because we lack the requisite data on the extent of private insurance coverage among the medically indigent. Only the *net* addition of persons to the insured roll is of concern to us here.

$U_t$: We assume that the extra utilization of insured persons is directly proportional to the level of real benefits received, or

$$U_t = 1 + \frac{n B_t}{CP_t}, \qquad (2)$$

where $B_t$ = average benefits per insured, in dollar terms. This is measured as private insurance benefits for 1948-65, and private insurance plus Medicare Part B benefits [59] for 1966-68.

$n$ = increase in utilization ratio for each dollar of real benefits. The customary price index is the appropriate price deflator for benefits: to the extent services are covered by insurance, they are very likely to be paid for at their full customary price. Data for 1963 are used to determine the constant $n$, since this is the only year for which a direct calculation of $U_t$ can be made; fortunately, the year falls in the second of our three periods of observation rather than at either end.

Utilization is measured not by the total number of visits, but rather by the value of services received.[3] There is much variation in the cost of different types of visits, and it seems reasonable that insurance coverage not only raises the total number of visits but also affects their average quality, shifting demand away from the less expensive outpatient visits to the more costly inpatient visits. Indeed, most policies offer little or no coverage for outpatient care. There would be a downward bias in our estimate of $U_t$ if this fact were not taken into account.

The first step in computing a meaningful measure of relative utilization in 1963 is to distinguish the relevant classes of visits. The total utilization of physicians' services by the average insured (uninsured) person is arrived at by determining the number of visits he makes of each class and then weighting the different visits according to their relative value (i.e., customary fee) and summing over all classes. Of course, it is not necessary to know the absolute number of visits of each kind; it is sufficient to know the distribution of visits by class for one group, say the insured, and the insured/uninsured visit ratio applicable to each class of visit. The formula for determining the overall utilization ratio is thus:

$$U_t = \frac{\Sigma_i S_i R_i}{\Sigma_i S_i / U_{ti} R_i} \qquad (3)$$

where $S_i$ = per cent of insured person's visits of class $i$; $R_i$ = relative cost of a class $i$ visit; and $U_{ti}$ = relative number of class $i$ visits by insured persons versus uninsured persons.

We distinguish 3 classes of visits: outpatient visits ($O$), hospital inpatient visits of a surgical variety ($HS$), and all other hospital inpatient visits ($HM$). The visit ratio for $O$

[2] The programs include Defense Department medical care (including military dependents), maternal and child health services, veterans' hospital medical care, workmen's compensation, public assistance, health insurance for the aged, temporary disability insurance, and medical vocational rehabilitation.

[3] We note that Feldstein chose the former method.

is obtained from the 1963-64 National Health Survey. Data on outpatient visits [56, pp. 13, 29] and surgical insurance status of the sample population [53, p. 3] are given for five income classes ($j$). Regressing per capita visits on the per cent of persons insured,

$$V_j = c + a\,INS_j + u_j, \qquad (4)$$

gives us an estimate of the number of visits per uninsured ($c = 3.939$) and per insured ($c + a = 4.876$), implying a utilization ratio of 1.24 for class $O$ visits. Its low value is not surprising, since surgical insurance policies (as indeed all physician insurance policies) generally do not reimburse expenses incurred for outpatient visits.

The Health Information Foundation-National Opinion Research Center survey reports six surgical procedures per 100 person-years for people with surgical and/or medical insurance, and three procedures per 100 person-years for those without either kind of insurance [3, p. 29]. The utilization ratio for $HS$ is thus 2.0.

Lastly, we assume that the relative utilization of insured persons for $HM$ visits is dependent upon the degree to which they are also covered by regular medical ($RM$) policies.[4] Specifically, those with $RM$ will demonstrate the 2.0 utilization characteristic of surgically insured persons on surgical visits, while those without it will demonstrate the 1.24 rate characteristic of generally uncovered outpatient visits. Approximately 78 per cent of those with $S$ also had $RM$ in 1963,[5] so the visit ratio for $HM$ in that year is estimated as $1.24\,(0.22) + 2.00\,(0.78) = 1.81$.

**Total Charges, Total Visits, and Charge per Visit for Six Classes of Physician Visits, January 1968**

| | Total Charges (Millions) | Total Visits (Thous.) | Average Charge per Visit |
|---|---|---|---|
| All | $203.3 | 20,091 | $10.12 |
| Outpatient | | | |
| 1. Home Visits | 10.8 | 1,141 | 9.47 |
| 2. Office Visits | 62.8 | 7,132 | 8.74 |
| 3. Outpatient Care | 7.4 | 882 | 8.39 |
| 4. Nursing Home Care | 12.3 | 2,696 | 4.56 |
| Hospital Inpatient | | | |
| 5. Surgical Inpatient | 54.4 | 1,498 | 36.32 |
| 6. Other Inpatient | 56.1 | 6,742 | 8.32 |

Source: [58].

[4] Recall that the definition of $I_t$, above, refers essentially to surgical insurance status ($S$).

[5] This assumes everyone with $RM$ also had $S$.

Information regarding the distribution of total visits of insured persons and the customary charge for each class of visit is from [58], based upon a survey of Medicare enrollees with supplementary medical insurance coverage. As it happens, only surgical inpatient visits (7.4 per cent of the total) are priced markedly out of line with other types of visits. Inpatient visits of a nonsurgical nature (34.1 per cent) can therefore be considered together with outpatient visits (58.5 per cent) in our utilization formula, since apparently they do not entail any additional utilization of physicians' services. A weighted average of customary charges for these outpatient and inpatient nonsurgical visits is $7.99, as compared to $36.32 for the surgical inpatient visit; the relative cost of surgical visits is thus 4.55. The utilization ratio applicable to the combined $O$-$HM$ visits is 1.42 (a weighted average of 1.24 and 1.81, the weights being the per cent of total visits in each class), as compared to 2.0 for the costlier surgical visits. The overall utilization rate is therefore computed as

$$U_{1963} = \frac{0.074\,(4.55) + 0.926\,(1)}{(1/2)\,(0.074)\,(4.55) + (1/1.42)\,(0.926)\,(1)} = 1.55 \qquad (5)$$

Insurance benefits per enrollee were $17.14 in 1963, and the customary fee index stood at 114.4, giving a "real" benefit figure of $14.98 in 1957-59 dollars. Substituting into (2), we solve for the constant $n$:

$$n = \frac{U_t - 1}{B_t/CP_t} = \frac{1.55 - 1}{14.98} = 0.037.$$

Each real dollar of insurance benefits raises the utilization of an insured person 3.7 per cent above that of an uninsured person. Since $B_t$ and $CP_t$ are known for all years, (2) can now be used to develop a $U_t$ series:

$$U_t = 1 + 0.037\,\frac{B_t}{CP_t}.$$

$k$ and $K_t$: The payments ratio for uninsured persons ($k$) is assumed to be constant. For insured persons it is allowed to vary with the fraction of their expenditures reimbursed; we assume they pay the full customary price to the extent they are covered, and at a rate ($k^*$) midway between $k$ and 1 on their uninsured expenditures:[6]

$$k^* = (1 + k)/2. \qquad (6)$$

[6] We have, rather arbitrarily, placed $k^*$ midway between $k$ and 1. The reasoning behind this is twofold: (1) Insured persons are concentrated among the middle- and upper-income groups.

(Footnote cont'd on page 50)

$k^*$ is also assumed to be constant. We have not found it possible to directly compute either of these constants from data in published sources, but, as in the case of $n$, we can derive these constants indirectly, using the data for 1963. Since expenditures for each group are equal to utilization multiplied by the payments ratio, we may write

$$U_t = \frac{U_{It}}{U_{Nt}} = \frac{E_{It}/K_t}{E_{Nt}/k}$$

$$= \frac{b_t E_{It} + (1 - b_t) E_{It}/k^*}{E_{Nt}/k} = \frac{k}{K_t} E_t , \qquad (7)$$

where

$E_{It}, E_{Nt}$ = expenditures per insured, uninsured in year $t$;

$b_t$ = fraction of insured person's expenditures reimbursed by insurance (and hence representing services paid for at their full value) in year $t$;

$k$ = payments ratio of uninsured person;

$k^*$ = payments ratio of insured persons on uninsured purchases;

$K_t$ = average payments ratio of insured persons in year $t$;

$E_t$ = $E_{It}/E_{Nt}$ = expenditures ratio in year $t$.

Thus a knowledge of $U_t$, $E_t$, and $b_t$ for any one year will allow us to solve for $k$, using the formula

$$\frac{U_t}{E_t} = k\,[b_t + (1 - b_t)/k^*] = kb_t + \frac{2k\,(1 - b_t)}{1 + k} . \qquad (8)$$

The expenditures ratio for 1963 is derived from the NHS survey in the same fashion as is the outpatient visit utilization ratio.[7] Regressing per capita expenditures [55, pp. 7 and 29] on per cent with surgical insurance [56, p. 3] for five income classes,

$$E_j = c + a\,INS_j + u_j, \qquad (9)$$

we estimate $E_{1963}$ to be $(c + a)/c$, or 2.08.

The value of $b_t$ is readily computed as the ratio of total insurance benefits to total expenditures of insured persons. Benefits in 1963 accounted for 36.0 per cent of private expenditures ($2,311 million/$6,416 million).[8] 72.2 per cent of the population was insured in 1963, and their share of private expenditures was $E_{It}\,I_t/(E_{It}\,I_t + E_{Nt}\,N_t)$.

$$\frac{E_{It}I_t}{E_{Nt}N_t} = 2.08 \cdot \frac{72.2\%}{27.8\%} = \frac{150.2\%}{27.8\%} \qquad (10)$$

$$\frac{E_{It}I_t}{E_{It}I_t + E_{Nt}N_t} = \frac{150.2\%}{177.8\%} = 84.4\% \qquad (11)$$

$$b_t = \frac{\text{total benefits}}{E_{It}I_t} = \frac{36.0\%}{84.4\%} = 42.7\% \text{ in } 1963 \qquad (12)$$

For other years, the expenditures ratio ($E_t = E_{It}/E_{Nt}$) which figures in (10) is unknown and so $b_t$ must be computed in a different fashion. We know that total expenditures equals expenditures of insured persons plus expenditures of uninsured persons:

$$EXPS_t = E_{It}I_t + E_{Nt}\,N_t. \qquad (13)$$

$E_{It}$ equals the value of services received by the average insured person times the payments ratio $K_t$; an equivalent formulation is benefits (the value of insured services) per insured plus the value of uncompensated services multiplied by their payments ratio $k^*$:

$$E_{It} = K_t\,U_{It} = K_t\,U_t\,U_{Nt} = \frac{K_t\,U_t\,E_{Nt}}{k}$$

$$= B_t + k^*\left[\frac{U_t\,E_{Nt}}{k} - B_t\right] . \qquad (14)$$

(Footnote cont'd from page 49)

Relative income of a patient is probably as important as insurance status in determining the size of the price discount he will be granted and the extent to which he pays his bills. (2) When the physician is aware that his patient possesses insurance, he will probably be less inclined to grant price discounts even though he realizes that insurance coverage is rarely comprehensive. Since the insured party need not pay at all for one portion of the services received, the physician may insist that he pay relatively more than uninsured persons for nonreimbursed services, though not necessarily that he pay for their full value.

[7] The survey questionnaire defines expenditures as all doctor's bills paid (or to be paid) by the person himself (or his family or friends) and any part paid by insurance, whether paid directly to the doctor or to the person himself.

[8] Only private expenditures should be considered in this context because $E_t$ is derived from data on private expenditures.

Substituting (14) into (13) and solving, we have

$$E_{Nt} = \frac{EXPS_t - I_t B_t (1 - k^*)}{N_t + I_t (k^*/k) U_t} \quad (15)$$

and

$$E_{It} = \frac{EXPS_t - E_{Nt} N_t}{I_t}. \quad (16)$$

We then solve (12) for $b_t$ in years other than 1963 by using dollar figures for benefits and for expenditures of the insured from (16) rather than by using percentages, as in (10) through (12). The appropriate expenditures concept for this purpose is private expenditures (direct consumer expenditures plus private insurance benefits) plus Medicare benefits.

Substituting the 1963 value for $b_t$ into (8), we have $\frac{1.55}{2.08} = 0.427\,k + \frac{1.146\,k}{1+k}$. Solving, we have the payments ratio of uninsured persons: $k = 0.67$. Substituting into (6) and (7), we have a formula for computing the annual payments ratio of insured persons,

$$k^* = 0.835$$

$$K_t = \frac{1}{b_t + (1 = b_t)/k^*} = \frac{0.835}{1 - 0.165\,b_t}$$

Having solved for all constants, we proceed as follows to derive the average price series:

1. $B_t$ = Benefits per insured (total benefits$_t \div I_t$);

2. $U_t = 1 + 0.037 \frac{B_t}{CP_t}$;

3. $E_{Nt} = \frac{EXPS_t - \text{total benefits}_t\,(1 - 0.835)}{N_t + I_t \frac{0.835}{0.67} U_t}$;

4. $E_{it} = \frac{EXPS_t - N_t E_{Nt}}{I_t}$;

5. $b_t = \frac{B_t}{E_{it}}$;

6. $K_t = \frac{0.835}{1 - 0.165\,b_t}$;

7. $AP_t = \frac{U_t I_t K_t + N_t (0.67)}{U_t I_t + N_t} . CP_t$.

# Appendix C. Cross Section: Sources and Methods

EXP:

1966 gross annual business receipts of physicians in self-employment practice [61, pp. 55-73; 142-56]. This material was originally published in [33, pp. 96-98]. We have restricted our sample to the thirty-three states for which data are available on both sole proprietorships and partnerships. Excluded from the sample are Alaska, Delaware, District of Columbia, Hawaii, Idaho, Maine, Massachusetts, Montana, Nevada, New Hampshire, New Mexico, North Dakota, Rhode Island, South Dakota, Utah, Vermont, West Virginia, and Wyoming.

Q:

Number of general practitioner (G. P.) outpatient visits or their equivalent.

AP:

Average price of a G. P. outpatient visit equivalent. Q and AP are implicitly defined by the identity

$$EXP \equiv Q \cdot AP. \tag{1}$$

We estimate Q for each state directly, employing our knowledge of outpatient visits, inpatient visits, and the extent of physician specialization, and then obtain AP from (1).

Total outpatient visit equivalents are equivalent to the sum of such visits by G. P.'s and such visits by specialists.

$$V = V_g G + V_s S = V_g (G + bS), \tag{2}$$

and total expenditures can similarly be decomposed into expenditures for G. P.'s and expenditures for specialists,

$$EXP = P_g V_g G + P_s V_s S = P_g V_g (G + abS), \tag{3}$$

where $P_g$, $P_s$ = average price per G. P., specialist outpatient visit equivalent; $V_g$, $V_s$ = number of outpatient visit equivalents per G.P., specialist; G, S = number of G.P.'s, specialists; $P_s/P_g = a$, $V_s/V_g = b$. $P_g$ is equivalent to AP, and thus:

$$Q = V_g (G + abS). \tag{4}$$

The number of outpatient visit equivalents, V, is defined by

$$V = O + wH, \tag{5}$$

where O = home and office visits; H = hospital inpatient visits; and w = outpatient visit equivalents per inpatient visit.

After appropriate substitutions, we have

$$Q = \frac{(O + wH)(G + abS)}{G + bS} \tag{6}$$

and

$$AP = EXP/Q. \tag{7}$$

According to (6), the quantity of physicians' services in a state equals the number of outpatient visit equivalents multiplied by a factor indicating the number of G. P. equivalent visits in the average physician visit. Sources for the right-hand side terms in (6) are described below.

O:

The National Center for Health Statistics provides data on number of home and office visits per capita for the four census regions in 1966-67 [57] and for the nine divisions in 1957-59 [52]. Home and office visits together accounted for 75 per cent of the total physician visits reported in the 1966-67 National Health Survey. We exclude visits in hospital outpatient clinics and emergency rooms (10 per cent) because these are performed by hospital physicians, not private practitioners. Also excluded are telephone visits (10 per cent), which are generally free of charge and represent much less utilization than in-person visits. The additional 5 per cent of visits occurred in company and industry health units, other places, or sites unknown.

We assume an intraregion distribution of per capita visits in 1966-67 comparable to the distribution that prevailed in the earlier period:

$$\text{1957-59: } O_1^* = O_{1a}^* W_{1a} + O_{1b}^* W_{1b} + \ldots. \tag{8}$$

$$\text{1966-67: } O_2^* = \frac{(O_{1a}^*)}{O_1^*} O_2^* W_{2a} + \frac{(O_{1b}^*)}{O_1^*} O_2^* W_{2b} + \ldots, \tag{9}$$

where

$O^*_{i(j)}$ = per capita home and office visits for this region at time i (in division j).

$W_{ij}$ = per cent of region's population residing in division j at time i.

In this way we can estimate 1966-67 per capita home and office visits for each of the divisions in a region by the term $(O^*_{1j})$. $(O^*_2)/O^*_1$. We then impute the same figure to each state in the division.

H:

We assume one hospital visit by a private practice physician for each day of stay in a nonfederal, short-term hospital. 1966 days of stay, the product of admissions and average length of stay, are known for each state [25, Aug. 1, 1967]. Our assumption is supported by survey data which indicate that the median number of hospital visits by self-employed physicians was 22 per week in 1966, and that the median number of weeks worked per year was 48 (in 1968) [30]. If physicians in these thirty-three states conformed to the national medians, they would have made 177 million hospital visits; in fact, the number of patient days in these states was quite close to this—185 million.

w:

The 1968 national ratio of average charge for a hospital inpatient visit relative to a home or office visit, or 1.71. Data apply to the Medicare population [58].

G, S:

Applies to physicians in private practice in 1966 [2, 1967].

a:

National ratio of specialists' average gross receipts per visit (AGR) to those of general practitioners. We assume that this ratio is the same for total visits (to which the data apply) as for outpatient visit equivalents. The AGR for G. P.'s was $5.48, computed from survey data for solo practitioners on 1966 median annual gross income from self-employment practice and number of annual visits (median weeks per year times median visits per week). Computation was made for each kind of practitioner, with G. P.'s and selected kinds of specialists together accounting for 80 per cent of self-employed solo physicians. A weighted average for the specialists was $10.55. Thus, a = 1.93, assumed constant for all states [30].

b:

1966 median number of weekly visits per specialist (a weighted average of all kinds of specialists) relative to median number of weekly visits per G. P., or 0.625, assumed constant for all states [30]. Again, we assume this ratio to be the same for total visits (to which the data apply) as for outpatient visit equivalents.

MD:

Number of nonfederal physicians active in "solo, partnership, group, and other practice." MD = G + S. The series excludes nonfederal physicians primarily engaged in teaching, research, industry, public health, or hospital-based practice.

BEN:

1966 private insurance benefits for physicians' services. Because data are not published on the type of health insurance benefits paid in each state, we estimate BEN from data on total health insurance benefit payments for a state (this includes hospital expense and disability income payments as well as physician expense) and on the number of state residents protected by the various kinds of policies (published only for hospital, surgical, and regular medical policies).

We assume first that hospital expense and physician expense benefits together constituted 89 per cent of the benefit total, since this is the ratio that prevailed nationally in that year. Then we separate out the physician expense benefits by assuming that the national ratio of hospital benefits per hospital insured to physician benefits per surgically insured (1.76) prevailed in each state. The data are from [23, 1967 and 1968]. Thus,

(1) $HIB = HOS + BEN + DI$;

(2) $0.89\ HIB \approx HOS + BEN$;

(3) $BEN + HOS = bB + hH \approx b\,(B + 1.76H)$;

(4) $$BEN = bB \approx \frac{.89\ HIB\ (B)}{B + 1.76H},$$

where HIB = total health insurance benefits, 1966; HOS, BEN, DI = hospital expense, physician expense, and disability income benefit payments, 1966; h, b = hospital, physician benefits per person with hospital, physician expense protection; H, B = number of persons with hospital, physician expense protection. B, the number of persons with *any* physician insurance (surgical, regular

medical, or major medical), is not precisely known, owing to an undetermined number of policyholders with two or more forms of coverage. The number of surgically insured persons serves as a very good proxy for B (see Appendix B). H and B are only available for the population under age sixty-five, but this should not bias the results, since only their ratio is of consequence.

PRM/BEN:

Ratio of all health insurance premiums to all health insurance benefits [23, 1968].

INC*:

1966 per capita disposable personal income [49, p. 29].

MED SCLS:

1966 [1, Nov. 21, 1966].

BEDS:

Beds in nonfederal, short-term general and other special hospitals, as of Mar. 1, 1967 [2]; from statistics collected by American Hospital Association.

UNION:

1966 labor union members [47, 1969, p. 236].

POPULATION:

July 1, 1966 civilian resident population [44].

*The following variables also appeared in the preliminary large-scale version of our model:*

DTH RT:

Average of 1965, 1966, and 1967 death rate per 1,000 residents [47, 1968, p. 56 and 1969, p. 56].

ΔINC*:

1966 INC* minus 1960 INC* [49, p. 29].

INF MRT:

1966. Deaths of infants under one year old, exclusive of fetal deaths, per 1,000 live births. A weighted average of published series for white and nonwhite births [47, 1968].

EDUC:

Median years of school completed by persons twenty-five years old and over [43, pp. 1-20, Table 12].

%URB:

1960. Per cent of total population classified as urban [43, p. xvi].

AGED:

Persons sixty-five years and over, July 1, 1966 [44], as per cent of population.

BRTH RT:

1966 live births, white plus nonwhite, per 1,000 persons [47, 1968, p. 55].

%BLK:

1960 [47, 1969, p. 27].

S&L GOV:

Fiscal 1967 state and local government expenditures for hospitals and "other health" [42, Table 18 of each state volume].

TEMP:

[47, 1969, p. 174] lists one average annual figure for all but fourteen states in our sample (California, Florida, Illinois, Michigan, Missouri, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Texas, Virginia, Washington). For these states, characterized by greater geographic variation in temperature and more widely dispersed populations, temperatures are given for two or three major cities. We have used a weighted average of the city figures (with the cities' populations as weights) as the basis for our TEMP variable in these cases.

%SPEC:

Specialists active in nonfederal, "solo, partnership, group, and other practice," as a per cent of MD [2, 1967].

HOSP MD:

Nonfederal, hospital-based physicians in 1966 [2, 1967].

%PART:

Number of physicians filing partnership business income tax returns for medical practice in 1966 as a per cent of total number of physicians so filing (sole proprietors plus partners) [61 or 33].

MD ORIG:

The sum of the number of first-year medical students originating from a state in each of six selected years (chosen so as to constitute a fairly representative sample of the 1966 physician stock). In the published data, state of origin is variously denoted as "birthplace" (1936, 1941), "residence" (1947, 1953, 1957), and "geographic source" (1961). The data for 1936 and 1941 apply to all medical students and hence describe the state of origin of entering students in the years 1933-36 and 1938-41, respectively; so as not to give undue weight to these years, only one-fourth of this figure enters the computation of MD ORIG [1, various issues].

Table C-1

Expenditures, Insurance, and Price, 1966

| State | Total Expenditures (Thousands) | Physician Insurance Benefits per Capita (BEN*) | Per Cent of Persons with Surgical Insurance | Average Price (AP) | Net Price (NP) |
|---|---|---|---|---|---|
| Alabama | $110,519 | $10.70 | 64.0 | $4.96 | $3.28 |
| Arizona | 83,252 | 12.40 | 47.4 | 7.22 | 5.52 |
| Arkansas | 57,612 | 8.25 | 45.9 | 4.84 | 3.49 |
| California | 1,265,801 | 17.20 | 67.7 | 8.31 | 6.23 |
| Colorado | 118,863 | 19.00 | 69.5 | 7.52 | 5.22 |
| Connecticut | 146,044 | 19.80 | 77.4 | 7.54 | 4.62 |
| Florida | 238,515 | 11.40 | 62.3 | 5.19 | 3.76 |
| Georgia | 148,515 | 11.10 | 74.5 | 4.87 | 3.29 |
| Illinois | 497,902 | 18.50 | 78.0 | 5.96 | 3.59 |
| Indiana | 200,540 | 17.30 | 75.8 | 5.86 | 3.37 |
| Iowa | 91,801 | 14.30 | 71.7 | 4.53 | 2.58 |
| Kansas | 98,479 | 13.10 | 59.9 | 5.78 | 4.05 |
| Kentucky | 118,176 | 10.10 | 57.0 | 5.94 | 4.35 |
| Louisiana | 158,431 | 8.86 | 49.5 | 6.06 | 4.85 |
| Maryland | 158,908 | 12.60 | 54.7 | 6.00 | 4.33 |
| Michigan | 340,574 | 24.10 | 79.6 | 5.23 | 2.11 |
| Minnesota | 125,355 | 16.00 | 71.3 | 4.22 | 2.31 |

(continued)

Table C-1 (concluded)

| State | Total Expenditures (Thousands) | Physician Insurance Benefits per Capita (BEN*) | Per Cent of Persons with Surgical Insurance | Average Price (AP) | Net Price (NP) |
|---|---|---|---|---|---|
| Mississippi | $65,498 | $8.17 | 47.1 | $5.03 | $3.58 |
| Missouri | 171,546 | 15.50 | 69.4 | 4.62 | 2.73 |
| Nebraska | 61,456 | 12.40 | 67.8 | 5.83 | 4.14 |
| New Jersey | 317,426 | 16.60 | 66.6 | 5.85 | 3.76 |
| New York | 895,435 | 22.30 | 86.2 | 5.55 | 3.04 |
| North Carolina | 161,411 | 9.72 | 68.6 | 4.54 | 3.21 |
| Ohio | 477,388 | 18.80 | 78.9 | 6.15 | 3.64 |
| Oklahoma | 85,159 | 11.30 | 69.4 | 5.11 | 3.46 |
| Oregon | 125,217 | 12.80 | 61.1 | 7.89 | 6.31 |
| Pennsylvania | 427,291 | 17.50 | 76.9 | 4.35 | 2.29 |
| South Carolina | 66,278 | 8.70 | 67.7 | 3.92 | 2.63 |
| Tennessee | 134,408 | 12.90 | 68.3 | 4.97 | 3.14 |
| Texas | 423,597 | 12.70 | 61.5 | 5.70 | 3.91 |
| Virginia | 160,820 | 12.00 | 56.4 | 5.15 | 3.50 |
| Washington | 138,211 | 16.20 | 71.5 | 6.00 | 3.90 |
| Wisconsin | 163,130 | 18.00 | 77.5 | 4.99 | 2.70 |

Table C-2

Physicians by Type of Practice, 1966

| State | Physicians in Private Practice | Specialists in Private Practice |
|---|---|---|
| Alabama | 2,190 | 1,321 |
| Arizona | 1,491 | 1,000 |
| Arkansas | 1,310 | 621 |
| California | 24,465 | 16,895 |

(continued)

Table C-2 (concluded)

| State | Physicians in Private Practice | Specialists in Private Practice |
|---|---|---|
| Colorado | 2,207 | 1,558 |
| Connecticut | 3,412 | 2,571 |
| Florida | 5,353 | 3,910 |
| Georgia | 3,084 | 2,048 |
| Illinois | 9,979 | 6,164 |
| Indiana | 3,896 | 2,122 |
| Iowa | 2,093 | 1,023 |
| Kansas | 1,729 | 952 |
| Kentucky | 2,237 | 1,279 |
| Louisiana | 2,804 | 1,904 |
| Maryland | 3,211 | 2,279 |
| Michigan | 6,603 | 4,469 |
| Minnesota | 3,342 | 2,044 |
| Mississippi | 1,385 | 702 |
| Missouri | 3,577 | 2,446 |
| Nebraska | 1,246 | 649 |
| New Jersey | 6,905 | 4,730 |
| New York | 24,292 | 17,347 |
| North Carolina | 3,450 | 2,225 |
| Ohio | 9,135 | 5,865 |
| Oklahoma | 1,873 | 1,101 |
| Oregon | 2,002 | 1,320 |
| Pennsylvania | 11,249 | 7,052 |
| South Carolina | 1,605 | 891 |
| Tennessee | 2,986 | 1,986 |
| Texas | 8,679 | 5,471 |
| Virginia | 3,486 | 2,277 |
| Washington | 3,162 | 2,021 |
| Wisconsin | 3,611 | 2,217 |

Table C-3

Weighted, Logarithmic Correlation Matrix, 1966

(N=33 states)

| | EXP* | Q* | AP | NP | BEN* | MD* | EXP/MD | Q/MD | DTH RT | INF MRT | INC* | MED SCLS[a] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Q* | .55 | | | | | | | | | | | |
| AP | .91 | .15 | | | | | | | | | | |
| NP | .71 | -.07 | .88 | | | | | | | | | |
| BEN* | .50 | .70 | .24 | -.21 | | | | | | | | |
| MD* | .83 | .79 | .59 | .38 | .64 | | | | | | | |
| EXP/MD | .27 | -.43 | .54 | .57 | -.26 | -.31 | | | | | | |
| Q/MD | -.84 | -.52 | -.74 | -.57 | -.49 | -.93 | .18 | | | | | |
| DTH RT | -.27 | .29 | -.47 | -.53 | .25 | .01 | -.49 | .15 | | | | |
| INF MRT | -.52 | -.58 | -.33 | -.05 | -.67 | -.58 | .11 | .46 | -.12 | | | |
| INC* | .73 | .73 | .49 | .14 | .86 | .79 | -.12 | -.67 | .15 | -.74 | | |
| MED SCLS[a] | .44 | .72 | .16 | -.01 | .55 | .73 | -.52 | -.60 | .25 | -.24 | .51 | |
| UNION* | .50 | .64 | .27 | -.12 | .87 | .59 | -.17 | -.45 | .41 | -.69 | .82 | .46 |
| BEDS* | -.01 | .54 | -.29 | -.39 | .36 | .23 | -.43 | -.00 | .60 | -.36 | .25 | .39 |
| PRM/BEN | -.59 | -.55 | -.42 | -.08 | -.71 | -.63 | .07 | .55 | .06 | .46 | -.64 | -.44 |
| %SPEC[a] | .59 | .59 | .37 | .23 | .41 | .63 | -.14 | -.54 | -.15 | -.14 | .45 | .43 |
| ΔINC* | .36 | .42 | .21 | -.12 | .68 | .40 | -.08 | -.31 | .16 | -.61 | .78 | .25 |
| EDUC | .78 | .54 | .66 | .41 | .60 | .70 | .13 | -.66 | -.12 | -.73 | .77 | .23 |
| %AGED[a] | -.03 | .34 | -.21 | -.23 | .20 | .18 | -.37 | -.05 | .77 | -.36 | .22 | .13 |
| %BLK[a] | -.53 | -.55 | -.35 | -.07 | -.69 | -.56 | .07 | .47 | -.18 | .89 | -.72 | -.22 |
| %PART[a] | -.16 | -.21 | -.08 | -.04 | -.21 | -.30 | .26 | .30 | -.30 | -.03 | -.28 | -.40 |
| BRTH RT | -.20 | -.51 | .03 | .09 | -.34 | -.42 | .41 | .29 | -.60 | .50 | -.37 | -.34 |
| MD ORIG* | -.40 | .10 | -.53 | -.58 | .17 | -.08 | -.55 | .18 | .61 | -.10 | -.02 | .22 |
| S&L GOV* | .44 | .55 | .24 | .07 | .45 | .61 | -.30 | -.52 | .05 | -.19 | .46 | .61 |
| HOSP MD* | .43 | .79 | .11 | -.16 | .72 | .69 | -.46 | -.49 | .27 | -.46 | .68 | .68 |
| TEMP | -.07 | -.40 | .13 | .43 | -.68 | -.21 | .25 | .05 | -.45 | .64 | -.55 | -.13 |
| %URB[a] | .77 | .70 | .55 | .27 | .73 | .82 | -.11 | -.74 | .01 | -.51 | .85 | .57 |

[a]Linear variable.

TABLE C-3 (Concluded)

| UNION* | BEDS* | PRM/BEN | %SPEC[a] | ΔINC* | EDUC | %AGED[a] | %BLK[a] | %PART[a] | BRTH RT | MD ORIG* | S&L GOV* | HOSP MD* | TEMP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .37 | | | | | | | | | | | | | |
| -.68 | -.10 | | | | | | | | | | | | |
| .30 | -.09 | -.55 | | | | | | | | | | | |
| .65 | .19 | -.28 | .11 | | | | | | | | | | |
| .51 | .13 | -.51 | .29 | .52 | | | | | | | | | |
| .27 | .61 | .13 | -.10 | .16 | .26 | | | | | | | | |
| -.68 | -.43 | .44 | -.12 | -.53 | -.75 | -.46 | | | | | | | |
| -.23 | .12 | .26 | -.36 | -.02 | -.02 | -.10 | .03 | | | | | | |
| -.38 | -.46 | .12 | -.09 | -.13 | -.35 | -.71 | .56 | .33 | | | | | |
| .20 | .60 | .04 | -.33 | .07 | -.30 | .30 | -.05 | -.03 | -.29 | | | | |
| .35 | .17 | -.32 | .53 | .38 | .29 | .11 | -.11 | .02 | -.06 | .04 | | | |
| .67 | .43 | -.63 | .68 | .48 | .33 | .16 | -.40 | -.34 | -.32 | .25 | .56 | | |
| -.72 | -.54 | .30 | .06 | -.63 | -.25 | -.30 | .62 | -.14 | .31 | -.48 | -.11 | -.49 | |
| .66 | .12 | -.73 | .64 | .42 | .70 | .12 | -.54 | -.41 | -.27 | -.17 | .46 | .62 | -.17 |