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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

$$U_t = 1 + \frac{n B_t}{CP_t}, \tag{2}$$

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:

$$U_t = \frac{\Sigma_i S_i R_i}{\Sigma_i S_i / U_{ti} R_i} \tag{3}$$

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,

$$V_j = c + a\,INS_j + u_j\,, \tag{4}$$

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

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

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]

$$k^* = (1 + k)/2. \tag{6}$$

[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

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

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

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

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

(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.

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,

$$E_j = c + a\, INS_j + u_j, \tag{9}$$

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 $E_{It}\, I_t/(E_{It}\, I_t + E_{Nt}\, N_t)$.

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

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

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

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:

$$EXPS_t = E_{It}I_t + E_{Nt}\, N_t. \tag{13}$$

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^*:

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

$$= \bar{B}_t + k^* \left[\frac{U_t\, E_{Nt}}{k} - B_t\right]. \tag{14}$$

[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

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

and

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

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