STUDENT DISCOUNT RATES, CONSUMPTION LOANS AND SUBSIDIES TO PROFESSIONAL TRAINING

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The market for medical care is heavily subsidized by every level of government and at virtually every stage of production. More than 90 percent of the medical research done in this country is government sponsored. More than 40 percent of the direct educational expenditures for physician training are made by government. And roughly a quarter of the expenditure for physician care itself is government financed. Taken together, the net effect of all these subsidies is a reduction in the price of medical services by more than 50 percent.[1] There is little consensus on the rationale for these extensive subsidies of medicine. Indeed, it is fashionable nowadays to argue that Americans are overdoctored.[2] Laying aside that issue, however, these heavy educational subsidies pose a particularly perplexing puzzle in the case of medicine since many economists believe that the supply of medical services is restricted by professionally erected barriers. Were this true, such subsidies would have negligible allocative effects, providing for the most part additional rents to members of the cartel.

One explanation for the extensive government expenditures on physician training and medical care is that the AMA and related provider organizations have successfully manipulated the political process to provide such booty. Doubt is cast on this hypothesis by the observation that most professional medical organizations lobbied bitterly <u>against</u> these very subsidies. Indeed, close examination of the evidence bearing on the existence (or at least the effectiveness) of a provider cartel convinces us that -- at least in the postwar era -- providers have had at most a negligible influence on entry of new medical graduates into the profession. These issues are peripheral to this paper and are discussed in detail elsewhere.[3] As readers of earlier drafts of this paper have required reassurance on this point, however, section I provides a brief summary of the evidence on the cartel issue.

The major focus of this essay is the analysis of an alternative, efficiency-based explanation of subsidies to medical training and medical care. This explanation is based on underinvestment in medical training implied by the frequently asserted "imperfection" in the consumption loan market for medical students.[4] This argument has been widely used to justify a broad range of subsidies to education and professional training. It has never to our knowledge been empirically analysed, however. This paper seeks to do this for the market for medical education in the following steps.

For any given divergence in the borrowing rate faced by potential students and the desired social rate of return to investment in this training, there is an implied subsidy to medical schools which allows them to lower tuition to the point where such investment is undertaken to efficient levels. Section II of this paper develops the logic of this argument and calculates the level of the subsidy implied for an array of market discount rate and desired rate of return combinations. Then in section III we infer from the behavior of medical school applicants over the postwar period their actual marginal rate of time preference. Using this information and already published estimates of the "social discount rate" we can choose the implied efficient subsidy rate from the array developed in section II. Section IV contains our concluding remarks including a discussion of the comparison of implied and observed subsidy rates to medical schools.

I

The cartel hypothesis impinges on our discussion here because we ultimately wish to employ the applicant rate to medical school to measure the perceived attractiveness of a career in medicine. To the extent that such markets fail to clear at existing costs of training because of restraint by the medical profession on enrollments, then identifiable costs such as tuition and foregone earnings would fail to capture the full costs of medical training. Under such circumstances our attempt to estimate the underlying structure of applicant behavior would contain bias. We shall therefore limit our attention in this discussion of the cartel hypothesis to those variants which conjecture that medical schools respond to pressure from organized medicine by restraining output to below the market clearing level at existing tuition rates.[5] The presence of such restraint should manifest itself in three ways. (1) Returns on investment in training for a medical career should be higher than "normal." (2) An excess demand for medical training should be observed at all times. And (3) medical school capacity decisions should be uninfluenced by demand.[6]

Although Friedman and Kuznets (1945) originally found physicians earning rents on their training, these conclusions were subsequently questioned by Lewis (1963) and Lindsay (1971) on methodological grounds. Hansen (1964), Lindsay (1973) and Leffler (1978) have independently analysed physician earnings for various periods since 1947 and find that returns are not inconsistent with the hypothesis that supply of medical training adjusts to eliminate rents in the long run. Returns information is not conclusive, however, for nominally "equilibrium" earnings may contain positive or negative rents in the form of nonpecuniary occupational advantages or disadvantages.

Analysis of queues for admission to medical school is troubled by a similar ambiguity. Medical schools have never admitted more than 60 percent of those applying, and some economists (e.g., Kessel, 1958; Sloan, 1976) interpret this as adequate proof of non-competitive restraints on admissions. Such a conclusion is implied, however, only if all applicants are homogeneous -- an assumption which is patently invalid for this cohort. Applicants for medical school are carefully screened, at least in part, to select those among the applicants who exhibit sufficient ability and motivation to succeed in the training program and social characteristics indicating success in the practice of medicine. There is good reasons, furthermore, for applying such standards to admitting students. Student tuition provides on average only roughly 10 percent of school training costs. Bearing such a small share of the cost of training, students will not make efficient decisions with respect to the risk of failure. Thus, some screening of applicants is implied by economic efficiency.

Nor does it really make sense for medical schools to ration admission in order to restrain entry into the profession. Why not simply raise tuition to the point where the desired number of matriculants applies? In view of the heavy deficits which medical schools run on tuition revenues, they could easily 'justify' such tuition increases as required by costs. Instead, they devote much effort and energy to the raising of funds from government, foundations, alumni and other sources, with the likely results that it reduces tuition and increases applicants.

Finally, there is the historical behavior of the medical education sector itself. As noted above, a cartel seeking to maximize the income of physicians should exhibit no responsiveness to changing demand conditions.

Individual practitioner incomes must fall with increases in supply from medical schools. The demand elasticity for practitioner services is highly inelastic, so increases in medical school output will also lower total physician revenue. Yet analysis of medical school enrollment behavior finds a high responsiveness to conditions in the market for medical care and conditions in the market for medical training. In another paper (1977) we regress medical school graduates over time against lagged excess demand for medical school admissions and a lagged measure of the physician "shortage." Both variables have positive and significant coefficients. Hall and Lindsay (1978) develop a more extensive economic model of medical school behavior in which both capacity and tuition are endogenous. Behavior there is found to be inconsistent with cartelized output.

In conclusion there is little empirical basis for the widely held belief that medical schools act as pawns of organized medicine in restraining their output. The present paper is about subsidies to medical education, however, and the issue of cartelization in medicine is important only at two points. First, our analysis depends on applicant behavior to reveal student perceptions of the attractiveness of medicine as a career and, through this, their subjective discount rates. A cartel which limits enrollment might itself influence this perceived attractiveness in unmeasurable ways and thus bias our estimate of this discount rate. A cartel which restricts output by raising tuition or extending the training period would not bias our results, however, since these changes would themselves be reflected in our attractiveness variable. Secondly, the wisdom of any subsidy is questionable in the presence of a cartel whose output is insensitive to subsidies.

On the first count we interpret the evidence discussed in this section to imply that applicant behavior is free from this bias such that the profitability of medical training should be an adequate measure of career attractiveness. The absence of an effective cartel also raises skepticism about the likelihood of medical training being unresponsive to subsidy increases. More direct evidence on this issue is provided by Hall and Lindsay (1978) who find medical school enrollments to be positively influenced by subsidy levels.

II

This section analyzes the "imperfection" in the consumption loan market and its influence on investment in training capital. In this context we also calculate the subsidy implied by such a divergence between the social discount rate and the subjective discount rates of medical school applicants.

The cash flow problem presented by medical education is particularly severe. Students must forego most of their earnings for a minimum of four years during which time they must somehow finance their consumption, school tuition and any other associated costs of training. These cash requirements clearly surpass the available liquid resources of many otherwise qualified potential applicants. Recourse to the capital market is the obvious source of funds, and if this market operated without transaction costs, there would be no problem. In the absence of other barriers, borrowing and training by impecunious students would continue until the capital value of training fell to zero. This would result, in turn, in the efficient number of physicians being trained.

Friedman (1962) and more recently Nerlove (1972) have developed arguments which suggest that even in markets with free entry purely private financing of educational investment leads to underinvestment in this training. As the capital created in these investments is human capital, it may not be used to secure the loan. A person to whom such a loan is granted may flee, declare bankruptcy, or simply refuse to use the capital to earn sufficient income to repay the loan. Lenders aware of this risk will demand an interest premium on loans to cover the possibility of default. However, this private risk of default is unrelated to the social risk associated with the productivity of the capital. An additional doctor is trained regardless of whether he repays or defaults on loans. The riskiness of such loans is, in other words, greater than the riskiness of the investment in medical training, and it is the latter alone which governs the social value of this investment.

Borrowers in the market for medical training must pay high interest rates inclusive of such a risk premium. As the number of applicants is hypothesized to be related to the economic attractiveness of given careers, and the number trained in turn related to the demand for training, the high discount rates faced by prospective medical students diminishes the equilibrium rate of entry into medicine.[7]

Under such circumstances it is appropriate for the government to encourage medical training, and it is of interest to determine how much encourage is justified on the basis of the capital market "imperfection." The attractiveness of this career (and therby the demand for this type of training may be enhanced by offering tax deductions or direct subsidies to the purchase of care, by offering tax deductions or direct subsidies to the purchase of care, by offering subsidies to medical schools which lower fees, subsidies (scholarships) to students, or interest subsidies to the lenders themselves.

The various levels of government employ all of these subsidy forms. In order to aggregate the various subsidies and make them comparable, we examine these subsidies from the point of view of their influence on the price of the final good, physician care. Our discussion is couched in terms of subsidy rates which should be interpreted as the percentage reduction in market fees for physician care produced by the subsidy regardless of where applied. In doing so, we assume that this effect is fully reflected in physician earnings. That is, we assume that supply prices are proportional to physician earnings.[8]

Important parameters involved in the "optimal" subsidy due to capital market imperfections change from year to year so that it is impractical to develop too precise an estimate of this value. We calculate here the optimal subsidy using a simple human capital framework. We assume the estimated subsidy rates provide "neighborhood" estimates of the precise ideal values. We assume that expected lifetime earnings profiles are rectangular, and that occupational choices are made solely by comparison of the pecuniary aspects of the alternatives. Assuming individual's alternatives are the same, long run supply schedules for careers involving training are perfectly elastic at earnings levels which offer a normal return on the training investment. Such equilibrium earings for a physicial Y_i may be calculated from earnings available in alternative occupations involving no training Y_{cg}, student borne direct costs of the training T, the length of both the training period j, and the expected adult working life t, and the discount rate r_i shown below:

$$Y_i = \frac{Y_{cg} \int_o^t e^{-r_i t} + T \int_o^j e^{-r_i t}}{\int_j^t e^{-r_i t}}$$

If T reflects all costs of educating medical students other than foregone earnings, and the interest rate reflects only the "real" riskiness of investments in medical training, such an equilibrium will result in the efficient quantity of physicians being trained. However, if the market discount rate r_1 exceeds the socially appropriate rate r_2, then physicians' equilibrium earnings Y_1 (hence fees) will be higher than they otherwise would be. This higher price will cause less than the efficient quantity of physicians' services to be purchased. A subsidy or subsidies at various points in the production process may offset the effect of the inefficiently high market discount rate. The efficient subsidy will lower the supply price to the level associated with the lower discount rate r_2. Thus, using our expression for equilibrium physician earnings, allowing for different interest rates in the two cases, this subsidy rate in terms of the enumerated variables is given by:[9]

$$\frac{Y_1 - Y_2}{Y_1} = 1 - \frac{\int_j^t e^{-r_1 t}(Y_{cg}\int_o^t e^{-r_2 t} + T\int_o^j e^{-r_2 t})}{\int_j^t e^{-r_2 t}(Y_{cg}\int_o^t e^{-r_1 t} + T\int_o^j e^{-r_1 t})}.$$

Values of this optimal subsidy rate for a range of parameter values are shown in Table 1. These are calculated for varying values of the student borrowing rate and the socially appropriate discount rate. A length of student training equal to four years was used throughout, and as the calculations were reasonable insensitive to changes in alternative earnings Y_{cg}, and training costs T, these are reported only for Y_{cg} equal to $15,503, which equals median college graduate earnings for the year 1973 and T equal to $21,580, which is the total educational expenditure per student per year for American

TABLE 1

OPTIMAL SUBSIDY RATES IN THE MEDICAL CARE MARKET

FOR VARIOUS APPROPRIATE AND MARKET DISCOUNT RATES: 1973

	Market Rate						
Socially Appropriate Rate	.08	.09	.10	.11	.12	.13	.14
.01	.343	.384	.422	.457	.490	.521	.548
.02	.308	.352	.392	.429	.463	.495	.524
.03	.269	.315	.357	.396	.432	.466	.497
.04	.224	.273	.318	.359	.398	.433	.466
.05	.175	.226	.274	.318	.359	.397	.432
.06	.121	.176	.227	.274	.317	.358	.395

medical schools in that year. The latter value is assumed to approximate the tuition which would be charged by medical schools in a situation in which there were no subsidies to the schools.

One must be impressed by the magnitude of these "capital market imperfection" subsidy rates. Even for an interest rate differential of only two percent, the optimal subsidy rate is 12 percent. As we shall see in the next section, evidence suggests that the difference in the market and the appropriate discount rates is substantially greater than this.

III

In this section we estimate from the behavior of medical school applicants the discount rate which they actually apply to future earnings in medical careers. For most investments the market discount rate implies investors rates of time preference. Unfortunately, medical training costs are not generally financed by access to conventional capital markets. The impoverished student is all too familiar a picture, indicating that training is financed chiefly by reductions in current consumption. According to Altenderfer and West (1965), less than twenty percent of the out-of-pocket expenses of medical students are offset by loans and nearly all these loans are federally insured.

In such a "thin" market other measures of the prospective students' marginal rates of time preference must be developed. One alternative is the internal rate of return earned by physicians on their investments in training. Given free entry, this internal rate of return will, in equilibrium, equal the marginal rate of time preference of student investors. There are, however, problems with this method of measuring the discount rate faced by medical students. Though we have argued otherwise, if supply into this market is restrained, positive "equilibrium" profits will be earned on investment in this training, and the internal rates of return will exceed the relevant discount rates. Even in the absence of any supply restraints, internal rates of return equal marginal rates of time preference only when markets are in long run equilibrium. Given the long training period of physicians and the low individual supply elasticities, long run equilibrium is infrequently observed. Internal rates of return on medical training at particular points in time may therefore be unreliable as indicators of the discount rates utilized by these students.

Another alternative is to infer the level of student rates of discount from the internal rates of return earned on training capital in other similar areas. The problems posed by possible barriers to entry are presumably not present in, for example, the market for college graduates. If we assume that undergraduate college education is competitively supplied and in equilibrium over the long run, then the internal rate of return to college training may proxy the relevant discount rate for investors in medical training. Many estimates of this rate of return are available, and some are shown in Table 2.[10]

The final alternative developed here is to infer the rate of discount from observed behavior. The rate of application to medical school from a cohort of a given size should vary with the attractiveness of a medical career, and this attractiveness itself is influenced by the rate at which expected future earnings in alternative careers are discounted. More explicitly, we hypothesize the following relationship:

(1) APPL = f(PROF, CG, ACPR)

TABLE 2

Internal Rates of Return to

College Education

Author	Estimated Internal Rate of Return
Chiswick (1974)	8.0
Hanoch (1967)	9.6
Becker (1964)	13.0
Hansen (1963)	10.2

where APPL is the number of applicants (not applications) to American medical schools, PROF is the expected pecuniary attractiveness of a medical career, CG is the pool of individuals qualified to make applications to medical schools, and ACPR is the expected probability of acceptance to medical schools for a marginal candidate.

The "pool" variable CG measures the number of individuals making career choices at a point in time. It is plausible that non-pecuniary tastes for medical careers vary among individuals, but that this variation is systematic in the population. Recognition of this variation in tastes suggests that the number of individuals who find a medical career attractive on both pecuniary and non-pecuniary grounds at any point in time will be related both to the pecuniary attractiveness and to the number of individuals making career choices. Hence, larger "pools" of potential applicants imply larger numbers of applicants for a given profitability.

The expected probability of acceptance ACPR is included because application to medical school is itself costly. The lower the expected chance of acceptance for potential applicants, holding constant the pecuniary gain if accepted, the lower will be the expected returns from application. This variable thus simply refines our measure of pecuniary attractiveness.

The expected pecuniary attractiveness of a career is conceptually the present value of the difference in the earnings stream of this career and its next most attractive alternative. It will thus depend upon the rate of time preference used by potential applicants to evaluate alternative career earnings streams. This is shown below for investment in physician training:

$$(2) \qquad PROF = \sum_{i=1}^{N} (EPE_i - EAE_i)(1+R)^{-i}$$

where EPE_i is the expected physician earnings in the i^{th} year after investment,

EAE_i is the expected earnings in the alternative career in the i^{th} year after investment,

R is the discount rate, and

N is the expected career length.

In practice, however, the measurement of this expression is subject to serious ambiguity. In addition to R which we hope to estimate, neither EPE_i nor EAE_i is actually observed, but must be inferred from other observed variables. In this paper we assume that current age-adjusted earnings of physicians and college graduates are the best estimates of expected earnings in this career and its alternative. We have experimented elsewhere (1978) with other algorithms involving more "rational" expectations on the part of applicants, but find their behavior explained best with this "naive" specification. Complicating the process further is the fact that there is no homogeneous "physician" population, but rather numerous specialties and subspecialties requiring different training programs and periods. We therefore restrict our analysis to the "basic" physician, the general practitioner. The GP generally receives the minimal formal training, consisting of four years of in-school training after undergraduate college and one year of internship. We thus treat the decision to specialize (involving more training) as a distinct and separable investment decision.[11]

The appendix gives all data sources and discusses in detail the calculation of the profitability of medical training. Table 3 gives the resulting

TABLE 3

PHYSICIAN PROFITABILITY: VARIOUS DISCOUNT RATES[a]

DISCOUNT RATE

Year	5	8	10	12	15
1947	12106	$ -5243	-11464	$ -15333	-18538
1948	21583	-1122	-9258	-14345	-18618
1949	39789	8702	-2497	-9580	-15701
1950	44423	9973	-2374	-10158	-16878.
1951	49969	15106	2622	-5257	-12086.
1952	45422	11312	-960	-8714	-15403.
1953	46596	12257	-25	-7757	-14401
1954	55743	16159	1917	-7101	-14954
1955	57821	16801	2003	-7400	-15625
1956	61815	18622	3037	-6867	-15543
1957	66719	21013	4544	-5920	-15098.
1958	70564	24250	7256	-3713	-13537
1959	67861	21550	4542	-6389	-16078
1960	82600	29178	9742	-2731	-13831
1961	78218.	25993	7015	-5134	-15902
1962	79824.	27103	7946	-4324	-15213
1963	81872.	29270	9739	-2969	-14462
1964	98932.	38857	16535	1972	-11274
1965	99713.	38072	15366	617	-12748
1966	106534	41218	17267	1789	-12127
1967	140930	61876	32610	13481	-4069
1968	129731	55712	28230	10262	-6193
1969	130889	56885	29389	11374	-5186
1970	145982.	67252	37904	18571	612.
1971	140057.	66181	38369	19877	2475
1972	109757.	49142	26040	10588	-3997
1973	113788.	53881	30740	15089	9318

[a]Constant 1976 dollars. Ability adjusted, average of estimates from adjusting physician earnings down and college graduates earnings up for differential hours. See the appendix for clarification.

estimates for various discount rates for the period 1947 to 1973. This table highlights the importance of the discount rate to these calculations. If the appropriate discount rate was as low as 5 percent in real terms, then medicine as a career has been extremely attractive in economic terms throughout the postwar period. Expected profits on investment in this training never fall below $40,000 (1976 dollars) after 1949. On the other hand, if the appropriate discount rate is as high as 15 percent, then physicians consistently experienced actual economic sacrifice in choosing medicine as a career.

Having developed the economic attractiveness variable, we have left CG and ACPR as independent variables. For the "pool" variable CG we use the number of college graduates in each year. Two alternative variables are available to proxy the expected probability of acceptance to medical school ACPR. First, the recent acceptance to application ratio should provide an indication to potential applicants of given qualifications of their likelihood of acceptance. As this ratio rises, ceteris parabis, the number of applicants is expected to rise. Alternatively, the average ability of recently accepted students may indicate the acceptance probability for a given candidate. This can be proxied by the science score on the Medical College Admissions Test (MCAT). We expect that as the average MCAT science score of recently accepted students increases, the number of applicants will, ceteris parabis, fall. Both these variables will affect the number of applicants with a lag since the information is available only with a lag and since prerequisites for medical school admission may preclude immediate responses in applications. This lag permits us to treat these variables as exogeneous variables in estimating the demand for training equation.

The profitability variable PROF is also expected to affect applicants with a lag. First of all, information on salaries is not immediately available to applicants; published data are reported with at least a two year lag. Most applicants clearly do not explicitly compute profitability, and the information used to assess the changing attractiveness of medical training appears gradually in piecemeal fashion.[12] Secondly, the decision to apply to medical school is made relatively early in the college career. A survey of college freshmen by Astin (1972) shows that of those surveyed who applied to medical school in 1968, ninety-two percent made the decision in or by their freshman year. The tight prerequisite requirements of medical schools are one reason for this.

The absolute number of students who apply for medical school has varied considerably over the twenty-seven years investigated. There were 24,434 applicants for admission to the 1949 class. This number declined to 14,381 for the 1961 class, and climbed to over forty two thousand for the 1974 class declining again since 1974. During this period there were large changes in the size of the pool from which most medical students come. The number of college graduates fell from 433,734 in 1950 to 287,401 by 1955, rising to nearly a million by 1973. In 1947, over 9 percent of college graduates applied to medical school. This fell to 3 percent in 1970.

Considerable variation thus remains to be explained in the rate of application to medical school. We hypothesize that a significant part of that variance is explained by the economic attractiveness of medical school, and that measures of that attractiveness which employ the discount rate actually used by potential applicants will perform better than measures which employ discount rates which are either too high or too low. In essence we select the discount rate by regressing measures of profitability of medical training on the applicant rate using different discount rates and selecting that which fits best. This amounts to a maximum likelihood search on the discount rate in which our criteria for selection is that value which minimizes the summed squared residuals.

We have tried three alternative specifications of equation (1):

$$(3) \qquad \text{Log}(\text{APPL}_t) = {}_1b_0\text{PROF}_{t-5} + {}_1b_1\text{Log}(\text{CG}_t) + {}_1b_2\text{ACPR}_{t-3} + {}_1b_3 + {}_1e_t$$

$$(4) \qquad \text{APPL}_t = {}_2b_0\text{PROF}_{t-5} + {}_2b_1\text{CG}_t + {}_2b_2\text{ACPR}_{t-3} + {}_2b_3 + {}_2e_t$$

$$(5) \qquad \text{AP/EN} = {}_3b_0\text{PROF}_{t-5} + {}_3b_1\text{CG/EN}_t + {}_3b_2\text{ACPR}_{t-3} + {}_3b_3 + {}_3e_t$$

where APPL, PROF and CG are defined as above. AP/EN is the number of applicants per position available in medical school (i.e., first year enrollment) and CG/EN is the number of college graduates per medical school position. The lags on both profitability and the probability of acceptance were selected by experimentation. In all cases the sample period on the dependent variable is 1952 to 1976.

Estimation by ordinary least squares produced severe serial correlation for all three equations. The data were therefore transformed using the Cochrane-Orcutt technique. Tables 5, A, B and C show results of estimating rho (the serial correlation adjusting coefficient), b_0, b_1, b_2, and b_3 for equations (3), (4), and (5) where the lagged acceptance rate is used for the probability of acceptance variable. For all three equations we find that the summed squared residuals of the regression are minimized at discount rates of between 9 and 11 percent.

TABLE 5

ESTIMATION OF MEDICAL STUDENTS RATE OF TIME PREFERENCE

A. Dependent Variable: Number of Applicants to Medical School
Pool Variable: Number of College Graduates

Equation Number	Discount Rate (%)	Profitability Coefficient	OLS S.E.	"Pool" Coefficient (X10)	OLS S.E. (X10)	Acceptance Probability Coefficient	OLS S.E.	Constant	Rho	Summed Squared Residuals ($X10^{-5}$)	R^2
1	5	.147	.0709	.399	.0731	6504	10415	-13038	.87	436.21	.9817
2	6	.185	.0846	.395	.0719	6883	10368	-12449	.87	428.70	.9820
3	7	.227	.0997	.392	.0708	7198	10326	-11656	.87	422.13	.9823
4	8	.272	.118	.390	.0697	7428	10290	-10688	.86	416.72	.9825
5	9	.316	.132	.392	.0696	7465	10203	- 9839	.86	412.49	.9827
6	10	.362	.148	.393	.0688	7486	10173	- 8674	.86	409.82	.9828
7	11	.407	.165	.394	.0681	7408	10152	- 7464	.86	408.54	.9829
8	12	.449	.182	.397	.0676	7237	10137	- 6252	.86	408.56	.9829
9	13	.488	.199	.401	.0673	6988	10129	- 5076	.86	409.72	.9828
10	14	.523	.216	.404	.0671	6678	10126	- 3966	.86	411.83	.9827
11	15	.553	.232	.408	.0670	6322	10128	- 2942	.86	414.70	.9826
12	10	.3245	.1389	.0381	.00658			- 3695.	.87		

TABLE 5 (Cont.)

B. Dependent Variable: Number of Applicants per Medical School Position (Appl/First Year Enrollment)
Pool Variable: College Graduates Per Medical School Position

Equation Number	Discount Rate (%)	Profitability Coefficient ($X10^5$)	OLS S.E. ($X10^5$)	"Pool" Coefficient (X10)	OLS S.E. (X10)	Acceptance Probability Coefficient	OLS S.E.	Constant	Rho	Summed Squared Residuals	R^2
1	5	1.55	.555	.391	.0188	1.60	.868	-1.86	.85	.29523	.9766
2	6	1.91	.661	.392	.0186	1.59	.854	-1.81	.86	.28994	.9770
3	7	2.29	.777	.393	.0185	1.60	.847	-1.74	.86	.28614	.9773
4	8	2.70	.903	.393	.0183	1.60	.842	-1.64	.86	.28369	.9775
5	9	3.11	1.04	.393	.0184	1.62	.843	-1.52	.85	.28285	.9775
6	10	3.53	1.18	.394	.0184	1.59	.839	-1.39	.85	.28310	.9775
7	11	3.94	1.32	.395	.0184	1.55	.837	-1.24	.85	.28460	.9774
8	12	4.32	1.47	.395	.0185	1.51	.835	-1.09	.85	.28720	.9772
9	13	4.68	1.63	.396	.0187	1.45	.834	- .941	.85	.29071	.9769
10	14	5.00	1.78	.396	.0188	1.39	.833	- .791	.85	.29494	.9766
11	15	5.29	1.94	.397	.0189	1.32	.833	- .648	.85	.29972	.9762
12	10	2.76	1.13	.404	.0184			- .661	.89	.32442	.9742

TABLE 5 (Cont.)

C. Dependent Variable: Log of Applicants
"Pool" Variable: Log of Number of College Graduates

Equation Number	Discount Rate (%)	Profitability Coefficient (X10^6)	OLS S.E. (X10^6)	"Pool" Coefficient	OLS S.E.	Acceptance Probability Coefficient	OLS S.E.	Constant	Rho	Summed Squared Residuals	R^2
1	5	7.78	2.62	.892	.148	.598	.406	-2.56	.84	.061665	.9827
2	6	9.57	3.11	.891	.147	.609	.400	-2.53	.84	.060233	.9831
3	7	11.6	3.65	.884	.145	.618	.397	-2.40	.84	.059140	.9834
4	8	13.7	4.23	.881	.143	.622	.395	-2.31	.84	.058385	.9837
5	9	15.9	4.85	.882	.142	.620	.394	-2.27	.84	.05800	.9837
6	10	17.9	5.49	.887	.141	.612	.392	-2.27	.84	.057981	.9838
7	11	20.0	6.16	.895	.141	.598	.392	-2.31	.84	.058311	.9837
8	12	22.0	6.85	.899	.140	.582	.394	-2.28	.84	.058977	.9835
9	13	23.6	7.54	.912	.142	.560	.395	-2.38	.84	.059867	.9832
10	14	25.0	8.24	.925	.143	.536	.396	-2.49	.84	.060958	.9829
11	15	26.1	8.93	.938	.146	.510	.397	-2.60	.84	.062193	.9826
12	10	14.8	5.27	.819	.139			-1.02	.84	.065018	.9818

Figure 1 plots the summed squared residuals from Table 5, C. Results in this table consistently have the higher r^2.

Coefficients for the pool and profitability coefficients are more than twice their standard errors while the "discouragement" coefficient is generally more than one and a half its standard error. Table 6 reports the results for a discount rate of 10 percent in the three specifications when the lagged MCAT score is substituted for the lagged acceptance rate. In addition, when we exclude an acceptance probability variable, the summed squared errors of all regressions are minimized at 10 percent.

In summary, revealed preferences of medical applications point strongly toward a discount rate in the neighborhood of 10 percent. Applicant behavior is best explained when that discount rate is used to calculate economic attractiveness of a medical career. In addition, at 10 percent we find for the period prior to medicare (1947-1964) an average net return to physician training of only $2,795 (1976 dollars). Such meagre returns cast further doubt on the cartel hypothesis discussed in section II. We also note that this estimate is consistent with the evidence on internal rates of return to undergraduate education discussed above.

IV

In section II above we calculated subsidy rates which just offset capital market "imperfections" for persons who must borrow to finance their investment in physician training. The efficiency of such subsidies results from a disparity in the discount rate faced by human capital investors and the "appropriate rate" reflecting only the real economic risk implicit in such investment. In section III above we estimated that the discount rate employed by students to discount future earnings is 10 percent. We have no

FIGURE 1

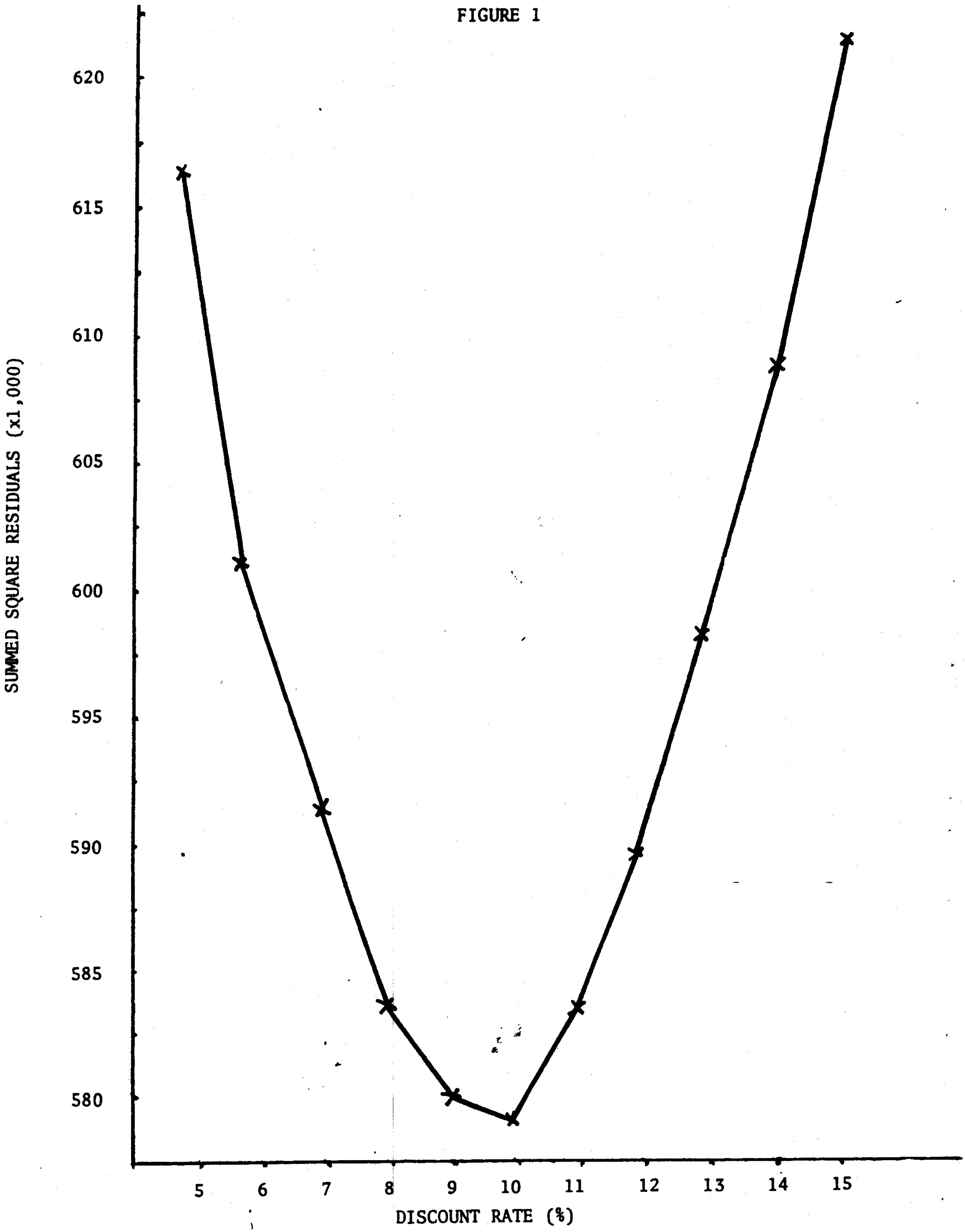
620
615
610
605
600
595
590
585
580
SUMMED SQUARE RESIDUALS (x1,000)
5
6
7
8
9
10
11
12
13
14
15
DISCOUNT RATE (%)

TABLE 6

REGRESSIONS EXPLAINING MEDICAL SCHOOL APPLICANTS USING MCAT SCIENCE SCORE
OF ACCEPTED MEDICAL SCHOOL APPLICANTS LAGGED THREE YEARS AS A DISCOURAGEMENT VARIABLE

Discount Rate Equal 10%

Equation Number	Dependent Variable	Profitability Coefficients	OLS S.E.	Pool Variable	Pool Coefficient	OLS S.E.	Science Coefficient	OLS S.E.	Constant	Rho	Summed Squared Residuals	R^2
1	Log Applicants	1.56 ($X10^5$)	.559 ($X10^5$)	Log College Graduates	.841	.147	-.798 ($X10^3$)	1.51 ($X10^3$)	-.878	.84	.064119	.9821
2	Applicants	.369	.142	College Graduates	.395 (X10)	.0657 (X10)	-44.3	36.9	19707.	.87	392.56 ($X10^{-5}$)	.9835
3	Applicants Per Position	3.11 ($X10^5$)	1.18 ($X10^5$)	College Graduates	.400 (X10)	.0188 (X10)	-.367 (X100)	.324 (X100)	1.43	.87	.30684	.9756

similar estimate of the appropriate rate but are confident that it lies somewhere in the range shown in Table 1. An unexceptional point estimate might be 5 percent.[13] Thus the optimal subsidy rate resulting from the capital market imperfection alone is in the neighborhood of 27 percent. That is, a set of subsidies which effectively lower the market price of medical care about 27 percent will just offset the inefficiency caused by inappropriately high discount rates.

In Lindsay, Hall, and Leffler (1976) the effect of all government subsidies on the price of physician services is estimated. Direct subsidies in the market for care together with "tax expenditures" resulting from the deductability of care expenditures were estimated to reduce the demand price by 27 percent. Indirect subsidies to the care market through grants to medical schools and students were estimated to have lowered the demand price for physician services by another 26 percent. The combined effect of all subsidies to the medical care market taken together is a net reduction of 53 percent in the price of these services. This figure is about twice our estimates, though this capital market imperfection explains a considerable share of the existing subsidies. Our analysis thus suggests that either excessive resources are being devoted to training physicians or that this subsidy is being undertaken for reasons in addition to capital market imperfections.

In closing we note one final conclusion of this analysis which has some policy significance. We mentioned in the introduction that the government commitments in the health area are quite substantial. Let us assume that the chief objective of this involvement is to increase public access to physician care. The government may do this alternatively by subsidizing demand via National Health Insurance or some such program, or it may subsidize medical schools and physician training. However, only after these subsidies have generated increases in the stock of physicians will access to care increase. Both ultimately make a medical career more attractive and thus should eventually increase the supply of practitioners and lower the price of medical care. The first by supplementing demand would drive up supply prices and earnings, and thus the demand for medical training. An increased demand for training in turn promotes medical school expansion by lowering the cost of such expansion. The second alternative, subsidies to training, acts similarly, directly lowerigg the cost of medical school expansion and also making fee reductions possible. The latter of course results in an increased demand for training.

The results discussed above imply that in the absence of distributional considerations, subsidies to medical schools are preferred to subsidies in the care market. This occurs because the relative attractiveness to prospective applicants of a subsidy while in school versus a subsidy later during active practice differs substantially from the government's relative cost of making these two forms of subsidy. Medical school applicants face a (subjective) cost of delaying present consumption of about 10 percent while estimates of the government's social rate of discount are considerably less than this.[14]

Assuming an applicant discount rate of 10 percent and a social discount rate of five percent, we can calculate the savings from increased school aid (or scholarships) vis a vis subsidies to demanders of care. For example, an increase in aid to schools of $1,000 per student per year would cost the government in present value terms $3,546 per student. This would increase expected profitability to prospective medical students by $3,037 and, using regressing 6 in table 5c, would have increased total applicants in 1976 by 2355. For the same cost, the government could subsidize physicians over their lifetimes by $252 per year. This, however, would increase profitability by only $1,186 and increase applicants in the same year by 904. The cost per additional applicant more than doubles by giving subsidies in the care market rather than in the training market. This is a general conclusion applicable to all human capital markets facing "high" borrowing costs. Subsidies to trainees will be less costly than equal valued subsidies to the practitioners during their working careers.

APPENDIX

Calcualtion of the Profitability of Physician Training

Values for expected physician earnings EPE_i are developed from a series of median earnings of general practitioners taken from quadrennail surveys of physician earnings from 1947 to 1959 and annual surveys from 1961 to 1973 published in Medical Economics. Between surveys, earnings are assumed to increase at a constant growth rate. This series is presented in Table A1. These Medical Economics surveys periodically report experience-earning profiles. From these, age-earnings to median earnings ratios are calculated for the purpose of introducing life-cycle variability into our estimates. These ratios are also shown in Table A1.

The costs of medical school training includes tuition, scholarships, veterans' benefits and summer earnings. Interns' earnings are available for 1958-1973 from the Journal of the American Medical Association. From 1947 to 1957, intern earnings are assumed equal to real 1958 earnings.

TABLE A1

A. MEDIAN GENERAL PRACTIONER EARNINGS, 1947-1973

1947	8,088	1961	21,115
1948	8,957	1962	21,700
1949	9,920	1963	22,250
1950	10,986	1964	24,420
1951	12,164	1965	25,090
1952	12,778	1966	27,720
1953	13,423	1967	31,370
1954	14,101	1968	32,430
1955	14,817	1969	35,149
1956	15,972	1970	37,135
1957	17,218	1971	37,400
1958	18,561	1972	37,065
1959	20,000	1973	38,357
1960	20,550		

B. RATIO OF AGE-SPECIFIC EARNINGS TO MEDIAN EARNINGS

Age	
27 - 32	.840
33 - 37	1.094
38 - 47	1.072
48 - 57	1.030
57 - 70	.810

Median earnings of male college graduates are assumed to be the relevant alternative earnings. Age-earnings profiles are available from Census data and are used to estimate expected life-cycle earnings in each year. Incomes of both physicians and nonphysicians are adjusted for taxes. Marginal tax rates are estimated from Individual Income Tax Returns, IRS, 1947 to 1973. All post-tax incomes are deflated by the consumer price index (1976 = 1.00)

These earnings are not expected with certainty; each career entails various risks which should be incorporated into the analysis. Census data reveal that earnings of individuals with only four years of college have greater coefficient of variation than earnings of physicians. No adjustment is made to our calcualtions for this lesser riskiness of a medical career. The calculated returns to medical training may be understated for this reason. In addition, an investor's risk of death influences his investment decision. The value of human capital falls to zero when the "investment" dies, a risk not born by physical capital. Human capital may therefore earn a premium reflecting this uncertainty. No adjustment is made in our calculations for the riskiness aspect of mortality. Ideally these two risks may to a certain extent offset one another.

The effect which mortality during the earning years has on the capital value of the alternative earnings streams themselves is incorporated into our analysis. Previous studies (Sloan, (1970); Fein and Weber, (1971)) have treated such career earnings as expected with certainty; this significantly overstates the attractiveness of a medical career. Investing in medical training physicians effectively trade-off early years earnings (when probability of death is low) for higher earnings in later years (when the probability of being alive is low). We have adjusted the alternative income streams for expected mortality as reported in U. S. Vital Statistics.

Our earnings figures also include a weighted average of military and nonmilitary earnings for the relevant ages and years. Until 1973 when the draft was abolished, physicians faced an average probability of 0.80 of induction into the Armed Services. Nonphysicians, however, faced only a 0.25 probability of being drafted.

In addition, Fein and Weber (1971) suggest college graduates earnings should be increased 10 percent to account for the greater than average abilities of medical school applicants. Our calculations include a more conservative upward adjustment of college graduate earnings by 5 percent.

Finally, expression (2) may not perfectly mirror the attractiveness of a medical career because individuals work with different intensities in different careers. As Lindsay (1971) has shown, investment in human capital is associated with an increase in the cost of leisure, such that part of the higher earnings of individuals with greater training represents a pure substitution effect of pecuniary income for leisure at the new relative prices. Lindsay's analysis (1971) demonstrates that the actual value of returns to such investment is approximated by standardizing earnings at both the physician and nonphysician earnings work-level. Recent studies, surveyed by Sloan (1975) suggest a reasonable estimate of a physician work week is 52 to 55 hours.

Table A2 summarizes the results of the estimations of the profitability of physician training. The effects of the adjustments due to ability and hours differentials for five year intervals at a ten percent discount rate are indicated in the table. The ability adjustment causes an average decrease in the estimated profitability of approximately $5,800. The adjustment for differential work hours causes a further decrease averaging about $30,000 (both 1976 dollars). Column 6 of Table A2 shows the profitability found by averaging the under and over differential hour adjustments estimates.

Alternative adjustment procedures affect largely the levels of the estimates of the attractiveness of physicians training. Our primary purpose here is not to determine the returns to such training but rather to examine which discount rate best explains applicants behavior, hence the exact adjustments become less crucial.

TABLE A2

PHYSICIAN PROFITABILITY: VARIOUS ADJUSTMENTS, DISCOUNT RATE EQUAL TEN PERCENT[a]

Estimate	1	2	3	4	5	6
Adjustments						
Ability[b]	No	Yes	No	Yes	Yes	Yes
Hours[c]	No	No	Physician Earnings Down	Physician Earnings Down	College Graduates Earnings Up	Average of 4 & 5
Year						
1950	22069	17367	1413	- 3287	- 1458	- 2374
1955	29350	24283	5791	724	3281	2003
1960	41367	35610	13213	7457	12026	9742
1965	51849	45247	19163	12561	18171	15366
1970	79128	71994	41082	33947	41861	37904

[a]All estimates in constant 1976 dollars.

[b]Adjusting college graduates' earnings up by five percent.

[c]Adjusting physician earnings down by twenty percent (40/50) or college graduates' earnings up by twenty-five percent (50/40).

FOOTNOTES

[1]See Lindsay, Hall and Leffler (1976), Chapter Four, for the development of these statistics.

[2]The list of adherants to this view includes Feldstein (1970), Evans, (1947), Fuchs (1978), and the President's Council on Wage and Price Stability (Dyckman, 1978).

[3]Lindsay, Hall and Leffler (1976), chapter nine, and Leffler (1978).

[4]We follow the conventional and misleading use of the phrase "imperfect market" to describe a market functioning well in that lenders are charging appropriate premiums for risky loans. See Stigler (1967) for an extended discussion of the senses in which capital markets can be perfect or imperfect.

[5]Another variant of the cartel hypothesis discussed by Lindsay (1973) and Kessel (1958) holds that markets clear for medical training but that the medical profession uses its influence to raise the level of investment required for an MD degree by adding requirements to the medical school curricula. As such costs (e.g., added years of training) would be incorporated in our estimates in section III, this type of cartel behavior implies no bias for these results, and we shall therefore ignore the possibility of this type of "restraint." Evidence of this sort of cartel influence is also very weak, however.

[6]This assumes that the AMA actually operates in the interests of its members as opposed, for example, to the interest of its executives who may see economics advantages in larger membership, *per se*. It is, of

course, antithetical to the narrow economic interests of practicing physicians for medical schools to graduate any new MDs.

[7]Stan Liebowitz has called our attention to an ambiguity in this argument. He points out that where bankruptcy is a possibility, individuals may borrow with the express purpose of defaulting on their loans. If attendance at medical school is a condition for the granting of such loans, the result may be efficient or even excessive levels of demand for training -- even at high discount rates. Investment in training becomes, in effect, a license to steal. The high discount rates have little deterrent effect on borrowing and studying medicine since these borrowers do not intend to pay the high rates anyway.

In the limiting case such an argument leads to the conclusion that no market will exist at any discount rate, for no lenders will supply a market where there are no qualifications for bankruptcy. Such markets so exist, however, possibly indicating either that most people are honest or that the policing of such fraud is reasonably effective. As long as bankruptcy is allowed in cases where human capital creation is unimpaired, the market rates are nevertheless inefficiently high and too little training will be demanded.

[8]Evidence on the price inelasticity of supply of individual physicial services discussed in Lindsay, Hall and Leffler (1976) suggest that such an assumption is reasonable.

[9]As an example of this subsidy calculation, assume that because of the excessive cost of borrowing the supply price of physicians services at the socially appropriate discount rate is 10 percent lower than at the existing

no subsidy market equilibrium. Assuming a realistic demand elasticity, this would imply something like a 4 percent deficit in medical care consumption relative to that which would be purchased at the efficient supply price. One subsidy which would obviously extend medical care consumption to the optimum is a subsidy to lenders influencing them to lower their discount rates to students to the socially appropriate rate. Such a subsidy would by definition lower the price of care by the optimal amount, i.e., a 10 percent subsidy. Medical care may also be subsidized at other levels, such as the market for medical education, so as to produce the desired price change in the care market. A dimension of the choice of the optimal subsidy is therefore choosing the package of subsidies to various levels and actors in the industry which minimizes the cost of obtaining the desired price change (i.e., subsidy rate).

[10]This range provides a useful check on the "realism" of our own estimates of this parameter from the revealed preferences of medical school applicants.

[11]Sloan (1970) has shown that general practitioners typically earn far greater profits on their investment in training than do most specialists. As we are here less concerned with the level than the variation of PROF over time, this poses little difficulty.

[12]Such things as the cars physicians drive, the country clubs they belong to, reports in newspapers, and job offers of friends would all tend to indicate the general level of returns to continued training as a physician.

[13]Harberger (1969) places the real social discount rate at between 3 and 6 percent.

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