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PART FOUR Policy Issues

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Policy Issues in the Education Industry

Economists have a great deal to contribute to the formulation of policy issues when they look at education through the prism of industrial analysis. Besides analyzing the demand and supply of factors used by, or produced by, education, they can throw some light on the effect of educational inputs on achievement, especially that of slow learners. Economists are brave enough to ask what is optimized. They have already contributed much to the "gutsy" issues in education, namely, whether the level of quality of resources makes a difference in terms of educational outcomes. They may further contribute to answering the bothersome question of what would be produced by allocating a richer or better mix of resources to slow learners, as contrasted to investing the same resources to benefit the gifted.

Currently, we are just scratching the surface in the analysis of education as an industry. In order to sharpen the issues which are high on society's agenda, it may be well to describe the present pressures on the educational establishment and point out how they are affecting the problems which economists are expected to tackle. In the past twenty years, education in the United States has been geared to do the things which it knows best how to do, namely streaming large numbers of students through educational institutions. The coverage of American education has become well-nigh universal between the ages of six and sixteen, and an increasing proportion of children below that age, as well as those above it, are now participating in the educational experience.

The present dissatisfaction with the state of events can be traced to the criticism that education still acts as a sorting device, benefiting the gifted more than the slow learners, and the children of the rich more than the children of the poor. It has been argued that this is an important failing of the educational system.

At the same time, as attendance rates have swelled, and costs per student have continued going up, the resources assigned to education have increased substantially. Especially in the postsecondary area, there is increasing difficulty in providing the funds for rising enrollments.

In a nutshell, education is being asked to equalize opportunity and control costs at the same time. Can economists contribute to the achievement of these goals?

The first step in this direction is to build models which describe what is happening in the educational process. The value of modeling the system is twofold. In the first place a model can handle various pieces of the system and, if broad enough, quantify the consequences of different combinations of resources. Second, a broad-based model may help bring together disparate pieces of information and test whether they are consistent with each other.

CLARIFICATION OF THE CONCEPT OF EQUALITY OF EDUCATIONAL OPPORTUNITY

Before discussing which models have to be built and which issues they ought to address, a clarification of the concept of equality of educational opportunity is essential. It lies at the very heart of defining what outputs of education economists ought to be measuring.

Most discussions concerning the improvement of the educational process are conducted in the context of equalizing educational opportunity for children of various social classes. Even this objective is often stated imprecisely. In some instances, it implies that children from various socioeconomic groups ought to benefit from the same number of years of education. In other instances, the objective is translated to mean that children of the poor and children of the rich should attain the same level of schooling, say twelve grades of education. In yet other cases, equality of educational opportunity is taken to mean a state of affairs where, irrespective of social background, children who have equal achievement, or equal intelligence, benefit from the same number of years of education, or reach the same level of schooling. Depending upon the definition which is adopted, the implications for the goals of education reform are substantially different.

The different implications of these standards for policy are best illustrated with actual examples. According to the U.S. Census of 1960, for instance, the attainment of the children of the poor was well below that of the children of the rich. While only 4 per cent of the children of rich parents, those with incomes of $10,000 or more, were in grades below the mode for their age, 37 per cent of the children of the poor were in grades lower than the mode for their age. The children of parents with incomes of less than $3,000 a year were likely to be one grade behind the average of the population. The children of the poor generally start school later than the children of the rich, according to the information of the U.S. Census, and they are more likely to repeat grades.[1]

The children of the poor are also more likely to discontinue their education at an earlier stage. Among young adults aged twenty to twenty-four who were high school dropouts in the United States in 1962, nearly eight out of ten were the children of high school dropouts.[2] Two factors conspired to limit their educational attainment. In the first place, the atmosphere of the home and the aspirations of the parents were not conducive to the continuation of the education of such young people. Parents with less education generally aspire to lower levels of attainment for their children, and the aspirations of the parents are generally shared by their offspring. This state of affairs is illustrated by Table 1, which gives the latest available data about the plans of twelfth-grade students

TABLE 1 College Aspirations for High School Seniors by Mothers' Educational Attainment and College-Going Plans of Seniors, 1966

A. Per Cent of Mothers Wanting Seniors to Attend College

	Education Attainment of Mothers			
	0–8 Years	9–11 Years	12 Years	1 or More Years of College
Male	73	84	91	98
Female	60	72	87	97

B. Per Cent of Seniors Planning to Attend by Mothers' Aspirations

	High-School Seniors' Plans	
Mothers' Wishes for Seniors	College	No College
College	82	16
No College	18	84

SOURCE: Unpublished tabulations from Special U.S. Census Bureau Survey.

in 1966. The lower the educational attainment of the mother, the lower the expectation for postsecondary education of both the parent and the child.

The second cause for the weaker persistence of children of the poor in the educational process is their generally lower achievement in school. This lag has been documented convincingly by a number of studies, and is illustrated below by data collected by the American Institute of Research in a large-scale study conducted in the early 1960s. Table 2 presents a matrix showing the dropout rate between the tenth and twelfth grades by socioeconomic status and by achievement on a nationally standardized test. The sixteen cells of the table divide the population into four socioeconomic groups and four roughly equal achievement groups.

The data in the table show that in 1960 the dropout rate between grades ten and twelve was six times as high in the lowest socioeconomic group as in the highest socioeconomic group. If the comparison between socioeconomic status (SES) groups is made while taking achievement into account, a different picture emerges. The dropout rate in the low socioeconomic group compared to the high SES group was double in the bottom half of the ability distribution, and roughly five times higher in the top half. Thus, about half the difference in the dropout rate between the upper and lower socioeconomic groups is explained by differences in achievement and the rest by differences in socioeconomic status.

There is some evidence that since the 1960s the dropout rate of higher-ability students has declined considerably, especially in the third quartile of the population. In 1967, by contrast with 1960, the number of students who failed to complete twelfth grade after starting this level declined drastically in the third quartile. There are considerable grounds for hypothesizing that the possibility of enrollment in postsecondary institutions favorably affects the retention rate. While this development

TABLE 2 Dropout Rates Between Tenth and Twelfth Grade by Ability and Socioeconomic Status (Per Cent)

Socioeconomic Status Quartiles	Ability Quartiles				
	Low	2	3	High	Total
Low	28.8	15.2	10.8	5.6	19.0
2	21.6	11.9	5.7	3.2	10.4
3	17.4	8.6	4.4	2.0	8.1
High	13.5	6.5	2.0	1.4	3.2

SOURCE: Project Talent, 1965.

may be a harbinger of what social programs can achieve in equalizing the number of years attained, we still have very little indication of the usefulness of additional years of education for persons with different levels of achievement or intelligence.

Some preliminary data on the earnings of males in the late 1950s and early 1960s is highly disquieting, and tends to indicate that additional years of schooling are not likely to contribute to earnings for persons whose general level of ability is low. Data from the U.S. Social Security System analyzed by Cutright indicates that the marginal contribution of additional schooling over and above primary education is much higher for males in the high-ability ranges than for those whose ability is mediocre or low[3] (see Table 3). Thus, it is not at all clear to what extent equalizing the number of years of school attended can serve to equalize incomes. Probably, to reach that goal, the equalization of achievement must be increasingly emphasized.

In theory, it is possible to equalize achievement by (1) introducing remedial measures which will equalize the learning rates of different groups of the population, or (2) applying a higher level of resources to those groups where there is a greater incidence of slow learners. These policies can be oriented to raising the average of a group, but it is unlikely that they will eliminate the variability within groups unless very precise, individualized prescriptions are worked out for each member.

EQUALIZING LEARNING RATES

There is now some evidence that human learning characteristics are shaped by the environment, and may be affected by efforts expended in

TABLE 3 Illustrative Contributions of Education to Income by Ability Quartile (Dollars)

	Ability Quartiles			
	Low	2	3	High
Primary School	1,238	539	215	191
Some High School	6,113	738	947	1,213
High School	2,081	1,860	1,308	na
College	–	–	2,848	3,456

na = not available.

SOURCE: Adapted from Phillip Cutright, *Achievement, Mobility, and the Draft, Their Impact on the Earnings of Men* (Washington, D.C.: Department of Health, Education and Welfare, Social Security Administration, O.R.S., Staff Paper 14, 1972).

the early life of a child. Benjamin Bloom of the University of Chicago has provided some evidence that one-half of the human traits of intelligence are formed by the age of four.[4] It is precisely in these critical years that environmental factors may determine future learning characteristics.

Bloom's hypothesis of the development of human characteristics can, with some license, be represented by the equation $h = a^{\alpha}$, where h is the learning rate, a is age, and α is an exponent equal to ½. The resulting formula shows that human characteristics related to learning are accumulated extremely rapidly during the first few years of life and more slowly later. Table 4 shows the rate at which these characteristics are accumulated.

If it is assumed that efforts or expenditures are more likely to affect the learning rate of a child during the period when these characteristics develop fastest, expenditures at a later age are less likely to affect human characteristics of learning than outlays earlier in life. If the effects on characteristics are proportional to the effort expended, i.e. a multiplicative model where the exponent of the resource function is one, the formula can be rewritten as $h = Ea^{1/2}$, when E is the unit of effort expended. We shall refer to E, for convenience, as a year of effort. Some arithmetic examples may illustrate the implications of this "learning curve" for educational policy.

Assume that in some social classes the effect of the environment is such that it produces a learning rate only seven-tenths that of the learning rate for other social classes. (This estimate is roughly in line with the Coleman Report's findings for the relative learning rate of children of poor parents. We shall not consider in this paper the effect of different genetic endowment or biological factors.) How much effort is required to bring h from .7 to 1.0? It can be estimated that in order to

TABLE 4 Rate of Accumulation of Human Characteristics Related to Learning (Increments of ½ for Ages One to Eighteen)

Age	Increment	Age	Increment	Age	Increment
1	1.000	7	.196	13	.141
2	.414	8	.183	14	.136
3	.318	9	.172	15	.131
4	.268	10	.162	16	.128
5	.236	11	.154	17	.123
6	.216	12	.148	18	.119

reach the desired level, the effort must be increased 43 per cent. ($E_1 a^{1/2}$; $.7\ E_2 a^{1/2}$, $E_1/E_2 = 1.0/.7 = 1.43$, i.e. $1.43 E_2 a^{1/2} = E_1 a^{1/2}$)

Pushing this analysis further, we can also calculate the amount of effort needed to have the average development of the slower group catch up. If more effort is expended during the first year, the answer is $43\ E_1$, as was shown earlier. If one neglects to take remedial action during the first year, the area under the growth curve at the end of year two of life is $.7 \times 1.414$ or .9898, i.e. .4242 units behind. The learning development rate in the second year is again 70 per cent of .414, equal to .2970. In order to catch up during this year, an additional 1.429 years of effort is required. Instead of adding .43 units of effort two years in a row, an additional effort of .57 units is now required. If the remedial effort is postponed to the third year, the child is likely to be .520 units behind, and with a learning rate of .2236, require 2.34 years of additional effort. In other words, by accepting this model, one perceives that in this case postponement has doubled the required effort.

At a later age, say nine, the needed effort is of gargantuan proportions. If the children's average learning rate was .7 during nine years, this segment of the population is now 2.7 years behind, and the equivalent of 23.2 units of effort is required to close the gap. This is a formidable, if not impossible, challenge.

The challenge becomes even more awesome when one assumes that the outcome of additional efforts is not simply multiplicative, but that incremental efforts have a smaller effect on the development of learning characteristics. For instance, if an exponent of .5 is attached to the effort function, and the expression is rewritten as $L = E^{1/2} a^{1/2}$, more than double the effort (1/.72) is required to achieve the required results. The effect of postponement would then be even more dramatic. We would require roughly six units of effort to make up the differences in the second year, and the cost of doing nothing during the first year would be equivalent to the cost of four years of effort. The crucial unresolved issue in the whole matter of affecting human characteristics is whether a group can be brought to a higher learning rate permanently, or whether the effect is a temporary one, with additional infusion of resources needed to keep the learning rate up.

Because of the somewhat primitive analysis to date, however, we can only make wild guesses about what is likely to happen to experiments that try to affect the learning rate. On the other hand, the impact of changing learning rates on the level of required additional effort is not to be underestimated. If the difference in learning rates between social groups can be reduced by one-half through enrichment by age six, it can be hypothesized that the learning rate of deprived populations, now approximated by the coefficient of .7, could be increased to .85. This increase could dramatically reduce the outlays needed for remediation.

In all probability, the learning process does not depend merely upon the student's ability or speed of learning. To some extent, it also depends upon the stock of knowledge which has been accumulated up to a given time. Perhaps it can be represented as a function of both the learning rate and the previous stock of knowledge S.

$$\Delta S_j = S_{jt} - S_{jt-1} = (\alpha E_{ij} a^{1/2} + \beta S_{jt-1}) E_j$$

A given unit of learning ΔS_j will require an amount of effort proportionate to the sum of $(\alpha E_{ij} a^{1/2} + \beta S_{jt-1})$. If this formulation is accepted, the postponement of offering a given unit 1 till βS_{jt-1} reaches a certain level will allow a smaller expenditure of effort to be expended to master it than if it is presented to the student earlier.

The considerations above are put forward to make a simple point: it is quite likely that production functions in education are not uniform for children of different ages or of different abilities.

TOWARDS AN ECONOMIC ANALYSIS OF THE EDUCATIONAL PRODUCTION FUNCTION

The role of education (measured by scholastic achievement tests) as a neutral filter has been demonstrated by Case in an imaginative analysis of the Equal Opportunity Report. Case found that the children of parents with a low educational attainment stayed the same number of standard deviations behind the children of rich parents from grades one through nine. Only in grade twelve, after the worst students had dropped out, was the difference between children of parents with a grade-school education and those with a college education somewhat narrower than at grade one.[5]

Among educators, this gap has been ascribed to the failure of the school and the family, but it remains for an economist to try to quantify the interaction between family and school and to attempt to assign some numerical values to the influence of these two important factors in determining achievement.

Denis Dugan, while a Brookings fellow, spent a year at the Office of Program Planning in the U.S. Office of Education trying to estimate production functions which would take into account the contribution of both the home and the school. In a nutshell, Dugan's models try to estimate the contribution to children's attainment made by parents as well as by schools.[6] This is a much more realistic description of the situation than one which assumes that all learning originates in the school. Using information from the Equal Opportunity Survey, Dugan attempted to explain inequalities in educational outcomes as a function

of both parental investment, during preschool and school years, and school investment.

The value of parental investment was measured by a proxy of average earnings of persons with different levels of education. School investments were considered to be equal for children in all social classes. As with many pioneering efforts, many factual and methodological questions can be raised about the precision or even reasonableness of the estimates, but the present writer, who helped develop the Dugan model, believes this approach throws more light than confusion on the dynamics of learning.

Fundamental to the whole model is the estimate of parental contribution to children's learning. The model assumes that parental contribution or investments could be measured by, or at least scaled in proportion to, the opportunity cost, i.e. the market price of the time which the parents devote to the cognitive activities of their children during the years from birth to age eighteen. These expenditures are then lumped with the costs of formal education to arrive at a total cost.

In this expanded view of the educational process, total educational investment is substantially greater than formal school expenditures. For instance, at grade nine, the cumulative value of parental investment is roughly $19,800, or 81 per cent of the total educational investment—totaling $24,500—for a child whose parents are college graduates, as contrasted to 53 per cent—i.e. $5,500 of a total of $10,500—for a child whose parents had less than an eighth-grade education. These startlingly high estimates of parental contribution to education were derived on the basis of fairly conservative assumptions. Thus, it was assumed that a mother spent 43 per cent of her time in the preschool period with her child or children. In cases where several preschool children were in the house simultaneously, the mother's time was allocated partially to each child. During the period of formal schooling, 5 per cent of the mother's time was allocated to educational activities of children and 5 per cent of the father's time was allocated to the educational activities of children. The parental services were divided up among the children in the family.

In the calculations which related the stock of services to the attainment of the child, the contributed services of both parents and of the school were compounded at a rate of interest of 5 per cent to differentiate services provided in different time periods. In effect, the method of accumulating these services took into account the alternative investment opportunities available to both parents and society.

These estimates were used to derive a set of production functions which explained the achievement of students as a function of the capital embodied in their education. Suffice it to say here that one model which attempted to explain the difference in resources was in a linear multiplicative form, and the other was of a nonlinear character. This later

model was transformed into the linear-in-the-logarithms function, which can be estimated by regression analysis.

While the linear model assumes equal returns in all ranges of the "production function," the nonlinear model implies decreasing returns to scale. Intuitively and empirically the nonlinear model seems to describe the learning process somewhat more realistically and accurately, since the regression coefficients for this model are somewhat higher than those for the linear model.

Using the empirical results of this model, it is possible to calculate the amount of expenditures which may be required to close the gap between a disadvantaged group and one which is relatively more advantaged. Below we cite some examples, taken from the United States experience, of expenditures which would be required to equalize the achievement of black children—whose parents on the average have less education—and that of white children.

The cumulative investment which would be required to equalize achievement between these two groups by grade nine (age fifteen) is $6,999 according to the linear model, and $18,177 according to the nonlinear model. There are two reasons why the required expenditures are higher with the nonlinear model. In the first place, the marginal rate of substitution is less favorable, i.e. lower, for school expenditures, as compared to parental outlays, in the nonlinear model. Second, the effectiveness of resources applied in the school increases less than proportionately when incremental expenditures are added to school resources.

There are several ways of looking at the results of the model. If the resources of the white home environment were made available to blacks, it would appear that 90 per cent of the difference could be made up by the infusion of parental resources. In other words, even then, something extra is needed to have black students come up to the white average.

Another way of looking at the results of such an analysis is to examine how much of the achievement gap could be closed by increasing school resources. Again, the empirical results, for whatever they may be worth, indicate that most of the gap between whites and blacks in the United States can be closed if resources are increased by 75 per cent with the linear model, and that even an increase in resources of 150 per cent would not quite close the gap with the nonlinear model.

An interesting implication of the model is that cultural differences play a role in the effectiveness of parental investments. To what extent those differences are due to differences between black and white cultures and to what extent they are a reflection of the rural origins of many blacks deserves further investigation. The higher than expected educational attainment of Jewish and Oriental children has often been cited as

an exogenous cultural factor. Yet, we have very little information on the power of this factor in producing learning.

The analysis above is only a step in the right direction in analyzing learning in a realistic context. It would be well if the model were broadened to take into account the contribution of children's school peers to their attainment. An analysis of the Equal Opportunity Report indicates that the influence of the school cannot be separated from the social background of the student. As Alexander Mood has pointed out: "Speaking very roughly, when one looks at variations in achievement scores between pupils, about 65 per cent of it occurs between pupils in the same schools and about 30 per cent of it occurs between schools."[7]

Such a study of tradeoffs should be very high on the agenda of the economics profession because economists handle problems sequentially, having been trained to accept the ceteris paribus assumptions. Their conclusions, right or wrong, are easier to understand and are more likely to have an impact than those of other social scientists.

MORE ON PRODUCTION FUNCTIONS

It may appear paradoxical that a concluding paper of a conference dealing with education as an industry should raise more problems than it can answer. Yet it should be realized that economists have only begun to analyze the problems of education as an industry. Up to now, most of the economic analyses of education discussed cost/benefit problems where the assumption was that the output of education and costs are uniform for the purposes at hand. The opening up of the topic of education as an industry makes it imperative to look at a new set of problems.

Once one starts looking at differences in costs caused either by variations in the number of factors applied or in their quality, the definition of production functions becomes even more difficult. We are currently not too sure about how the factors should be combined or what attributes of production factors should be measured. Henry Levin has pointed out that teacher quality plays an important part in determining the student outcomes.[8] A similar finding was documented by Piccariello in a study of deviant schools, where the achievement of children was one standard deviation above or below the one expected, given the school's socioeconomic composition.[9]

Those economists who have worked with educational production functions have often suspected that some factors which are currently being used to improve performance are probably redundant and contribute

little or nothing to the learning process. By contrast, other factors which are not measured play an important part in determining achievement.

Attempts to determine tradeoffs between capital and labor have been especially frustrating. There are some indications that the value of school plant plays no role in influencing achievement.[10] There is little or no information about the effect of adding educational hardware in the school setting, or its role in affecting learning. Anyone who has ever ventured into the schools to observe what happens must conclude that variations between schools may be caused more by variations in the way personnel or equipment is used than by variations in the level of resources devoted to teaching. The presence or absence of a language lab, for instance, does not foretell the possible achievement of students in foreign-language studies. In many schools, the labs exist but are not used. These variations in practice have discouraged investigations of capital/labor tradeoffs in schools.[11] Only if we moved to teacher-proof systems of instruction might such analysis become easier.

Perhaps while we think of new methods of tackling this difficult problem, we may wish to analyze variations between schools at a lower level of generality. Economists have been known to make contributions in understanding the effect of organization upon output. Investigation of the organization of the American school may not be out of place. For instance, analyzing the findings of the international study of mathematical achievement may yield some interesting insights.[12] If this study is to be trusted, our educational system is not producing achievement which is anywhere near the acceptable level. Thirteen-year-olds in the United States perform well below Japanese students of the same age. The lower achievements were especially surprising since our standard of living is higher, our teachers are trained longer, and the resources we spend on education are higher.

The chairman of the International Project for the Evaluation of Educational Achievement (International Education Association), Benjamin Bloom, has hypothesized that the organization of the classroom had a great deal to do with the gap in achievement. Based on some educational theories of John B. Carroll,[13] he and his students have been running experiments to change the competitive atmosphere of the classroom to a cooperative one. They have also organized a hierarchy of remedial services to insure that students understand basic concepts before moving on to more complex applications. I understand that the results so far have been encouraging.

Perhaps if labor economists become interested in this problem, they may contribute to improving the effectiveness of schools. They may also contribute to a reorganization of curriculum choices. A cafeteria approach to curriculum may be hampering teaching and learning. The

effects of multiple-course objectives upon motivation must be traded off against the difficulty of teaching under circumstances where multiple roll calls, administrative announcements, and cumbersome traffic regulations dominate the management concerns of the school.

The popular notion that a principal can make or break a school may also require examination by economists. Are there optimum ratios of supervisor to teacher? To what extent is it possible to trade off supervisory personnel at a lower pay for supervisory personnel who are paid relatively more?

While an analysis of education as an industry has been started for elementary and secondary education, little effort to link inputs with outputs has been evidenced in postsecondary sectors. The studies of Astin and his associates appear to indicate that there is a very high correlation between entering freshmen's Scholastic Aptitude Test scores and Graduate Record Examination scores.[14] This stability seems to hold for a large number of schools, irrespective of the level of resources expended.

These results are equivocal because the majority of postsecondary institutions cater to relatively homogeneous student bodies in terms of ability. We also know that the resources expended on education are roughly proportional to the ability of entering freshmen. Able students enjoy more resources expended than those who test less well.

An interesting hypothesis has been advanced by Lloyd Humphreys in an unpublished paper on the nature of intelligence. Humphreys claims that the effect of good schools should not be considered neutral and that the expenditure of resources has prevented the student body from regressing toward the mean. Humphreys' hypothesis certainly deserves testing. It would be interesting to rescale our expenditures with this hypothesis in mind and come up with a price for excellence, or at least above-average achievement. In order to perform this analysis, we would have to disaggregate the data from the less prestigious colleges and try to isolate the outcomes of students of above-average abilities in settings where expenditures are below average.

The whole matter of outcomes in higher education is extremely vexing. Postsecondary education has been justified on a variety of grounds, many of which appear to be intuitively reasonable. Some of these have since proved wrong, while others cannot be readily quantified. The most attractive argument for justifying further schooling is the demand for skilled manpower in a highly technological society. This argument is heard less and less these days as the output of postsecondary education is meeting, if not exceeding, the demand for professional, technical, and managerial workers. Forecasts of these developments were heard, but not heeded, some seven to ten years ago.[15]

Another argument used to justify postsecondary education is increased social awareness, translated into more frequent or more enlightened voting. Schultz has pointed out, in that connection, that this is one of the more expensive ways of getting high voter participation.[16]

Another argument, and this does seem to hold water, is that higher educational attainment results in longer participation in the labor force for men, i.e. greater flexibility and adaptability to change. For women, the results are even less equivocal. Labor participation for women of all ages substantially increases as their educational attainment rises.[17]

It may be reaonably argued that it is too early to ask the question: "What are we buying?" before homework has been completed on the costs of various levels and kinds of education. Although we do know that instructional costs vary both by level of instruction—lower-level undergraduate, upper-level undergraduate, and graduate students—and by type of curriculum—humanities, social sciences and physical sciences—the variations between individual institutions may dwarf the variations between levels and disciplines. A study at the U.S. Office of Education, which attempted to classify institutions along conventional lines—universities, four-year liberal arts colleges, teachers' colleges and junior colleges—threw very little light on why costs varied. It did raise some questions. Thus, private institutions spent somewhat more on undergraduates than state institutions; on the average, the cost of instruction of lower-level undergraduates is no less in junior colleges than in state institutions; and so on.[18]

Perhaps the data were equivocal and inconclusive because rough measures were used to allocate costs between graduate and undergraduate students. It may not be sufficient to divide salaries of senior faculty by the number of credit hours paid for by graduate students to derive a credit-hour cost. The status of the graduate student in a university is more complex. If my impression is correct, the presence of graduate students may reduce the cost of teaching undergraduates. Also, much of the funded research of senior faculty would probably be priced out of the market if they did not have access to cheap graduate-student labor. This question is raised despite the fact that I have little hope that it will be researched.

Without good cost information, we are left with the impression that bachelor's, master's, and doctorates cost vastly different amounts to produce. The variation is present within the same school and is probably even wider between schools. The costs to students also vary widely. The amount of the subsidy, i.e. costs less tuition, seems to favor able students. Able students get more resources expended on them. Generally, they do not pay the full excess cost of these resources. We are thus left with the unresolved question of whether the traditional pattern of rich

schools attracting gifted students is justifiable, or whether we are pandering to an intellectual elite, largely the children of the well-to-do.

AN UNCONVENTIONAL VIEW OF EXTERNALITIES

It is now fashionable to look at the spillover effects of industry. We are just as worried about automobile exhaust fumes as about the car's cost in getting us to and from work. In the case of education, one of the externalities, the effect of education on income distribution, has not received the attention that it deserves.

In the elementary- and secondary-school sectors, additional attention should be paid to achievement levels. Currently, most of the analysis of returns to education has assumed that the number of years of schooling is what matters. In the postsecondary sector, where some part of the education is subsidized, though only a fraction of the population participates in the postsecondary experience, an even closer analytic look at what is produced is advisable.

Conventional cost/benefit analysis in which additional income was ascribed to a college education was based on the experience of a period during which (a) college places were rationed, and (b) subsidies, though substantial, did not provide subsistence allowances to the majority of needy students. Under those circumstances, it was quite likely that returns to postsecondary education would be high. In the first place, only the most able students with low-income parents gained access to postsecondary education; second, fewer college-educated persons were produced than were demanded by a society in which technology was advancing rapidly.

It would be interesting to describe a system where the differentials in incomes are kept to a minimum and the required number of college students are educated. In order to achieve this goal, every subsequent level of attainment should either cost less than the previous one, or have a lower internal rate of return. Subsidies are an obvious way to achieve this goal. It was argued elsewhere that subsidies to college students will reduce income differentials because the amount invested will be reduced, even if the expected rate of return does not change. It is also quite likely that the existence of subsidies will tend to depress the expected internal rates of return. The internal rate of return may very well depend upon the amount of the investment and the risk of not completing college for financial reasons. Thus, subsidies may have secondary income-leveling effects.[19]

From a policy point of view, it is imperative to estimate which proportion of the eligible population would be attracted to college, given different levels of subsidies, and what their subsequent earnings would be. It is quite likely that subsidies to students are going to claim large sums of public budgets because the student's investment, i.e., the cost of tuition and living expenses, is probably going to be an increasing burden to a larger number of American families. It has been creeping up as college costs escalate more rapidly than they were projected to in 1969, and an increasingly large proportion of personal income may be consumed by college expenses.

It may be necessary to estimate the burden of college expenses in relation to discretionary purchasing power—a concept developed by the National Industrial Conference Board—to quantify the amount remaining in the hands of consumers after net contractual savings and outlays for essential goods and services have been made.

In 1965–66, full-time undergraduate student costs were estimated at $4.9 billion, or 1.8 per cent of discretionary purchasing power. In 1968–69, they rose to $6.6 billion and amounted to 2 per cent of discretionary purchasing power. By 1975–76, it is quite possible that undergraduate costs will amount to $11.8 billion and may claim as much as 3.4 per cent of discretionary purchasing power. Even when grants and loan funds are subtracted from undergraduate outlays, the discretionary purchasing power devoted to paying for student undergraduate instruction is found to have risen 1.4 per cent to 1.7 per cent in 1969.[20]

Although these percentages seem small in relation to total discretionary purchasing power, it should be remembered that only one family in ten has children in college at any one time. Hence, possibly as much as one-third of the discretionary income of a typical family with children in college may be consumed by undergraduate outlays in 1975–76.

The increasing burden of college expenses, even in the upper-income groups, is no longer a trivial issue. An examination of costs is especially timely because of the new trend toward substituting loan funds for grants to the majority of the students. The current administration's proposals also place fairly low ceilings on the total amount of grants and loans available to all students, thus forcing a large number of children to attend low-cost community-type institutions.

The reasonableness of this policy, in the light of probable declines in the relative benefits of a college education, calls for some careful examination. The whole matter of available spaces, available subsidies, and the future supply of college-educated personnel should be viewed in the context of (a) meeting the social aspirations of Americans for a college degree, and (b) what they will actually receive if they get one, both in monetary and psychological terms.

CONCLUSIONS

Economists have tended to be very pleased when they could fit functions to the behavior of students or institutions so as to show that these groups' activities could be explained in rational terms. Beyond that, only a small number of economists have tried to crack the difficult problem of the educational production function.[21] Others have tried to measure the effects of changing the resource mix, or the levels of resources expended upon the education of slow learners, euphemistically called the disadvantaged.[22]

All of these efforts are to be welcomed, and they do contribute toward a better understanding of education as an industry. Yet they fall short of the goal of providing policy prescriptions, which may result from broader and more ambitious modeling of the process of learning and its consequences.

This paper has argued that a better understanding of learning theory may contribute to the building of more realistic educational production functions. It has implied that simple models of learning would prompt investment early in life, rather than later on. Also, it has indicated that the curriculum for slow learners must be special, not only in content, but also that its "power" should be several times higher than that of conventional curricula.

The implication of models of learning which broaden the relevant inputs to both family and school make this last argument even more compelling. For instance, in the Dugan model, in order to close the gap between blacks and whites and keep remedial expenditures at a reasonable 25 per cent of regular outlays, a technology 1.5 to 2.0 times as effective as the one used today must be devised.[23]

Since economists are generally concerned with tradeoffs, it would be well to look at tradeoffs in curriculum structure, organization of the classroom, school socioeconomic composition, and the relevant variables in the educational production function to devise an effective educational system. Only very modest beginnings have been made in this direction.

In the elementary and secondary educational sector, arguments about quantifying the outputs of the educational system beyond reading, writing, and arithmetic, to encompass other outputs such as citizenship, career orientation, and life adjustment, have been so free-form as to discourage economic analysis. While economists have been rightly discouraged by the vagueness of the debate on outputs, they should join it if for no other reason than to introduce educators to the concept of joint products. If educators were made to realize that a semiliterate person is less likely to make a satisfactory adjustment to the twentieth century

world, this would dampen the ardor of those who argue that adjustment should be emphasized at the expense of reading.

The financial crisis in postsecondary education, which is already upon us, will certainly require even more attention to the outputs and purposes of colleges and universities. Issues such as the equalization of income will probably be mentioned more often in the face of a more generous supply of college graduates relative to demand.

Some recent projections for 1980, prepared by my staff and myself, place the supply of persons with bachelor's degrees at roughly 7 per cent over the demand for persons with this educational attainment. Thus, it is quite likely that the opportunities for college graduates to find employment in professional, technical, and managerial occupations will decrease considerably. The unemployment rate, which was practically nonexistent among these categories in the 1960s, may then go up drastically in the 1970s. (In the first year of this decade, unemployment among professional, technical, and kindred workers increased from 1.0 to 2.5 per cent.) These projections are based on naive extrapolations of past trends. It is quite possible that the lower B.A. recipients may fill less-skilled jobs. It is also possible that the more generous supply of college graduates in relation to demand may retard earnings growth for this type of labor.

Looking at education as an industry, it would be interesting to study how individual colleges and universities will be able to differentiate their product from that of others. Pressure to differentiate products is much more likely to be present in a buyer's market. It will also be interesting to see to what extent the customers of the institutions will be able to gauge the advantages to be gained from attending expensive versus cheap schools. The behavior of consumers of various types of postsecondary education is hence likely to become more important to institutions.

The reluctance of state legislatures and private donors to escalate their support to this sector will either: (1) force students and their families to shoulder a larger share of postsecondary costs, or (2) have the federal government carry an increasing burden in financing students. Unless there are drastic changes in the attitudes of the federal government, the level of support per student which it is willing to shoulder is not likely to meet the institutions' rising deficits per student. Could it be possible that expensive institutions will have unfilled places? No one is ready to make this forecast yet. But such an eventuality is not ruled out.

The problems of education in the next decade will be serious. Now is the time to build a macromodel, based on the scattered findings of micromodels such as the ones presented at this conference.

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11 COMMENTS

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Froomkin points out that his paper raises more problems than it can answer. In a discussion of policy toward the education industry, such a conclusion should be neither surprising nor disturbing. The important issue is whether the problems raised and the ways in which they are presented contribute to possible solutions. In the following remarks, I first discuss Froomkin's paper in terms of its contribution to better understanding and resolution of policy issues in the education industry, and then indicate some of my own views as regards a useful framework for these purposes.

This paper, as most of those presented at the conference, views the study of education as an industry primarily from the standpoint of the educational production function. Also, as in the other papers, education is virtually identified with formal schooling. As a result, the discussion of policy issues in education becomes almost inseparable from the problem of the proper specification of the production and cost functions of schools. Froomkin appears to share the general presumption that, difficult as the task may be, once these functions are specified, educational policy can proceed in accordance with the well-known principles of economic maximization. Henry Levin's contribution to the conference provides a thorough exposition of the application of these principles to education.

The propriety of concern for educational production functions can scarcely be questioned. Warnings about pitfalls in both the estimation and use of empirical studies of such functions may serve to improve the techniques employed and the sophistication with which results are related to policy. When, however, the subject is "policy issues" one hopes for more than

another interpretation of the implications of input-output relations for resource allocation decisions in schools.

Froomkin does provide, early in the paper, an indication of his conception of the essential policy problem in the education industry: "Education is being asked to equalize opportunity and control costs at the same time." He suggests that the first step that economists can take to solving this problem is, "to build models which describe what is happening in the educational process." If I interpret Froomkin correctly, the economists' models should treat equality of educational opportunity as the objective function. But, as Froomkin shows by reference to a variety of data and analysis, years of schooling received, performances on test scores, dropouts, earnings for those with equivalent years of schooling but differential test scores, and virtually all other operational measures of educational opportunity, reveal it to be concentrated among those already privileged and powerful.

What is to be done? Froomkin, if I read him rightly, suggests compensatory remedial and enrichment programs. However, he finds no basis in the empirical studies of school production functions for decisions about the character, intensity, and timing of such programs. Under these circumstances, he turns to learning theory to provide estimates of the nature of the required enrichment or remedial training.

This is rather like using engineering specifications to estimate production functions in manufacturing, and its results are at least as arbitrary. This is not to say that learning theory is irrelevant to the matters at hand. But, because Froomkin chooses so general a learning hypothesis (learning rate $= \sqrt{\text{age} \times \text{educational effort}}$) his conclusion is trivial and without significant policy implications: "it is quite likely that production functions in education are not uniform for children of different ages or of different abilities." We do not need learning theory to draw such conclusions. Instead of substituting the most general of hypotheses about learning for empirical analysis of the schooling process, what is needed are attempts to substantiate detailed hypotheses which relate specific learning situations to particular consequences or outcomes.

Froomkin next takes up the problem of the interaction of the school, the pupil, and society in the determination of scholastic achievement. Scholastic achievement, a proxy for educational opportunity, should be equalized. If the school is to accomplish this, it is necessary to distinguish in-school from out-of-school influences. Here, however, Froomkin prefers parameters derived empirically rather than from learning theory. In this context, Froomkin reports on an approach he and others have developed for summarizing family influences on pupil achievements in a single continuous variable representing the amount of parental investment in their childrens' education. For the first time in the paper, the idea that education can be other than schooling arises, but only to avoid biasing estimates of the effects of in-school factors. My objection to the concept of parents' investment in childrens' education is that it, too, is so general that it ignores important underlying details. Of course, the variable, as measured, works in regression analysis of pupil achievements; it essentially substitutes for conventional

socioeconomic (SES) status variables. To achieve the full potential of this sort of approach in the explanation of scholastic achievement requires rather detailed specifications of the amount and type of interaction among family members and the prevalence of such interactions across families.

The method reported on by Froomkin, however, incorporates none of this. A measure of educational investment derived by assuming that all parents spend equivalent time in educational activities with their children, and then weighting this equal time by the differential potential earning power of the parents, can reveal nothing about the different achievements accomplished through various types of parent-child interactions nor about the prevalence of such productive practices among various groups in society.

A better specified measure of parental investment would permit, among other things, a test of the significance of the association of pupil performance and parental attitudes toward school as found in the Plowden Report on *Children and Their Primary Schools* in England. The strongly positive association of students' performance and favorable attitudes of their parents toward schools may be a reflection of the time spent by such parents in educational activities with their children. If so, it would cast doubt on the policy of attempting to change the attitudes of parents of low SES and suggest instead the need for changes in their behavior.

Froomkin concludes by pointing to some of the problems which remain unresolved due to lack of knowledge of the educational production function. These include the inability to specify tradeoffs among school inputs, especially between labor and capital and among types of labor, the ignorance of the effects of alternative organizational structures, the failure to establish a hierarchy of goals, and even the mundane matter of the costs of existing school programs.

Policy conclusions deal primarily with suggestions for further study. Thus, Froomkin worries about the projected surplus of secondary school graduates in relation to the rising costs of college education. This leads him to wonder how colleges will vary their products to avoid unfilled places or how future earnings of college students may be affected. He regards the application of learning theory to education as potentially highly fruitful. Finally, he avers, "Now is the time to build a macromodel based on the scattered findings of micromodels. . . ." But, this conclusion hardly seems warranted by what has gone before. We have little firm knowledge of production relations in schools, no model of the interaction of schools and other sources of education, and, most important, no substantive treatment in Froomkin's paper of the interrelation of educational outputs and the economy or society. Without specification of the structural relations between education and manpower, output, and economic growth, it is difficult to conceive what a macroeconomic model of education might be like. Surely, such macromodels cannot be built solely out of the findings of micro cost or production models. One component of a macro educational model would, of course, encompass production of education, but this part would have to be structurally integrated within a wider system whose elements are not mentioned.

It is probably evident by now that my major reservations about the present

paper concern the omission of what appear, to me, to be the truly important issues of policy for the education industry. To treat schooling as the totality of the education industry diverts attention from perhaps the most basic policy question. What are the consequences of alternative mixes of educational modes? These include formal schooling for the young; informal education in homes, churches, and community organization, and through personal interactions; books, television, and other media; job-related education; and organized adult education—in specialized schools or through other institutions, including labor organizations and the military. Possibilities here encompass both combinations of modes and the timing of exposure to various modes over the lifetime of the individual. A recent study of the Educational Policy Research Center of Syracuse University has shown more people involved in the educational periphery than in the formal educational core. The identification of education with schooling so narrows the alternatives that the analysis of policy choices in the education industry tends to degenerate into studies of school production functions and their inevitably ambiguous implications for policy.

Even taken on its own terms, Froomkin's perspective does not at all recognize contemporary criticism of the school as an organization which promotes conformity and individual repression. Policy toward education as an industry cannot ignore the role of schools in fostering racism and stultifying intellectual and emotional growth. Without accepting in full the views of Kozol, Silberman, Kohl, Illich, and others, economists concerned with policy must look beyond the resources needed to attain minimum standards, or to achieve equality in the performance of schools or of pupils, to the question of whether any of these performances are personally or socially destructive. Clearly, this point is related to the previous one. If the production function in schools cannot be altered to reduce their destructive effects to tolerable limits, greater emphasis on alternative educational instruments is called for. Limitations of measures of output to pupil performance provides no information on these vital matters.

A most useful area of policy-oriented research would be to examine the organizational, staffing, and other implications of some of the more radical proposals for school reform. So far, little is known about differences in the administrative and personnel requirements of various proposals for extensive modification of the conventional classroom situation. No amount of empirical analysis of existing schools will provide cost and output information about as yet untried models. Ultimately, pilot studies may yield some of this information, but preliminary analysis can suggest what one or another of these alternatives would look like in operation, and what might be its input requirements and organizational character.

If the school is to change—not simply to provide all with equal opportunity but to enhance human potential—new forms of control, governance, and finance are necessary. Here is a vital area for policy, and although Froomkin makes mention of school organization as a factor influencing productivity, he does not discuss alternatives and their possible significance. In addition to the conventional concerns of public versus private operation and finance of

schools (i.e. the problem of pricing) we need to turn our attention to how such arrangements as a school inspectorate, central influence over curriculum and location of school buildings, and nationwide collective bargaining for teachers might influence what happens in classrooms. Evidence of many of these matters is available from comparative analysis of education, especially in Western Europe. For example, the studies of comparative pupil achievement by the International Association for the Evaluation of Educational Achievement hold promise of exposing relations between achievement and types of school organization and control with which we in the United States have had little or no experience.

Finally, in addition to looking at the school within the context of the entire educational system and at its social, cultural, and political effects, policy requires attention to linking skills learned in school with future demands for them. Policies toward schools must be concerned with curriculum, with the mix of special and general training and the timing of specialization, with the availability of places in various fields in higher education, and with incentives for students. All these, in turn, must be rationalized with sources of training other than schools. Froomkin touches on some of these points, but his overriding concern for internal production relations leads him to gloss over them.

Equality of schooling is an important concern. We must know something of the consequences of inputs on outputs in schools. The education industry, however, extends far beyond the formal school. Proper concern for the inputs provided and the outputs produced by schools greatly transcends the question of whether all pupils enjoy equal amounts of either. If the future of our society is dependent upon education to a substantial degree, discussions of it, especially by economists, must concern the relations of the school and other educational institutions to the economic and social order and to the determination of man's place in it.

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Economists have already made important contributions to the study of policy issues in education. Most of their theroretical and empirical contributions to the examination of such issues have been at the macro level, utilizing rate-of-return techniques to assess the effect of investments in education. As a result of the work of Becker, Dennison, Hansen, and others, we are now able to address ourselves, although crudely, to such important policy questions as: How much should society invest in education as opposed to other public and private undertakings? How should resources be allocated among the various levels of education? What is the cost/benefit relationship associated with major technological alternatives, such as the increased use of

educational television? Is the productivity of educational systems increasing or decreasing over time?

Since this conference has been devoted to the analysis of education as an industry, Froomkin's paper is properly concerned with micro- rather than macroanalysis. He discusses economic production functions, which provide a means to deal with problems of resource allocation within educational systems. While these studies are still at an early stage, the work of Kiesling, Levin, and others may well lead to better resource allocation within schools and school districts.

As a person whose prime interest is in the improvement of education, I welcome the contribution which Froomkin describes. In my opinion, economists are uniquely able to deal with the kinds of issues that govern the development and operation of educational systems. In particular, they can attempt to deal with the recalcitrance of systems that appear to be committed to practices leading to constant or even decreasing productivity.

The difficulties facing economists as they approach these problems are immense. In particular, they must recognize that the main dependent variables at their disposal (in particular, student achievement) are psychological and not economic. Furthermore, the independent variables also tend to be based on psychology and sociology rather than economics. The tools of microeconomics can therefore be applied to education, but a great deal of patience and a willingness to work with scholars from other disciplines are required. In other words, production-function studies can be most meaningful when approached from an interdisciplinary framework.

A prerequisite for success is an understanding that important and sophisticated work has already been conducted by scholars in other fields. The literature in child development is extensive.[1] There are numerous empirical studies dealing with the education of the disadvantaged. Research into the relationship between learning patterns and students' backgrounds is well advanced.[2]

However, these psychological studies usually ignore such basic economic concepts as cost, and hence the feasibility of proposed treatments is often doubtful. Economists with their tools of marginal analysis can provide an input which is indispensable if psychological studies of learning are to be put into practice. Since most empirical work in education has lacked an economic dimension, new experiments which identify the parameters of production functions, and which can determine the degree to which one set of inputs can be substituted for another are required.[3] This approach appears much more promising than the continued mining of questionable cross-sectional data.

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