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HOMOGENEITY IN EDUCATION

A comment on the economic theories

of education

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Introduction

During the first quarter century after W.W.II, most Western countries experienced rapid expansion of their educational systems, especially marked in higher education. This expansion was often supported by widely held optimistic assessments of the potential benefits of increased education in promoting economic growth and also in contributing towards an equalization of incomes. The human capital approach, developed during the same period by Chicago economists, provided a way of more strictly formulating the basis for these assessments and of incorporating the educational system into the main body of economic theory. Its conceptual framework made it possible - or so one hoped - to derive testable statements about the impact of education on productivity and growth and about the way the spoils of this growth were divided between individuals and between functional and educational categories.

In the last few years retarded economic growth in many countries has seemingly put a brake on both demand for higher education and the flow of tax-money available for educational expansion. At the same time the mood seems to have changed among both decision-makers and analysts. In discussions on educational policy, in West-european countries at least, one is now less apt to take the economic benefits of increased education for granted and more concerned with the qualitative direction of the educational system.

More than ever before there is an acute need for answers to the central questions about the economic role of education - what does education do to people, what do educated people do to production and what do they get out of it? So far economic analysis does not seem to have provided any clear-cut and wholly convincing answers in spite of the quite considerable empirical research work carried on during the last decades and the increasingly sophisticated refinements of human capital theories. The outcomes of attempts to measure the contribution of human capital to economic growth are still highly divergent and the methods very controversial. The distributional implications of the human capital theory have also been confronted with various kinds of empirical evidence especially in the form of estimated rates of return to educational investments. The results presented so far seem inconclusive and difficult to evaluate. While a considerable, sometimes major, part of income differentials can often be accounted for by educational differences, the existence in some countries of large divergences in the rates of return on different kinds of education and the unexpected degree of permanence in absolute and relative levels of these rates, even

during periods of rapid educational expansion, seems harder to accommodate at least within the simpler versions of human capital theory.

There are also rival ways of interpreting the evidence. One such alternative interpretation that has lately attracted a good deal of attention views education mainly as a filtering device, whose main function is to measure and certify the given inherited ability of the students. That this interpretation cannot be just rejected as obviously conflicting with the given evidence is shown by the continuing laborious search - so far not very successful - for discriminating empirical tests to be used for choosing between the alternative theories. Since the policy-implications of the alternatives are in many ways radically different, this is certainly not a very reassuring state of affairs for the policy-makers.

At the same time developments in economic theory, especially the incorporation of uncertainty in general equilibrium theory and the outcome of the so called "capital controversy" in capital theory, seem to accentuate the need for a basic re-assessment of the economic theories of education and a search for new approaches.

The aim of this paper is to make a modest contribution towards such a reassessment by focusing attention on one particular assumption in the current economic theories of education. This is the assumption of homogeneity - homogeneity of people and homogeneity of education - which we consider to be of strategic and pivotal importance in giving direction to educational analysis and research as well as to educational policy.

1 The one-dimensional man of economic theory

In general economic theory man appears in two very different roles. As consumer, property owner, manager and organizer the individual is treated as a very distinct personality set apart from his fellow beings by his own characteristic tastes and endowments of wealth and talent. Considered as a factor of production on the other hand he is usually reduced to an anony-mous labor unit, whose hourly effort is indistinguishable from that of his fellow workers. The interest in economic theories of production and investment has traditionally been centered on real capital, which by being heterogeneous and immobile, supposedly defines the productive capacity of the firm or the economy. In contrast to this, labor - when defined as homo-geneous, mobile and in given supply - is simply an amorphous commodity to be utilized within the chosen production technique. It regains an independent role only when attention is shifted from production theory to the theory of employment and capacity utilization.

This tradition of treating labor as a homogeneous factor of production goes back to the classical economists, for whom homogeneous labor units also provided a "measuring rod" for economic values. Abstracting from individual characteristics may also have involved less risks for misrepresenting the economic realities in the early industrial period when produc-tion in factories was organized simply, utilized mostly manual skills, and dealt with unorganized labor in abundant supply.

With the successive increase in the relative scope and complexity of the "control sphere" of production and in the amount of specialized education and on-the-job-training in-volved, the assumption of homogeneous labor becomes much more difficult to defend. As increasingly more heed is paid to the vested interests of different groups in the labor market and the aims of social security are widening to include security of work of a certain type in a certain place, the assumption of mobile labor also becomes more contro-versial.

The tendency among economists to fall back on an assump-tion of homogeneous labor is not just an historical accident or due to analytical laziness. Instead it depends on certain

inherent characteristics and limitations of the economic approach to social reality.

Economic theory is - at least in its central core - a theory about commodities and the exchange of commodities. Commodities can be anything in this world, goods or services, as long as they are completely specified, physically, temporally and spatially. Economic analysis usually presupposes a given well-defined commodity space. Every commodity - be it green figs or the services of an electrical engineer - is a given well-defined entity, the amount and price of which can be expressed in real numbers. From the point of view of economic theory each commodity is a black box with a given precise label. What is inside that box - the qualities and internal organization of the commodity - is not of concern to the economist, whose analytical toolbox does not equip him for that task. Instead that task is supposed to be handled by divers technical, or psychological, expertise.

Man as the object of exchange in the educational and labor markets makes up a special class of commodities - commodity man, who is supposed to have all the necessary educational and professional labels to make him a well-defined black box. Once he is so labelled we can supposedly treat him analytically as just another commodity, whose supply and demand and market price can be measured unambiguously.

Given the commodity space, the primary task of economic analysis is to find analytical expressions for the various and intercorrelated activities going on in the economy. For our interest here it is enough to point out three main categories of such activities, education, production and consumption. Here again the economist's ambition is limited. What really goes on within these activities, how the qualities of commodities there are created and appreciated, is something left to pedagogical, technological and behaviorial specialists to analyze and express. The economist just takes it for granted that enough of this job has been done already so that he can start with a certain given description of education, production and consumption.

More specifically the description of technologies available for these activities should be given in terms of inputs and outputs of the well-defined commodities. This means the economist needs answers to questions of the following kind. If we put a certain number of men, with secondary school certificates and a given distribution of capability in some well-defined sense, through the existing process of higher education, what mix of doctors, engineers, economists and drop-outs can we get, how long will it take and what other commodities will be needed? How many engineers of different kinds do we need to keep a certain kind of paper process operation running at a given scale? How much paper of various kinds is needed for certain consumption activities, say small-boat navigation, and what is the output

of "satisfaction" as measured in terms of some individual utility index? Given all these "technological" data in terms of commodities or functions of commodities the economist can get started on his special task which is the analysis of how all these millions of divers activities are intercorrelated and controlled, in the most usual case by way of market pricing.

This division of labor, the specialization of economic analysis, has almost certainly been a necessary condition for developing that unified body of analytical tools - general equilibrium theory - in which economists take a justified pride. It has indeed proved most effective, as long as economists stick to their primary task, the analysis of intercorrelated markets. The treatment of man as commodity-man, a well-labelled but otherwise unanalyzed entity, is then a well-motivated analytical conveniance.

Problems will arise, however, whenever the economist oversteps these self-chosen limits and tries to use his tools to analyze the technology and the technological change in education, production or consumption. To do so successfully he would somehow have to break into the black boxes with commodity labels to find out how they are organized , what qualities they possess and why they possess them. This is what technology is all about and technological change means among other things a reorganization of commodity components and a new mixture of physical characteristics. In the case of commodity man used as production input he would need to know e.g. what the elementary skills and capacities are that determine how good a certain professional is at his job and to what extent he can be substituted by some other kind of commodity man. If they wanted to analyze technological change they would also need to know e.g. in what way this vector of skill requirements depended on the machines used and on the general work organization in production, etc. To follow this up with a similar analysis of education they must find out how the training of these skills depends on various multifacetted characteristics in the trainee and on the educational environment.

There are indeed economists that compete with other social scientists in studying these kinds of questions. But they cannot expect much help or guidance in this from the standard tools of economic analysis. Nor can they hope to arrive easily at results that are simple and general enough to be incorporated into standard economic theory.

What theoretical economists have normally done is to try and find a shortcut into technological analysis by way of simplifying assumptions. Since the paramount difficulty has to do with analyzing the heterogeneity of input and output commodities, the obvious way to try is to assume away most of this heterogeneity. We can e.g. try to describe production technology as if there exists only one kind of machines, one kind of labor, and one kind of output, although machines could be bigger or smaller and men more or less efficient. Even a truely staggering simplification

like this seemingly gains some sort of credibility by a superficial association to the financial concepts of total labor costs and total capital costs. Should we then manage to estimate a production function in these simplified terms - and such estimates have indeed been made by the thousands although it is somewhat difficult to say exactly what has been estimated - we have also found a way to deal simply with technological change. We merely define this change as measured by the change in efficiency in either the machine or the labor unit or both. Technological change is said to be capital-augmenting, labor-augmenting or neutral. An outside critical observer of this whole procedure would probably be apt to think that the attempt rather shows the economist in the role of artful dodger. Technology and its change has been analyzed under the assumption that there is no technology in any real sense that can be changed. An assumption of homogeneity can of course serve equally well if we move from production to education technology. Since the output of education is the labor input to production, assumed to be homogeneous, there must be only one kind of educational results, although individual results, measurable in labor efficiency units or units of "human capital", can be larger or smaller. To arrive at a simple unified formula for education technology, without having to peep inside the black box of commodity-man, we also need a homogeneous input. The student then may be more or less smart, but his degree of smartness should be measurable on some linear scale, in terms of some given efficiency or capability unit.

The homogeneity assumption in education would appear to be at least as hard to support or interpret in terms of real life, as the analogous assumption in production, on which it depends. Not only does it abstract from all questions concerning the structure of educational technology. In as far as education is a way of sorting out people with divers talents and of making use of their comparative advantage for a labor market requiring a successively increasing specialization of skills any homogeneity assumption would appear extremely misplaced.

The one-dimensional man of economic theory thus becomes a very displaced person when he is designated as the central figure of a theory of education. An economic theory of education that attempts to analyze simultaneously the technology of education and production, to explain the role of education and of educated labor within production technology, without breaking into the black box of commodity man, would seem to be doomed to end up in meaningless abstractions or trivialities. To analyze the conditions and fluctuations in the markets for educated labor is one thing - and well within the scope of traditional economic analysis. To try to explain what happens to a man who gets educated, and how this affects his physical contribution in production is something else - and far beyond the limits of applicability for the standard tools of economic analysis. This is our contention here. Let us first take a closer look at the most widely used economic theories of education to see how they appear from this point of view. To what extent do they rest on an assumption of homogeneous labor?

2 The homogeneity of human capital [x)]

The dominant school of thought in the economics of education builds its explanations around the notion of human capital, as reinterpreted and revitalized in the pioneering works of Becker and Mincer; see Becker (1962, 1964) and Mincer (1962).

Research work based on human capital theories has, during the last decade, been extensive, branching off into many divers directions. This makes it by now somewhat difficult to examine the conceptual basis of "the" human capital theory, or, more specifically, to establish the exact meaning and pre-assumptions of the human capital concept. The author has elsewhere (Ysander (1977) , appended to this book of essays) reported on a modest attempt to explicate the notion of human capital in spite of these difficulties.

Both in economic literature and in common parlance "human capital" is used with many different connotations and in widely different contexts. One trivial but important distinction here is between the notion of physical and financial human capital respectively. Any individual, viewed as a potential source of some kind of labor services, can be said - in the economic jargon - to constitute a physical capital, since 'physical capital', definitionally, refers to something that yields services. That most economists still choose not to treat individuals as capital goods in this sense in their models is mainly a question of practical convenience. As long as you are focusing your interest on market operations and are not especially interested in the rather special category of educational investments, calling people capital goods in the model would simply mean renaming the individuals without getting any analytical gain.

People are not sold on markets or owned by firms like machines. Neither are e.g. the benefits of on-the-job-training offered on the market with a price tag. This means that if you want to treat individuals as capital goods and really study how they change by participating in educational and production activities your model must incorporate distinctions and transactions that have no explicit counterparts in real life markets. If you want to do this in a general way - meaning in a general equilibrium context as

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x) In dealing with the problems in this section I have profited much from comments by Åsa Sohlman, who will present a more extensive analysis of the human capital concept in a forthcoming report within the same research project.

done in Ysander (1977) - it means i.a. assuming that households lease their human capital, i.e. their special labor capacity, to the firms under contracts which stipulate separate charges for the way these capacities are affected by the contracted work. In other words you must be able, always and everywhere, to account separately for all kinds of human investments and disinvestments. What you can gain by such a modelling effort is not really any new knowledge, but simply a consistent way of expressing yourself in discussing how an individual's working capacity develops over his life time. This general use of a concept of physical human capital certainly does not constitute any "human capital theory". It is more of a semantic convention.

The general financial concept of human capital is simpler and more straightforward. Any individual who can be expected to earn money in the future by selling his work services thereby constitutes a financial asset, whose value is the discounted sum of those expected future earnings. This financial concept of human capital can be used as a summary or shorthand notion in analyzing individual expectations and the way the individuals' choice of education and work may be determined by their earning expectations. This is again more a semantic convenience than a specific theory. "Human capital theory" could possibly be used as a kind of general name for all those theories about individual behavior in educational and labor markets that assume earning expectations to be an important determining factor. It would then be a very general name indeed. It can be shown that this financial concept can be worked into the general framework with physical human capital in such a way that you can define things like rate of return on human investments in a way consistent with the analogous definitions for non-human capital. This is not surprising and does not get us any closer toward a "human capital theory" in any more specific sense.

Any theory that is to have some substantial power of explanation must obviously be more than a way of framing concepts. Most of the research efforts of human capital theorists have been directed toward explaining various aspects of the income distribution in terms of human capital. What they are really trying to do is to reverse the reasoning that led to the financial concept of human capital. Instead of defining human capital as the discounted sum of future earnings, the task now is somehow to "explain" future earnings by means of a human capital concept that then cannot be financial but must be physical.

You are then really trying to explain the differential "productivity" of man. In terms of our previous discussion any such analysis and evaluation of the individual contribution to the joint commodity-man to determine the physical and mental characteristics that govern how well he or she operates in the technological organization. If you do not feel equipped for such a

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pioneering effort you can always resort to a homogeneity assumption, spiriting away the problems by way of definition.

There can be no doubt that this is essentially what is being done in modern versions of human capital theories, although the exact scope and content of the homogeneity assumptions may vary among the more sofisticated versions of the theory. [x]

What assumptions have to be made in a simple and pure human capital theory, aimed at "explaining" relative earnings in terms of accumulated human capital - in terms of what first God and then men have invested in an individual - in such a way that the empirical information necessary for testing could in principle be distilled from existing market data? In what ways must a general equilibrium model with physical human capital be restricted to yield the desired type of relation? One possible way of answering these questions has been presented in Ysander (1977) and can be summarized in following manner.

First of all you should make sure that your explanation of relative earnings is really concerned with the physical productivity of the individual and is not just a way of rehashing the given data on market pricing. Relative earnings should depend only on the given amount of any existing forms of human capital, i.e. the given number of individuals with various earning capacities, but be independent of the rest of economy. This assumption can be shown to be equivalent to a necessary condition for aggregating human capital, for being able to substitute one number representing aggregated labor for the vector of differently skilled individuals in the description of the production technology. There is a certain irony in the fact that human capital theories, thus building on aggregating conditions, was first developed and circulated at the very same time, when - as an outcome of the

[x] At the start of chapter 7 in Becker's book (1964) the author characterizes his own work in the following way: "Virtually all the implications of the theory of investment in human capital developed in Part One depend directly or indirectly on the effect of human capital on the earnings and productivity of persons and firms. Consequently most of my empirical work has been concentrated on measuring and assessing these effects."

That human capital must be interpreted as being physical becomes especially apparant when human capital theorists - following the example set by Ben-Porath (1967) - introduce a "production function" for human capital (see e.g. the revised version of Becker's book).

The homogeneity assumption is also explicitly stated by Becker in his book (1964): "Another assumption made throughout most of the paper is that human capital is homogeneous in the sense that all units are perfect substitutes in production for each other and thus add the same amount of earnings."

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so-called capital controversy - economists finally seemed to agree on the impossibility of capital aggregation in general.

Secondly, you must also assume that the human capital of different individuals is really all the same - just more or less of the same type of capacity. You can always use one man for another man's job but, depending on his relative amount of "human capital", you may then get a bit more or less done than before.

If "human capital" is to become something more than an empirically meaningless variable you also have to relate it to the various investments, training and job experiences, that have been made in order to form this capital. To avoid letting in heterogeneity by the back door you must assume some simple and common process for forming this homogeneous capital. If you want to keep it really simple you must assume that investments also are homogeneous - going to night school or gaining experience as a travelling sales man is really only more or less of the same thing.

Even after these assumptions you are still stuck with the fact that people are different and react differently to human investment efforts. If you want to reach an explanation of relative earnings that is quite generally applicable you somehow have to make people homogeneous. This can be done - and is usually done - by assuming that there is some unambiguously defined property called ability, with which individuals can be more or less generously endowed.

With these successive forms of homogeneity assumptions you can finally arrive at a general hypothesis concerning the relation between ability, investments and relative earnings. Whether you can test your human capital theory will thus mainly depend on the availability of valid and reliable data on this property called ability and on the various forms and measures for human investments.

Since there are many kinds of human capital theories there are certainly many relevant forms of homogeneity assumptions. What can be said generally is that in as far as human capital theories try to say something about the physical productivity of man they do so on the basis of far-reaching assumptions of homogeneity and can - in our view justifiably - be criticized on this account. They are trying to make summary conclusions about the role of man in production technology without really studying either man or technology; the homogeneity assumptions merely express the absurdity of any such attempt.

There is an alternative possible interpretation of the human capital theories. Perhaps "human capital" is not really meant to have any physical counterpart in reality but functions merely as an "intervening" or "theoretical" variable - a practical conveniance in giving a more general form to the empirical hypo-

theses concerning wages as partly determined by training investments? Becker and Mincer were after all colleagues of Milton Friedman at the University of Chicago. In a celebrated essay on economic methodology Friedman (1953) argued that the use of false or empirically meaningless postulates should be accepted as long as they lead to valid and interesting conclusions. (For an interpretation of this argument in terms of theoretical variables cf Ysander (1961)).

The Friedman argument has not found much support among economists and even less among the philosophy of science specialists. Even if it were accepted the burden of proof would anyhow lie with the proponents of human capital theories. They would have to show what general and testable conclusions are added by the introduction of a human capital concept. If the aim of the exercise is to show relative earnings as a well-behaved function of human investments or, more especially, of education, the use of a human capital concept does not seem to help to "explain" this relation in any real sense - but rather clouds the issue.

There are of course many alternative ways of explaining this relation. One such way might start with the idea that although people are different and function differently in production, employers seldom have any reliable means of controlling and measuring these factual differences; cf. e.g. Alchian-Demsetz (1972). By social convention they therefore take educational level etc. as one main starting-point in wage negotiations, since this at least is easily known and documented. They could then be said to practice a homogeneity assumption without having to believe in it. This hypothesis is just mentioned here as one of the many possible explanations that are open to you once you start interpreting human capital theories as theories about people behaving as if there existed a homogeneous human capital. They all have one common feature - that Occam's razor or the law of scientific parsimony would in most cases require you to avoid the use of homogeneous human capital as being both superfluous and cumbrous.

These objections to the use of a physical concept of homogeneous human capital should, however, not be construed as belittling the value of the empirical findings of research work carried out within human capital models. During the last decade this has helped us gain much useful knowledge about the correlations between distributions of human investments and distributions of associated earnings. What has been questioned here are not these data on the yield of various human investments but rather the attempt to interpret and "explain" these data in terms of homogeneous human capital.

3 Filtering homogeneous students: The Arrow model

The best known - or at least most talked about - alternatives to human capital theories in explaining educational impact on earnings are the so called filter theories of education, first presented in pioneering articles by Arrow (1973) and Stiglitz (1972, 1975). The central and rather provocative idea in these models is that instead of developing existing ability by investing the student with new skills, education merely functions as a way of certifying for the employers' benefit the given ability of the student. The rather depressing conclusions to be drawn from these premises are that in as far as this certification merely affects distribution of income between employees without improving the allocation among jobs, education is simply a social waste.

Filter theories have usually been viewed as representing the extreme opposite to human capital theories. As we intend to show in the following, the two kinds of theories can equally well be seen as rather close - and from an empirical point of view often indistinguishable - substitutes, that both make the same basic assumptions. We use the Arrow model as the point of reference, as it is the simplest and most straightforward of the filter models presented so far. We present his premisses successively, interspersed with comparisons of their implications with those of human capital theory.

Arrow's filter model and human capital theory can be said to share two basic assumptions. First, people and educational processes are assumed to be homogeneous, although some students may be smarter than others. Secondly there is no generation of new knowledge through education, neither about the world around them nor about the students themselves. There is only a redistribution of already existing knowledge.

The homogeneity assumptions mean that as in the human capital theory, the filter theory totally abstracts from the technology of education and from the role of educated labor in production. While it attempts to explain why we have education at all, it cannot touch on the equally interesting questions of what determines the choice of a particular kind of education or a particular kind of job.

There is no search for new knowledge in the filter theory. Education is not a procedure for establishing the scholastic potentialities of the student, which are supposed to be closely, although stochastically, related to general ability or productivity. These individual probabilities of scholastic success are usually[x) supposed to be known already to the student and, after admission scrutiny, also to the school authorities. All that education ever does is to certify for the employers something which is known all along by both students and schools. This means incidentally that the Arrow model cannot really explain why education is so time-consuming, why schools do not just pass on - for a price - the full extent of the information about the student they have gained on admission.

Compared to the human capital theories the filter model could be characterized by saying that its education system redistributes knowledge about the students to employers and the production sector, while in human capital theories the flow of redistributed knowledge goes the other way - knowledge about skills used in production are transferred from production to the students. The big difference is that, while in human capital theories knowledge of skills is assumed to make you more productive, the social value of information about students given to the employers in the filter theories are at best limited.

Does this in itself necessarily make the filter theories empirically very different from the human capital theories? Unfortunately this is not the case. Their conclusions about individual market behaviour could in fact be empirically impossible to identify separately.

What the alternative theories are both stating is that earnings - in terms of which a human capital can always be defined - are a function of ability and educational costs invested by the individual, (we abstract here from the fact that human capital functions have rarely been formulated stochastically as in the Arrow model). You could then in principle choose forms of investment functions and sets of investment possibilities for the individual such that the resulting pattern of investments and earnings in equilibrium would be the same in both kinds of theories. Then, from just studying an equilibrium solution in a real life economy, you could never tell the theories apart. For that you would need to dislodge the equilibrium, e.g. by rationing educational opportunities, and study the consequences on total production.

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x) Arrow sometimes makes the alternative assumption that the students themselves do not know these probabilities (cf. e.g. p. 199 in the 1973 article). This, however, raises the problem - not discussed by Arrow - of how demand or self-selection for education is then determined and what can be known about demand as a sample of the total population.

One such way of bringing the theories closer together would be a kind of perfect filtering process, such that the longer you stayed in education, the higher the ability you could certify - assuming you had it. If wages were paid in proportion to certificates, and education costs were low, educational investments would then be monotonically increasing with ability, which is a common feature of many human capital theories etc.

Looked at from this point of view the provocation of filter models really arises from exploiting a general dilemma of economic equilibrium analysis. As long as we are limited to studying an equilibrium position of the economy in terms of market transactions, we usually cannot hope to distinguish between alternative dynamic explanations of how we have arrived at the equilibrium. Instead of framing the provocation in terms of humans you could equally well let it deal with, say, paper machines. You could make the hypothesis that paper machines are never really used for making paper, as naively supposed. They are instead simply a status symbol used to "certify" your capacity both to the world at large and to the marketing division of the company. You could undoubtedly go on to frame the hypothesis in such a way that it could never be refuted by just looking at an equilibrium solution. Only be getting far enough outside the equilibrium - or by getting permission to peep inside a paper plant - could you hope to settle this controversial question. In the case of the filter theories, you are certainly not supposed to be able to take a close look inside production to watch the performance of naked ability.

We have so far only dealt with those basic premisses in the filter model, that are so to speak generic to the filtering idea and thereby distinguish these theories generally from the human capital models.

The Arrow model has at least two other special traits. These are extremely important for his conclusions but do not necessarily separate his model from human capital theories, into which they could possibly be incorporated.

The first trait has to do with lack of discrimination on the part both of employers and educators.

Although educational authorities are supposed to know at the outset the individual scholastic indicators of relevance to productivity they are assumed to behave in a mean way. After having extracted a price from the students they only give the employers a small and rather distorted part of this information. What the employers get to know is only if the student has passed or not. For the successful students this means that the employers can make an estimate of the average scholastic potentialities, which is then supposed to govern their wage-setting for graduates.

One important consequence of this lack of discrimination, this averaging of certificates and wages, is that it can make edu-

cation profitable also for some less able students who, as graduates, will be paid above what their ability would justify in a more discriminating world. It thus introduces a new source of possible inoptimal allocation into the model.

This assumption about a lack of discrimination in the labor market could in principle also have been superimposed on a human capital model, although it would undoubtedly detract from the formal elegance and simplicity of the theory. It is an assumption about the state of information on the market, which could be combined with many alternative explanations of productivity.

To illustrate that filters may also have a socially beneficient function, Arrow also uses a second set of assumptions about the labor market. Filtering students will obviously improve allocation - if we abstract from educational costs - when the results can be used to assign students between different jobs in such a way that their ability is better utilized. In a model with homogeneous students and homogeneous education it is rather difficult to introduce heterogeneous jobs in any real sense. Arrow avoids this difficulty by assuming a very special segmentation of the labor market. Half of the total utilized productivity of labor must be used for jobs in which only a minimum of potential productivity, common to all labor, can be utilized by each employee. We can visualize these jobs e.g. as manual tasks of operating simple machines, such that any individual can manage one machine but none can cope with more than one for physical reasons. Filtering by education can then help in assigning less able people to these simple but tedious tasks. What is assumed is thus a special combination of indivisibility and complementarity in the labor market.

What interests us here is not whether the assumptions can be said to model any relevant features of real life - which may be doubtful. The point to be made is instead that these assumptions are not in any way necessarily related to the filter hypothesis, although they determine the possible social benefit of an educational filter. Similar assumptions - formulated as limited possible yield of human capital in certain employments - could evidently also be introduced into human capital models.

Arrow's conclusions and evaluations about the equilibrium amount and distribution of educational investments all depend on his special "labor market assumptions". Other assumptions would of course lead to other conclusions. We could e.g. assume that the labor market were partitioned into as many segments as ability, with each segment only allowing the use of a certain limited ability, and that education could function as what we above called a perfect filter, successively filtering out higher degrees of ability. If the marginal productivity gain and wage increase from more education were every-

where larger than the marginal educational costs there would be no risks of inoptimality in equilibrium.

The results of our discussion could perhaps be summarized in the following way. The filter and human capital approaches are usually seen as dramatic contrasts. They could equally well be described as rather close substitutes, which share many decisive basic assumptions, including that of homogeneity. The provocative difference in conclusions - if we abstract from other superimposed assumptions about the labor market etc. - arises from different interpretations of the productivity of educated labor, in a given equilibrium situation. What makes this difference especially provocative is the fact that it may be empirically impossible, within equilibrium analysis, to decide which interpretation is right.

A much more radical departure from current orthodoxy would be a model of search by learning, which incorporated the heterogeneity of students, educations and jobs and the generation of new knowledge in education, by analyzing the educational process as a search for the genuinly unknown qualities of the students. If the only way to find out what you are good at is by learning to do different things, with various degree of success, then the conflict between the alternative interpretations of productivity would also tend to disappear. If ability, as measured on the scales of intelligence tests, merely gives the length of your capacity vector, without telling the direction - which could be even more decisive for your productivity in a special job - then there may not be any competition between the claims of ability and the claims of training. If education is partly a way of "getting to know yourself" as the ancient Greeks believed, then the form and structure of the educational search is all-important and the educational choices for the individual much more complex than what is modelled in current theories.

We mention this possibility here only to emphasize our conjecture, that homogeneity versus heterogeneity is a much more strategic choice for the direction of any future economic research in education than the human capital versus filter interpretation.

4 Homogeneity in educational policy

The homogeneity assumptions in the economic theories of education may not only distort the theoretical conclusions but also lead to misunderstandings in educational discussions and to mistakes in educational policy.

There exists an unfortunate tradition of mutual misunderstanding and disrespect between economists and sociologists. Real communication and cooperation between them nowhere seems so hard to achieve as in the field of education. (There are many outstanding exceptions to this rule - one being our co-author in this volume - Mary Jean Bowman). In view of our earlier discussion of the homogeneity assumption this is hardly surprising. Sociologists, who aim at establishing the differences in people - in background, experience and mental characteristics - that determine their choices of different educations and jobs, must surely find it hard to pursue a meaningful discussion with economists who start by assuming away all, or almost all, relevant differences. In the same manner there seems to be an obvious lack of common ground for economists and pedagogical research workers as long as economists insist on treating as both homogeneous and irrelevant the black box of the human mind, that pedagogical research aims at analyzing and manipulating.

Reasoning about education on the basis of homogeneity assumptions, however, is not a special prerogative of economists. Many policy decisions in the educational field - we refer especially to Swedish policy for higher education in recent years - seem to be based on reasonings of a similar kind.

Discussions about the organization of higher education are often focused on two rather different models, central rationing and decentralized marketing of educational opportunities. Homogeneity assumptions appear to be pivotal in weighing the decision in favor of central rationing.

If you are willing to act as if the homogeneity assumptions were true, i.e. as if students were all the same - only some smarter than the others - and indifferent between various kinds of education this means that students, teachers and local school authorities have no information relevant for distributing various educational opportunities that is not also easily available to central authorities. These authorities, on the other hand, should be able to interpret signals about labor market demands, both in the short and in the long run, better than any one individual in this standard collection of students. Social efficiency reasons

then weigh in favor of central rationing. So as a matter of fact do equity reasons as long as equity can be identified with equal educational and labor market status.

If instead you start from the contrary assumption, that students are fundamentally different in kind and in their aptitude for different sorts of educations and jobs, you will be faced with information problems of quite another dimension. There is so much more you now need to know about each individual in order to channel him or her into the right kind of education and the right kind of job - and much of this information may be available even to the student himself only after a laborious search process. For the same reasons the segments and aspects of labor market information which are relevant will now differ between the individual students. Instead of having almost a corner in relevant information, central authorities now appear to have lost all comparative advantage in distributing opportunities and in steering the individual student through the maze of courses and crafts. With this starting-point you will then tend to favor a decentralized marketing of education services with quality competition for students between the various educational organizations, leaving it to the student himself to interpret and react on market signals both from education and from the labor market.

Even the equity goals may look different from these premisses. If students are really that much different it does not make sense to define equity simply as having an education or a job of equal status with the rest. Strategically important aspects will now be how apt and motivated you were for the kind of education you got, which in turn will determine how well you do and how adjusted you will be in the job your education prepared you for. Equality in education must then be treated separately and independently of equality in the labor market. Equal opportunity to search for and find what you really want to do and feel good at - should constitute the equality aims of education. It will lead to social equality in a more comprehensive sense only if combined with the equalizing of status and pay in the labor market which however requires other kinds of policy instruments. To try to equalize the labor market by way of educational policy is anyhow not only ineffective - at least in the short run - but would also appear to be a rather half-way kind of ambition, since it means that you want to adjust the educational system to the traditional unjustices in the social evaluation of different jobs.

Whether the prevalence of homogeneity assumptions in policy discussions is to some extent due to the impact of economic reasoning or if it just happens that such ideas come naturally and spontaneously to the bureacratic mind, is difficult to know. What our examples above show - if somewhat obiquely - is anyhow that economic theories of education, if taken seriously, could have important - and in our view disastrous - implications for educational policy.

5 From commodity-man to sequential machines

We have so far only discussed the two dominant theoretical themes among the economic theories of education, both of which were found to be based on homogeneity assumptions. This does not mean that there has been no attempt by economists to break into the black box of commodity-man. Such attempts have been made in various directions, although so far without any definitive breakthrough either in concepts or in empirical measurements.

The importance of differentiating, in terms of quality the analysis both of students and education beyond the one-dimensional ability variable has been stressed by many writers who have dealt with education in relation to the labor market; cf. e.g. Blaug (1966) and Rees (1971). A few economists have even tried, theoretically, to define the individual explicitly in terms of a vector or profile of qualifications, which are changed by education and which determine his usefulness in different employments. By so doing you not only gain a way of discussing the students' comparative advantages, when faced with heterogeneous opportunities of education and work. You also overcome a traditional handicap of economic analysis by being able to "explain" and not only register relations of substitution between students and between jobs and the effects of introducing new kinds of education or new kinds of jobs.

Tinbergen (1963) and Mandelbrot (1962) are perhaps still the two best known examples of economists, who have tried to use this kind of model to explain relative earnings. Tinbergen assumes demand for employees in different jobs to be specified in terms of required profiles and then derives a wage function, common to the whole labor market, from the common utility function of the individuals. Mandelbrot goes the opposite way, assumes a separate wage function as well as a totally elastic demand of labor within each job category and then studies the result of simple wage-maximizing by the individuals, who are supposed to be distributed among different profiles in a well-known way. Neither deals explicitly with education. A natural way of analyzing education in these kinds of models would be to describe it as a way of simultaneously changing and gaining knowledge about the originally given profile of an individual.

Further progress in this direction seems so far, however, to have been blocked by the lack of empirical data for interpreting the "profiles" in the models. Early hopes of being able to use e.g. military service records and the results of currently made

so called requirement analyses for different jobs, have all been frustrated. These records turn out, in most cases, not to measure - at least not in a systematic fashion - the kinds of functional qualifications and attitudinal properties that would be needed. This unfortunately leaves us with elegant theories, whose concepts remain empty.

Instead of hoping that knowledge of what are the relevant dimensions will somehow be furnished from someone else - work psychologists perhaps - some economists have recently attempted at least to structure the problem by analyzing the intellectual functions involved in controlling production.

One simple intuitive idea behind these attempts is to draw advantage from the fact that we are living in the computer age. If man can be at least partly replaced in an increasing number of jobs by sophisticated computors, then, surely, we should be able also to do the reverse and analyze some of the main intellectual functions of man in his role as organization man by studying the network of mechanical components that could replace him. Even a rather simple clerical task to be replaced, requires a sequence of elementary computor units with capacity respectively to, say, receive signals, decode and interprete, memorize, apply decision rules, calculate and evaluate consequenses, code and transmit signals, etc. By studying man as sequential machines in different job situations, we might hope to pinpoint some of the main dimensions of intellectual capacity, important for the individual contribution to work in an organization. Machines, however, can be self-organizing only to a certain limited extent and therefore we cannot ever hope to catch all the more creative facets of the work effort. It may anyhow provide a starting-point for what really interests us here, the analysis of how these capacities can be acquired by variously gifted people through education.

Starting from this idea, it seems natural to apply the same method also to the analysis of a whole organization. A pioneering attempt in this direction has been made by Radner and Marshall in their well-known work: Economic Theory of Teams" (1972).

The theory of teams studies organizations as networks of component units for receiving and interpreting information, for computation, for the application of decision rules and for the execution or the transmitting of orders. It can be used to calculate e.g. optimal decision rules and/or optimal information structures for a given organizational network, whose aim or pay-off function is known. From these calculations you can go on to compare the efficiency of alternative networks, when optimally utilized.

These rather abstract notions can be given some intuitive content by way of a simple and extremely stylized example.

Let us think of a shipping company that sometimes finds it profitable to operate in two special freight markets - here called markets 1 and 2 - where freight rates tend to diverge markedly, both in positive and negative directions, from rate levels in the company's accustomed market, where they are supposed to be able to forecast developments accurately. If they engage in market 1 - with a fleet of a certain given size - and relative rate developments are favorable - let us represent this as $x_1 = 1$ - they stand to make an added profit of α millions of dollars, while unfavorable developments, $x_1 = -1$, will result in a symmetrical relative loss of the same amount. They have only two alternatives in this respect; either they decide to engage - represented as $a_1 = 1$ - or they do not, $a_1 = 0$. Their situation when it comes to market 2 is completely analogous, although here the potential profit or loss amounts to β. There is one complication, however. If they try to engage in both markets simultaneously they will run out of ships and will sustain an extra cost of c millions for hiring the required extra tonnage. We assume that $\alpha > c > \beta$ which means that it can never be profitable for the company to hire outside tonnage.

These assumptions can be summarized in the following pay-off-function which simply states the total relative profit, resulting from the company's actions in these markets:

$$\Pi = \alpha x_1 a_1 + \beta x_2 a_2 - c a_1 a_2$$

Several types of management functions are required to handle this problem. An observation function, 0, is needed, to "read" or forecast the relative rate development in the respective markets. On the basis of these forecasts, a decision function, D, must make decisions on whether to engage or not. Finally these decisions must be realized by an executive function, E.

Three alternative networks for combining these functions are depicted in Fig. 1.

The first alternative, Fig. 1a, means that both forecasts and decisions are made centrally and without using specialist knowledge on the respective markets. The price for this lack of specialized knowledge is represented here by an error in forecasting, ϵ, which with probability q, takes on the value, -1, i.e. makes both market forecasts misleading, but is otherwise equal to 1.

In the second alternative, Fig. 1b, two specialist observers are used, supposedly making the risk of error negligible. Their reports, however, are still fed into a central decision unit etc.

The third alternative differs from the second in that decisions are also made on a decentralized basis by the specialist

observers, which introduces the risk of incurring extra costs by having to hire tonnage.

With specified assumptions on the probability distributions involved - for x_1, x_2 apart from ε - definite conclusions can be derived about the comparative advantages of these alternative networks, when utilized in an optimal fashion.[x]

What is of special interest to us here is the possibility of deriving organizational demand for various types of intellectual capacities as a function of optimal organizational structure, which in turn will be determined by organizational aims and costs and by environmental conditions.

In our simple example we can study, for instance, the organizational demand for specialist freight market observers mainly as a function of the stochastic properties of the special freight markets involved and of the organizational costs of centralized decision-making. We can thus estimate the value of the contribution or "marginal productivity" of these specialized capacities under varying environmental and organizational conditions. We have then taken a first step towards "explaining" how certain acquired intellectual capacities contribute to the joint output or organizational pay-off-why learning may motivate earning.

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x) If we assume that the two alternative values of x_1 and x_2, 1 and -1, are equiprobable with correlation coefficient r, elementary calculations show that the expected gross value of alternative c is:

$$E_{\Pi_c} = \frac{1}{2}(\alpha + \beta) - \frac{1+r}{4}c$$

A change over to alternative b - centralizing decisions - increases relative gross profits by the following positive amount:

$$E_{\Pi_b} - E_{\Pi_c} = \frac{1+r}{4}(c - \beta)$$

The effects of a further change into alternative a would decrease the expected relative gross profit:

$$E_{\Pi_a} - E_{\Pi_b} = -(1-q)\left(\alpha + \frac{1-r}{2}\beta\right)$$

These gross profit figures must then be combined with the organizational costs for the various alternatives to arrive at conclusions about the most profitable network.

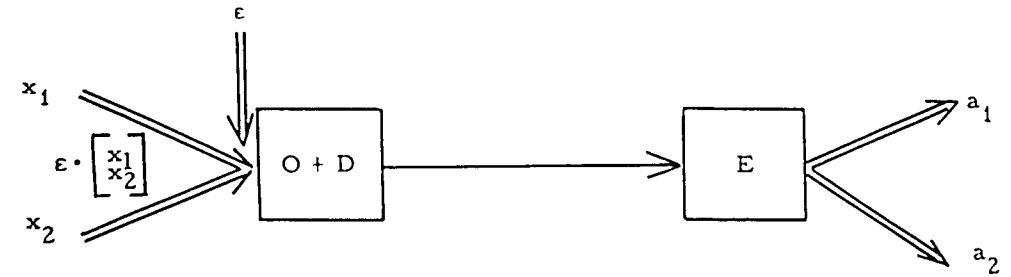Figure 1a. Centralized observation and decision

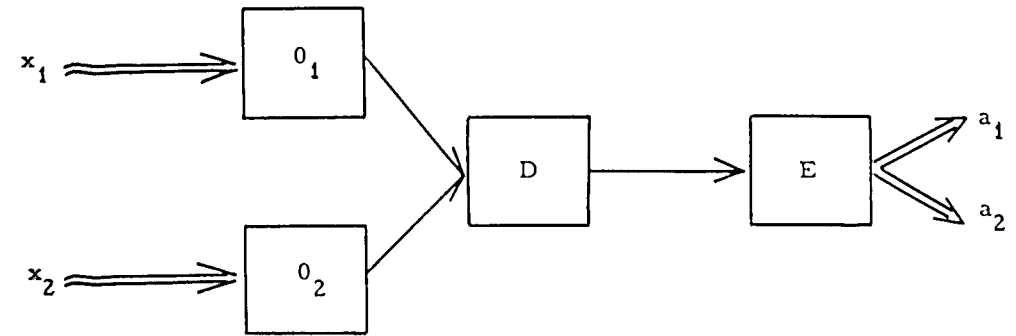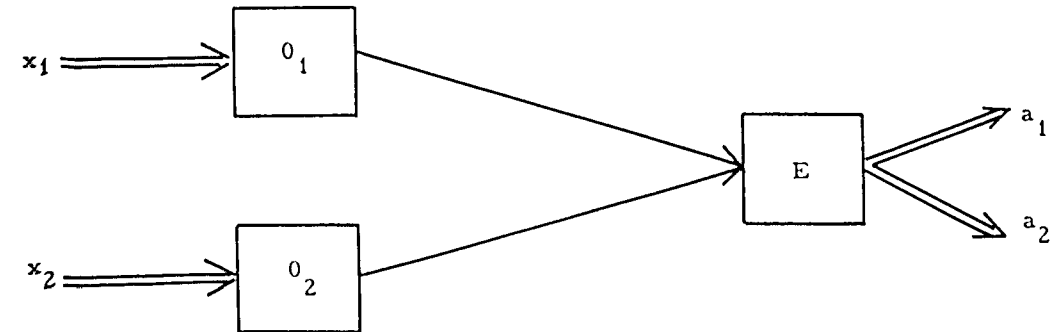Figure 1b. Decentralized observation and centralized decision

Figure 1c. Decentralized observation and decision

What one would ideally like to envisage is an interpretation of these "computer-capacities" as psychologically measurable categories, so that a start could be made in really analyzing the ways in which education makes people "more productive".

It should be admitted, however, that so far we have little basis for any great hopes in this respect. The theory of teams and

related approaches are still only abstract conceptual schemes, whose empirical usefulness still has to be proved. Moreover the capacity categories used are still probably much too general to make a psychological interpretation possible. But the approach does represent a rather unique attempt to break into the black box of commodity-man in production.

Even if this attempt should prove successful we have only gone part of the way towards an economic theory of the role of education in production. Man is undoubtedly more than a sequence of machines, he is also a living organism, a complex of sometimes conflicting motivations as well as a bundle of creative instincts. The effects of education on productivity must probably be analyzed also in these terms since most changes in the educational system tend to change the psychological and social conditions for study.

6 Education for variety

The conclusions of our discussion of economic theories of education have been mainly negative. It was suggested above that economists have been forced into making homogeneity assumptions when trying to use their analytical tools for problems outside their traditional and legitimate field of market studies - in trying to probe into the "interior" of educational and production processes. By using this "short-cut" their results have also in our view been rendered rather useless but unfortunately tend to support the corresponding policy assumptions which may have far-reaching effects on the shaping of educational organizations. Attempts to develop new analytical methods for the analysis of the "productivity" of educated labor have been made but have not yet been developed far enough to hold definitive promises. Our own conclusion from this would be that economists still have to be very modest in their claims of "explaining" the effects of education in production. They can claim to have real expert knowledge only as long as they stick to those relations in the labor market which can be verified from market data.

We know that the homogeneity assumptions, taken in a literal sense, are false. To substantiate our criticism above we would however need to know how wrong they are in relevant respects; something which unfortunately we cannot know in the present state of research. For the present we have to fall back on subjective beliefs and attitudes. If we start with a one-dimensional view of our fellow-men, it will be consistent to view education as a way of spoonfeeding the test-tube babies in "1984" and educational policy as mainly a question of choosing the spoons. If we base our beliefs on an explicitly pluralistic conception of man-kind, we arrive instead at a conception of education as a way of finding and developing the special talents and motives of each individual within the restrictions given by production technology. The aim will then be an education for variety which also means a variety of educations and a corresponding variety of signals and signposts to make it possible for the individual to make rational choices in each successive step of learning and earning.

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