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EARNINGS GROWTH WITHOUT INVESTMENT

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FOREWORD

Sharply reduced rates of population and industrial growth have been projected for many of the developed nations in the 1980s. In economies that rely primarily on market mechanisms to redirect capital and labor from surplus to deficit areas, the problems of adjustment may be slow and socially costly. In the more centralized economies, increasing difficulties in determining investment allocations and inducing sectoral redistributions of a nearly constant or diminishing labor force may arise. The socioeconomic problems that flow from such changes in labor demands and supplies form the contextual background of the Manpower Analysis Task, which is striving to develop methods for analyzing and projecting the impacts of international, national, and regional population dynamics on labor supply, demand, and productivity in the more-developed nations.

This paper, written by a member of IIASA's Young Scientist Summer Program of 1980, focuses on an alternative explanation of the concave age profile of the path of a worker's lifetime earnings. The author argues that such concave earnings streams can be generated by a model that focuses on demand behavior independent of supply considerations. He then discusses the identification problem that results.

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ABSTRACT

Estimation of individual and social rates of return is typically done using the labor supply model of human capital theory. Traditionally, concave age-earnings profiles are found. This paper points out that employer hiring practices, instituted because of imperfect information of worker productivity, will generate concave earnings profiles. The implied identification problem for empirical estimation is discussed.

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INTRODUCTION

Income usually increases over a worker's life. It follows a concave path: rising quickly at the beginning but increasing at a successively slower rate as the worker ages. To explain this fact human capital theory suggests that workers choose to forgo current consumption to pay for training that will yield a higher income in the future. Empirical work appears to have confirmed that this type of optimization is widespread in the labor force (see references cited in Blaug 1976, and Mincer 1970). The maintained hypothesis in this empirical work is that observed earnings streams can be explained using what is essentially a model of individual labor supply.

However most workers are constrained in their choice over types of employment. Unless a worker is self-employed, he must accept that not just the level of training, but his training with respect to all other workers is important in determining his job. Personal characteristics other than training will also affect one's job offers. If education acts as a screening device, there may not be an "optimal" investment for a job. To the extent that workers are rank ordered (according to any criterion) and fit into preexisting job slots there may not even be stability of return to a given level of investment.

This paper will discuss how demand and supply behavior interact to determine employee earnings streams. The demand model used was developed in Arthur (1979). It will be shown that with few assumptions on Arthur's model, and none on individual behavior, reduced-form empirical results of concave earnings streams can be expected. This implies that empirically there is an identification problem, with both supply and demand explanations for why income has its observed growth path over time. Econometric studies that interpret their results solely with a supply story may well be misleading.

The human capital and signaling theories of investment and income determination are discussed briefly in Section 1. Sections 2 and 3 outline the model and present comparative statics results for different labor market situations. Section 4 goes back to the human capital literature to see how this model fits in with previous work.

1. INCOME GROWTH IN A DEMAND CONSTRAINED LABOR MARKET

Human capital theory suggests that workers plan for the future by investing in training while young that will give them a higher income in the future. The exact time sequence of training and earnings is determined by individuals' discount rates (Becker 1964; Mincer 1974; Rosen 1972). A concave growth path of income arises because the present value of the return on additional training decreases as the worker ages.

Very special assumptions on labor demand are necessary to make market behavior consistent with the human capital supply model and therefore permit rate of return estimation. Calculation of social returns requires perfect (costless) information about an employee's productivity so that he may be correctly compensated for his investment in training. Calculation of individual returns requires that wage rates for skilled jobs remain stable and predictable regardless of possible excess supply in any job category. It is argued below that these conditions will not in general obtain.

In a highly specialized economy the majority of jobs are dictated by the needs of existing companies. A worker does not create a position. Instead he chooses for which of the available jobs he will compete. To match the labor force with the existing jobs requires that employers set up a rank-ordering system to help them make hiring decisions. There may be many applicants who would perform satisfactorily in a given position, or there may be none.

A possible inefficiency in this matching process is already apparent. If workers' desired employment is constrained because of a limited demand by employers of those with a particular skill, then some workers will have been "over-trained" for the job they are forced to take.

This type of inefficiency is even encouraged by the hiring system (Arrow 1973). In practice training costs cannot be measured exactly before hiring a worker but must be imputed through variables believed to be correlated with worker quality. Imperfect knowledge of a worker's ability before he is hired will increase the probability of bad matches. To minimize the uncertainty over finding desirable employment, workers will tend to "over-invest" in education or develop other personal characteristics that make them more attractive to employers. Investment as an (imperfectly used) quality signal rather than as a measure of productive ability explains why private and social rates of return to education may differ. This is discussed in depth in Spence (1973, 1974).*

The notion of a social return to education is further blurred by the fact that the marginal product of a worker may in fact be unknown to either the employer or employee. In the production sector few products are the output of an individual worker but rather of an assembly line where each worker is essential but whose marginal product is not the entire output.

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*Another interpretation of the labor queue is a ranking according to training costs given in Thurow (1974). To the extent that most employment training is done on the job and employers must pay some of the costs, workers can be ranked by desirability in inverse order of their training costs.

Police are not paid for the crimes they prevent, nor are politicians paid for leadership given. The value of the output from many white collar and bureaucratic jobs is not easily calculable.*

The existence of signaling does not preclude a stable hiring process that might generate stable individual returns to education. But there is enough variation in the economy's employment structure to make the prediction error for individual return calculations too large. Changes in both the skill-level requirements for evolving technology and the average quality of the labor force must be predictable so the rank-ordering with respect to training will be stable. Interaction between signals will render a very low predictability with respect to any one signal. The return to a college education for an inner-city youth and a son of a successful businessman will be significantly different. The relative values for their educations will change as hiring practices change, e.g., affirmative action programs.

With uncertainty about how much to invest in training for an undetermined job with unknown productivity (wage), a worker will be subject to tradition and convenience in his hiring and promotion. Neither individual returns nor societal returns to education can be (numerically) calculated with significant confidence. Modeling individual behavior is not enough when jobs and even the time sequence of income in a job are imposed by the employer. The object of the next section is to present one approach to modeling the structure of the demand for labor within which individual decisions are made.

2. THE MODEL

This section will discuss an institutional demand model of the labor market. The analytics and exposition closely follow Arthur (1979). Thurow (1974) presents a similar model of the

*The social usefulness of many government bureaucracies, even if they do their job is another question.

labor market based on job-competition rather than wage competition. The Arthur model will be used to derive simple comparative statics results that suggest demand behavior, independent of supply considerations, will give rise to concave earnings streams.

In this model jobs are organized into a hierarchy.* Workers enter the labor market and are assigned an initial position relative to other workers based on personal characteristics. Employers exhibit a preference across personal characteristics and age that determines what job a worker will get and how quickly he will advance. A worker is promoted not because of increased productivity, but because the number of workers preferred to him diminishes due to deaths and retirement.** His earnings stream is determined by the wage rates assigned to the seniority levels he passes through from entrance to exit from the labor force. An individual may affect the job for which he is selected by changing the signals that employers see, but the job structure remains the same. To the functioning of the system it makes no difference which individual is selected for a given job. It will be assumed that all jobs are open to anyone with the right combinations of ability or age, and that all vacancies are filled immediately. For simplicity the number of jobs will be assumed to be exogenously determined outside of the labor market.

Four functions will be set up to explain the worker's earnings streams: A job seniority hierarchy, its corresponding wage function, a labor force distribution function over personal characteristics and time, and a preference ordering that determines how workers should be promoted. Each function will initially be specified independently. Possible links between these functions will be explored later in the section.

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*The hierarchical job structure is taken as given. Possible motivation for this type of structure is discussed in Stiglitz (1975) and Lazear and Rosen (1979).

**Keyfitz (1973) looks at an institutional job hierarchy where promotion is determined by the ratio of percent above to percent below in the hierarchy. He also observed concave seniority profiles.

2.1 Job Hierarchy

At any time t, there are $m(\alpha,t)$ jobs at seniority level α. The seniority index α is ordinal, and for convenience will be normalized over the interval (0,1). The sum of all jobs above level α in the economy is

$$M(\alpha,t) = \int_{\alpha}^{1} m(s,t)ds$$

Most hierarchial structures have fewer people in the more senior positions, suggesting $M_\alpha < 0$, $M_{\alpha\alpha} > 0$, where the subscripts represent the first and second derivatives with respect to α. It can be expected that the job supply will grow over time at a rate similar to the growth in population (exponential) implying $M_t > 0$, $M_{tt} > 0$.

2.2 Wage Distribution

Associated with each seniority level at any point in time is a wage rate, $w = w(\alpha,t)$. This function reflects the employer's decision on how to divide the aggregate output between workers. Both first derivatives will most likely be positive. With the wage rate assumed to be a monotonic function of seniority, the wage function will not be discussed, and seniority will be interpreted as equivalent to the earnings level.

2.3 Labor Force Density Function

There are $L(x,t,y)$ number of workers of age x at time t in the labor force, distributed across "ability" y. The vector y represents all non-age factors which might be used as selection criteria by a potential employer. These characteristics might, for example, be schooling, knowing the right people, or race. It is assumed that each of these characteristics is quantifiable so that it can be ranked along an axis. Any assumptions made on derivatives with respect to y will be assumed to hold for each characteristic. For illustrative purposes I will treat y as a single ability axis. With a constant or growing population $L_t > 0$. Geometric or exponential growth implies $L_{tt} > 0$.

2.4 Promotion System

A preference ordering in ability-age space decides which of two canditates is preferred for a particular job. As illustrated in Figure 1, in each year new entrants distributed across the ability axis enter the labor force. As they age, and those above them retire or die, the promotion system determines their rate of advancement within the institutional structure. Both A and B in Figure 1 are the same age: but person A crosses preference curves more quickly than B and soon ends up more preferred. In addition to the basic assumptions of reflexivity, completeness, and transsivity, the following observations about employer preferences justify the use of convex preference curves:*

Postulate 1: Greater ability is preferred to lesser ability

If ability is defined as being any characteristic desired by the bureaucratic hiring office, this just says that hiring practices are rational.

Postulate 2: Greater age is preferred to lesser age

Long term employment is essential to the creation and maintainance of a bureaucracy. It is also thought to be good business sense to have older rather than younger managers. Age and personal maturity are explicitly rewarded.**

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*A concave advancement mapping in ability-age space may be observed in the manpower planning literature, see Plougonven (1978).

**Doeringer and Piore (1971) found age (independent of productivity) to be one reason for promotion in the firms they interviewed. Minimum age limits "to insure that the applicants have the maturity necessary for successful job performance" are explicitly considered by the United States of Government in hiring (U.S. Civil Service Commission 1978, p.6). The Japanese (nenkō) system of advancement is also partly based on seniority (Galenson and Odaka 1976, p.609).

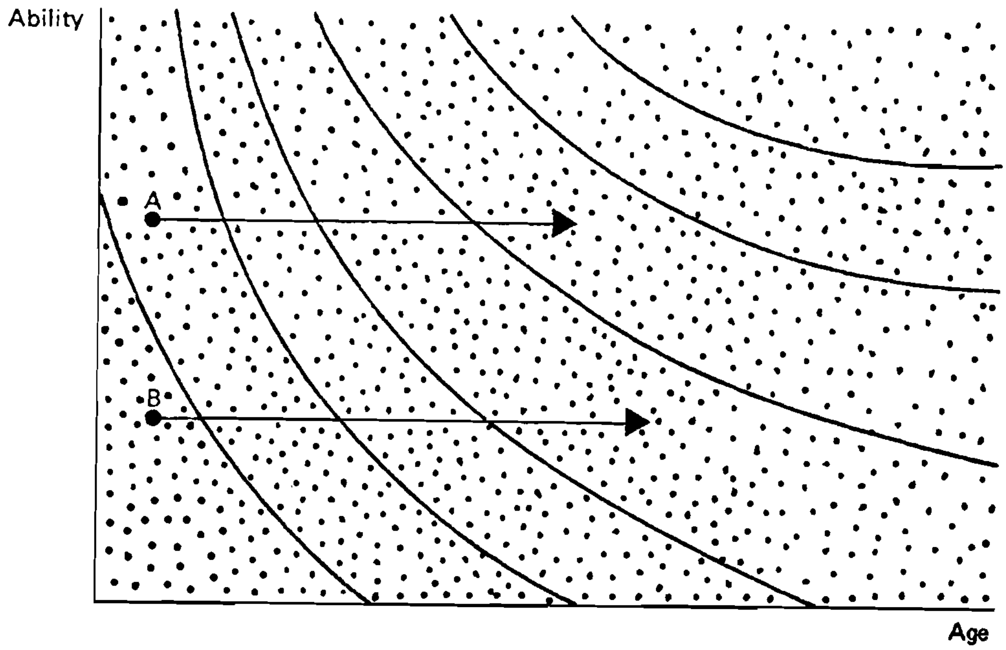

Figure 1. Advancement of two workers of the same age but with different abilities.

Postulate 3: Diminishing returns

While age is valued, as a worker gets older he is rewarded with proportionally less of an increase in "preference". A person's maturity increases (proportionately) more when he is young than when he is old. Concavity of preference in age is also necessary for the promotion system to be consistent with a concave hierarchial system. Likewise substantive quality differences between workers are not recognized by the bureaucracy which merely ranks workers with respect to one another.

The preference function can be represented by $a = h(x,y)$, where y and x are ability and age, and a is a (cardinal) index of preference. While preference itself is ordinal, to represent the preference curves in Figure 1 a cardinal index that changes with each preference locus must be created. The preference function may evolve over time. That possibility is discussed in Section 3.

It is straightforward to interpret the restrictions Postulates 1-3 have placed on the function $a = h(x,y)$. Postulates 1 and 2 imply that seniority is increasing in x and y so that $\frac{\partial a}{\partial x}$ and $\frac{\partial a}{\partial y}$ are positive. There exists a trade-off between ability and age so $\frac{\partial y}{\partial x}$ is negative. Diminishing returns to ability and age at a given level of preferment implies that $\frac{\partial^2 a}{\partial y^2} < 0$ and $\frac{\partial^2 a}{\partial x^2} < 0$.

3. MODEL APPLICATIONS

To illustrate how this system works the derivatives of the seniority function will be computed analytically. The simplest case, where each function is exogenously determined and the labor force distribution is static $[L = L(x,y)]$, gives the most straightforward analytic results and will be dealt with first. Some of the restrictive assumptions will then be relaxed in order to examine what the model implies about specific types of labor market behavior.*

3.1 The Static Case

Figure 2 illustrates how to calculate the number of people preferred to person A. One first finds the implicit index a* of the indifference curve determined by A's ability $(\bar{y})$, and age $(\bar{x})$, such that $a^* = h(\bar{x},\bar{y})$. The formula for the curve is $a^* = h(x,y)$. The area above $a^* = h(x,y)$, (the upper contour) specified by $\phi(a^*)$, will be called the "region of preferment" to A. Integrating over the preferred area gives the formula

$$N_A(t) = \iint_{\Phi(a^*)} L(x,y)\,dx\,dy \tag{1}$$

*Most of these examples are discussed in less detail in Arthur (1979).

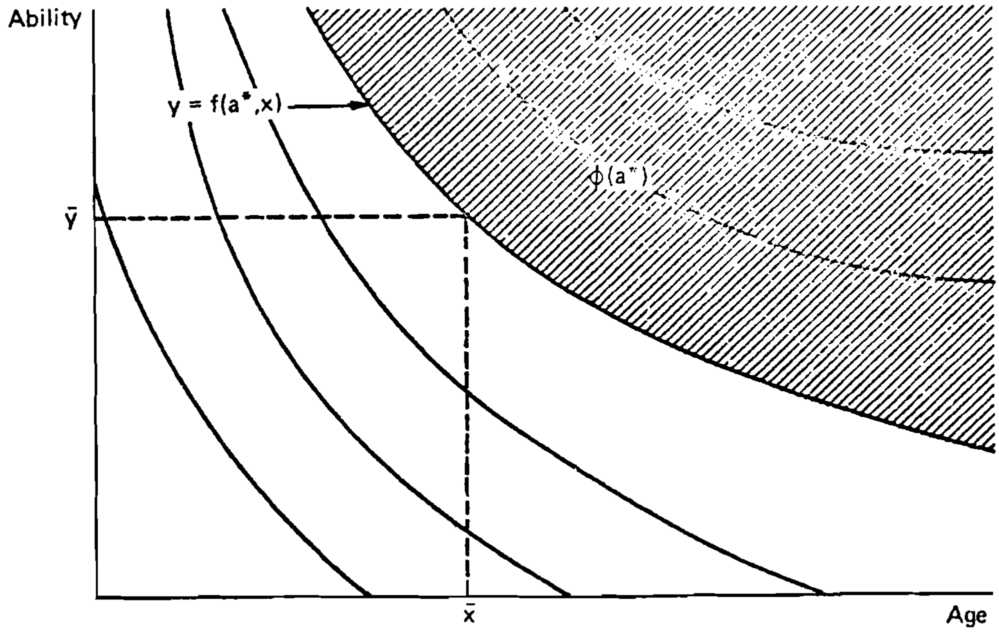

Figure 2. Estimation of the region of preferment for a worker with age $\bar{x}$ and ability $\bar{y}$.

where $N_A(t)$ is the number of all persons preferred to A. $M(\alpha_A,t)$ people will be employed at higher seniority jobs in the hierarchy. It is assumed that all vacancies are filled immediately. Therefore the following identity

$$N_A(t) \equiv M(\alpha_A,t)$$

will hold at each point in time. This identity can be solved implicitly for seniority α as a function of time, given the functional forms and the person's ability level $\bar{y}$. The wage function will map seniority into earnings.

Look first at the seniority function $M(\alpha,t)$, breaking it up for convenience into the product of two single argument functions $R(\alpha)$ and $S(t)$, such that

$$M(\alpha,t) = R(\alpha)S(t)$$

From the arguments above it is expected $R_\alpha < 0$, $R_{\alpha\alpha} > 0$, $S_t > 0$, $S_{tt} < 0$. Assuming the inverse function R^{-1} exists

$$\frac{\partial \alpha}{\partial t} = \frac{1}{R_\alpha}\left[\frac{N_t}{S} - \frac{S_t N}{S^2}\right] \tag{2}$$

where the capital letters represent entire functions. The rate of change of seniority is unambiguously positive for $N_t < 0$. In the case where S_t is less than zero, where the number of jobs decreases over time, seniority may decrease and the comparative statics are rightly ambiguous. The second derivative

$$\frac{\partial^2 \alpha}{\partial t^2} = -\frac{\left[N_t S - S_t N\right]}{R_\alpha^2 S^2} + R_{\alpha\alpha}\left[-\frac{2N_t S_t}{R_\alpha S^2} + \frac{2S_t^2 N}{R_\alpha S^3} + \frac{N_{tt}}{R_\alpha S} - \frac{S_{tt} N}{R_\alpha S^2}\right] \tag{3}$$

will be unambiguously less than zero, implying a concave seniority locus over time, if both $N_t < 0$ and $N_{tt} > 0$. It is still possible for seniority advancement to be concave if $N_{tt} < 0$, but then the relative magnitudes of the two terms in equation (3) become important.

It is now necessary to confirm that in fact $N_t < 0$ and $N_{tt} > 0$. Note that even if the labor force does not change over time, the number of people preferred to A remains a function of time because $\phi(a^*)$ is a function of both ability and time (the worker's age). Solving the integral in equation (1) (the age of the worker, x, is fixed)*

$$N(t) = \iint\limits_{\forall x,y:\phi(x,y)>\phi(\bar{x},\bar{y})} L(x,y)\,dxdy = \int_{\hat{x}}^{1}\int_{y=f(a,x)}^{1} L(x,y)\,dxdy = \int_{\hat{x}}^{1}\left[1 - f(a,x)\right]L(x)\,dx$$

*To make the analytics more tractable it will be assumed $a = h(x,y)$ can be written $y = f(a,x)$. Also, in the above expression $\hat{x}$ is the lowest age of anybody more preferred to a, such that $a = h(\hat{x},1)$.

Here the maximum ability and age have been normalized to one. Using Leibnitz's rule for differentiation inside an integral,

$$\frac{\partial N}{\partial t} = - \int_{\hat{x}}^{1} L(x) \frac{\partial f}{\partial a} \frac{\partial a}{\partial t} dx < 0 \tag{4}$$

There is only one term because $f(a,\hat{x}) = 1$. Postulates 1 and 2 presume that both ability and age are preferred, implying $\frac{\partial f}{\partial a}$ and $\frac{\partial a}{\partial t}$ are positive. The derivative in (4) is negative because all arguments in the integral are nonnegative. Diminishing returns to advancement with respect to both ability and age, imply that $\frac{\partial^2 f}{\partial a^2}$ and $\frac{\partial^2 a}{\partial t^2}$ are negative. Therefore the second derivative over N(t) with respect to time

$$\frac{\partial^2 N}{\partial t^2} = - \int_{\hat{x}}^{1} L(x) \left[\frac{\partial^2 f}{\partial a^2} \left(\frac{\partial a}{\partial t} \right)^2 + \frac{\partial f}{\partial a} \frac{\partial^2 a}{\partial t^2} \right] dx \tag{5}$$

is positive. The few assumptions made so far are enough to guarantee concave seniority advancement.* Note that diminishing returns with respect to age $\left(\frac{\partial^2 a}{\partial t^2} < 0 \right)$ is sufficient but not necessary for concave advancement. If $\frac{\partial^2 a}{\partial t^2}$ were greater than zero the result would depend on the relative magnitudes of the two terms in equation (5).

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*The mapping of seniority into earnings has received little attention. A positive first derivative of $w(\alpha,t)$ with respect to α is easily posited. However the concavity of the second derivative $\frac{d^2w}{dt^2}$ depends on $\frac{\partial^2 w}{\partial \alpha^2}$ as well as $\frac{\partial^2 \alpha}{\partial t^2}$. $\frac{\partial^2 w}{\partial \alpha^2}$ measures the convexity of the rate of salary advance for increasing seniority and could very well be positive. Then the convexity of the wage function relative to the concavity of the advancement function determines the shape of the earnings stream. This question would have to be settled empirically.

3.2 Labor Force Growth

When the labor force is permitted to change over time, such that $L=L(x,t,y)$, the sign of N_t becomes indeterminate. The first derivative

$$\frac{\partial N}{\partial t} = \int_{\hat{x}}^{1} \left[\frac{\partial L}{\partial t}[1 - f(a,x)] - \frac{\partial f}{\partial a} L(x,t) \frac{\partial a}{\partial t}\right] dx \tag{6}$$

is now the difference of two positive terms. The term from equation (4) keeps the same density but permits the region of preferment to shrink, while the additional term represents the rate of increase in worker density for a fixed region of preferment.

For small labor force increases it can be expected that all current workers will advance within the hierarchy. Workers with high ability will be displaced less than low ability workers, because both their region of preferment is smaller $[1 - f(a,x)]$ and their rate of advancement is greater, $\frac{\partial^2 a}{\partial t \partial y} > 0$. If there is a large increase in the labor force unaccompanied by job creation all workers below some ability level will find they are redundant. This would happen if the first term in equation (6) dominated the second causing $\frac{\partial N}{\partial t} \geq 0$ below some level $\bar{\alpha}$. This model of employment that ranks everyone and then leaves the least-skilled-lowest-ability people unemployed is consistent with the large amount of "structural unemployment" now observed in the United States.

With the first derivative of N(t) of indeterminate sign, the second derivative also loses its unambiguous positive sign. Two more terms appear within the integral in equation (7) compared to equation (5)

$$\frac{\partial^2 N}{\partial t^2} = \int_{\hat{x}}^{1} \left\{\frac{\partial^2 L}{\partial t^2} [1-f(a,x)] - 2\frac{\partial f}{\partial a}\frac{\partial L}{\partial t}\frac{\partial a}{\partial t} - \left[\frac{\partial^2 f}{\partial a^2} L(x,t) \left(\frac{\partial a^2}{\partial t}\right) + \right.\right.$$

$$\left.\left. + \frac{\partial f}{\partial a} L(x,t) \frac{\partial^2 a}{\partial t^2}\right]\right\} dx \tag{7}$$

Both additional terms are positive. The first term is the derivative of population increase integrated over the region of preferment. It increases the concavity of the seniority function. However, since population increases slowly, $\frac{\partial^2 L}{\partial t^2}$ is likely to be small. Consequently the first term may be swamped by the second, which is the combined effect of an increased labor force and decreased region of preferment. The net effect on $\frac{\partial^2 N}{\partial t^2}$ is indeterminate.

3.3 Baby Boom

The effect of a sudden increase or decrease in labor force growth can be analyzed with this model. Arthur (1979) has gone through the analytics. I will not reproduce them here but merely explain the implications.*

Advancement within the hierarchy is determined solely by the number of people preferred. Both the age and ability of those in the labor force bulge relative to one's own are important. These determine how much the change in the labor force density will effect one's region of preferment. High ability people older than the large cohort will be only slightly affected, as only the most able younger workers will be able to leapfrog over them to higher seniority positions. Low ability people both in the bulge and behind it will be especially hard hit. They will advance slowly and in periods of economic downturns, suffer spells of unemployment.

3.4 Supply Response to Wage Rates

So far the four distribution functions that make up this model--seniority, wage, labor force, and promotion--have been assumed to be independent of one another. However, a labor force participation response to changes in the wage rate is empirically observed, such that the labor force distribution function might be

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*Cornford (1980) has used this model to empirically study the effects of the Baby Boom on career advancement in the American academic labor force.

specified as *

$$L(x,t,w) = \lambda(x,w(t),y)B(x,t,y) \tag{8}$$

The net effect to equation (6) of specifying $L(x,t,w)$ as in equation (8) is to add another term inside the integral that is the responsiveness of the $\lambda(x,w,y)$ function to wage changes over time. A case can be made for $\frac{\partial\lambda}{\partial w}$ being either positive (income effect) or negative (secondary worker effect). It is crucial that the λ function include y as an argument. Labor force fluctuations are important to an individual's career only if they affect the numbers of workers preferred to him. Therefore only the supply response of workers with higher ability or slightly lower ability but greater age is important. Cyclical participation of "discouraged workers" who are most probably low in the job ranking will not affect many workers.

3.5 Both Competitive and Institutional Markets

Not all jobs in the economy fit into an institutional framework of the type presented here. It is more accurate to recognize that only some professions, e.g., government and corporate bureaucracies, can be well described by an institutional system. Salaries for other jobs, such as piecework-production jobs or the self-employed, are determined in more competitive markets where productivity is measureable and duely rewarded. One can ask what the implications are of assuming the coexistence of these two types of job markets.

The expected utility of an identical worker starting in each system should be equal, but expected earnings might not be. A decision to sell labor in either market will depend on risk aversion (the institutional job will provide greater certainty of employment), individual rate of time preference (the intertemporal stream of earnings offered by institutional employment may not

*For a study of ability (schooling) responsiveness to wage rates see Dresch (1975) and Freeman (1975).

coincide with the worker's preference), and the degree of mobility between the two sectors (where a worker from the competitive sector would be placed in the seniority ladder). Little can be said mathematically without committing oneself to a specific distribution of individual utility across ability levels.

3.6 Generalizations

Other specific cases could be discussed but as they get more complex the comparative statics become even less determined.

The four separate functions that have been specified are in some sense arbitrary. Including linkages between them would be more realistic. In this simple system the labor force distribution function models labor supply, while the preference ordering and seniority function determine labor demand. The demand functions cannot be completely independent but must maintain some consistency between the hierarchical structure and the rate of promotion. The labor force distribution and promotion functions are the only two that depend on the way ability is measured, therefore they cannot be specified independently.

The purpose of the comparative statics excercises was to illustrate the behavior of this model, and to show that for weak but realistic assumptions on the basic wage determination relations concave earnings functions are implied. No assumptions about individual income maximizing behavior are necessary.

4. COMPATABILITY OF THE SUPPLY AND DEMAND MODELS OF WAGE DETERMINATION

The individual behavior suggested by the human capital and signaling models is consistent with this institutional explanation of how workers are matched with jobs. But, it is argued, the inefficiencies that form the basis for the institutional model render precise estimates of rates of return impossible.

Both the signaling and institutional models allow for social inefficiencies through the possible imperfect correspondence between the "employer observed relationship between productivity and signals" and the "true relationship". However the signaling model proposes a feedback mechanism that will iterate to a (possibly non-optimal) equilibrium: employees invest in signals to be used as hiring criteria by employers; and employers in turn evaluate the signals they receive from prospective employees on the basis of their experience in the labor market. This is illustrated in Figure 3.

In the institutional model there is no tendency to move towards an equilibrium where institutional preferences are consistent with marginal product because marginal product is not relevant. The origins of the promotion system may lie in exactly the type of institutionalization process Spence describes. But as jobs change it is impossible to keep track of individual productivity and the preference system loses its foundation in rational determination. The box in the lower left of the diagram is only imperfectly determined. For modeling purposes, the workings of the promotion system must be posited. A rather loose attempt from observing the market is presented in Section 2.

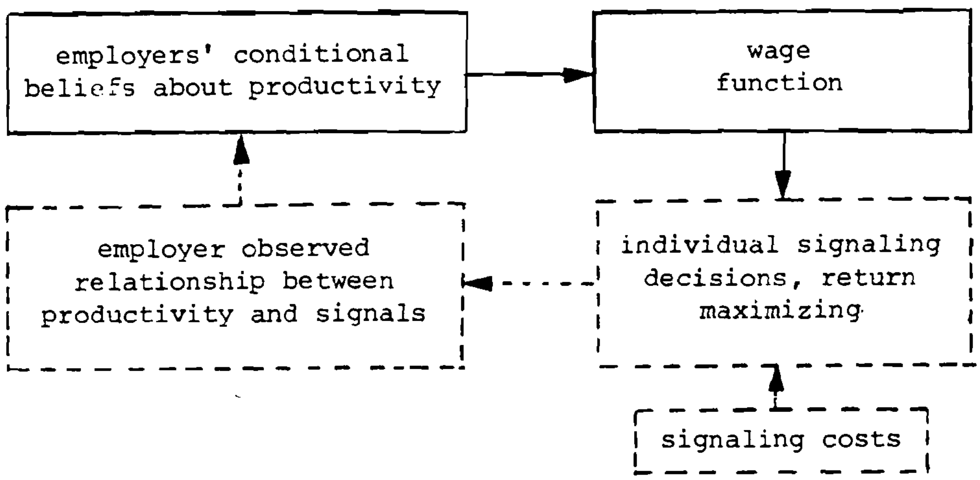

Figure 3. Signaling feedback mechanism. (Source: Spence 1973, p.359, or 1974, p.17.)

The institutional model can incorporate individual planned investment in human capital. Even with a bureaucratic hiring process a person may observe that different earnings paths are available for workers with different signals and choose to invest in schooling. However individual supply decisions play no role in the institutional decisions over what jobs to offer workers. Since any one worker is directly competing with others within a rank-ordered system for predetermined jobs, the job he finally ends up in, and consequently the return to his education, depends on the signals of everyone else in the labor force.

There is also no reason to expect the wage function with respect to any given set of signals to necessarily be stable. The preference function or labor force distribution function could change at any time altering how aggregate output is distributed.* This suggests that the box in the lower right hand side of Figure 3 can also not be accurately modeled as part of a feedback system.

The existence of a promotion scheme that is not based on acquisition of human capital makes it difficult to determine empirically the return on educational investment. The "control" for the simple human capital model is a flat (Mincer) or declining (Ben-Porath, 1967) income stream. This paper argues that the structure of demand in the labor market already gives workers a concave income stream. Human capital investment may add to that concavity but in a (numerically) undetermined fashion.

In many bureaucratic jobs it can be argued that there is little human capital investment, so that most salary increases can be modeled using Section 2. In jobs where salary is the result of

*One example of this in practice is the tendency to require higher and higher credentials for jobs that used to be performed by less educated people. Workers who planned for one market find they must compete in another more educated market. Affirmative action programs represent purposeful changes in the institutional preference ordering that have real consequences for individual income streams.

a combination of increased productivity and institutional advancement it would be necessary to sort out the two effects for empirical estimation of either model. However these effects must be differentiated on theoretical grounds before approaching the data. The four distribution functions are sufficiently general that virtually any earnings streams could be consistent with solely institutional advancement, so the data cannot discriminate between productive and nonproductive bases for salary increases.* If in fact the underlying structural model were to be incorrectly specified, and the entire earnings profile explained with only a supply and not a true reduced-form model, then understandably the empirical results will not always be good, see Cambell and Curtis (1975).

CONCLUSION

It has been argued that for a large range of jobs, earnings are not determined by the individual but by an institutional system that is not responsive to marginal pricing mechanisms. An alternative explanation of how earning streams are generated is developed using a demand model of the labor market.

The theory presented here is still so general that most any type of labor market behavior could be explained by careful selection of the four underlying functions. Yet this model is appealing because it offers a simple, realistic foundation within

*Lazear (1976) attempts to differentiate between wage increases due to age and those due to experience using the observation that one does not gain experience when unemployed. His findings are not inconsistent with the model presented here. In the institutional model, if a worker becomes unemployed he must have been moved down below zero on the ability axis. A negative correlation between wages and unemployment is assumed. When he is retired because his age makes him preferred to younger, and unskilled, workers he will be at a higher seniority level but not as high as if he bad been employed the entire time.

which can be nested the more restrictive models of human capital theory and signaling. There are several specific implications of this theory

1. Concave seniority advancement (earnings) can be expected over time for almost all workers independent of individual behavior. It is a mistake to associate a given earning stream only with a worker's investment in training. Demand as well as supply behavior determines a worker's job and income stream and consequently the "return" on any investment.

2. Calculation of both private and social rate of return calculations are of little value. A worker cannot predict either where his investment will put him in the labor queue or what his income stream will be. The worker's observed income cannot then be viewed as the result of optimal planning. Belief in a constant estimable rate of return to investment is ill-founded.

This model has assumed the social return to schooling for institutional employees is zero. Individuals may invest in signals to gain a personal advantage in ranking, but increased output is not observed from the institution by the internal re-ranking. In a more realistic world with both competitive and institutional markets the social return to schooling will not be zero, but only impossible to determine empirically.

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