International Institute for Applied Systems Analysis
IIASA www.iiasa.ac.at

Age and Earnings in the Labor Market: Implications of the 1980's Labor Bulge

Arthur, W.B.

IIASA Working Paper

WP-79-118

December 1979

Working Paper

AGE AND EARNINGS IN THE LABOR MARKET:
IMPLICATIONS OF THE 1980'S LABOR BULGE

W.B. Arthur

December 1979
WP-79-118

International Institute for Applied Systems Analysis
A-2361 Laxenburg, Austria

AGE AND EARNINGS IN THE LABOR MARKET: IMPLICATIONS OF THE 1980'S LABOR BULGE

W.B. Arthur

December 1979
WP-79-118

INTERNATIONAL INSTITUTE FOR APPLIED SYSTEMS ANALYSIS
A-2361 Laxenburg, Austria

This paper was prepared for presentation at the Sixth World Congress of the International Economic Association, on "Human Resources, Employment and Development," in Mexico City, August 1980.

ABSTRACT

This paper proposes a non-neoclassical model of earnings and advancement over the working lifecycle. It assumes an economy that generates job-slots or positions, arranged institutionally at different seniority levels, each carrying a salary tagged to its level. The individual is driven upward in rank and salary as time passes, not because his productivity or human capital necessarily increases, but because retirement and death progressively thin out the numbers "above him" who occupy positions at higher levels.

Larger labor cohorts (for example the 1980's "labor bulge") would depress age-earnings profiles within this system. The extent of earnings loss depends on the relative number of job-slots at different levels, on the age-location of these cohorts within the labor force, on the extent to which they bring into being new productive jobs, and on the promotional policy in force.

AGE AND EARNINGS IN THE LABOR MARKET: IMPLICATIONS OF THE 1980'S LABOR BULGE

W.B. Arthur

1. INTRODUCTION

Current theories offer conflicting guidance on how demographic changes in the labor force affect earnings and advancement over the working career. Human capital theory, as reflected in Welch (1978) for example, would predict that larger age-cohorts than normal would earn less throughout their careers.[1] If, as human capital theory assumes, earnings are based on productivity, then the increased competition for complementary inputs must lower productivity and hence salaries. Members of larger labor cohorts will therefore have lower age-earnings profiles.

Demographic theory on the other hand, if we extrapolate slightly the mobility models of Keyfitz (1973), would indicate a different result. Assuming earnings based on seniority or "rank", and "rank" in the labor force measured by relative position within the age-pyramid (the proportion above the age in question divided by that below) then the older members of a succession of large age-cohorts would be enhanced; they would gain in rank and hence in salary over their careers. The younger members, by the same token, would lose. Depending then on whether we see earnings tied to productivity or tied to demographic rank, larger labor cohorts

[1] For other human capital writings on age-earnings see for example Becker (1964), Kreps (1977), Mincer (1971), and Rosen (1972).

might either impede or benefit their members over their careers.

Cohort size, as a major influence on salary and career progress, is a question of some current importance. Most of the developed countries in recent years have witnessed much larger age groups than normal entering their labor forces: the post-war Baby Boom of the 1950s has grown up to become the "Labor Bulge" of the 1980s. Can we expect members of this Labor Bulge, young people now in their twenties and early thirties, to advance in salary and seniority at normal rates? Will they be speeded forward, or more likely, be held back by their greater numbers?

To answer this question, we must first construct a theory of how career advancement and salary vary with age. And for such a theory, neither the viewpoint of human capital, with its strong productivity-earnings assumption, nor that of demographic theory, with its peculiar definition of rank, is totally satisfactory. In most labor markets these days, earnings are no longer tied directly to productivity. Soldiers, by and large, are not paid directly for wars won, nor are professors paid directly for knowledge imparted. Instead, in most labor markets, people are paid simply for occupying their jobs. Whether they produce more or less makes little difference to their salary in the job they hold. Similarly, neither earnings nor seniority are tied directly to relative position within the age pyramid. Large numbers of young people could well be added to the civil service, for example, without necessarily affecting either the positions or salaries held by those higher up.

This paper proposes a model of age and advancement based on assumptions different from those of both theories outlined above.[1] In this model the economy generates large numbers of job-slots or positions, arranged for organizational reasons into various levels of seniority. Each position carries a salary, decided institutionally according to its level. The members of the labor force fill these positions and they progress not by learning to be more productive in the same job, but by advancing slowly through the hierarchy of positions according to their age and ability,

[1] For a more detailed and less informal account of this model, treating other labor market issues, see Arthur (1980); and for an interesting application of this model to a single profession, the American academic profession, see Cornford (1979).

occupying progressively more senior and more highly paid positions as those ahead of them thin out through retirement, early exit or death. Thus, in this model earnings are tied to positions, not to people, and seniority is measured directly by position held, not by demographic rank. Within this model we shall look first at how advancement varies with age, then at the effect of a labor bulge on the careers of its members.

2. THE MODEL

The labor economy considered here consists of four basic components: (i) a job seniority distribution, (ii) a wage function, (iii) a labor-force age distribution, and (iv) a promotional system.

(i) *Job Seniority Distribution.* The economy, it is assumed, generates job-slots or positions at various levels of seniority. Thus, at time t, there are m(s,t) positions at seniority level s. The seniority indicator, we assume, is well-defined (the U.S. government GS levels would be an example) and varies continuously between lowest level $\underline{s}$ and highest level $\bar{s}$. The shape of this job-seniority distribution, the actual number of slots at different levels in other words, is arbitrary and may change with time; it reflects the economy's organizational and institutional arrangements. Above level α there are

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

positions. In total, at time t there are

$$(2) \qquad \bar{M}(t) = \int_{\underline{s}}^{\bar{s}} m(s,t)ds$$

positions in the economy.

(ii) *Wage Function.* To each position at seniority level s and time t is attached a wage w(s,t). The wage function w is largely arbitrary but given, decided by an political-institutional process. We assume that w increases monotonically

with seniority level s, so that wage and seniority at any time are in one-to-one correspondence and can be used interchangeably. Together w and m are constrained so that the total wage bill equals non-invested total product F(t):

$$(3) \qquad \int_{\underline{s}}^{\bar{s}} w(s,t)m(s,t)ds = F(t) \quad .$$

(iii) *Labor-Force Age Distribution.* Occupying the positions generated by the economy is a labor force which has L(x,t) members aged x at time t. In total, at time t, there are

$$(4) \qquad \bar{L}(t) = \int_0^{\omega} L(x,t)dx$$

members of the labor force, where ω is retirement age.

(iv) *Promotional System.* We assume a promotional system P, determined by an arbitrary (and perhaps unconscious) social-institutional process. The promotional system tells us which of any two members of the labor force would be *preferred*, on the basis of age, education, background, sex, industriousness, or other labels and signals, if a position senior to both opened up. For simplicity we will condense the non-age factors into the general term "ability".[1] In short, the promotional system establishes a preference ordering over the labor force, preference being determined on age and ability.

To complete the model, we assume all positions are in principle open to all people, and that vacancies if they occur are filled immediately. We assume that if one person is *preferred* to another we find him in a higher job. And we assume at least as many people in the labor force at all times as jobs, so that $\bar{L}(t) \geq \bar{M}(t)$. The difference, $\bar{L}(t) - \bar{M}(t)$, corresponds to unemployment.[2]

---

[1] We can construe "ability" here as the general ability to satisfy the non-age requirements and preferences of the selection process.

[2] If the unemployed are to be paid an institutional wage, the model must be modified slightly. One possibility would be to declare the lowest seniority grade, $\underline{s}$, to correspond to unemployment; (3) would then hold as before.

To begin with we shall treat the four main components of this labor economy as causally independent and exogenously given. We can think of the economy's stock of capital and resources and its organizational habits as calling into being a necessary number and distribution of job-slots. This distribution changes over time, of course, as the economy grows or fluctuates. Population processes, separate from the economy, generate the labor force. The wage bill is constrained by total output, and its distribution is decided by a social or institutional process that attaches salary to the seniority or importance of each job. Finally, promotion follows traditions of preference, and is uninfluenced by both the labor force and the economy. Later we shall look briefly at how the main components might to some degree influence each other.

Our task is now to show how the job seniority distribution, the wage function, the labor force, and the promotional system come together to determine the paths of seniority and earnings over age, and how demographic changes in the labor force would alter this path.

3. THE CAREER PATH

Imagine the members of the labor force as scattered over an age-ability plane (see Figure 1), each person located, at a

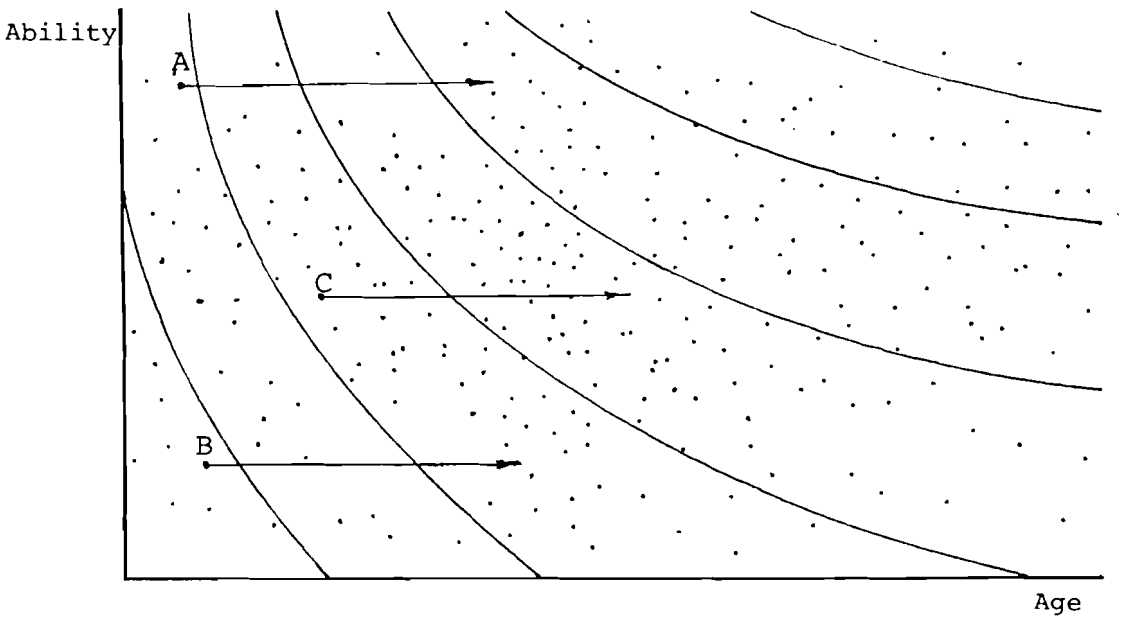

Figure 1

particular time, at the point that corresponds to his age and ability. Supposing the promotional system is rational (that is, if one person is *preferred* to a second, and this second to a third, then the first is also *preferred* to the third) we can represent it as a series of indifference curves on the age-ability plane. For a particular person with age a and ability i, the area to the "right" of the indifference curve passing through his location, we will call his *region of preferment* $\phi(a,i)$. The number of points in this area tells us in total how many people are *preferred* to him at that time. As time passes, all points move uniformly to the right -- each person ages one year every year -- with certain points disappearing as people retire, leave or die, others newly appearing as people enter the labor force.

To illustrate some possibilities consider people A, B, and C in Figure 1, each with given and unchanging ability. High ability person A, under the system of Figure 1, starts off slightly preferred to low ability person B. As the years pass he crosses the indifference lines faster than B to become yet more *preferred:* his region of preferment rapidly shrinks. Person C starts off *preferred* to both A and B; he remains ahead of B at all times. But as time passes he is bypassed by A. Time and age alone allow A eventually to "leapfrog" C in the preference ordering for higher jobs. Similarly, if we allow changes in ability over the life cycle further leapfrogging can occur.

Within this labor force we now choose an arbitrary reference person whose fortunes we follow. This reference person -- call him person R -- was born in year t_R, is aged $t - t_R$, has ability level $i_R(t)$, and occupies seniority level α in year t. The function $\alpha(t - t_R)$, R's seniority level as it depends on his age -- his *career path* as we shall call it -- is what we seek to determine.

At time t, under the given promotional policy P, there are $N_R(t)$ members of the labor force *preferred* to person R. Where $\phi(t - t_R, i_R(t))$ is R's region of preferment at time t, total numbers *preferred* to him are given by

$$(5) \qquad N_R(t) = \iint_{\phi(t - t_R, i_R(t))} L(x,t)\,dx \quad .$$

Now, these people, *preferred* to R, must occupy positions senior to his level α at time t, and we know that there are $M(\alpha,t)$ such positions above level α at that time. It now follows from our earlier assumptions, as a fundamental accounting identity, that the number of people above R equals the number of jobs above his level:

$$(6) \qquad N_R(t) \equiv M(\alpha,t) \quad .$$

Solution of this identity for α at each time t gives us the function $\alpha(t - t_R)$, person R's career path. R's age-earnings profile follows immediately as the function $w(\alpha(t - t_R),t)$.

We may use the fundamental identity to plot person R's career path over time, for ease of illustration holding the job distribution fixed over time.

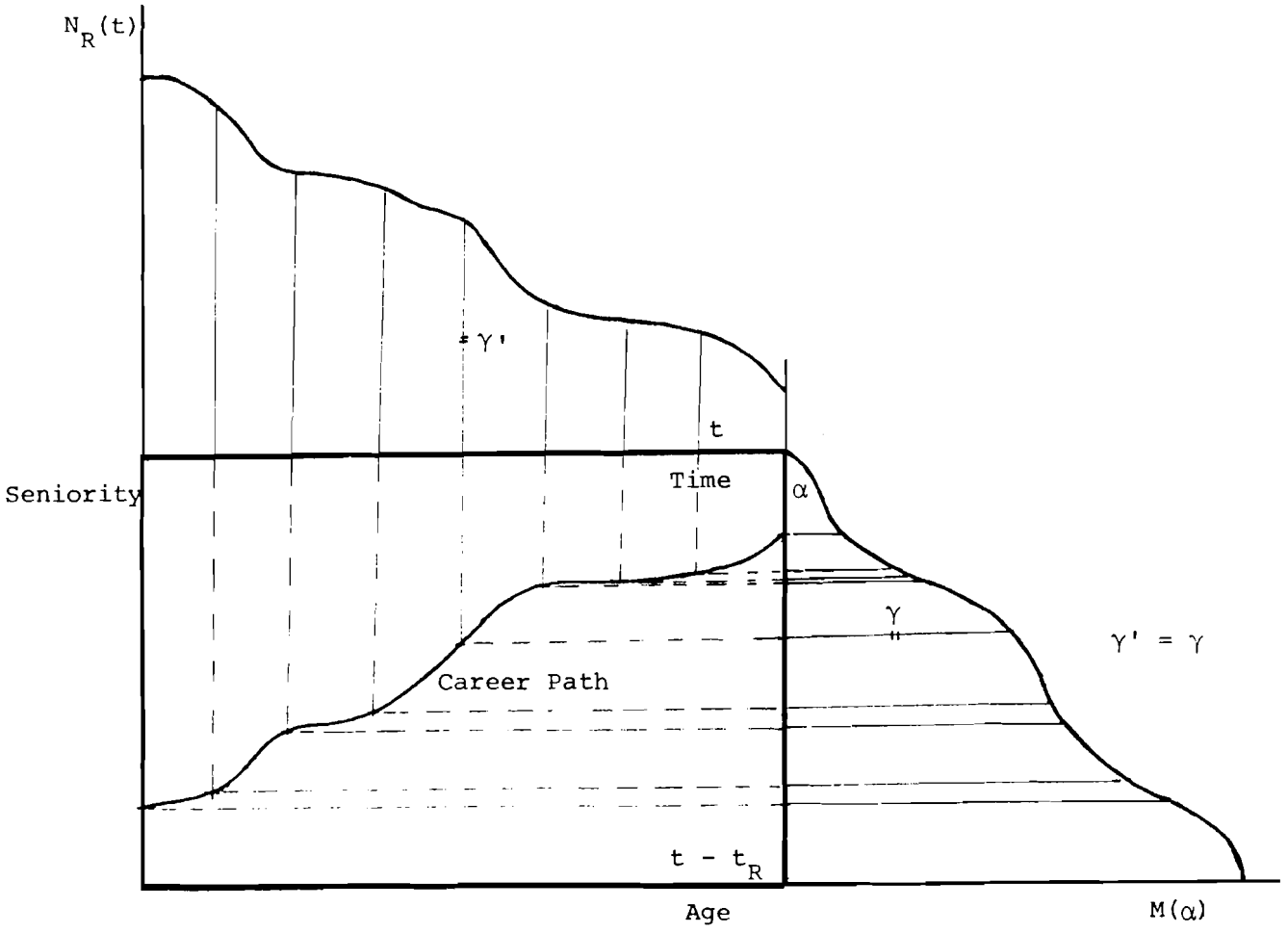

Figure 2

To construct R's career path in Figure 2 we begin with functions $M(\alpha)$ and $N_R(t)$, chosen arbitrarily. M, by definition, will decrease as seniority level rises. N_R, the numbers ahead of R, in the usual case will decrease with time. As R ages older cohorts retire in sequence from the labor force and other members, *preferred* to him, may leave early or die. Barring major shifts in ability between R and his rivals then, N_R will decrease over time. Given $N_R(t)$ and $M(\alpha)$ the career path may be plotted as the set of points where N_R vertically equals M horizontally. Thus, as Figure 2 shows, the passage of time pushes the representative person upward in seniority by diminishing progressively those *preferred* to him for positions in the hierarchy. In this way the aging of those in the labor force drives the dynamics of advancement, the actual path of the career depending on relative numbers in the labor force at different ages, the promotional policy in force, and the relative numbers of jobs at different levels.

It is instructive to sketch the career path for a number of special cases:

(i) For a high-ability person A, we can expect that $N_A(t)$, the number *preferred* to him, will fall rapidly. He will therefore reach the top rapidly as can be seen by plotting his career. Low ability person B, on the other hand, will rise only slowly, as numbers preferred to him dwindle (if at all) at a low rate. He will be condemned to low levels throughout his career; worse, if $N_B(t)$ should exceed the total availability of jobs, $\bar{M}(t)$, a possibility more likely while he is young, he will be forced downward from time to time into unemployment.

(ii) For promotion based strictly on age alone, with older people preferred to younger so that the indifference curves are vertical, all career paths for members of a given cohort are identical. Each person, in this case, if he enters at the youngest age, must start at the bottom; and he must reach the top position just before retirement holding it briefly just as long as he is the oldest person in the labor force. The career path will be relatively steep.

(iii) For promotion based strictly on ability alone, with the indifference curves now horizontal (imagine for example an entire economy consisting of nothing but Formula One Grand Prix racing drivers), the career path of any given person will be flatter, fluctuating up and down as his ability changes and as the net number of more able workers varies with entries and exits from the labor force.

(iv) For an expanding economy with job-slots increasing at all levels ($\partial m/\partial t > 0$), all persons, regardless of ability, will advance more rapidly than otherwise. This can be seen by plotting the same N_R time-curve against successively expanding job distributions. Conversely, if the job market is contracting at all levels, advancement will be less rapid for any given person; indeed his seniority and salary may well decline.

4. EFFECTS OF A LABOR BULGE

Loosely defined, a labor bulge is a succession of labor cohorts larger than normal. More precisely, we may assume some nominal "usual" size distribution for labor cohorts, the deviation from this (see Figure 3) being the labor bulge.

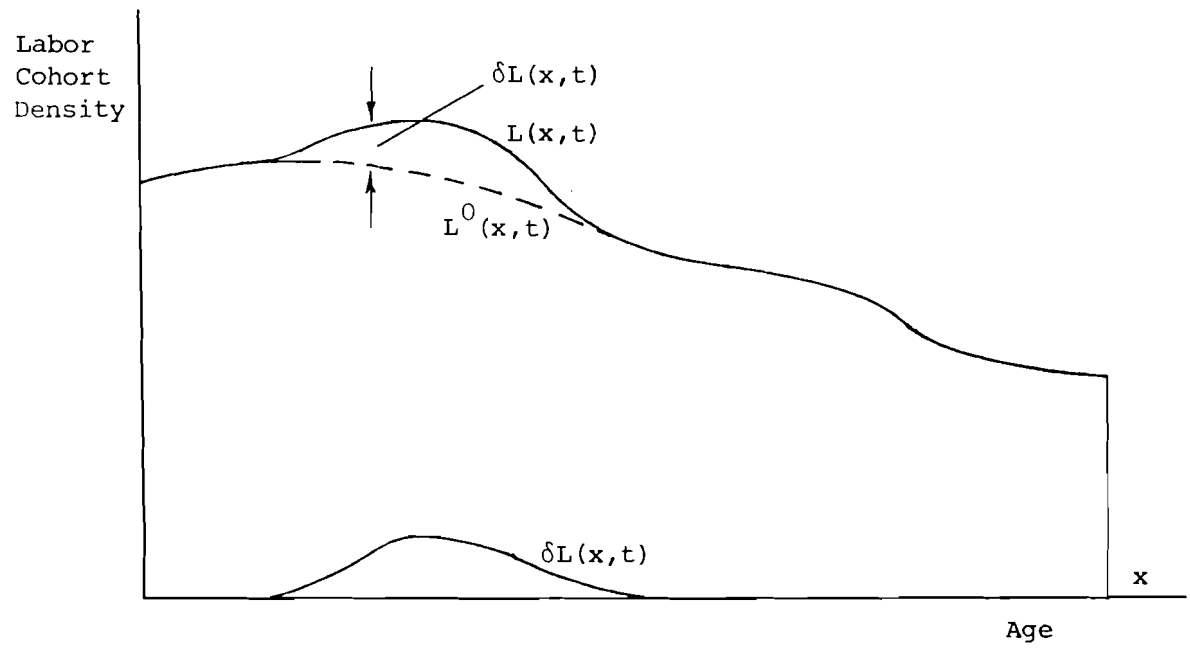

Figure 3

Thus a labor bulge can be written as the differential function

$$(7) \qquad \delta L(x,t) = L(x,t) - L^0(x,t)$$

where L^0 is of course arbitrary. The question is now how much the presence of a labor bulge will affect both the career and salary paths of workers of different ages and with different abilities.

At time t, the labor bulge will cause R's career path to change by $\delta\alpha[t - t_R]$ seniority units, and his salary by $\delta w(t - t_R)$ monetary units. And since these depend on the particular function δL we write them in full as $\delta\alpha[t - t_R;\delta L]$ and $\delta w[t - t_R;\delta L]$. Now, according to our earlier assumptions, the labor bulge cannot affect the distribution of work-places: m was given exogenously. (In the next section we will relax this, allowing additions to the labor force to cause the creation of new positions.) For the moment the labor bulge can affect only the numbers and placement of the labor force in the given array of positions. Accordingly, it will change the numbers *preferred* to person R at time t by an amount

$$(8) \qquad \delta N_R(t) = \iint_{\phi} \delta L(x,t)\,dx \quad ,$$

where the region of preferment $\phi(t - t_R, i_R(t))$ is abbreviated for convenience to ϕ.

Writing the fundamental identity in implicit form

$$(9) \qquad N_R(t) - M(\alpha,t) \equiv 0$$

we see that $\delta\alpha$ must be such that it compensates for the change in N_R, to preserve the identity at zero. Thus, taking differentials across (9),

$$(10) \qquad \delta N_R(t) - \frac{\partial M(\alpha,t)}{\partial \alpha}\,\delta\alpha = 0$$

and recalling that

$$\partial M(\alpha,t)/\partial\alpha \;=\; -m(\alpha,t)$$

we therefore have the change in R's career path at age $t - t_R$ as

$$(11)\qquad \delta\alpha[t - t_R;\delta L] \;=\; -\frac{\delta N_R(t)}{m(\alpha,t)}$$

or, using (8)

$$(12)\qquad \delta\alpha[t - t_R;\delta L] \;=\; -\int\!\!\int_{\phi}\frac{\delta L(x,t)\,dx}{m(\alpha,t)} \quad .$$

The change in the earnings profile follows simply as

$$(13)\qquad \delta w[t - t_R;\delta L] \;=\; -\frac{\partial w}{\partial\alpha}\cdot\int\!\!\int_{\phi}\frac{\delta L(x,t)\,dx}{m(\alpha,t)} \quad .$$

In words then, person R's loss in seniority equals the additional numbers preferred to him at time t divided by the job density at his level. To see why this should be so, imagine the job-slots generated by the economy as arranged on a large staircase. The width of the staircase at level α corresponds to the number of jobs $m(\alpha)$ at that level. The labor force fills this staircase in an order that follows from the promotional-preference system. Suppose now we add a labor bulge somewhere in the middle of the age distribution. From person R's viewpoint, an additional number of people δN_R, *preferred* to him, have been added. And since they must be fitted into positions senior to him on the stairway they must displace an equal number of people (including himself) downward. The presence of the labor bulge will therefore displace R downward on the stairway by an amount equal to the additional numbers *preferred* to him, divided by the width of the stair at R's level. His salary will be lower than otherwise by a corresponding amount.

Not all members of the labor force are affected identically of course. What matters is how much a person's region of preferment, ϕ, at any time "captures" the labor bulge. Suppose, in an extreme case, promotion is based on age alone. Those ahead of the bulge, older than it, under this system have none of the bulge *preferred* to them; their ϕ-regions do not capture the function δL.

Hence they suffer no losses from the bulge. Those behind it, on the other hand feel its full force. All members of the bulge are "preferred" to them, all are older. If we assume realistically that numbers of job-slots narrow as seniority rises, then (12) shows that the loss in seniority increases as the career progresses, reaching a peak just before the older members of the bulge retire out, and diminishing rapidly to zero thereafter. Thus, under pure-age promotion, careers for those behind the bulge appear to sag progressively, showing a rapid spurt toward the end. The severity of this "mid-career crunch" of course depends on how far behind the bulge one is. Those just behind the bulge are hit worst over their careers. Those forty years or so behind on the other hand are displaced but little, and only at the beginning of their careers. Five years or so into their careers the bulge begins to retire out. Age location with respect to the labor bulge is all-important.

Now suppose, more realistically, that promotion is based on both age and ability. The situation in this case is more complicated. Those ahead of the bulge in age no longer completely escape. Their region of preferment may be invaded by members of the bulge younger than them but nevertheless more able. The integral limits defining N_R now capture some members of the labor bulge. Those ahead of the bulge in age will therefore be slightly delayed in reaching more senior levels. Conversely, with promotion now based on ability as well as age, there is some hope for those who come behind the bulge. If they have high ability, they may rise rapidly in preferment, gradually "leapfrogging" the main concentration of the bulge: under age-ability promotion their loss in seniority and salary will be less than under pure-age promotion.

From the discussion of the last two paragraphs we can conclude that the degree of loss caused by the presence of large labor cohorts depends very much on age-position with respect to these cohorts, on the shape of the job-seniority distribution, and on the extent to which people are selected and promoted for factors other than age.

5. EXTENSIONS OF THE MODEL

So far we have looked at advancement and the effect of demographic changes within a model whose main components are separate and largely independent. In practice of course, the labor force may be causally connected -- perhaps strongly, perhaps weakly -- to the wage function, the job distribution may be linked to the labor force, and so on. Tracing the precise effects of the many possible linkages, fully closing the model in other words, would require the addition of many further assumptions and macro-mechanisms. This is a task that will not be attempted here. Instead, we will confine ourselves to some speculative remarks on what might happen if two of the more important linkages were built in.

Suppose first that the labor force can influence the job distribution. Suppose in fact that the very presence of larger labor cohorts tends to bring new positions into being. One way this might happen is through a Say's Law type of process, where the "naked worker", not covered by one of the economy's ready-made job slots, by his presence in the market creates his own work. A freshly qualified lawyer for example may generate new cases, an additional police recruit may discover new crimes, without necessarily diminishing job positions for their colleagues. If this happens, the job distribution may widen partly to accommodate larger labor cohorts. A second way a labor bulge may enlarge the job distribution is through the creation, by the government or by other bodies, of artificial positions -- posts that do not add to social product -- the motivation usually being the desire to ease the additional unemployment caused by the bulge.

In both cases, we can say the labor bulge δL "creates" new positions $\delta m(s)$ at level s. Above level α therefore there are in total

$$(14) \qquad \delta M(\alpha,t) = \int_{\alpha}^{\bar{s}} \delta m(s,t)\,ds$$

additional positions created. An argument similar to that of the previous section shows that person R's seniority loss at time t will now be

$$(15) \qquad \delta\alpha[t - t_R] = - \frac{\delta N_R(t) - \delta M(\alpha,t)}{m(\alpha,t)} \quad .$$

The seniority loss is smaller now because some of the additional numbers preferred to R are absorbed into newly created jobs above his level. In the case where each member of the bulge creates his own position, δN_R will equal δM, and the seniority loss will be zero. Exact evaluation of (15) would require assumptions about the particular mechanism of job creation; without this we can say that seniority losses of the previous section are offset as in (15) by the degree to which additional jobs are created.

What of salary losses? Here a further complication is added. The additional jobs $\delta\bar{M}$ will create additional non-invested product δF, so that the entire wage function will be forced to change to preserve the social budget (3):

$$(16) \qquad \delta F(t) = \int_{\underline{s}}^{\bar{s}} w(s,t)\,\delta m(s,t)\,ds + \int_{\underline{s}}^{\bar{s}} \delta w(s,t)\,m(s,t)\,ds \quad .$$

How much the wage function will change at a given level depends on how much the additional positions cover their cost (first two terms in (16)) and on how the additional product is distributed (third term). In the extreme case where the additional positions are totally artificial so that δF is zero, the same product must be distributed over more jobs and real wages must fall for some if not all levels. This will happen either by institutional redistribution, or, if money wages are maintained at their previous levels, by inflation. Thus R's salary at age $t - t_R$ will be twice affected by the labor bulge: first in an amount corresponding to his loss in seniority, second in an amount corresponding to the adjustment of the real wage function.

In sum, to the extent that the labor bulge does not create new positions it will cause both seniority loss and unemployment. And to the extent that the positions it does create are artificial, it will cause a shifting down of the real wage function, possibly in the form of inflation. We can therefore not escape the possibility that a large labor bulge such as the present one might cause at the same time both higher unemployment and higher inflation.

As a second possible linkage, suppose that membership in the labor force is not exogenously given, but that the labor force is attracted into the market by the wages it can command. That is,

$$(17) \qquad L(x,t) = \lambda(x;w^0)B(x,t)$$

where λ is the probability of belonging to the labor force at age x, given salary path w^0, and $B(x,t)$ is the size of the surviving age cohort at age x. Under these conditions the larger the labor bulge the more it will depress salary paths, and so the more it will discourage membership in the labor market. Eventually an equilibrium will be reached between the size of the bulge and the wage losses it occasions. Knowing the labor-force age distribution at equilibrium, the theory would go through as before.

As a final speculation, we may relax the assumption that everyone in the economy is eligible for every job -- that there is only one industry, as it were. It will be useful here to distinguish two polar situations: an economy consisting entirely of *open professions*, and one consisting entirely of *closed professions*. We define an open profession to be one which anyone may join at any time and be placed according to age and overall personal ability. Post-office work or other civil service jobs might be good examples. A closed profession by contrast cannot be entered except at the start of one's career. The church, medicine, the officer corps in the military, and many closed-shop trades are examples. Most professions would lie in between.

Where the economy consists solely of closed professions the analysis would apply as before, but separately this time for each trade. Each profession in the economy would have its own labor force and job supply, for our purposes acting as a miniature labor economy unto itself. Career and salary paths would then differ according to the fortunes of the industry in question and the ups and downs of its past intake of recruits. Losses caused by a labor bulge would depend on the share of the bulge admitted to the profession in question. By contrast, an economy with

nothing but perfectly open professions, with workers changing trades at any sign of a wage differential, would behave as one large homogeneous industry. Providing we order jobs now by wage and not by seniority, salary paths for people of the same age and ability would then follow just as before. In a real economy, somewhere between these polar situations, we can expect career paths not to differ as much as they would in the closed case, nor yet to be identical for similar people as in the open case.

6. CONCLUSIONS

In this paper we have put forward a model of the labor economy and the individual's place in it. And we have looked at the effects of demographic changes in the labor force on the individual's path of advancement and salary. Much of the usual picture of the economy, with its emphasis on production, capital-labor ratios, and the like has been deliberately kept in the background. Instead the key determinants of income over age here are the supply of a set of seniority-and-salary-tagged positions and the existence of a promotionally-ordered age-and-ability varying labor force to fill them.

No apology is made for the fact that the outlook in this model is heavily institutional. It would be stretching reality to invent neoclassical mechanisms for the way society arranges its production into an organizational hierarchy, for the way it attaches salaries to levels of this hierarchy, and for the way it selects and promotes people to fill these levels. These days, by and large, industry, government and the service sector define and advertise job positions, they tag salaries to them, they select people to fill them, and they pay their employees usually not piece-by-piece, but by the week or month for the occupancy of their positions. This does not mean of course that individual productivity, initiative, and ability count for nothing. If productivity is rewarded in the promotional system an individual may advance rapidly, certainly without it he may not occupy his position for long.

Above all, what places this model outside the neoclassical framework is the fact that salary is not determined by any

marginal-value analysis, but instead by an accounting identity that states that the jobs "above" any person must be filled by and be equal to the number of people "preferred" to that person. On the way each side of this identity might change over time hangs both the fate of the individual and the implications of the labor bulge.

Different as its assumptions are, the model does contain overtones of both the human capital and demographic themes. Even if the worker is not paid his marginal product, the fact that the job-slot covering him determines his salary is close to the human-capital viewpoint that the capital covering him (plus his own experience) determines his salary. The difference is, and this should be emphasized, the present model need assume no learning nor indeed any such concept as "human capital" to explain the fact that salaries usually rise as the career progresses. What fuels the individual's career, what drives him upward in salary, is the fact that as time passes he grows older, and as he grows older the numbers "preferred" to him thin out through death and retirement. As time passes he has fewer and fewer rivals for positions in the hierarchy; he occupies higher positions and these are better paid. Here we have echoes of the demographic hierarchy theory, but with one important difference: position in the age pyramid is only half of what determines seniority; how the pyramid itself is fitted into the seniority distribution of jobs is the other half. For the individual the distribution of jobs above him, their numbers, their level and their salary, is just as crucial to his career prospects as the number of people or the proportion of people above him.

Finally, it must be said that the model put forward here and sketched out fairly roughly, would more suitably form the core of a larger model in which the four independent components are linked together in various ways. What is surprising though is that a simple model with few components -- a job distribution, a labor age distribution, a promotional system, and a wage function -- can go far to describe what our career experience over our working lives might have to do not just with age and ability, but with the vagaries of promotional policy, the expansion and contraction

of the economy, and the ups and downs of the changing age distribution of the labor force.

References

Arthur, W.B., "Career Advancement and Professional Labor Markets: Implications of the Baby Boom, Delayed Retirement, and Job Shrinkage", forthcoming, 1980.

Becker, G.S., *Human Capital*, National Bureau of Economic Research, 1964.

Cornford, A., "A Life-Cycle Model of Career Experience: The American Academic Labour Force", unpublished manuscript, 1979.

Keyfitz, N., "Individual Mobility in a Stationary Population", *Population Studies* 27:335-352, 1973.

Kreps, J.M., "Age, Work and Income", *Southern Econ. Journal* 43: 1423-1437, 1977.

Mincer, J., "Schooling, Age and Earnings", National Bureau of Economic Research, 1971.

Rosen, S., "Learning and Experience in the Labor Market", *Journal of Human Resources* 7:327-342, 1972.

Welch, F., "Effects of Cohort Size on Earnings: The Baby Boom Babies' Financial Bust", unpublished mimeo., The Rand Corporation, 1978.