AN APPROACH TO THE THEORY OF INTERPERSONAL DIFFERENCES IN SEARCH BEHAVIOUR

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In recent years economists have developed a theory of frictional unemployment which is based upon the absence of full information in the labour market, but which is otherwise embedded in a neoclassical framework. 1/ That is to say, individuals in the labour market have to find a strategy which maximises an income stream in the face of incomplete information about for example, the wage-distribution and its behaviour over time. It has been shown that by regarding information as a commodity whose acquisition confers benefits, but is not costless, optimal search behaviour can be defined in terms of the parameters of the labour market. 2/

The intellectual origins of this theory lay in a series of attempts to reinterpret the Phillips curve strictly in neoclassical terms. 3/ Rather than differing rates of wage increase being "caused" by different unemployment rates, the line of causation was reversed, and different rates of unemployment were generated by different rates of wage (or price) inflation. 4/ Search theory provided the underlying reasons why unemployment, at least in the short run, was determined by variations in the money wage level; if money wages were generally rising, workers searching the labour market would be more inclined to accept wage offers which in fact were good absolutely but not relatively and the average duration of unemployment would fall; while if money wages were generally falling, workers engaged on search would be more likely to reject what were in fact high relative, though low absolute, wage-offers, and the average duration of unemployment would rise.

Now since the unemployment rate may be defined as the rate of entrants into unemployment times the average duration of unemployment, ceteris paribus, the unemployment rate is positively related to the average duration and will change as the latter does. Thus at least in the short-run, there will be an inverse relationship between the rate of unemployment and the rate of growth of money wages. We note that the origins of search theory, and the majority of consequent literature, have been couched in time-serial terms, the fundamental aim having been to isolate those factors which cause aggregate search behaviour to change systematically over the cycle.

A pressing social and economic problem, however, particularly in the U.S.A., has been the continued existence of substantial differences in unemployment rates across socio-demographic groups, while aggregate unemployment has been in some sense "low". In Table I below we indicate unemployment rates for selected groups. The growth of search literature, and the consequent tendency to emphasise frictional unemployment, have led some writers to approach interpersonal unemployment differences from a search theory viewpoint. 5/ In terms of cross-section analysis, the search model would regard the unemployment rate for a group as being determined by its average flow into unemployment times its average duration of unemployment. Differences in unemployment rates between two groups may be explained in terms of one or other of these components. The implication of this type of analysis is that some at least of the unemployment differences may be thought of as frictional, and consequently may only require marginal changes (if any) in government policy. 6/

TABLE I

Average Annual Unemployment Rates for Selected Socio-Economic Groups, USA,1972

Selected Group	Unemployment rate %
Men 20 years and over	4.0
Women 20 years and over	5.4
Men 16 to 19 years	15.9
Women 16 to 19 years	16.7
White	5.0
Black	10.0
White men 20 and over	3.6
Black men 20 and over	6.8
White women 20 and over	4.9
Black women 20 and over	8.8
White-collar workers	3.4
Blue-collar workers	6.5
Service workers	6.3
Total labour force	5.6

Source: See footnote (7)

By and large unemployment is borne most heavily by the most disadvantaged groups. It is particularly important to establish whether high unemployment rates are voluntary (but if so, whether they are amenable to government influence) or whether high quit rates and long duration indicate demand side phenomena. As Hall has succinctly pointed out, "In the framework of the search theory, a satisfactory explanation (of differences in unemployment rates) would involve demonstrating that it is in the interest of disadvantaged workers to search for jobs more often and for longer periods .... it remains an urgent unsolved problem of modern economic research." 8/

This paper examines the extent to which search theory can throw light on interpersonal differences in unemployment experience. We consider first, what are the determinants of optimal search time for an individual? Secondly, how does search time change as the parameters of the model change? And thirdly, to what extent are these parameters likely to vary systematically across socio-demographic groups, and thus generate systematic cross-section differences in optimal search time?

As noted above, however, a large part of unemployment variation is attributable to differences in quit rates, rather than longer duration; the number of spells of unemployment, rather than the duration of those spells, is the critical factor. 9/ Search theory has been slow to explore this distinction. 10/ Such frequency of quitting has been described as misdirected, irrational, and even indicating "pathological job instability". 11/ We argue below that such behaviour may be consistent with search theory for individuals to whom the capital market will not lend freely. Far from the workers in the labour market behaving irrationally, high quit rates may be seen as a rational response to capital market imperfections.

Table 2.

Spells and duration of unemployment for various sex and age groups, USA, 1972

Sex and age group	Group unemployment rate (per cent)	Average duration (weeks)	No. of spells per year per worker
Males:			
16-19 years	14.0	4.0	1.82
20-24 years	8.4	4.8	0.91
25-44 years	2.9	5.8	0.26
45-64 years	2.5	6.9	0.19
Females:			
16-19 years	14.4	3.9	1.94
20-24 years	7.9	4.0	1.03
25-44 years	5.1	4.4	0.60
45-64 years	3.3	5.4	0.32

Source: See footnote (12)

Section I

In this section we show the determinants of optimal search duration for a simple model of search behaviour. The model is similar to that presented by Alchian, [13/] although we ignore the problem of on-the-job search. Since we are interested in interpersonal comparisons we shall assume that the parameters of the model are for any individual constant over the period for which we examine their role.

Alchian assumes that "potential wage offers are distributed normally around a mean, m, the present available wage", and that the potential wage rises with continued sampling though at a decreasing rate. We make similar assumptions except that our interpretation of the potential wage function is slightly different. We assume that the individual is aware of the wage-ranking of firms, but may not know if they have vacancies nor if he is qualified for particular vacancies.[14/] Hence search generates information about vacancies rather than about wages. Now if the individual knows the wage-ranking of firms he will tend to sample the highest wage payers. But we additionally assume that this is a widespread phenomenon, so that the highest-paying firm has the largest number of applicants per period, and hence presents the least likelihood of a successful application, *ceteris paribus*.

We therefore write the gross benefits from search (B) as:

$$B = u\,(1-e^{-\gamma\Theta}) \int_{\Theta}^{N} e^{-rt}\,dt$$

where u is the maximum attainable wage difference between his current job and another, i.e. $u = W_{max} - W_o$.

Θ is the number of periods of search, and N is the number of periods ahead when he expects to leave the new job.

γ, being the rate per period at which his highest wage offer approaches u, may be viewed as a proxy for the intensity of search.

r is a discount rate.

We write the cost of search (C) as a simple linear function of the length of search;

$$C = c\int_0^{\Theta} e^{-rt}\,dt,$$

where c is the per period cost of search, which we assume for simplicity to equal income foregone while searching, less any income maintenance payments.

Hence the return, or net benefit from search (G) can be written:

$$G = B - C = \frac{u}{r}\,(1-e^{-\gamma\Theta})\,(e^{-r\Theta}-e^{-rN}) - \frac{c}{r}\,(1-e^{-r\Theta}).$$

Solving for Θ^*, the value of Θ which maximises G, and writing h for u/c, we have the necessary condition,

$$G' = \frac{\gamma}{r}\,h\,e^{-\gamma\Theta}\,(e^{-r\Theta}-e^{-rN}) - h\,(1-e^{-\gamma\Theta})\,e^{-r\Theta} - e^{-r\Theta} = 0,$$

which is an implicit function in Θ; numerical solutions for Θ^* are shown in Appendix B, below.

Thus Θ^* is a function of the parameters N, h, r, and γ. Our main interest here is to show how Θ^* varies as do these parameters.[15/]

Since $\frac{\partial G'}{\partial \Theta} \, d\Theta^* + \frac{\partial G'}{\partial x} \, dx = 0$ around $G' = 0$, we can write for each parameter

$$\frac{d\Theta^*}{dx} = -\frac{\partial G'}{\partial x} \bigg/ \frac{\partial G'}{\partial \Theta}$$

and obtain the following results:

$$\frac{d\Theta^*}{dN} > 0; \quad \frac{d\Theta^*}{dh} > 0; \quad \frac{d\Theta^*}{dr} < 0; \quad \frac{d\Theta^*}{d\gamma} \text{ of indeterminate sign}$$

That is, an individual will increase the optimal duration of search if he expects to work longer at the new job, or if his expected wage differential increases, or if his discount rate falls. However an increase in the intensity of search has an ambiguous impact upon search duration.[16/]

In Appendix B, Table 1, we present numerical solutions for optimal search time which are derived by making various assumptions about parameter values. By casting our net fairly wide, particularly in regard to values of γ and of N, the model generates solutions for optimal search duration from zero to periods greater than one year. To a degree these results are encouraging in that some of the solutions seem quite plausible; on the other hand, Θ^* rises rapidly as γ and/or N increase, and takes on values which must be regarded as unreasonably high.

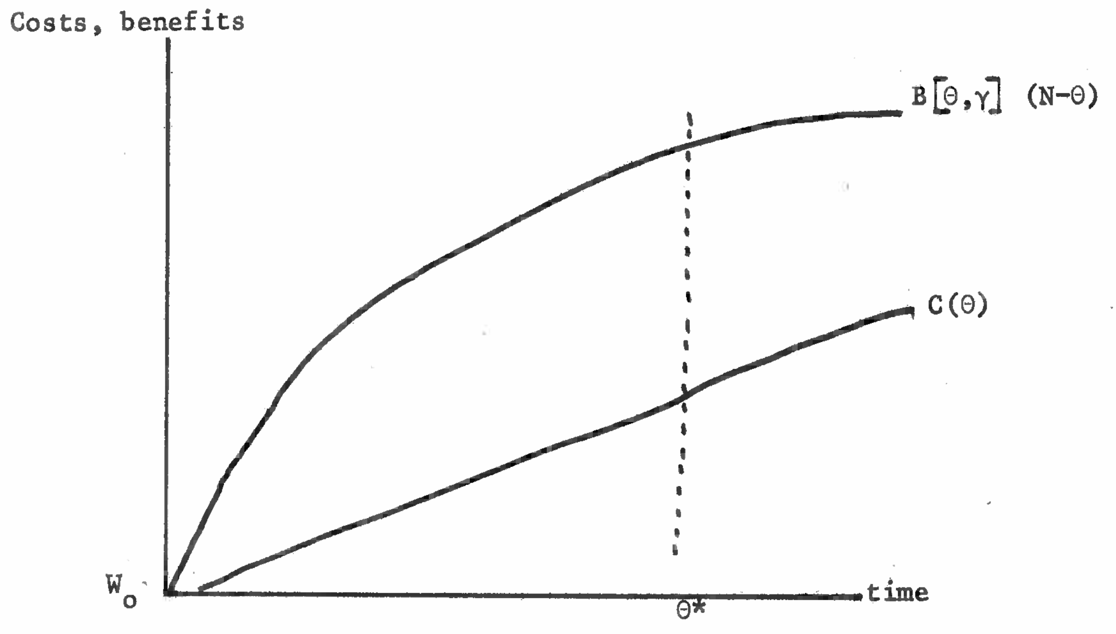
However, we note that the true value of γ is mere guesswork, while it is possible that uncertainty about long-run job prospects will tend to make workers cautious about their expected time in a new job. Equivalently, income streams accruing from many years ahead may be discounted at much higher rates, which again would have the effect of reducing optimal search time.

Alternately, while we need not attach much credibility to the absolute values of Θ^*, the relative effects of different parameter values are somewhat more acceptable. For example, the effect on Θ^* of allowing N to vary suggests that there should be a marked difference in search strategy between primary and secondary workers. In general the solutions show a high degree of sensitivity to variations in parameter values.

Section II

In this section we shall examine what, if anything, can be said about interpersonal search differences on the basis of the above model. The effects on search time of differences in N, h, and r are in the direction that one would have intuited. However the effect of differences in γ is interesting. The view that the duration of unemployment is longer than it need be because the intensity of search is low is not a viable argument even at the theoretical level. Increasing γ does not necessarily decrease θ^*. The diagram below indicates why this is so.

Diagram 1



The schedules are drawn for the undiscounted case, and we assume that the time on the new job, $N-\Theta$, can be treated as a constant, K. Search time is optimised when the two schedules are parallel. The $B(\Theta,\gamma)$ schedule is one of a family of schedules which may be drawn for different values of γ. As γ increases $B(\Theta,\gamma)$ shifts upwards; but the effect on Θ^* depends upon how the slope of $B(\Theta,\gamma)$ changes as it shifts. For certain values of γ and Θ, the slope of $B(\Theta,\gamma)$ increases around a given Θ^*, so that the functions become parallel at higher values of Θ, and Θ^* increases. For other values of Θ and γ the slope of $B(\Theta,\gamma)$ decreases around a given Θ^*, and consequently Θ^* decreases. More rigorously, since we can write

$$B = Ku(1-e^{-\gamma\Theta}),$$

then

$$\frac{\partial B}{\partial \Theta} = \gamma KUe^{-\gamma\Theta} ;$$

now

$$\frac{\partial \left[\frac{\partial B}{\partial \Theta}\right]}{\partial \gamma} = Kue^{-\gamma\Theta} - \gamma K\Theta ue^{-\gamma\Theta}$$

$$= Kue^{-\gamma\Theta}(1-\gamma\Theta) \quad ;$$

Hence in the undiscounted case, a necessary and sufficient condition for an increase in γ to decrease the slope of $B(\Theta,\gamma)$ and hence to decrease Θ^* is $\gamma\Theta>1$. $\gamma\Theta<1$ is necessary and sufficient for an increase in γ to increase Θ^*.

In appendix A, (iv), we see that in the discounted case we no longer have these simple solutions; however, $\gamma\theta>1$, while no longer necessary, remains a sufficient condition for an increase in γ to cause θ^* to fall.

We now consider whether N, h, and r vary in a systematic way across socio-demographic groups. The variable N indicates the (expected length of stay at one's next job. Thus in a general way we would expect N to be lower, the older the individual concerned. This would have the effect of lowering the optimal search time of the elderly. However, we should add two provisos here. Secondary workers, who may have a weaker attachment to the labour force, and who may intend to work for a short spell and withdraw again will presumably have a lower N value. Furthermore, primary workers who by virtue of their occupational or industrial characteristics are prone to spells of involuntary unemployment may come to expect relatively short spells of continuous employment and accordingly have a relatively low N value. It is easily established that the incidence of involuntary unemployment (job losers) varies across occupational groups. The table below indicates the rate of job loss for various skill groups.

TABLE 3

Per cent of U.S. labour force unemployed
and "job loss rate" by occupational group.
1972

Occupational group	Unemployment Rate	"Job loss Rate"
Sales workers	4.3	1.70
Clerical workers	4.7	1.77
Craftsmen	4.3	2.95
Operatives (excl. transport)	7.6	4.66
Labourers	10.3	5.80
Average, all groups	5.6	2.40

Source : see footnote (17).

Furthermore, the same argument can be applied to minority groups. Below we show the rate at which whites and blacks lose their jobs.

TABLE 4

Per cent of U.S. labour force unemployed and job loss rate by age, sex and colour. 1972 [18]

Colour, Sex & Age	Unemployment Rate	Job Loss Rate
White, total	5.0	2.15
Males & females 16-19	14.2	2.78
Men 20 and over	3.6	2.26
Women 20 and over	4.9	1.86
Black, total	10.0	3.97
Males & females 16-19	33.5	5.59
Men 20 and over	6.8	4.16
Women 20 and over	8.8	3.35

Source : see footnote (18).

Hence we would expect that the elderly, the less skilled, minority groups and secondary workers would by virtue of their N values exhibit shorter optimal search duration than the average.

We now consider the variable h. This variable indicates the relationship between the wage differential attached to the new job, and the cost of search, which we are regarding as income foregone. For given income foregone, h will vary with the wage-distribution facing the individual. The knowledge that, say, women earn less than men is not very helpful since the problem here in essence concerns the variance of the distribution.

It is possible that for an elderly male earning the mean wage for males, the number of high wage jobs available would be less than for a prime-age worker. (19) If high wages are associated with training, and if firms look for a long period over which to recoup their training outlays, then elderly workers would have fewer opportunities for high wage jobs. Ceteris paribus, this will reduce their optimal search time. Generally, if discrimination takes the form of reserving the best-paid jobs for particular groups, then those groups discriminated against may have a lower N value, and accordingly a shorter optimal search time.

Turning to differences in search costs we first note that the mere fact of low wages (and hence low income foregone) does not in itself influence search time. Since h is a ratio of wage differential to income foregone low wages will only alter search time if they are accompanied by a variance in the wage distribution different from the average. Low wages may however influence the decision whether to undertake on-the-job search or whether to quit and search.

It is clear that income maintenance payments may alter search time, depending upon the method used. What is critical, other things equal, is whether the proportion of income foregone which is made up in income support varies across groups. If it does, then those groups for whom the proportion is highest will have a high h value and consequently relatively lengthy search time.

While h may therefore vary across individuals it is not clear that it will vary systematically across groups, except in the case of elderly workers, when we expect it to take on a lower than average value. As a result, the search time of elderly workers will tend to be shorter.

Finally, we consider the variable r, the rate of discount. Even if we assume that r is equal to "the market rate of interest", it is possible that it may vary interpersonally if certain individuals are excluded from particular credit sources. For example, the cheapest source of credit, say a loan from a credit union, may not be available to many individuals because of a low credit rating, which may in turn be based upon subjective factors. [20/] If such people do attempt to borrow they are likely to be faced with higher interest rates. We would tentatively suggest that this interest rate effect would be experienced in general by the low paid and by minority groups. Consequently their search time should be reduced.

To conclude this section we have argued that optimally, elderly workers should search for shorter duration than the average through the impacts of lower values of N and of h. Unskilled workers should have shorter duration via the impacts of N and of r; this conclusion could be generalised to include minority groups. Further, we would expect secondary workers to search for shorter duration than primary. In the case of young people we have conflicting influences on the value of N; however, in the case of women, and particularly that of married women, the theory would predict shorter job search via the influence of N and possibly of r.

We have looked for systematic differences in parameter values across socio-demographic groups. We saw that, in general, nothing in our model suggested that the disadvantaged would optimally search longer. Indeed, the weight of our argument suggested that the higher-paid, higher-skilled groups would be more likely to have longer search duration. Referring back to Hall's statement 21/, we must conclude that there is nothing in search theory to suggest that it is in the interests of disadvantaged workers to search for longer periods. We must therefore consider what interpretation may be put on the finding, that the duration of unemployment frequently is longer for disadvantaged workers. The obvious interpretation is surely that the longer duration is generated by demand-side rather than supply side factors. To test this hypothesis we would require data which does not exist, namely desired, as well as actual, search time. Until such data is generated, we must simply argue that on the basis of the above model, the data on duration of unemployment is not consistent with the view that emphasises the frictional or voluntary nature of unemployment.

An empirical finding which adds some weight to this argument has been presented by G.L. Perry 22/. In Table 5 below we present data which shows how the probability, that a worker who is unemployed this month will leave unemployment by next month, varies across demographic groups. A comparison with Table 2 above shows, as we should expect, that average duration of unemployment and monthly probability of leaving unemployment are inversely related. But we also find in Table 5 the probabilities of an unemployed worker being timed (H) and leaving the labour force (D). Since the workers concerned dropped out after a spell in unemployment rather than directly out of employment, we infer that they were basically interested in continuing in the labour force but became discouraged. We will therefore assume that the higher is D the greater is the ratio of actual to desired unemployment duration.

From Table 2 we see that for each age group females experienced lower average duration than males; but in Table 5 we see that females invariably had a higher probability of dropping out than males. We take this to mean that while actual duration is shorter for females, intended or optimal duration is shorter still, so that the ratio of actual to optimal duration is higher for females than for males. Table 2 and Table 5 are thus consistent with the prediction of our model, that females will tend to have shorter desired search time than males.

Again while the actual duration of unemployment does not differ very much between blacks and whites, we note in Table 5 that the probability of dropping out is greater for blacks than for whites. This is consistent with the view that optimal search time is shorter for blacks than for whites, which again is suggested in the search model above.

TABLE 5

Monthly probability of an unemployed worker leaving unemployment, by color, sex, and age, USA, 1971

Color, sex, age	Total probability of leaving unemployment	Probability of leaving by reason	
		Being hired	Dropping out
Whites			
Males:			
16-19 years	0.58	0.28	0.30
20-24	0.50	0.35	0.15
25-59	0.42	0.34	0.08
Females:			
16-18 years	0.64	0.26	0.38
20-24	0.57	0.29	0.28
25-59	0.53	0.24	0.29
Blacks			
Males:			
16-19 years	0.58	0.19	0.39
20-24	0.41	0.22	0.19
25-59	0.43	0.31	0.12
Females:			
16-19 years	0.60	0.16	0.44
20-24	0.53	0.19	0.34
25-59	0.54	0.20	0.34

Source : see footnote (22).

Section III

In this section we argue that an important part of interpersonal mobility differences can be integrated within the search theory framework. There are two aspects of mobility, described in the literature as "job changes" and "job shifts". The former refers to the number of workers in a particular group who change employers at least once in a given period; the latter refers to the number of times a movement between employers takes place. Since some individuals move more than once, the latter measure is normally greater than the former. Alternately, the sum of the number in a given group who move only once, plus those who move twice or more, will equal the number of job shifts generated by the group.

The following table shows the contribution of different numbers of job changes to total mobility.

Table 6

The frequency of repeated job-changing and its contribution to observed mobility in selected years in Germany and U.S.A.

Number of job changes	USA 1955		GERMANY 1959		GERMANY 1961	
	% of mobile persons	% of jobs changed	% of mobile persons	% of jobs changed	% of mobile persons	% of jobs changed
1 job change	66.8	43.2	67.2	46.3	68.1	47.4
2 job changes	21.4	27.7	20.4	28.1	20.1	28.0
3 job changes	5.6	10.8	12.4	25.6	11.8	24.6
4 or more	6.2	18.3				
Total	100.0	100.0	100.0	100.0	100.0	100.0

Source: See footnote (23)

We note that while approximately two-thirds of job changers in each year change jobs only once, their contribution to total mobility is well under half. Conversely, the one-third or so who move more than once account for more than half of total mobility. The results are strikingly similar between the U.S.A. and Germany. It is this phenomenon of multiple job-changing that we are interested in here. It has frequently been asserted in the literature that such multiple changing is evidence of misdirected mobility, irrational behaviour, and the like. We argue that on the contrary it may be viewed as a perfectly rational response to capital market imperfections.

The essence of our model above has been that the search decision is an investment decision. The investment outlay is the income foregone, plus direct search costs, and the gross return the wage differential in the new job. The expectation of a positive net return will induce the worker to quit. Nothing in the model suggests that quit rates should differ across individuals or groups, (although whether or not it is optimal to quit first and search later can be handled within this framework). To that extent we must look outside search theory.

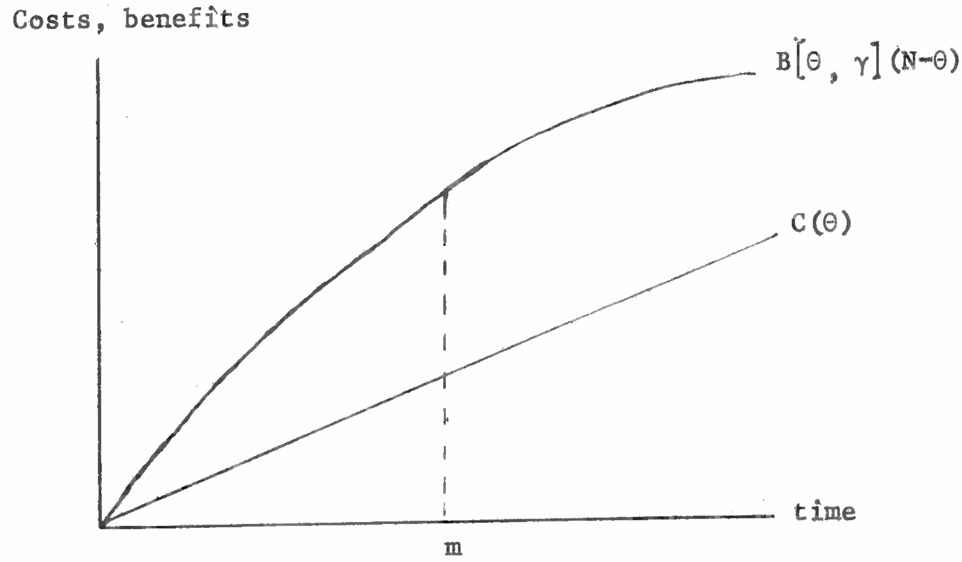
Suppose now that a worker has decided to quit to search. We tacitly assume no impediments to search other than the cost of search. This implies that foregone income does not act directly as a constraint, which in turn implies that workers can borrow freely. Since workers must eat, they must be able to borrow enough to compensate for income foregone while they search.

We now postulate that for some workers, search is not unconstrained; specifically, we assume that certain workers are unable to borrow freely and that in consequence they must finance search out of their own savings. We say that the capital market is imperfect if it refuses to lend to a worker for whom the net benefit of search is expected to be positive. It is not hard to imagine the socio-demographic groups to whom capital market imperfections are most likely to apply. Since borrowing on the strength of (expected) human wealth is likely to be difficult, groups which have few assets and hence little collateral, groups which have failed to build up a credit rating, in general the poorly-paid and under-privileged, are likely to find difficulty in borrowing. These groups must finance search out of their own savings.

Imagine now a worker who is unable to invest in search because he is unable to borrow freely. Assume he has a simple savings function $S_t = \alpha W_t$, and that search costs equal income foregone. In order to search at all he must accumulate savings. If he wishes to search for m periods and maintain his consumption level then he must work for $m\left(\frac{1-\alpha}{\alpha}\right)$ periods, given his savings function. Our individual now has to decide his optimal search strategy. Suppose he believes that with the ability to borrow freely he would optimally search for m periods, and find a wage W_m. He must decide between the following extreme strategies: to work for $m\left(\frac{1-\alpha}{\alpha}\right)$ periods, and finance a search of m periods, or to work for only $\frac{1-\alpha}{\alpha}$ periods, search for one period, work for another $\frac{1-\alpha}{\alpha}$ periods, search for another period, and so on, until he arrives at the wage W_m. We must evaluate which of these strategies pays off better.

The position of such a worker is shown below in Diagram 2 for the undiscounted case.

Diagram 2

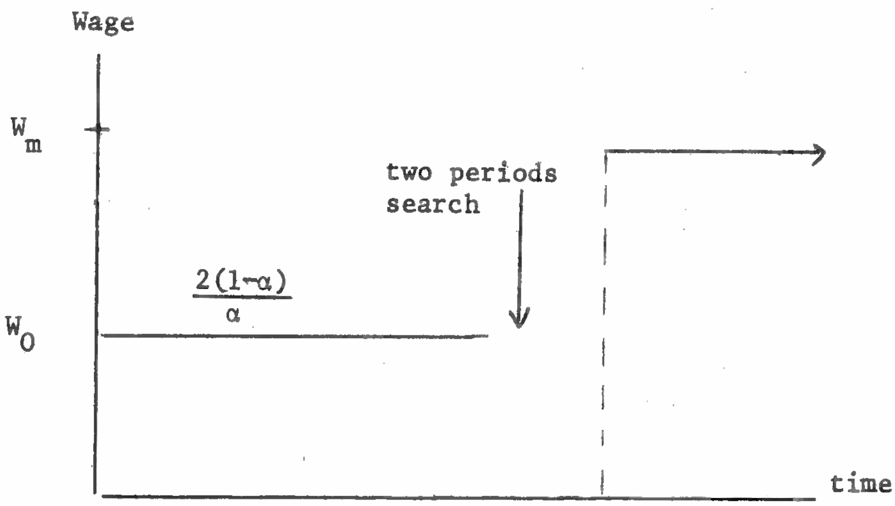


If he could borrow freely he would search for m periods. His problem is now, given that he has to finance search out of savings, whether to save enough to finance a search of m periods, or whether to search in a series of small stages.

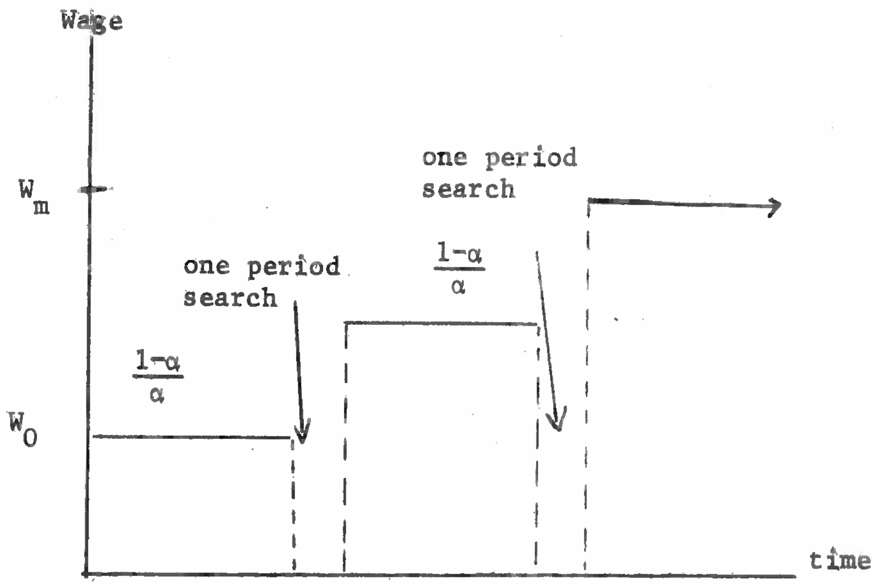
Consider the following highly simplied model. There are two individuals, A and B, who have identical savings functions, $S_t = \alpha W_t$, and who currently earn the same wage, W_o. Assume that A decides that two periods of search would be optimal, and consequently works for $2\left(\frac{1-\alpha}{\alpha}\right)$ periods. Meanwhile B decides to work only long enough to finance a one period search, find a (slightly) higher-paid job, and repeat the process. The diagram below shows the work-search pattern of these two individuals.

Diagram 3

Individual A



Individual B



We now consider the relative magnitude of these two streams in the simple, undiscounted case. Individual A works for $m\left(\frac{1-\alpha}{\alpha}\right)$ periods at a wage of W_0; he then searched for m periods, incurring a cost (income foregone) in each period of W_0. Hence his income stream up to this point is given by

$$Y_A = m\left(\frac{1-\alpha}{\alpha}\right)\left(W_0 - mW_0\right)$$

$$= mW_0\left[\frac{1-\alpha}{\alpha} - 1\right]$$

and for B, $Y_B = \sum_{t=0}^{m} W_t \left(\frac{1-\alpha}{\alpha} - 1\right)$, since he earns W_0 for $\frac{1-\alpha}{\alpha}$ periods, then incurs a cost of W_0 for one period, then earns W_1 for $\frac{1-\alpha}{\alpha}$ periods, and so on up to m units of work-and-search Since $\sum_{t=0}^{m} W_t$ is greater than mW_0, it follows that Y_B will exceed Y_A as long as $\frac{1-\alpha}{\alpha} - 1$ is positive, which implies $\alpha < 0.5$. Since our model pertains to lower-paid workers we assume that $\alpha < 0.5$ is realistic.

In the discounted case, it is clear from Diagram 3 that the discounted costs of individual A will be less than that of B, while the discounted income of A will be less than that of B. The outcome can be shown to depend upon the percentage increase in wages achieved after one period of search by A and the rate of discount. For very small increases in wages and very large discount rates A's strategy may be better. However, since the overal time period we are considering is relatively short (weeks rather than months, probably) the effect of the discount rate will tend to be small, and B's strategy will tend to be superior.

In any event, there are good reasons to believe that the multiple job-change approach has more in its favour than this calculation reveals. The wage information which leads the worker to believe that m periods of search are optimal may change over time. Hence accumulating savings over $m \frac{1-\alpha}{\alpha}$ periods may seem a risky strategy, since the expected benefits may disappear before he has begun to search.

We have argued that an inability to borrow freely may prevent a worker taking full advantage of profitable search. In this situation he will have to devise a strategy which maximises his income stream in the light of this constraint. It appears that a strategy of multiple job changes is his best solution. Although no direct empirical testing is possible, we can find indirect support in the literature for the existence of twin search strategies, and the consequent need for rational choice on the part of the individual.

Although our model emphasises voluntary search, some empirical findings from studies of involuntary unemployment may be relevant. In a study [24/] of white-collar redundancy, we learn that:

> "Weekly paid men who had not found jobs within a week or two of leaving almost invariably took the first thing that came along. Monthly paid men on the other hand, frequently turned down offers and deliberately took their time to find just the right job. One factor of importance ... not only did the monthly paid men more often have savings to fall back upon, they also received more generous ex-gratia payments from the company ... they could afford to be more choosy."

A perhaps more relevant study, into the behaviour of a large number of redundant workers, was conducted by D.I.Mackay.[25] The sample was drawn from workers who had been declared redundant in the West Midlands over the period 1966-68. Our interest is in the identification of two groups of workers, described as "stickers" and "snatchers". The former are characterized by a longer duration of unemployment, but by remaining in the job finally selected. The latter have a relatively short duration of unemployment but may have several job changes after their first post-redundancy job.

Unfortunately the individuals who participated in this study did not provide financial data, so that we cannot be sure about the reasons for these differing strategies. But what is impressive is the evidence in support of the contention that the "snatchers" adopt their strategy as a deliberate, thought-out policy. A characteristic of snatchers is that their post-redundancy period of unemployment is significantly shorter than that of stickers. This could be taken to indicate ignorance of labour market conditions in that these individuals take unsatisfactory jobs which they later reject. However interview data suggests strongly that the first post-redundancy job was taken in the full knowledge that it was a temporary position. Approximately two-thirds of the workers who followed this strategy appear to have done so as a conscious policy.

A knowledge of the asset, debt, and income characteristics of these workers would be necessary to relate their behaviour directly to the theory outlined in Section III. However the findings are significant inasmuch as they suggest a deal of deliberation about which strategy pays off best, which is of course at the root of search theory.

Conclusion

Our broad conclusion is that a simple model of search can generate interesting predictions about interpersonal differences in search behaviour. Unfortunately, a direct test of the model is ruled out by the absence of data on intended duration of unemployment. It is clear that it would be inadmissable to test the model by recourse to data in which intended and unintended duration are intermingled. And yet that is precisely what much of the search literature has tended to do, at least in an implicit fashion. Instead of seeking to separate voluntary from involuntary unemployment, and assess the quantitative importance of search theory, many writers have simply assumed that all unemployment can be regarded as voluntary. The justification for this, if given at all, is a rather ad hoc analysis which attributes either less efficient search strategies or weaker attachment to the labour force to the less-skilled.

Clearly, search theory need not rely for its impact on the proposition that all unemployment is frictional. A substantial amount of search activity does take place both between jobs and upon entering (or re-entering) the labour force.[26/] Frictional unemployment is quantitatively important. The above model represents an attempt to create a theoretical framework within which interpersonal differences in search behaviour may be handled.

Notes

1. See G.J. Stigler, "Information in the labor market", Journal of Political Economy" October 1962 (supp) vol. 69.

and E.S. Phelps et. al., Microeconomic Foundations of Employment and Inflation Theory, 1970, especially "Introduction".

2. See for example R.Gronau, "Information and frictional unemployment", American Economic Review, June 1971, vol. 61.

and J.J.McCall, "Economics of information and job search", Quarterly Journal of Economics, February 1970, vol.84.

3. E.S.Phelps, et. al., op.cit., "Introduction".

4. for example, D.T. Mortensen, "Job search, the duration of unemployment, and the Phillips' curve", American Economic Review, December 1970, vol.60.

5. for a recent attempt, see D.Metcalf, "Urban unemployment in England", Economic Journal, September 1975, vol.85.

6. for example, C.C.Holt suggests that "if the offices of the U.S. Employment Service were kept open in the evenings, perhaps more of the job search could be done while workers are still employed ...". See C.C.Holt, "Improving the labor market trade-off between inflation and unemployment", American Economic Review Papers and Proceedings of the Eighty-first Annual Meeting, 1968, May 1969, vol.59, p.142.

7. Monthly Labor Review, December 1973, Current Labor Statistics, Table 8.

8. R.E.Hall, "Why is the unemployment rate so high at full employment?", Brookings Papers on Economic Activity, 1970, vol.3.

9. See below Table 2.

10. an exception is D.O.Parsons, "Quit rates over time : a search and information approach", American Economic Review, June 1973, vol.63.

11. R.E.Hall, op.cit., p.389.

12. taken from G.L.Perry, "Unemployment flows in the US labor market", Brookings Papers on Economic Activity 1972 No.2, p.259. These figures are calculated on the assumption that aggregate unemployment is 5%.

13. A.A.Alchian, "Information costs, pricing, and resource unemployment" especially "Appendix", in E.S.Phelps et.al., op.cit., p.27-52.

14. increasingly, search is described as being about vacancies, rather than about wages. See, for example, J.M.Barron, "Search in the labor market and the duration of unemployment : some empirical evidence", American Economic Review, December 1975, vol.65.

15. See below, Appendix A. I am much indebted to Norman Ireland for assistance with this section.

16. note that we have made search intensity independent of the cost of search. See Appendix A(v) for the effect of interdependency.

17. calculated from data presented in "Job losers, leavers and entrants", Monthly Labor Review, August 1973. Table 6, p.12. The method of calculation was to derive the job loss rate by multiplying the group unemployment rate by the proportion of the unemployed who were job losers. The problem with this approach is that if job losers, voluntary quits, and entrants have different durations of unemployment, then it will generate misleading results. For example, suppose that only a very few workers are fired, but those that are have a very long duration of unemployment. Then the job loss rate calculated by the above method would clearly overstate the likelihood of an individual being fired. Ceteris paribus, the higher the duration of unemployment of a particular category, the more this method overestimates the true job-loss rate.

18. calculated from data presented in the Monthly Labor Review, December 1973. Current Labor Statistics, Table 2. See note (17).

19. ample evidence exists on the life path of income to suggest that income reaches a peak around the age of 50 and declines thereafter. Although there is no consensus on the reasons for this effect, its existence may tend to inhibit the mobility of the elderly. See for example, J.Mincer, "Investment in human capital and personal income distribution", Journal of Political Economy, August 1958, vol.66, p.294.

20. it is well known that there are substantial differences in interest charges across lending institutions. For example, J.C.Chapman and R.P.Shay (eds.) in The Consumer Finance Industry show that in descending order of costliness, the major sources of consumer borrowing were (a) consumer finance companies, (b) sales finance companies (c) commercial banks, and (d) credit unions. If we take credit unions charges as unity, then the relative charges of the other institutions were (in 1959) 2.63, 1.82. and 1.10, respectively. It is hard to establish, but easy to believe, that the poorest sections of the community will tend to borrow from the costliest source.

21. see p. above.

22. G.L.Perry, op.cit., p.

23. taken from Wages and Labour Mobility, O.E.C.D., Paris, 1965, Table 14, p.55.

24. D.Wedderburn, "White-collar redundancy", The Times Review of Industry and Technology, February 1964, quoted in Wages and Labour Mobility, O.E.C.D., Paris 1965, p.82.

25. D.I.Mackay, "After the shake-out", Oxford Economic Papers, March 1972, New Series vol.24.

26. For example in 1972, in the U.S., only 43% of the unemployed had actually lost their jobs. The others were in some sense "voluntarily unemployment" See footnote (17) for the source of these findings.

Appendix A

(1) Where $B = u(1 - e^{-\gamma\Theta}) \int_{\Theta}^{N} e^{-rt}\, dt$

and $C = c \int_{0}^{\Theta} e^{-rt}\, dt$

we can write net benefit $G = B - C$

$$= \frac{u}{r} (1 - e^{-\gamma\Theta}) (e^{-r\Theta} - e^{-rN}) - \frac{c}{r} (1 - e^{-r\Theta})$$

Differentiating with respect to Θ, writing h for u/c, and setting equal to zero as a necessary condition for a maximum, we have

$$G' = \frac{\gamma}{r} h e^{-\gamma\Theta} (e^{-r\Theta} - e^{-rN}) - h(1 - e^{-\gamma\Theta}) e^{-r\Theta} - e^{-r\Theta} = 0$$

and

$$G'_{\Theta} = -\frac{\gamma^2}{r} h e^{-\gamma\Theta}(e^{-r\Theta} - e^{-rN}) - 2 \gamma h e^{-\gamma\Theta} e^{-r\Theta}$$

$$+ r h(1 - e^{-r\Theta}) e^{-r\Theta} + r e^{-r\Theta}$$

which is of indeterminate general sign.

Now $r G' = \gamma h e^{-\gamma\Theta} (e^{-r\Theta} - e^{-rN}) - rh (1 - e^{-\gamma\Theta}) e^{-r\Theta}$
$- r e^{-r\Theta}$

i.e. $r h (1 - e^{-\gamma\Theta}) e^{-r\Theta} = - rG' + \gamma h e^{-\gamma\Theta} (e^{-r\Theta} - e^{-rN})$
$- re^{-r\Theta}$

(1) I am much indebted to Norman Ireland for assistance with this and with the next appendix

We can write:

$$\therefore \quad G'_{\Theta} = -\frac{\gamma^2}{r} h e^{-\gamma\Theta} (e^{-r\Theta} - e^{-rN}) - 2\gamma h e^{-\gamma\Theta - r\Theta} - r G'$$

$$+ \gamma h e^{-\gamma\Theta} (e^{-r\Theta} - e^{-rN})$$

$$= (e^{-r\Theta} - e^{-rN}) e^{-\gamma\Theta} h(\gamma - \frac{\gamma^2}{r}) - 2\gamma h e^{-\gamma\Theta - r\Theta} - rG'$$

and for $G' \geq 0$, a sufficient condition for this to be negative and hence for G to be a maximum, is $\gamma > r$.

(2) For $\gamma>r$, we can establish the following qualitative predictions around Θ^*:

(i) $G'_{\Theta} \; d\Theta + G'_N \; dN = 0$

hence $\frac{d\Theta}{dN} = - G'_N / G'_{\Theta}$

$$G'_N = \gamma h e^{-\gamma\Theta - rN} > 0$$

and since $G'_{\Theta} < 0$,

$$\frac{d\Theta}{dN} > 0$$

(ii) $G'_{\Theta} \; d\Theta + G'_h \; dh = 0$

hence $\frac{d\Theta}{dh} = - G'_h / G'_{\Theta}$

$$G'_h = \frac{\gamma}{r} e^{-\gamma\Theta} (e^{-r\Theta} - e^{-rN}) - (1 - e^{-\gamma\Theta}) e^{-r\Theta}$$

$$= \frac{G' + e^{-r\Theta}}{h} > 0$$

and since $G'_{\Theta} < 0$,

$$\frac{d\Theta}{dh} > 0$$

(iii) $G'_\Theta \; d\Theta + G'_r \; dr = 0$

$$\frac{d\Theta}{dr} = -G'_r / G'_\Theta$$

$$G'_r = \frac{-\gamma}{r^2} \; h \; e^{-\gamma\Theta} \; (e^{-r} - e^{-rN}) + \frac{\gamma}{r} \; h \; e^{-\gamma\Theta} \; (N \; e^{-rN} - \Theta \; e^{-r\Theta})$$

$$+ \Theta \; h \; (1 - e^{-\gamma\Theta}) + \Theta \; e^{-r\Theta}$$

Now $\Theta G' = \frac{\Theta\gamma}{r} \; h \; e^{-\gamma\Theta} \; (e^{-r\Theta} - e^{-rN}) - \Theta h \; (1 - e^{-\gamma\Theta}) \; e^{-r\Theta}$

$$- \Theta \; e^{-r\Theta}$$

and so we can write

$$G'_r = \frac{-\gamma}{r^2} \; h \; e^{-\gamma\Theta} \; (e^{-r\Theta} - e^{-rN}) + (N - \Theta) \; e^{-rN} \; \frac{\gamma}{r} \; h \; e^{-\gamma\Theta}$$

$$+ \; \Theta G' ,$$

since $(N - \Theta) e^{-rN} \; \frac{\gamma}{r} \; h \; e^{-\gamma\Theta} = \frac{\gamma}{r} \; h \; e^{-\gamma\Theta} \; (N \; e^{-rN} - \Theta e^{-r\Theta})$

$$+ \frac{\Theta\gamma}{r} \; h \; e^{-\gamma\Theta} \; (e^{-r\Theta} - e^{-rN}) \; ;$$

and therefore $G'_r = \frac{-\gamma}{r^2} \; h \; e^{-\gamma\Theta} \; (e^{-r\Theta} - e^{-rN}) + (N - \Theta) \; e^{-rN} \; \frac{\gamma}{r} \; h \; e^{-\gamma\Theta}$

around $G' = 0$.

$$G'_r = \frac{\gamma}{r} h e^{-\gamma\theta} \left[\frac{1}{r} (e^{-rN} - e^{-r\theta}) + (N - \theta) e^{-rN} \right]$$

$$= \frac{\gamma}{r} h e^{-\gamma\theta} \left[e^{-rN} \left\{ \frac{1}{r} + (N - \theta) \quad - \frac{1}{r} e^{-r\theta} \right\} \right]$$

$$= \frac{\gamma}{r} h e^{-\gamma\theta - r\theta} \left[e^{-r(N-\theta)} \left\{ \frac{1}{r} + (N - \theta) \right\} - \frac{1}{r} \right]$$

Now writing Z for $e^{-r(N-\theta)} \left\{ \frac{1}{r} + (N - \theta) - \frac{1}{r} \right\}$,

we note that $Z = 0$, and $G'_r = 0$, if $N = \theta$.

Consider how Z, and hence G'_r, changes as

$(N - \theta)$ changes;

$$Z = e^{-r(N-\theta)} \left\{ \frac{1}{r} + (N - \theta) \right\} - \frac{1}{r}$$

$$\frac{dZ}{d(N-\theta)} = - r e^{-r(N-\theta)} \left\{ \frac{1}{r} + N - \theta \right\} + e^{-r(N-\theta)}$$

$$= e^{-r(N-\theta)} \left[1 - r \left(\frac{1}{r} + N - \theta \right) \right]$$

$$= - e^{-r(N-\theta)} (N - \theta)$$ which is negative

for $N > \theta$.

Hence $G'_r < 0$

and $\frac{d\theta}{dr} < 0$ for $N > \theta$

(iv) $G'_\Theta \, d\Theta + G'_\gamma \, d\gamma = 0$

Hence $\frac{d\Theta}{d\gamma} = - G'_\gamma / G'_\Theta$

$$G'_\gamma = \frac{h}{r} e^{-\gamma\Theta} (e^{-r\Theta} - e^{-rN}) - \Theta \frac{\gamma}{r} h e^{-\gamma\Theta} (e^{-r\Theta} - e^{-rN})$$

$$- \Theta h e^{-\gamma\Theta} e^{-r\Theta}$$

$$= h e^{-\gamma\Theta} \left[\frac{1}{r} (e^{-r\Theta} - e^{-rN}) (1 - \gamma\Theta) - \Theta e^{-r\Theta} \right] - e^{-r\Theta}$$

which is indeterminate in general. However, a sufficient condition for $G'_\gamma < o$ and hence $\frac{d\Theta}{d\gamma} < 0$ is that $\gamma \Theta > 1$

(v) Finally, we show that these results hold for the case where γ , viewed as a proxy for search intensity, influences the cost of search. Consider a new cost function

$$C = (1 + \gamma) c \int_0^\Theta e^{-rt} \, dt$$

The effect of this change is to multiply the final term in the expression for G', and for G'', by the factor $(1 + \gamma)$. Since the last term in G'' disappears in any event upon manipulation, the second-order conditions still hold, that is, a sufficient condition for G'_Θ to be negative is $\gamma > r$.

The last term in the expression for G' does not influence the signs of $\frac{d\Theta}{dN}$, or $\frac{d\Theta}{dh}$. G'_r does contain the factor $(1 + \gamma)$ but as above, this term is in any event eliminated in manipulation. G'_γ changes slightly, with a new term $- e^{-r\Theta}$, being added. However, the sign of G'_γ remains indeterminate.

Appendix B

Below we present numerical solutions for Θ^* in the equation

$$G' = \frac{\gamma}{r} h e^{-\gamma\Theta} (e^{-r\Theta} - e^{-rN}) - h(1 - e^{-\gamma\Theta}) e^{-r\Theta} - e^{-r\Theta} = 0$$

By assuming values for N, h, r, and γ we solve for the values of Θ^* which sets $G' = 0$. Clearly we must select parameter values which are reasonable approximations to reality. For h and r we can choose values which must be reasonably accurate. Estimates of h can be derived from local labor market data on the one hand and income maintenance data on the other. On this basis we can establish limits outside which h is unlikely to lie. We know from various wage studies (1) that the wage distribution for given skills in a local labor market may have a range (highest to lowest wage) of up to 100%. Thus if we write the lowest wage as W, the highest will be of the order of 2W, and the mean 1.5W. Hence the ratio of the highest to the mean wage is 2/1.5, or 1.3. Since u is the difference between the highest potential wage and the mean wage in the distribution, we may write $u = W_{max} - W_o = 1.3\ W_o - W_o = 0.3\ W_o$. For a relatively narrow wage distribution in which $W_{max} = 1.5\ W_{min}$, W max would equal $1.20\ W_o$, and hence $u = 0.2\ W_o$. Thus u seems likely to lie between $0.2\ W_o$ and $0.3\ W_o$.

The cost of search for period, c, may be less than income foregone to the extent of income maintenance payments. If these are non-existent then cost is given by W_o, the current wage. Since our model purports to explain the behaviour of voluntary leavers, then it is likely that income maintenance would be relatively small. Therefore we assume that the least cost is given by 0.5 W_o – that is, no more than half of income foregone is compensated for by income maintenance payments.

We thus have the following two ranges; $0.2\ W_o \leq u \leq 0.3\ W_o$; and $0.5\ W_o \leq c \leq W_o$.

Now since $h = \frac{u}{c}$, we can say that the minimum value of h will be given by u_{min}/c_{max}, or $0.2\ W_o/W_o = 0.2$, and the maximum value of h will be given by u_{max}/c_{min}, or $0.3\ W_o/0.5\ W_o = 0.6$. Thus we assume that $0.2 \leq h \leq 0.6$.

The rate of interest, r, we shall allow to take on values 0.10 and 0.20.

It is difficult to establish with certainty the likely range of the parameter N. Conceivably there are some 20 year olds who expect to remain in their current job for the next 45 years. On the other hand, the separation rate for men aged 20 to 24 in the U.S. in 1961 was 42.4%. 1/ Thus the average stay in one job for this group was approximately 2½ years. Similarly, the average length of stay for males aged 25 to 54 was approximately 6 years, while the average for the whole working population is also of the order of 6 years.

1/ Taken from Wages and Labour Mobility, OECD, Paris 1965, Table 15, p.56

It is not clear to what extent workers would be aware of this information far less take it into account. However we will allow N to vary between 2 and 20, in the hope of capturing the true value.

The parameter whose value is the hardest to pin down is manifestly γ. In the undiscounted case, the gross benefit, or wage differential, $\tilde{B}$, is given by the relationship $\tilde{B} = u - ue^{-\gamma\theta}$, the second term representing the extent of the worker's "distance" from u. Let us assume fairly arbitrarily that on average, after a search of one year, a worker will lie between 0.25 u and 0.9 u. Accordingly, we can show (2) that γ must lie between 0.29 and 2.30. Hence we shall assume that γ lies within this range.

Below in Table 1 we report the results for the ranges of parameter values suggested in the above discussion.

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(2) if $u - u\,e^{-\gamma\theta} \geq 0.25\,u$

then $1 - e^{-\gamma\theta} \geq 0.25$

i.e. $0.75\,e^{\gamma\theta} \geq 1$

i.e. $e^{\gamma\theta} \geq 1.33$

and since $\theta = 1$,

$\gamma \geq 0.29$ approx.

Similarly for

$u - u\,e^{-\gamma\theta} \leq 0.9\,u$,

$1 - e^{-\gamma\theta} \leq 0.9$,

i.e. $e^{\gamma\theta} \leq 10.0$

and since $\theta = 1$, $\gamma \leq 2.30$ approx.

TABLE 1

Selected numerical solutions for Θ* in the light of different assumptions about parameter values.

h	r	γ	Θ* N=2	N=5	N=8	N=20
0.3	0.1	0.33	0.0	0.0	0.0	0.0
		0.66	0.0	0.0	0.19	0.76
		1.32	0.0	0.25	0.51	0.84
		1.98	0.02	0.33	0.53	0.75
	0.2	0.33	0.0	0.0	0.0	0.0
		0.66	0.0	0.0	0.0	0.08
		1.32	0.0	0.12	0.32	0.47
		1.89	0.0	0.25	0.39	0.49
0.5	0.1	0.33	0.0	0.0	0.0	0.73
		0.66	0.0	0.23	0.60	1.19
		1.32	0.07	0.50	0.73	1.06
		1.98	0.18	0.51	0.67	0.90
	0.2	0.33	0.0	0.0	0.0	0.0
		0.66	0.0	0.04	0.27	0.52
		1.32	0.04	0.38	0.54	0.69
		1.98	0.15	0.42	0.54	0.64

We note that h is a pure number, while r, γ, N, and θ* are expressed in annual terms. We allow h and r to take on two values each, while γ and N have four values each. The entry under θ* N = 8, row 2 is 0.19. This means that for L = 0.3, r = 0.1, γ = 0.66 and N = 8, optimal search time is 0.19 years.