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ABSTRACT

A major benefit of education is the lower risk of unemployment at higher educational levels. Analysis of statistical data on the white male labor force drawn from the Panel Study of Income Dynamics (PSID) indicates that the reduction of the incidence of unemployment is far more important than the reduced duration of unemployment in creating educational differentials in unemployment rates. The lower unemployment incidence of the more educated workers is due equally to their greater attachment to the firms employing them and the lower risk of becoming unemployed when separated from the firm. The lower frequency of job turnover of more educated workers, which creates fewer episodes of unemployment, is in large part attributable to more on-the-job training. The following factors may explain the lower conditional unemployment of educated workers and the somewhat shorter duration of their unemployment: (1) more educated workers appear to search for new employment while already employed, which is less costly than searching for employment while unemployed; (2) more educated workers are more efficient in acquiring and processing job search information; and (3) firms and workers search more intensively to fill more skilled vacancies. Statistical data on seven tables are included. Discussions of two of the equations used in the analysis and a list of 24 references are appended. (FMW)

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Department of Economics
Columbia University

Technical Paper No. 11

October 1989

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PREFACE

The National Center on Education and Employment is funded by the Office of Educational Research and Improvement (OERI) of the U.S. Department of Education. The Center is based at Teachers College, Columbia University, in New York City. The RAND Corporation of Santa Monica, California, and Washington, D.C., is a partner with Teachers College in this enterprise.

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ABSTRACT

A major benefit of education is the lower risk of unemployment at higher educational levels. In PSID (Panel Study of Income Dynamics) data on the male labor force, the reduction of the incidence of unemployment is found to be far more important than the reduced duration of unemployment in creating the educational differentials in unemployment rates. In turn, the lesser unemployment incidence of the more educated workers is, in about equal measure, due to their greater attachment to the firms employing them, and to the lesser risk of becoming unemployed when separated from the firm.

The lesser frequency of job turnover of more educated workers, which creates fewer episodes of unemployment, is in large part attributable to more on-the-job training.

In explaining the lesser conditional unemployment of educated workers and the somewhat shorter duration of their unemployment, indirect evidence is provided that (1) costs of on-the-job search for new employment relative to costs of searching while unemployed are lower for more educated workers; (2) that these workers are also more efficient in acquiring and processing job search information; and (3) that firms and workers search more intensively to fill more skilled vacancies.

EDUCATION AND UNEMPLOYMENT

COMPONENTS OF UNEMPLOYMENT AND DIFFERENTIALS BY EDUCATION

Accounting Schemes and Gross Differentials

Educated workers enjoy at least three basic advantages over less educated workers in the labor market: higher wages, greater upward mobility in income and occupation,¹ and greater employment stability. An immense literature is available on the wage structure by education; much less research is devoted to mobility and unemployment aspects of education. This study explores the relation between education of workers and their unemployment experience. That this relation is negative is well known from nearly ubiquitous observation.² But the reasons for it have not been subjected to thorough scrutiny.

The approach we take is to analyze several aspects of labor market behavior which combine to affect the unemployment rate of a group of workers. The analysis is facilitated by a decomposition of the unemployment rate into factors which correspond to somewhat distinct behavioral aspects. The same rate can obtain if more workers experience unemployment for a shorter time or fewer for a longer time. The probability of leaving employment, which we call unemployment incidence, is separable from, though not unrelated to, the probability of leaving unemployment, that is, to its duration.

The decomposition of the unemployment rate (u) is best seen if we define it as the fraction of time lost by all members of the labor force within a unit period, say a year: Let L be the number of workers in the labor force, $Wk(1)$ the number of weeks in the labor force, N_u the number of workers who experienced unemployment, and $WK(u)$ their weeks of unemployment. Thus, the average weekly unemployment rate is:

¹ On occupation, see Nachum Sicherman (1987).

² Some exceptions have been reported in less developed countries (e.g. India in the 1950s and '60s) (Blaug et al, 1969).

$$(1) \quad u = \frac{\sum_i Wk(u_i)}{\sum_j Wk(l_j)} = \frac{N_u}{L} \cdot \frac{\overline{Wk}(u)}{\overline{Wk}(l)} = P(u) \cdot \frac{D_u}{52 - D_o} = P(u) \frac{d_u}{1 - d_o}$$

Here, incidence, or the probability of unemployment is $P(u) = \frac{N(u)}{L}$, while D_u is the average duration of unemployment for those who experienced it, and D_o is the average number of weeks out of the labor force of all workers; d_u and d_o represent fractions of time spent in unemployment and out of the labor force, by the unemployed and by all workers respectively. Equation 1 shows that the unemployment rate of a group of workers is the *product* of their probability of experiencing unemployment $P(u)$ during the time they are in the labor force, and of the fraction of labor force time spent in unemployment of those who experience unemployment (d_u).

Going behind the incidence factor, we note that:

$$(2) \quad P(u) = P(s) \cdot P(u/s)$$

which is to say that the probability of being unemployed in the period depends on the probability of having separated from the previous job $P(s)$, and on the probability of encountering unemployment while separated. If restricted to job changes in the labor market,³ equation 2 points to the significance of labor mobility or turnover, and to on-the-job search as (partly distinct) behavioral factors affecting incidence. Off-the-job search behavior is, presumably, the basic content of the duration of unemployment.

Combining equations 1 and 2, the composition of the unemployment rate is:⁴

³ Separation can be generalized to include labor force entrants and exits. In the current report it is restricted to job changes.

⁴ The last term $\frac{1}{1 - d_o}$, is ignored in the empirical analyses of workers who are (almost) continuously in the labor force.

$$(3) \quad u = P(S) \cdot P(u/s) \cdot d_u \cdot \frac{1}{1-d_u}$$

Table 1 illustrates the fact that each of the components of unemployment gets smaller as the level of education in the group increases.⁵

It is worth noting that the behavioral data shown in Table 1 are rather closely duplicated by subjective expectations of workers. Two surveys conducted by the National Opinion Research Center in 1977 and 1978 asked a nationwide sample of employed workers whether they expect to lose their jobs in the next 12 months, and whether they could easily find another comparable job if they were separated from their current firm.⁶ Interpreting the responses to the first question as expectations about $P(u)$, and the second as expectations about $P(u/s)$,⁷ compare column 1 of Table 1a with row 2 in Table 1 and column 2 of Table 1a with row 4 in Table 1.

⁵ The statement refers to each row in Table 1. Comparisons of *levels* within columns are distorted by differences in sources and definitions of data. *Ratios* in the last column are comparable.

⁶ *Monthly Labor Review*, April 1980.

⁷ Perhaps the relative difficulty of finding another job (col. 2 of Table 1a) is more properly compared with $P(u/s) \times D_u$. Either way the results are similar.

Table 1
EDUCATION AND UNEMPLOYMENT COMPONENTS
Some Gross (unadjusted) Facts

Ed	<12	12	13-15	16+	$\frac{<12}{16+}$	Key to variables
u ^a	7.0	4.1	3.3	1.9	3.7	unemployment rate
P(u)	9.5	6.4	4.7	3.5	2.7	probability (incidence) of unemployment
P(s)	17.9	13.4	12.8	10.5	1.7	probability of separation
P(u/s)	53.2	48.6	37.8	33.2	1.6	probability of unemployment of job separators
Du	13.8	12.1	11.6	11.0	1.26	duration of unemployment of job separators (in weeks)
LFP ^b	92.1	97.0	96.4	98.2	.94	labor force rate

^a BLS data, White Men, age 25-54, in 1979

^b BLS data, same, age 35-44, in 1979

All other rows: PSID, White Men, years 1976-81, 11-25 years of work experience.

Returning to Table 1, unemployment of the least educated (<12 years) groups of male workers is typically over 3 times higher than that of the most educated (16+) groups. This ratio (R) shown in the last column of Table 1 can be decomposed following our equations, into products of component ratios, all of which are shown in the last column of Table 1.

Thus,

$$\begin{aligned}
 (4) \quad I(u) &= RP(s) \cdot RP(u/s) \cdot R(d_u) \cdot R \frac{(1)}{1-d_o} = \\
 &= 1.7 \times 1.6 \quad \times \quad 1.26 \times 1.06 \quad = 3.5 \\
 &= 2.7 \quad \times \quad 1.3
 \end{aligned}$$

Table 1a

**WORKER EXPECTATIONS ABOUT JOB LOSS AND
DIFFICULTY IN JOB FINDING IF SEPARATED**

Education	Percent Expecting to Lose Job	Percent Expecting Difficulty in Finding Another
Grade School	9.0	51.2
High School	8.8	43.1
Some College	9.0	31.6
College Degree	2.7	37.8
Graduate Work	1.3	27.7

Source: *Monthly Labor Review*, April, 1980, p. 53.

Here incidence of unemployment is 170% greater, but duration is only 30% greater in the least educated compared to the most educated group. Clearly, duration of unemployment is a relatively minor aspect of the educational unemployment differentials, a finding familiar from previous research.⁸

However, if the distinction is not between the probability of losing employment and that of leaving unemployment, but between labor mobility across firms and both on-the-job and off-the-job search behavior, we find that:

$$(5) \quad R(u) = RP(s) \times \text{Remainder} = 1.7 \times 2.0, \text{ where the remainder} = \dots RP(u/s) R(du) R\left(\frac{1}{1-do}\right)$$

While incidence is far more important than duration, job search behavior (on and off the job) is as important as job turnover in affecting the educational unemployment differentials.

⁸ See Ashenfelter and Ham (1979).

Net Unemployment Differentials by Education

Table 1 illustrated the patterns of educational unemployment differentials from various data sources. These differentials are gross, not standardized for other worker characteristics. We proceed to a description of the net or partial effects of education, in the presence of such characteristics. In this effort, we restrict the sample to adult white males, non-students, age 18-60. We consider unemployment of job changers only, so that recall unemployment and that of labor force entrants and exits is excluded. These exclusions are, in part, necessitated by the imperfections of our data. Although we may lose close to a half of the usually observed unemployment by these exclusions, the patterns of unemployment by education are quite similar⁹ whether or not we make the exclusions. However, the behavioral analysis pertains most directly to the group we study.

The PSID (Panel Study of Income Dynamics) sample we use contains observations on about 1,200 males in years 1976-1983, with some differences in temporal coverage, depending on availability of survey questions. The effective size of the samples varies also due to missing or faulty observations.

Table 2 shows the relation between education and the incidence of unemployment $P(u)$, and its components $P(s)$ and $P(u/s)$, net of other measured worker characteristics. In the linear specification of Table 2 (column 2), each additional year of schooling reduces the probability of unemployment by 1.3% points at given levels of working age ("experience").¹⁰ The effect is smaller (.8%) when other variables, especially training in the firm, are included. Looking across the row of coefficients on education, we see that both separation probabilities $P(s)$ and conditional unemployment (i.e., unemployment of movers) $P(u/s)$ are reduced by education.

The reduction in turnover and the lesser exposure to unemployment of those who turn over bring about the reduction in unemployment incidence of the better educated in just about equal measure. From the definition of $P(u)$ in equation 2, we have

⁹ Some preliminary evidence suggests that inclusions would actually steepen the relations observed here. See first column in Table 2.

¹⁰ The reduction accelerates at medium and higher levels of education, when a non-linear formulation is used.

$$\begin{aligned}
 (6) \quad \frac{\partial P(u)}{\partial Ed} &= \frac{\partial P(s)}{\partial Ed} \cdot P(u/s) + \frac{\partial P(u/s)}{\partial Ed} P(s) = \\
 &= -.014 \times .47 - .036 \times .18 = \\
 &= \quad \quad \quad -.007 \quad \quad \quad -.006
 \end{aligned}$$

The effects of education on the incidence of unemployment are reduced somewhat when additional variables are added in column 3 of Table 2. The (net) effect of education on the duration of unemployment, after standardization for other factors and characteristics, is shown in the first column of Table 6. An additional year of education (at $Ed = 12$) reduced duration of unemployment by nearly one week.

This effect amounts to about one-fourth of the decline in the unemployment rate due to an additional year of schooling. Since, in our sample, $u = P(u) \cdot d(u)$, the derivative is:

$$(7) \quad \frac{\partial u}{\partial Ed} = \frac{\partial P(u)}{\partial Ed} \cdot d(u) + \frac{\partial d(u)}{\partial Ed} \cdot P(u)$$

Given that $d(u)$ was, on average,¹¹ close to .24, and the mean (at $Ed = 12$) of $P(u) = .06$,

$$\begin{aligned}
 \frac{\partial u}{\partial Ed} &= -1.32 \times .24 - 2.4 \times .06 = \\
 &= \quad \quad \quad (-.32 \quad \quad \quad -.12)
 \end{aligned}$$

As in the unadjusted data (equation 4 above), the importance of education in reducing unemployment is nearly three times as great via reduction of turnover than via reduction of duration.

¹¹ Assuming an average of 50 weeks per year in the labor force.

TERM BY TERM ANALYSIS

Reasons for Lower Turnover P(s) at Higher Education Levels

In employing human capital analysis it is important to distinguish the more comprehensive concept of investments in human capital from investments in school education. According to early calculations, (returns on) investments in school education—in dollar volumes—represent no more than a half of (returns on) total human capital investments. Investments in job learning and training, in information, and labor mobility represent the other half of the total volumes.¹²

While higher wage trajectories of the more educated workers reflect returns on investments in schooling, patterns of wage growth and of turnover of workers are, in principle, related to training and learning in the labor market, not in school. Therefore, the relations that are observed—steeper wage growth and greater attachment to the firm for the more educated worker—are causally indirect. It is because job training tends to be (a) positively related to schooling, and (b) negatively related to turnover that we observe a negative relation between education and turnover.

Consequently, we break our questions into three parts: (a) Is job training positively related to education, and why? (b) Is turnover negatively related to job training, and why? and (c) Does education affect labor mobility apart from its correlation with training?

(a) Is job training positively related to education and why? Direct information on volumes of job training is provided in the PSID surveys of 1976 and 1978. The measure we use (RQT) is given by respondents' answers to a question: "On a job like yours, how long would it take the average new person to become fully trained and qualified?" The question followed several other questions about training *prior* to the current job, and it "was intended to measure the volume of the training investment attached to the current job."¹³

¹² This is net of investments in health which represent investments in "maintenance and repairs" of human capital (Mincer, 1974).

¹³ A check on whether the RQT measures in the PSID refer to the length of current training in the firm or to total (cumulated) on-the-job training needed for the particular job was performed by Sicherman (1987). A comparison by detailed occupation in PSID responses with DOT (Dictionary of Occupational Titles) estimates supports the assertion that RQT is not a cumulative measure antedating the current firm for most occupations, except for a minority of highly skilled professional occupations where RQT is overstated. When added to probably sizable errors of measurement this discrepancy creates an additional downward bias on estimates of effects of RQT in

That volumes of job training are positively related to school education of workers (when other characteristics are taken into account) is shown in Table 4 (column 1). In the PSID surveys conducted annually by the Institute for Social Research, University of Michigan, volumes of training were measured by the length of time in training and learning on the current job required for reaching a proficient ("fully qualified") level of productivity in the job.

Although this measure is far from accurate and ignores intensity (hours per period) of training,¹⁴ results shown in Table 4 (column 1) are supported in other data sets utilized by other investigators. In the most comprehensive study, Lillard and Tan (1986) analyzed the distribution of training across workers in larger and, in some respects, more detailed CPS and NLS samples. The training measure in both data sets is its incidence in the year before the survey. The location of training (whether in or outside of firms) is also indicated. (Our PSID data aim at in-firm training). Their findings regarding the incidence of training by education—with similar standardizing variables—provides strong support for the inferences based on Table 4 here.

But why do more educated workers engage in more on-the-job training? The general answer is that persons who have greater learning ability and better opportunities to finance the costs of human capital investments do invest more in all forms of human capital, including schooling and job training. Although this answer is sufficient, some analysts claim, in addition, that school education is a complementary factor to job training in producing human capital. In other words, education enhances the productivity of job training at work. It is clear, however, that schooling can also be a substitute for job training: thus, the decline in apprenticeships has been attributed to growth in educational levels over the long-run.

One direct test of complementarity fails in Table 4 (column 2): the coefficient of the interaction of education and training in the wage equation is not significant. However, the same test

statistical regressions.

¹⁴ Supplementary information on intensity is available in a 1980 study of PSID time budgets by Duncan and Stafford (1980). It contains data on the proportion of workers who were engaged in job training during the survey week and the hours spent in training by those engaged in it. Both components and their product increase with education (except for the higher level (16+)). Our measure (RQT) is, therefore, not misleading in terms of direction of effect of schooling on training.

applied to upward occupational mobility (or wage growth in the long run) was positive (Sicherman, 1987). The wage equation in Table 4 also reveals another reason for a link between education and training: both are more profitable where productivity growth (PG) is more rapid.

(b) *Is turnover negatively related to education, and why?* We saw in Table 2 that job training (measured by RQT) has a negative effect on separation rates, that is to say, it reduces the probability of leaving the firm in which training was received.¹⁵ The reason is that training which enhances skill and productivity in the firm is not fully transferable to otherwise comparable jobs in other firms. Since training processes at work tend to be integrated with production processes, idiosyncrasies in the latter create some degree of firm specificity in training. Consequently, workers who acquire large volumes of training on the job are less likely to move from one firm to another. Similarly, employers are less likely to lay off such workers (permanently) if they share in the costs and returns to training. Indirect evidence of such cost-sharing appears in the negative effects of training on quits and layoffs, in separate regressions.¹⁶ We may conclude that the observed negative relation between education and turnover is, in part, attributable to the positive correlation between education and on-the-job training.

(c) *Does education affect labor mobility, apart from (net of) its correlation with training?*

The answer is provided in Table 2, where the effect of education on turnover is reduced, but remains negative after training is introduced ("held constant") in the P(s) regression, suggesting that factors other than training may be important as well.

One possibility is that firms with high fixed labor costs—such as costs of screening, hiring, and fringes which do not depend on hours or work—will aim to cut these costs by reducing turnover. This may be done by selecting more productive, capable, and stable workers, substituting adjustments in hours for adjustments in employment, and postponing rewards to workers in the form of steeper wage growth and/or of pensions. In substituting quality for quantity of employment, such firms tend to hire larger proportion of better educated workers. Information on the amount of fixed labor costs is

¹⁵ For additional evidence see Mincer (1987).

¹⁶ Ibid.

scarce.¹⁷ However, many firms that are large and more capital intensive (the two tend to be correlated) are likely to have higher fixed costs of employment and therefore tend to engage in the above described policies in order to reduce turnover. Of course, another reason for lesser turnover in large firms is that their size permits job changes and, especially, upward mobility within the firm, thus limiting inter-firm mobility. There is abundant evidence that larger firms employ larger proportions of better educated workers, and that turnover is lower in such firms.¹⁸

It may also be true that more educated persons are more efficient in job matching, that is in finding suitable employment with less job shopping—resulting therefore in lesser turnover. If matching gains are equated with wage gains in moving from one firm to another, the proposition is testable and we do find that wage gains (in percent terms) are greater for more educated workers (see Table 6) who move, especially by quitting.¹⁹

The greater mobility gain of educated workers, in part results from their longer distance geographic migration, in which costs and therefore returns are higher. Indeed, geographic mobility is an exception to the proposition that more educated workers engage in lesser job mobility. While lesser mobility of more educated workers holds within local markets, and local mobility dominates the overall picture,²⁰ geographic mobility increases with education. Indeed inter-regional migration is twice as frequent among workers with 16 or more years of schooling than for those with 12 or less. Of course, having migrated, educated workers stay much longer on the job and in the new locality than do others (DaVanzo, 1983).

The apparent contradiction between effects of education on local and on geographic job mobility can be reconciled on the following grounds: Although educated workers change jobs less frequently, when they do, they are more likely to migrate geographically. It should be noted that most

¹⁷ See, however, Oi (1962), and Mincer and Higuchi (1988).

¹⁸ For a summary of a growing literature, see Idson (1986).

¹⁹ See also Table 4 in Mincer (1986).

²⁰ Geographic mobility amounts to about 25% of total job mobility in Census data. It was less than 20% in the PSID.

job changers have accumulated very little of specific capital,²¹ that this is especially true of young workers, and that migration is especially selective of young workers. At the same time, job search by the more educated is likely to be more efficient where information is less complete (such as in long distance opportunities) because they accumulate more information and process information more efficiently. Indeed, educational selectivity is greater the longer the distance (e.g., in interstate vs. intercounty migration), and return migration is much less frequent among more educated than less educated migrants (DaVanzo, 1983).

The purpose of this section was to explore the negative relation between education and labor turnover, because the latter is an important component of unemployment incidence. The following factors appear to give rise to this relation: job training which is partially specific to the firm, high turnover costs which induce firms to substitute schooled and trained workers for others, more intensive screening by firms, and more efficient job search of more educated workers.

Tied to these factors are sources of demand for educated workers in the labor market: firms in which training is important, firms in which turnover costs are high, large firms, and firms in geographically diversified industries. At the sectoral (industry) level we can add two additional sources: sectors with more rapid productivity growth, and sectors in which product demand, hence employment demand, is stable.

That demand for educated workers is greater in industries with more rapidly growing productivity is evident in Table 4 (column 2): the return to education (and to training) is greater in sectors with more rapid productivity growth.²²

Industries in which employment fluctuations are mild are also likely to demand more educated labor. This is because training is less risky in stable industries, as capital losses due to infrequent layoffs are smaller. Since more training is received by the more educated workers, more of the latter are hired and sort themselves to such industries. The evidence is shown in Table 5, where sectoral

²¹ Most job movers had short tenures in the firm they left.

²² Similar and related findings were obtained by Lillard and Tan (1986) and in Japanese data (Mincer and Higuchi, 1988). Reasons were analyzed by DaVanzo (1983) and in Bartel and Lichtenberg (1987).

instability is measured by unemployment incidence of high school graduates, showing that the proportion of workers with over 12 or with 16+ years of schooling as well as frequency of training are inversely related to instability.²³

Reasons for Lower Unemployment of Job Changers P(u/s) at Higher Educational Levels

As we saw in Table 2, more educated job changers are less likely to experience unemployment in the transition to a new job. The probability of becoming unemployed upon separation P(u/s) depends, in part, on whether the separation was a quit or a layoff, since close to 70% of layoffs but only 25-30% of quits become unemployed. Indeed, more educated job changers are somewhat less likely to separate by layoff than by quit (column 3 in Table 3). But this is a minor part of the reason for the lesser probability of unemployment of educated job changers. The major part is played by the lesser probability of unemployment of educated job changers both in quits and in layoffs.

This conclusion is based on the sizes of the coefficients of the education variables in Table 3. Given that, by definition:

$$(8) \quad P(u/s) = P(u/L) \frac{L}{S} + P(u/Q) \left(1 - \frac{L}{S}\right),$$

where P represents conditional probabilities of unemployment, given separation (s), layoffs (L), and quits (Q), respectively.

The effect of education is

$$(9) \quad \frac{dP(u/s)}{dEd} = \frac{dP(u/L)}{dEd} \cdot \frac{L}{S} + \frac{dP(u/Q)}{dEd} \left(1 - \frac{L}{S}\right) + [P(u/L) - P(u/Q)] \cdot \frac{d\left(\frac{L}{S}\right)}{dEd}$$

At the means of education (Ed = 12) and of L/S (.4), the numerical value of the last term is no more than one sixth of the total effect.

²³ Instability here is an industry characteristic, not a consequence of more training received by more educated workers.

We know by now that more educated workers are less likely than others to quit or to be laid off. But why are they less exposed to unemployment when they do quit or are laid off? The general answer to this question lies in job search behavior of workers and hiring efforts of firms.

It is important to realize that job search of workers takes place both on the job (while employed) and off-the-job (while unemployed). (Indeed, over half of all job changes occur without unemployment, involving search or accepting offers while employed.) The proportion is even greater among the more educated, who are more likely to search on the job rather than off-the-job. A basic reason from the worker's point of view is that the cost of off-the-job search (while unemployed) relative to the cost of on-the-job search is greater for the more educated. Larger foregone earnings and smaller unemployment compensation offsets make search off-the-job more costly, while greater efficiency in accumulating information and greater flexibility in time at work lower the cost of on the job search. Consequently, while over 40% of less educated (Ed<12) quitters quit into unemployment in order to search, only 20% of the more educated (16+) do so.

The greater stock of information and greater efficiency in search can also account for the lesser risk of unemployment of more educated workers who are laid off, provided layoff notices permit some time for search on the job, and especially if the more educated workers are more likely to receive advance notices of layoff. Indeed, a recent study by Ehrenberg and Jakobson (1987) indicates that (a) workers who receive advance notices of layoff or of plant shutdown are less likely to experience unemployment, and (b) advance notices are more likely to be received in plants where proportions of skilled blue-collar workers and of college educated workers are larger. The study also shows that, given advance notice, the laid off more educated white collar workers are less likely to become unemployed.

On the hiring side, one would expect a greater intensity of search for more educated workers by firms, since costs of unfilled vacancies for skilled jobs, in terms of foregone production, are clearly higher. Hence more educated workers are likely to receive offers from other firms while they are

employed elsewhere. In other words, the costs of search shift in part to employers as education of workers rises.²⁴

Direct evidence on the informational efficiency in job search of educated workers is not available. Indirect evidence of migration behavior was cited before. Greater wage gains in job changing will be shown in the next section together with other evidence on efficiency which applies both to on-the-job and off-the-job search.

Job Search and the Duration of Unemployment

The hypotheses concerning search efficiency of workers and greater search effort of employers in hiring educated workers apply to workers' search on as well as off-the-job. These hypotheses provide explanation for the educational patterns of unemployment durations and of wage gains in moving, both observable in our data.

To understand the findings about effects of education on unemployment of job changers, its duration, and on wage gains in moving, we view them as implications of a theoretical model of job search. It can be described, in a simplified manner, as follows:

Workers sample from sets of alternative wages available in potential jobs (the set is called the "wage offer distribution") finding at least one vacancy per unit of time with probability p . The worker's strategy in accepting a job offer is to decide on a minimum acceptable wage ("wage floor") which equates the gain from an additional period of search to the cost of it. Formally, the decision rule (see Appendix 1) is:²⁵

$$(10) \quad \frac{k}{i} p \cdot P_a (\overline{W}_a - W_a) = C, \text{ where } k = [1 - (\frac{1}{1+i})^t]$$

Costs (c) are on the right side of equation 10; gains on the left.

²⁴ Another reason for this shift (proposed by Stigler, 1962) is that the ratio of workers to potential employers declines at higher education levels.

²⁵ See Note 1 in Appendix for derivation. For an extensive survey of job search models see Mortensen (1987).

Since gains accrue over a long period following accession to a new job, their capital value appears on the left hand side of equation 10, when divided by the discount rate i . The term $\frac{1}{i}$ is

multiplied by $k = [1 - (\frac{1}{1+i})^t]$, a correction for the finite payoff period t . The shorter the period the smaller the gain ($k < 1$ and declines as t declines).

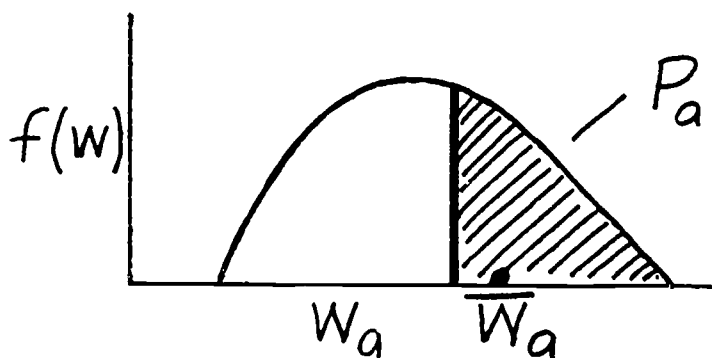
These concepts are easily visualized in a graph:

Figure 1. Wage Offer Distribution

W_a = acceptance wage

$P_a = P(W > W_a)$ = area to the right of W_a ,

\bar{W}_a = mean wage in the truncated area



The probability of finding a vacancy is p , so the probability of finding an acceptable job is (pP_a) .

The cost of search includes opportunity costs of time (C_o), direct costs of search (travel, communications, and of other forms of acquiring information) (C_d). Income offsets (z) which are contingent on continuing search, such as unemployment compensation, enter costs with a negative sign: thus $c = c_o + c_d - z$. The discount factor k depends on time preference, on the terms of credit available to the worker, and on the expected duration of the next job (t). Duration of unemployment (D_u) when identified with duration of search is the inverse of the (unconditional) probability of finding an acceptable job:

$$(11) \quad D_u = \frac{1}{p \cdot P_a}$$

Decision rule (equation 10) contains several factors differing by education, which determine both the duration of search unemployment and the minimal acceptable wage in the new job.

The model produces several important implications:

1. The lower the cost of search (c), the more time the worker can afford to spend searching and choosing among alternatives, and the higher the wage demanded.
2. The lower the discount rate (i) and the longer the expected stay on the new job, the greater future gains loom relative to current costs. The result is longer duration of search and better terms (here W_a) on the new job resulting from the more thorough search.
3. The higher the probability of finding a vacancy (p), the more likely is a worker to find an acceptable job during a given period. Hence the duration of search is likely to be shorter, and the new wage likely to be obtained is higher.²⁶

Schematically, the effects of these factors on duration of search and on reservation wages are indicated as follows:

Changes

Factor	Up (↑) Down (↓)	du	W_a
c	↑	↓	↓
i	↓	↑	↑
t	↑	↑	↑
p	↓	↓	↑

²⁶ On average, the new wage equals \overline{W}_a , which exceeds W_a .

Variations (across people) in costs of search (per unit of calendar time), in ease of financing (i), and in the expected payoff period (t) induce the same direction of effect on duration as on the acceptance wages. Only variations in (p), the efficiency of search, produce opposite signs.

In the first column of the diagram we assume variations that distinguish more from less educated workers. Cost (c) of search (given its efficiency) is assumed to be higher per unit of calendar time, the discount rate (i) lower, expected stay in the new firm (t) longer, and probability of finding a vacancy (p) per unit of calendar time greater.

The analysis may be described as follows: cost of search, c (on the right side of our decision rule, equation 10), is likely to be higher for educated workers because of their greater foregone earnings and lesser offset by unemployment compensation. Of the left side variables, the discount rate i, reflecting the ease of financing search as well as time preference, is likely to be lower—as this is a factor, in addition to ability, which induced greater investment in education in the first place. Empirical evidence from Table 7, utilized in Appendix Note 2, confirms this hypothesis. Because of lower i and greater ability, educated workers also benefit more from all other forms of human capital, including information and training. Therefore, their search is more informed and they expect to continue training and learning on the next job. Hence they expect to stay longer in the new job than the less educated job changers do. The greater accumulation of information in turn raises p, the efficiency of search. The lower i and higher k and p raise the value of the gain from search.

We already alluded to several factors affecting efficiency. As just indicated, efficiency is not exogenous. It is affected by incentives of workers and firms to acquire information about alternative jobs and employees, and to search more intensively. Formally, we can express p (the probability of finding vacancies per unit of (calendar time) as a function:

$$(12) \quad p = p(\tau, x; e_i, e_m)$$

Here τ is the intensity of search (hours per week spent in search), x- other expenditures, such as advertising, transportation, etc. Educated workers have an incentive to spend more resources (τ and x) in order to shorten the period of unemployment, which is more costly in terms of foregone earnings to them compared to other workers. Evidence on greater job search intensity of more educated workers is available in Barron and Mellow (1979) and in Zuckerman (1982), based on a Bureau of

Labor Statistics survey of unemployed workers (1976) and (1973). The greater investment in (accumulation of) job market information appears in a larger e_i , personal efficiency variable, and the greater intensity of search by employers for more educated workers appears in the market efficiency variable e_m . Indirect evidence on e_i and e_m was cited before.²⁷ In support of a larger e_m , there is also evidence that more educated workers are less vulnerable in cyclical declines, partly because they are employed in more stable sectors (Table 5), and that greater demand for educated workers is generated by economic growth, as seen in the positive coefficient on Ed x PG in Table 4, and in other recent studies.²⁸

Comparing more educated to less educated workers, using decision rule (equation 10), we see

that the right side (c) is raised, but so is the left side, because of higher p and $\frac{k}{i}$. The empirical

findings suggests that the product $p \frac{k}{i}$ increases (with education) more than the opportunity cost c .²⁹

The adjustment to achieve optimum results in search when gains exceed costs is to equate the two sides of equation 10 by raising the acceptance wage W_a . This reduces the conditional probability P_a , but the unconditional probability of finding an acceptable job ($p \cdot P_a$) may remain higher after the

adjustment.³⁰ Duration of search, therefore, may decline, since $d_s = \frac{1}{p \cdot P_a}$.

²⁷ Direct evidence on the number of contacts with potential employers during the previous month shows that it was larger for the more educated unemployed searchers in the sample of Table 7. Similar evidence is reported by Yoon (1981) for earlier periods. This evidence reflects greater efficiency or greater intensity of search. Holzer (1988) reports greater diversity of search methods by more educated young unemployed workers in the NLS. Generally, he finds this variable reduces the duration of unemployment as well.

²⁸ See Bartel and Lichtenberg (1987), Lillard and Tan (1986), Mincer and Higuchi (1988).

²⁹ Note 2 in Appendix uses data of Table 7 to test the proposition.

³⁰ For proofs see Flinn and Heckman (1983). The theorem they prove is that the (negative) elasticity of P_a with respect to p is less than unity. This guarantees a reduction in duration of search when its efficiency (p) increases. Note that when a higher (rather than p) distinguishes more from less educated workers, duration of search increases. Our empirical findings indicate that p dominates the educational differentials.

The opposite scenario, where costs c increase more than gains in equation 10 would produce the opposite effects; reservation wages would be reduced and duration of search increased for more compared to less educated workers. This scenario is decisively rejected by the empirical findings in Tables 6 and 7.

Note that for empirical purposes (Tables 6 and 7), we are equating duration of unemployment with duration of search, and that both reservation wages and wages on the new job are deflated

(divided) by the wage on the old job (W_o). Since $W_e > W_o$, it must be true that $\frac{\bar{W}_e}{W_o} > \frac{W_e}{W_o}$, i.e.,

percent gains in wages are larger the higher the reservation wages. Deflation by W_o is necessary in order to standardize (keep fixed) the level of the wage offer distribution, which differs by education.

Reservation wages of workers unemployed during the survey were reported in 1980-1982.

Table 7 shows that $\frac{W_e}{W_o}$ moves up with education of job changers in quits and in layoffs with and

without unemployment.³¹ Wage gains $(\frac{W_e}{W_o})$ move correspondingly.

The behavior of variables in the decision rule equation 10 is similar for on-the-job searchers, and perhaps less ambiguous than in the case of unemployed searchers. p and $\frac{k}{i}$ are greater for the more educated workers whether or not they are employed. They also have lower costs of on-the-job search, if they are more flexible in their use of work time, while the unemployed may have somewhat less efficiency than the employed—as evidenced by their winding up in unemployment. Wage gains are indeed larger for employed than for unemployed searchers (Table 7). We conclude that $P(u/s)$, discussed in the previous section, is smaller among more educated workers not only because they find

³¹ There are very few layoffs among employed movers, hence only total separations are shown for them in Table 7.

it more economical to search on- rather than off-the-job, but also because their search is more efficient. The fact, shown earlier, that education reduces conditional unemployment $P(u/s)$ to a greater extent than it reduces the duration of unemployment is also consistent with this analysis.

Summary and Concluding Remarks

A major benefit of education in the labor market is the lower risk of unemployment at higher levels of education. In order to understand this relation, we analyze several aspects of unemployment which combine to produce the usually reported unemployment rates. We find that the reduction of the incidence of unemployment, that is of the probability of experiencing unemployment in a calendar period, is far more important than the reduced duration of unemployment in creating the educational differentials in unemployment rates. While this finding is not new, further analyses of components and factors in the incidence and duration of unemployment yield insights into the relevant behavior of workers and firms in the labor market.

The behavioral phenomena of basic importance are: training processes in firms, and search of workers and firms for one another. These phenomena are not quite unrelated, although they are analytically separable. We find that the lesser unemployment incidence of the more educated workers is, in about equal measure, due to their greater attachment to the firms employing them, and to the lesser risk of entering unemployment when separated from the firm. This lesser risk applies to both quits and layoffs and is, only in small part, due to the somewhat greater likelihood of quit than of layoff among the more educated job changers.

The lesser frequency of job turnover of more educated workers, which creates fewer episodes of unemployment, is in large part attributable to a greater likelihood of their engaging in on-the-job training. Because such training contains elements of firm specificity, its costs tend to be shared by workers and firms, and turnover, both in quits and in layoffs, is reduced. It should be understood that job training and learning is a comprehensive concept, not restricted to formal training programs or apprenticeships in firms.

Factors other than job training also play a role in the greater firm attachment of educated workers. Firms which bear relatively high fixed labor costs—in terms of hiring, screening, fringes—tend to substitute both physical and human capital for less skilled labor. Large firms, which

tend to have higher fixed labor costs, recruit larger proportions of educated workers, whose turnover is lower. Training costs are, of course, also a part of fixed costs and, indeed, there is evidence that screening costs tend to correlate with training costs.³²

In explaining the lesser conditional unemployment of educated workers and the somewhat lesser duration of their unemployment, we focus on search behavior. Moving from one firm to another without unemployment implies search on the job. The lesser risk of unemployment in job changing suggest greater efficiency of on-the-job search. We provide largely indirect evidence that (1) costs of on-the-job search relative to costs of searching while unemployed are lower for more educated workers; (2) that these workers are also more efficient in acquiring and processing job search information; and (3) that firms and workers search more intensively to fill more skilled vacancies.

All three reasons explain the more successful on-the-job search of the more educated workers. The second and third apply to off-the-job search as well. However, efficiency of search is not the only factor affecting duration of search unemployment. Three other factors: opportunity costs, the rate at which the future is discounted, and the expected length of the payoff period, that is of duration of stay on the next job, have conflicting implications for the duration of search. Information on wage gains in moving is useful in disentangling these contradictory forces. We conclude that the somewhat shorter duration of unemployment coupled with larger wage gains from search is due to the dominating effect of greater efficiency and intensity of search in the market for educated labor.

The interrelation between human capital investment behavior and search behavior can be seen in the following mutual links: since educated workers tend to invest more in training, they expect to continue doing so when they move to the next firm. Consequently they expect to stay at a firm longer than other workers. According to the economic model they will, therefore, search more thoroughly (though, as we have seen, not necessarily longer), and obtain greater wage gains in moving, as we observed.

³² See Barron et al (1986); also, Mincer and Higuchi (1988).

At the same time, the more informed the search, the more likely is a successful job match, hence the longer are workers likely to stay on the next job.³³ Thus search efficiency, which is characteristic of educated workers, may be an additional factor in their lesser turnover.

Having restricted our sample basically to workers who are in almost continuous employment—white men, non-students, age 18-60, we could ignore non-participation including entries into and exits from the labor force as components of unemployment. The bottom row of Table 1 showed that for our sample, the differences by education are negligible, except for the least educated (Ed<12) high school dropouts. The entry probabilities are likely to be higher for the more educated because they have fewer difficulties in finding jobs—as was shown in our search analysis. Lesser probability of leaving the labor force are suggested by the likelihood of greater training on the job: to the extent that the training is specific, losses of human capital deter workers from leaving the employing firm whether it is to go to another or to leave the labor force. But even when the training is transferable to other firms, as most of it tends to be, leaving employment for a longer time can erode the acquired human capital. Consequently more educated workers are less likely to drop out and stay out. In analyzing labor force groups in which continuity of employment is far from permanent, non-participation and labor force turnover must be singled out in addition to job turnover as an important factor in analyzing unemployment differentials.

³³ Some evidence is available in Mincer (1987).

Table 2

FACTORS IN THE INCIDENCE OF UNEMPLOYMENT*
(White Men, PSID, 1976-1981)

Variables	P(u)			P(s)		P(u/s)		Means
Intercept (c)	.41	.36	.35	.55	.61	.93	.81	P(u)=.082
	(21.6)	(15.2)	(13.7)	(19.5)	(15.4)	(120)	(6.8)	P(s)=.18
Education (Ed)	-.018	-.0132	-.008	-.014	-.008	-.036	-.018	P(u/s)=.47
	(14.6)	(11.1)	(9.8)	(7.7)	(7.8)	(6.4)	(5.8)	12.7
Experience (x)	-.012	-.0076	n.s.	-.018	n.s.	n.s.	n.s.	17.2
	(10.7)	(7.0)		(9.7)				
x ²	.0002	.00012	n.s.	.00026	n.s.	n.s.	n.s.	
	(6.6)	(4.2)		(5.7)				
Tenure (Ten)			-.021		-.038		-.036	9.1
			(15.7)		(20.2)		(3.9)	
Ten ²			.00056		.0012		.0011	
			(11.8)		(15.0)		(2.6)	
Married (mar)			-.038		-.055		-.061	.88
			(4.0)		(4.0)		(1.6)	
Union Member (Union)			-.024		-.076		.083	.35
			(3.4)		(7.3)		(2.2)	
Nat'l. Unempl. Rate ^a (NUR)			.007		n.s.		.054	.032
			(1.6)				(2.0)	
Training (RQT)			-.0026		-.0031		-.010	2.2
			(1.8)		(2.1)		(2.5)	

* Recall unemployment excluded except for the first left column.

^a of white men, age 35-44

n.s. = not significant

t = t - ratio

Table 3
UNEMPLOYMENT IN QUILTS AND LAYOFFS

Variables	P(U/Q)	P(U/L)	$\frac{L}{S}$
	(1)	(2)	(3)
Ed	.049	.076	.038
	(1.3)	(1.8)	(2.1)
Ed ²	-.003	-.004	-.002
	(2.2)	(2.5)	(2.5)
x	-.006	-.006	.009
	(1.0)	(1.0)	(2.6)
x ²	.0001	.0001	-.0001
	(.7)	(1.1)	(1.4)
Slope at Ed=12	-.023	-.020	-.010

$\frac{L}{S}$ = ratio of layoffs to all separations

$P\left(\frac{u}{s}\right)$ = probability of unemployment in quits

$P\left(\frac{u}{L}\right)$ = probability of unemployment in layoffs

Table 4

TRAINING AND WAGES IN CURRENT JOB
(PSID, 1976 AND 1978 pooled for RQT
1976-1981 for ln w)

Variables*	RQT	ln W
c	-0.50 (6.6)	.26 (7.2)
Ed	.245 (10.8)	.071 (42.2)
x	.107 (5.1)	.024 (13.9)
x ²	-.0013 (2.5)	-.0004 (10.2)
Ten	.04 (1.8)	.021 (12.1)
Ten ²	n.s.	-.0004 (6.5)
Mar	.46 (2.8)	.067 (5.3)
Union	-.55 (4.8)	.13 (14.0)
	Ed x PG	.073 (4.5)
	RQT x PG	.078 (1.9)
	RQT	.043 (14.4)
	Ed x RQT	n.s.
	NUR	-.039 (4.8)

PG = total factor productivity growth in industry 1970-1979

Its level was also included in the wage regression

Source: Conrad and Jorgenson (1985)

NUR = national unemployment rate

ln w = logarithm of wages

Table 5

UNEMPLOYMENT INCIDENCE AND THE PROPORTION
OF EDUCATED LABOR BY INDUSTRY, PSID 1976-1981
($i=25, n_i \geq 30$)

	P(E _d >12)		P(E _d ≥16)		RQT
C	.56	.27	.34	.06	2.38
	(8.4)	(1.3)	(5.3)	(.3)	(3.4)
P(U ₁₂)	-.76	-.56	-.56	-.37	-2.47
	(2.5)	(1.9)	(2.0)	(1.5)	(2.8)
x		.024		.022	n.s.
		(2.0)		(2.0)	
UnM		-.31		-.31	-.26
		(1.9)		(1.9)	(1.6)
R ²		.37		.32	.24

i = Industry, n_i = sample size in industry i

C = Intercept

P(U₁₂) = Incidence of unemployment of high school graduates in industry

x = Average years of experience in industry

UnM = Unionization rate in industry

n.s. = Not significant

Table 6

**DURATION OF UNEMPLOYMENT BETWEEN JOBS, AND
WAGE GAINS OF UNEMPLOYED MOVERS, 1976-1981, PSID**

Variables	Duration Coefficients		Wage Gain ($\Delta \ln W$) Coefficients
	(1)	(2)	(3)
Ed	-.56	-.54	.068
	(2.0)	(2.0)	(1.9)
Ed²	-.018	-.017	-.002
	(1.6)	(1.5)	(1.7)
x	-.032	.028	-.010
	(.9)	(.6)	(1.0)
x²	.003	.0014	.0002
	(2.2)	(1.0)	(.8)
u		1.40	
		(8.1)	
u			-.037
			(1.8)
Disabled		.72	-.049
		(1.8)	(1.6)
Mar		-.72	.044
		(2.1)	(1.8)
Ten		-.45	-.028
		(4.5)	(2.8)
Ten²		.020	.0007
		(3.8)	(2.7)

Ed = years of schooling
u = unemployment rate

Table 7

**RATIO OF RESERVATION WAGE AND NEW JOB WAGE
TO LAST WAGE OF MOVERS, AND AVERAGE DURATION
OF THE UNEMPLOYMENT SPELL, 1980-1982**

Education		<12	12-15	16+
$\frac{W_R}{W_O}$	Unempl. Q	.88 (12)	1.05 (22)	1.23 (6)
	Unempl. L	.82 (51)	.78 (69)	1.04 (14)
	Unempl. M	.83 (63)	.85 (91)	1.07 (20)
$\frac{W_N}{W_O}$	Unempl. Q	1.08 (37)	1.06 (78)	1.17 (17)
	Unempl. L	.97 (34)	.98 (96)	1.12 (17)
	Unempl. M	1.01 (71)	1.02 (174)	1.14 (34)
$\frac{W_N}{W_O}$	Empl. M	1.14 (63)	1.17 (163)	1.21 (81)
Duration of Spell	Unempl. Q	11.3 (41)	11.0 (113)	7.5 (25)
	Unempl. L	17.4 (59)	14.0 (174)	12.8 (28)
	Unempl. M	14.9 (116)	13.2 (333)	10.9 (60)

Sample sizes in parentheses.

W_R = reservation wage

W_O = last wage on prior job

W_N = new starting wage

Q = quits

L = layoffs

M = all movers

Appendix 1
Derivation of Equation 10

The decision rule in (sequential) optimal search is:

$$c = \int_{w_a}^{\infty} (w - w_a) f(w) dw$$

c = search cost
 w_a = reservation wage
 $f(w)$ = wage offer distribution

This may be rewritten as follows:

$$c = \int_{w_a}^{\infty} w f(w) dw - w_a \int_{w_a}^{\infty} f(w) dw = \int_{w_a}^{\infty} f(w) dw \cdot [w_a - w_a] = P_a [\bar{w}_a - w_a]$$

where $\bar{w}_a = E(w > w_a) = \frac{\int_{w_a}^{\infty} w f(w) dw}{\int_{w_a}^{\infty} f(w) dw}$, and $P_a = \int_{w_a}^{\infty} f(w) dw$

This is correct, if at least one wage offer (vacancy) appears in a unit period. More generally the probability of a vacancy encountered is p . Also, the gain from search will accrue at least over the period of the next job (t), hence the complete equation, taking account of discounting (i), is:

$$c = \frac{k}{i} p P_a (\bar{w}_a - w_a), \text{ where } k = 1 - \frac{1}{(1+i)^t}$$

Duration (D_i) is the inverse of $p P_a$. In most plausible distributions ($\bar{w}_a - w_a$) moves in the same direction as P_a (Heckman & Flinn). Hence the effects of any of the variables on w_a , P_a , and D_i are easily shown.

Appendix 2

EVIDENCE (FROM TABLE 7) THAT DISCOUNT RATE i IS LOWER AT HIGHER LEVELS OF EDUCATION

Optimal search³⁴: $\frac{k}{i} p P_a (\bar{w} - w_a) = c$

Let $\bar{w}_a = w_n$ and $c = \alpha w_n = \alpha \bar{w}_a$

Assume α same for all levels of education (e.g. employment agency fees proportional to the wage in new job).

So $\frac{k}{i} p P_a (1 - \frac{w_a}{w_n}) = \alpha$

Therefore ratio R of educ < ⁽¹⁾12 to educ \geq ⁽²⁾16:

$$R(\frac{k}{i}) R(p \cdot P_a) R(1 - \frac{w_a}{w_n}) = 1$$

Since $D_n = \frac{i}{p P_a}$, substitute numbers from Table 7 to get

$$\frac{k_1}{k_2} \frac{i_2}{i_1} = \frac{1,065}{2,255} \approx \frac{1}{2}$$

hence

$$i_2 = \frac{1}{2} i_1 \cdot \frac{k_1}{k_2}$$

Discount rate of educated (16+) at most half the size of that of the less educated³⁵

(Note $k = 1 - \frac{1}{(1+i)^t}$ and if $t_2 = 2t_1$, (average tenure) while $i_2 = 1/2 i_1$

$k_2 = k_1$, since $\frac{1}{(1+i)^t} = \frac{1}{(1+1/2i)^{2t}}$, when i is small enough.)

$$k = 1 - \frac{1}{(1+i)^t}$$

³⁴ Here is the discount rate, $\frac{1}{(1+i)^t}$, where t is the payoff period.

p = arrival rate of vacancies

P_a = Prob ($w > w_a$), w_a - reservation wage, \bar{w} - expectation of wage in new job, c - cost of search

³⁵ Ratio is smaller when the lesser offset by unemployment compensation is taken into account.

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