A THEORY OF JOB SHOPPING: A BAYESIAN PERSPECTIVE

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In situations in which individuals have imperfect information about the pecuniary and nonpecuniary attributes of a job, it will often be desirable to learn about the job's properties by working on the job and then quit if these experiences are sufficiently unfavorable. The process of experimentation with jobs and adaptive behavior is reflected in the higher turnover of youths and employees with few years of experience at the firm, and in the important influence of job hazards and other job attributes on a worker quitting.[1]

The job shopping notion underlying this behavior is the foundation of Johnson's [1978] analysis of uncertain income rewards of jobs.[2] In his model, workers behave as classical statisticians. The worker knows the true distribution of job rewards, but can only discover true firm-specific productivity with perfect certainty by working there. This productivity can then be used in estimating his productivity elsewhere, as the worker in effect runs a regression to determine this value. The major result of this analysis is that for any given mean return, the worker will prefer the job with the higher earnings variance.[3]

This result directly parallels the analysis in Viscusi [1976], which deals with workers learning about health and safety hazards through their on-the-job experiences. In that model, workers are not assumed to know the true distribution of risks, but instead have subjective prior assessments that are updated in Bayesian fashion based on the worker's experience. For any mean risk, the worker will prefer the job with the loosest prior probability distribution.

In this note, I shall develop a general Bayesian theory of job shopping that can be applied to worker learning about a job's income prospects, the risks posed by the job, or other job attributes. In particular, I shall focus on the fundamental result that workers will prefer jobs whose implications are dimly understood.[4] As I shall indicate below, the analytic motivation for this relationship is directly analo-

1. See Viscusi [1976, 1979] for detailed empirical analysis of these phenomena.

2. The job shopping concept, which has been noted by economists such as Reynolds [1951], has also been the subject of recent work by Mortensen [1975] and Jovanovic [1977].

3. See Propositions 1 and 2 in Johnson [1978].

4. Johnson's other results, such as those pertaining to mobility costs, also have direct analogs in the Bayesian adaptive framework. See Viscusi [1976].

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gous to that in Johnson's classically oriented model, thus integrating the job shopping theories for learning about both types of rewards in a broad Bayesian framework.

Consider a two-period model in which the worker has a utility function U conditional upon the present state of the world.[5] State 1 is the preferred state, or

$$U^1 > U^2, \tag{1}$$

and the marginal utility of income x in any state is positive and non-increasing; that is,

$$U_x^1 > 0, \quad U_x^2 > 0, \quad U_{xx}^1 \leq 0, \quad \text{and} \quad U_{xx}^2 \leq 0. \tag{2}$$

For simplicity, I ignore the role of insurance and the possibility of transferring income across periods.

In the case of monetary risks, the worker receives income $w + c$ if state 1 occurs, and w if state 2 occurs. The shape of the utility function is unaffected by whether the individual is productive and earns an earnings premium c. Nonpecuniary job attributes that can be converted into income equivalents can be treated similarly. In the case of health risks, such as those resulting in worker injury, the level of utility from any given level of consumption will be less. Moreover, the shape of the utility function may also be altered, as the marginal utility of consumption may be reduced. The wage in the good health state 1 is w. If there is a complete income loss when the worker is injured, the wage in state 2 equals zero. Let the wage in state 2 be indicated by δw, where δ is the fraction of the state 1 wage the worker receives when he is injured. For the monetary risk situation, $\delta = 1$. The analysis to be described below is equally applicable to all such specifications of utility functions that satisfy the general restrictions indicated in equations 1 and 2. All that is required is that the utility function for each state be well behaved and that the alternatives be specified so that the worker prefers state 1.

Let the worker have an assessed prior probability p that state 1 will prevail. If the worker experiences a successful outcome in period 1, he updates this probability favorably, yielding a value $p(1)$ exceeding p.[6] Similarly, an unfavorable outcome lowers p to a value $p(0)$. The extent of the revision diminishes with the degree of prior information γ associated with the worker's prior. For example, consider

5. This formulation of worker preferences is more general than that in Viscusi [1979] or Johnson [1978].

6. Worker learning through observation of job characteristics and other forms of indirect experience is treated in Viscusi [1976].

a prior distribution from the Beta family of distributions, which is ideally suited to analysis of Bernoulli-type trials such as this.[7] The distribution $\beta(\gamma p, \gamma)$ is parameterized so that p is the mean value of the prior and γ is an index of its sharpness.[8] The mean posterior probabilities are

$$p(1) = (\gamma p + 1)/(\gamma + 1)$$

and

$$p(0) = \gamma p/(\gamma + 1),$$

and their derivatives with respect to γ are

$$\frac{\partial p(1)}{\partial \gamma} = \frac{\partial}{\partial \gamma}\left[\frac{\gamma p + 1}{\gamma + 1}\right] = \frac{p - 1}{(\gamma + 1)^2} < 0,$$

and

$$\frac{\partial p(0)}{\partial \gamma} = \frac{\partial}{\partial \gamma}\left[\frac{\gamma p}{\gamma + 1}\right] = \frac{p}{(\gamma + 1)^2} > 0,$$

implying that tighter priors are revised less in either direction than sharper priors.

To complete the problem, let the expected utilities be discounted by a factor b equal to the reciprocal of 1 plus the interest rate and let there be an alternative riskless job offering a wage w_0, hence a discounted value over two periods of $(1 + b)U^1(w_0)$. With no loss of generality, $U^1(w_0)$ can be set equal to zero.[9]

If the worker chooses to work instead at the risky job, he has the option of switching to the known position if his experiences are unfavorable. Since the focus here will be on the lowest value of w that will lead the worker to accept the uncertain job, he will always quit after an unfavorable job experience.[10] Once the worker has accepted the uncertain job, he will not leave it after a favorable outcome, since its attractiveness has increased.[11] Given this sequence of decisions,

7. The Beta distribution is quite flexible and can assume a variety of skewed and symmetric forms. For this class of problems, its properties are superior to normal approximations. See Raiffa and Schlaifer [1961].

8. Referring to priors with higher γ's as being sharper or more precise accords with common usage of these terms but may not be a strictly accurate description for low values of γ for which the Beta density function is concentrated at each tail of the distribution.

9. For this general class of problems, the worker will never switch to the uncertain job once he works on the job with known properties. Alternatively, the problem could be formulated in terms of an alternative job with a probability q of state 1 that is known with precision.

10. This straightforward result is formalized in Viscusi [1976].

11. This stay-on-a-winner property of two-armed bandit models is derived by Yakowitz [1969], among others.

the worker's indirect utility function $V(w,p,\gamma,b)$ for the uncertain job consequently equals

$$V(w,p,\gamma,b) = pU^1 + (1-p)U^2 + bp[p(1)U^1 + (1-p(1))U^1] + b(1-p)U^1(w_0),$$

or

$$(3)\quad V(w,p,\gamma,b) = pU^1 + (1-p)U^2 + bp[p(1)U^1 + (1-p(1))U^2],$$

where $U^1(w_0)$ equals zero and the arguments of the U^1 and U^2 terms depend on the particular context being considered.

The key issue to be analyzed is how the precision of the worker's prior affects the reservation wage he requires to start the uncertain position. At this value of w, V must equal the value of the job alternative, which equals zero. Consequently, by implicit differentiation of equation (3), one obtains

$$(4)\quad \frac{\partial w}{\partial \gamma} = -\frac{V_\gamma}{V_w} = -bp(U^1 - U^2)\frac{\partial p(1)}{\partial \gamma} \Big/ (U_x^1 p(1+bp(1)) + \delta U_x^2[(1-p) + bp(1-p(1))]) > 0.$$

The attractiveness of the risky job declines (i.e., the reservation wage increases) as the precision of the worker's initial judgments increases. The required w will be higher if the worker is perfectly informed of the true probability of state 1, since that situation can be viewed as the limiting case of tight priors, where γ is infinite. For any given mean value of p and w, the worker will prefer the job associated with the loosest prior.

Since the benefits of job shopping and adaptive behavior are necessarily deferred, the worker's reservation wage for the uncertain job declines as the discount factor b increases (i.e., as the interest rate declines), or

$$\frac{\partial w}{\partial b} = -\frac{V_b}{V_w} = -\frac{p[p(1)U^1 + (1-p(1))U^2]}{U_x^1 p(1+bp(1)) + \delta U_x^2[(1-p) + bp(1-p(1))]} < 0.$$

a related result is that the rise in the reservation wage from a marginal increase in γ is increased as the discount factor b increases, since

$$\frac{\partial^2 w}{\partial b \partial \gamma} = p(U^1 - U^2)\frac{\partial p(1)}{\partial \gamma}[-pU_x^1 - \delta(1-p)U_x^2] \Big/ \{U_x^1 p(1+bp(1)) + \delta U_x^2[(1-p) + bp(1-p(1))]\}^2 > 0.$$

The attractiveness of loose prior assessments does not hinge on whether the worker is learning about his income prospects or nonpecuniary characteristics. Imprecise prior assessments are preferred because they are updated more quickly after a favorable experience, leading to higher expected second period payoffs. If the worker's experience is unfavorable, the worker can quit so that the greater downward revision of loose priors is not a matter of consequence.

This asymmetric aspect of the problem is shared by Johnson's [1978] analysis in which each job is characterized not by a prior probability of success, but by an actual distribution of rewards. The worker learns his actual earnings potential at the job with certainty in the first period rather than acquiring information that is used to update his prior. The source of preference for jobs with high variances in rewards is quite similar to the preference for loose priors. The high variance job has a higher mean value for its upper tail, which is all that is relevant to the worker in the second period, since the possibility of switching jobs eliminates the lower tail from consideration in situations in which the worker learns that his firm-specific productivity is low.[12]

The motivation for job shopping and the preference for jobs offering greater dispersion in possible outcomes does not hinge on the specific aspects of the learning process or on whether the uncertainty pertains to pecuniary or nonpecuniary rewards. It derives instead from the structure of the sequential decision problem. In particular, it is the possibility for learning and adaptive behavior that leads the worker to engage in job shopping. This type of result has many parallels in other sequential decision contexts in which there is the possibility for experimentation. For example, search activity is more attractive for distributions made more risky by a mean-preserving spread.[13] Since the potential gains from experimentation increase with the degree of initial uncertainty, there will be a systematic preference for jobs and other activities whose implications are not fully understood.

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12. See Johnson's [1978] article for a more formal description of this result and his model.

13. An analysis of search processes along these lines is provided by Rothschild [1974]. Although Rothschild speculates on the implications of subjective uncertainty such as that considered in this paper, his analysis focuses on the influence of mean-preserving spreads, which parallels the analysis by Johnson.

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