A Formal Theory of the Employment Relationship
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A FORMAL THEORY OF THE EMPLOYMENT RELATIONSHIP

By Herbert A. Simon[1]

A distinction is drawn between a sales contract and an employment contract, and a formal model is constructed exhibiting this distinction. By introducing a definition of rational behavior, a method is obtained for determining under what conditions an employment contract will rationally be preferred to a sales contract, and what limits will rationally be placed on the authority of an employer in an employment contract. The relationship of this model to certain other theories of planning under uncertainty is discussed.

In traditional economic theory employees (persons who contract to exchange their services for a wage) enter into the system in two sharply distinct roles. Initially, they are owners of a factor of production (their own labor) which they sell for a definite price. Having done so, they become completely passive factors of production employed by the entrepreneur in such a way as to maximize his profit.

This way of viewing the employment contract and the management of labor involves a very high order of abstraction—such a high order, in fact, as to leave out of account the most striking empirical facts of the situation as we observe it in the real world. In particular, it abstracts away the most obvious peculiarities of the employment contract, those which distinguish it from other kinds of contracts; and it ignores the most significant features of the administrative process, i.e., the process of actually managing the factors of production, including labor. It is the aim of this paper to set forth a theory of the employment relationship that reintroduces some of the more important of these empirical realities into the economic model. Perhaps in this way a bridge can be constructed between the economist, with his theories of the firm and of factor allocation, and the administrator, with his theories of organization—a bridge wide enough to permit some free trade in ideas between two intellectual domains that have hitherto been quite effectively isolated from each other.

1. THE CONCEPT OF AUTHORITY

The authority relationship that exists between an employer and an employee, a relationship created by the employment contract, will play a central role in our theory. What is the nature of this relationship?

[1] In preparing this I have been greatly assisted by comments on an earlier version by a number of persons, including Messrs. L. Hurwicz, R. Radner, D. Rosenblatt, and J. Templeton. The research was undertaken in my capacity as a consultant to the Cowles Commission for Research in Economics under its contract with The RAND Corporation. This paper will be reprinted as Cowles Commission Paper, New Series, No. 47.

We will call our employer B (for "boss"), and our employee W (for "worker"). The collection of specific actions that W performs on the job (typing and filing certain letters, laying bricks, or what not) we will call his *behavior*. We will consider the set of all possible behavior patterns of W and we will let x designate an element of this set. A particular x might then represent a given set of tasks, performed at a particular rate of working, a particular level of accuracy, and so forth.[2]

We will say that B exercises *authority* over W if W permits B to select x. That is, W accepts authority when his behavior is determined by B's decision. In general, W will accept authority only if x_0, the x chosen by B, is restricted to some given subset (W's "area of acceptance") of all the possible values. This is the definition of authority that is most generally employed in modern administrative theory.[3]

2. THE EMPLOYMENT CONTRACT

We will say that W enters into an employment contract with B when the former agrees to accept the authority of the latter and the latter agrees to pay the former a stated wage (w). This contract differs fundamentally from a sales contract—the kind of contract that is assumed in ordinary formulations of price theory. In the sales contract each party promises a specific consideration in return for the consideration promised by the other. The buyer (like B) promises to pay a stated sum of money; but the seller (unlike W) promises in return a specified quantity of a completely specified commodity. Moreover, the seller is not interested in the way in which his commodity is used once it is sold, while the worker *is* interested in what the entrepreneur will want him to do (what x will be chosen by B).[4]

We notice that certain services are obtained by buyers in our society sometimes by a sales contract, sometimes by an employment contract. For example, if I want a new concrete sidewalk, I may contract for the sidewalk or I may employ a worker to construct it for me. However, there are certain classes of services that are typically secured by purchase and others that are typically secured by employing someone to perform them. Most labor today is performed by persons who are in an employment relation with their immediate contractors.

[2] Our theory is closely related to the theory of a two-person nonzero-sum game, in the sense of von Neumann and Morgenstern. The various x's (the elements of the set of possible behavior patterns) correspond to the several strategies available to W.

[3] See Simon [4, p. 125] and Barnard [1, p. 163].

[4] A contract to rent durable property is intermediate between the sales contract and the employment contract insofar as the lessor is interested in the effect that the use of the property will have upon its condition when it is returned to him.

We may now attempt to answer two related questions about the employment contract. Why is W willing to sign a blank check, so to speak, by giving B authority over his behavior? If both parties are behaving rationally—in some sense—under what circumstances will they enter into a sales contract and under what circumstances an employment contract?

The following two conjectures, which, if correct, provide a possible answer to these questions, will be examined in the framework of a formal model:

1. W will be willing to enter an employment contract with B only if it does not matter to him "very much" which x (within the agreed-upon area of acceptance) B will choose or if W is compensated in some way for the possibility that B will choose an x that is not desired by W (i.e., that B will ask W to perform an unpleasant task).

2. It will be advantageous to B to offer W added compensation for entering into an employment contract if B is unable to predict with certainty, at the time the contract is made, which x will be the optimum one, from his standpoint. That is, B will pay for the privilege of postponing, until some time after the contract is made, the selection of x.

3. THE SATISFACTION FUNCTIONS

Let us suppose that W and B are each trying to maximize their respective *satisfaction functions*. Let the satisfaction of each depend on:

(a) the particular x that is chosen. (For W this affects, for example, the pleasantness of his work; for B this determines the product that will be produced by W's labor.)

(b) the particular wage (w) that is received or paid.

We assume further that these two components of the satisfaction function enter additively into it as follows:

$$S_1 = F_1(x) - a_1 w, \tag{3.1}$$

$$S_2 = F_2(x) + a_2 w, \tag{3.2}$$

where S_1 and S_2 are the satisfactions of B and W, respectively, and $w > 0$ is the wage paid by B to W. The opportunity cost to each participant of entering into the contract may be used to define the zero point of his satisfaction function. That is, if W does not contract with B, then $S_1 = 0$, $S_2 = 0$. Further, for the situations with which we wish to deal it seems reasonable to assume that $F_1(x) \geqslant 0$, $F_2(x) \leqslant 0$, $a_1 > 0$, $a_2 > 0$ for the relevant range of x.

Since $S_1 = 0$, $S_2 = 0$ if B and W fail to reach an agreement, we may assume that, for any agreement they do reach, $S_1 \geqslant 0$, $S_2 \geqslant 0$. When an x and a w exist satisfying these conditions, we say the system is *viable*. The condition may be stated thus:

$$F_1(x) \geqslant a_1 w, \tag{3.3}$$

$$-F_2(x) \leqslant a_2 w. \tag{3.4}$$

Equations (3.3) and (3.4) imply

$$a_2 F_1 \geqslant a_2 a_1 w \geqslant -a_1 F_2. \tag{3.5}$$

Conversely, if for some x, $a_2 F_1(x) \geqslant -a_1 F_2(x)$, we can always find a $w \geqslant 0$ such that (3.5) holds. Hence (3.5) is a necessary and sufficient condition that the system be viable.

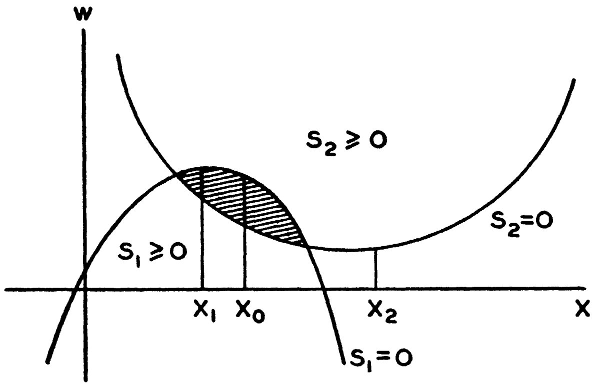

FIGURE 1

4. PREFERRED SOLUTIONS

Thus far we have imposed on the agreement between B and W the condition of viability—that the agreement be advantageous to both. In general, if an agreement is possible at all, it will not be unique. That is, if a viable solution exists, there will be a whole region in the (x, w)-space satisfying the inequalities (3.5), and only in exceptional cases will this region degenerate to a single point. (See Figure 1, where the set of x's is represented by a scalar variable; F_1 and F_2 are continuous in x, and reach extrema at $x = x_1$, $x = x_2$, respectively. The ruled area is then the region of viability.)

A stronger rationality condition[5] is the requirement that, when one agreement (i.e., a point $\{x, w\}$) yields the satisfactions (S_1, S_2) and a second agreement the satisfactions (S_1', S_2') to B and W, the first

[5] This stronger rationality requirement is also imposed by von Neumann and Morgenstern in their treatment of the nonzero-sum game.

will be preferred to the second if $S_1 \geqslant S_1'$, $S_2 \geqslant S_2'$, where at least one of the two inequalities is a proper one. Then we will speak of the second solution as an "inferior" one. The subset of solutions that are not inferior to any solutions we will call the set of *preferred* solutions.

We now define a function $T(x, w)$:

$$(4.1)\quad T(x, w) = a_2 S_1(x, w) + a_1 S_2(x, w) = a_2 F_1(x) + a_1 F_2(x) = T(x).$$

THEOREM: *The set of preferred solutions is the set* $\{x, w\}$ *for which* $T(x)$ *assumes its greatest value.*

PROOF: Let T_m be this greatest value. Then we will prove that: (1) if $T(x) = T_m$ for (x, w), then there is no point that is preferred to (x, w); while (2) if $T(x') < T_m$ for (x', w'), then there is a point (x, w), with $T(x) = T_m$, that is preferred to (x', w'). This will complete the proof.

(1) Suppose $T(x, w) = T_m$. Consider any other point (x', w') with $T(x', w') \leqslant T_m$. Then $a_2 S_1 + a_1 S_2 \geqslant a_2 S_1' + a_1 S_2'$; or, $a_2(S_1 - S_1') - a_1(S_2' - S_2) \geqslant 0$. Hence (since $a_1 > 0$, $a_2 > 0$), we cannot have both $(S_1 - S_1') \leqslant 0$ and $(S_2' - S_2) \geqslant 0$ unless the equality holds in both cases (i.e., unless $S_1 = S_1'$ and $S_2 = S_2'$). Therefore, (x', w') is not preferred to (x, w).

(2) Suppose $T(x', w') < T_m$. Let x be such that $T(x) = T_m$. Let $w = (1/T)(x')\{F_1(x)S_2(x', w') - F_2(x)S_1(x', w')\}$. Then

$$\begin{aligned}
S_1(x, w) &= F_1(x) - a_1 w \\
&= [1/T(x')]\{F_1(x)T(x') - a_1 F_1(x)S_2(x', w') + a_1 F_2(x)S_1(x', w')\} \\
&= [1/T(x')]\{a_2 F_1(x)S_1(x', w') + a_1 F_1(x)S_2(x', w') \\
&\qquad - a_1 F_1(x)S_2(x', w') + a_1 F_2(x)S_1(x', w')\} \\
&= [1/T(x')]\{a_2 F_1(x) + a_1 F_2(x)\}S_1(x', w'),
\end{aligned}$$

$$S_1(x, w) = \frac{T(x)}{T(x')} S_1(x', w') = \frac{T_m}{T(x')} S_1(x', w') > S_1(x', w').$$

Similarly, it can be shown that $S_2(x, w) > S_2(x', w')$. Hence (x, w) is preferred to (x', w').

5. EFFECT OF UNCERTAINTY

The argument thus far suggests that the rational procedure for B and W would be first to determine a preferred x, and then to proceed to bargain about w so as to fix S_1 and S_2.[6] If they follow this procedure they will arrive at a sales contract of the ordinary kind in which W agrees to

[6] Of course, $T(x)$ may assume its greatest value for several elements, x, but this complication is inessential.

perform a specific, determinate act (x_0) in return for an agreed-upon price (w_0).

Let us suppose now that $F_1(x)$ and $F_2(x)$, the satisfactions associated with x for B and W, respectively, are not known with certainty at the time B and W must reach agreement. W is to perform some future acts for B, but it is not known at the time they make their agreement what future acts would be most advantageous. Under these circumstances there are two basically different ways in which the parties could proceed.

1. From a knowledge of the probability distribution functions of $F_1(x)$ and $F_2(x)$, for each x, they could estimate what x would be optimal in the sense of maximizing the expected value of, say, $T(x)$. They could then contract for W to perform this specified x for a specified wage, w. This is essentially the sales contract procedure with mathematical expectations substituted for certain outcomes.[7]

2. B and W could agree upon a specified wage, w, to be paid by the former to the latter, and upon a specified procedure that will be followed, *at a later time when the actual values for all x of $F_1(x)$ and $F_2(x)$ are known*, for selecting a specific x. There are any number of conceivable procedures that B and W could employ for the subsequent selection of x. One of the simplest is for W to permit B to select x from some specified set, X (i.e., for W to accept B's authority). Then B would presumably select that x in X which would be optimal for him (i.e., the x that maximizes $F_1(x)$, since w is already fixed). But this arrangement is precisely what we have previously defined as an employment contract.

At the time of contract negotiations F_1 and F_2 have a known joint probability density function for each element x: $p(F_1, F_2; x)\, dF_1\, dF_2$. Defining the expectation operator, $\mathfrak{E}$, in the usual way, we have, for fixed x,

$$(5.1)\quad \mathfrak{E}[T(x)] = \mathfrak{E}[a_2F_1(x) + a_1F_2(x)] = a_2\mathfrak{E}[F_1(x)] + a_1\mathfrak{E}[F_2(x)].$$

ALTERNATIVE 1: *Sales Contract*. We suppose that at the time of contract negotiations B and W agree upon a particular x that will maximize $\mathfrak{E}[T(x)]$ and agree on a w that divides the total satisfaction between them. We can measure the advantage of this procedure by the quantity $\max_x \mathfrak{E}[T(x)]$.

[7] Von Neumann and Morgenstern have shown that introduction of mathematical expectations is equivalent to the definition of a cardinal utility function. We have already cardinalized our satisfaction functions by the simplifying assumptions leading up to equations (3.1) and (3.2).

ALTERNATIVE 2: *Employment Contract.* We suppose that at the time of contract negotiations B and W agree upon a set X from which x will subsequently be chosen by B and agree on a w that divides the total satisfaction between them. Subsequently [when $F_1(x)$ and $F_2(x)$ become known with certainty], B chooses x so as to maximize $F_1(x)$, i.e., he chooses $\max_{x \text{ in } X} F_1(x)$. We can measure the advantage of this procedure by the quantity

$$T_X = \mathcal{E}[a_2F_1(x_m) + a_1F_2(x_m)], \tag{5.2}$$

where x_m is the x in X which maximizes $F_1(x)$.

Generalizing our concept of preferred solutions, we can define a *preferred* set, X, as a set for which T_X assumes its maximum value. Our previous theorem can also be extended to show that, if B and W agree upon an X which is not preferred, the expected satisfactions of both could be increased by substituting a preferred X and adjusting w appropriately.

Our notion of a preferred set provides us with a rational theory for determining the range of authority of B over W (W's area of acceptance). Moreover, the sales contract is subsumed as a special case in which X contains a single element. Hence, the difference between max T_X for all sets and max T_X for single-element sets provides us with a measure of the advantage of an employment contract over a sales contract for specified distribution functions of $F_1(x)$, $F_2(x)$.

6. THE AREA OF ACCEPTANCE

As an illustration of the meaning of our theory, we consider the case where W's behavior choice is restricted to two elements, x_a and x_b. If, for example, W's behavior pattern is x_a, B and W will receive the satisfactions $S_1(x_a, w)$ and $S_2(x_a, w)$, respectively, where

$$S_1 = F_1(x_a) - a_1w, \tag{6.1}$$

$$S_2 = F_2(x_a) + a_2w. \tag{6.2}$$

Let us assume that, at the time of contracting, $F_1(x_a)$ and $F_1(x_b)$ have a joint probability density function given by

$$p(F_a, F_b)\, dF_a\, dF_b, \tag{6.3}$$

where $F_a = F_1(x_a)$ and $F_b = F_1(x_b)$.

Let us assume further that $F_2(x_a)$ and $F_2(x_b)$ have known fixed values:

$$F_2(x_a) = \alpha, \qquad F_2(x_b) = \beta. \tag{6.4}$$

If B and W enter into a sales contract, they will need to choose between x_a and x_b. On our previous assumptions of rationality, they will choose x_a if and only if

$$\begin{aligned}(6.5)\qquad \mathcal{E}[T(x_a)] &= a_2 \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} F_a p(F_a, F_b)\, dF_a\, dF_b + a_1\alpha \\ &\geqslant a_2 \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} F_b p(F_a, F_b)\, dF_a\, dF_b + a_1\beta = \mathcal{E}[T(x_b)].\end{aligned}$$

Suppose that, in fact, inequality (6.5) holds. Will the parties gain anything further by entering into an employment contract instead of a sales contract, that is, by giving B the right to choose between x_a or x_b when F_a and F_b become known with certainty? To answer this question we must compare the $\mathcal{E}[T(x_a)]$ of (6.5) with T_X of (5.2), where X consists of the set x_a and x_b.

We have

$$\begin{aligned}(6.6)\qquad \mathcal{E}\{\max_{x \text{ in } X} F_1(x)\} &= \int_{F_a=-\infty}^{\infty}\int_{F_b=F_a}^{\infty} F_b p(F_a, F_b)\, dF_b\, dF_a \\ &\quad + \int_{F_b=-\infty}^{\infty}\int_{F_a=F_b}^{\infty} F_a p(F_a, F_b)\, dF_a\, dF_b,\end{aligned}$$

where $p(F_a, F_b)$ is the joint probability density of F_a and F_b. Hence,

$$\begin{aligned}(6.7)\qquad T_X &= \int_{F_a=-\infty}^{\infty}\int_{F_b=F_a}^{\infty} (a_2 F_b + a_1\beta) p(F_a, F_b)\, dF_b\, dF_a \\ &\quad + \int_{F_b=-\infty}^{\infty}\int_{F_a=F_b}^{\infty} (a_2 F_a + a_1\alpha) p(F_a, F_b)\, dF_a\, dF_b,\end{aligned}$$

and to choose between the employment contract and the sales contract we must determine the sign of

$$\begin{aligned}(6.8)\qquad T_X - \mathcal{E}[T(x_a)] &= \int_{F_a=-\infty}^{\infty}\int_{F_b=F_a}^{\infty} [a_2(F_b - F_a) \\ &\qquad + a_1(\beta - \alpha)] p(F_a, F_b)\, dF_b\, dF_a.\end{aligned}$$

Since $(F_b - F_a) \geqslant 0$ in the region of integration, the employment contract will certainly be preferable to the sales contract (in which $x = x_a$) if $\beta \geqslant \alpha$ (if W prefers x_b to x_a), and even if $(\alpha - \beta)$ is positive but not too large.

To gain further insight into the meaning of (6.8) we may consider the special case in which $\alpha = \beta$ (W is indifferent as between x_a and x_b)[8] and F_a and F_b are independently normally distributed:

$$(6.9)\qquad p(F_a, F_b) = \frac{1}{2\pi\sigma_a\sigma_b} \exp\left\{-\frac{1}{2}\left[\left(\frac{F_a - A}{\sigma_a}\right)^2 + \left(\frac{F_b - B}{\sigma_b}\right)^2\right]\right\},$$

[8] This restriction is not essential. We could, instead, work with $F_a' = F_a + (a_1/a_2)\,\alpha$ and $F_b' = F_b + (a_1/a_2)\,\beta$. Then in (6.9) we would simply replace $(F_b - F_a$ with $(F_b' - F_a')$.

where A and B are the means and σ_a and σ_b the standard deviations of F_a and F_b, respectively. Equation (6.8) then becomes

$$T_x - \mathcal{E}[T(x_a)] = \frac{a_2}{2\pi\sigma_a\sigma_b} \int_{F_a=-\infty}^{\infty} \int_{F_b=F_a}^{\infty} (F_b - F_a) \cdot \exp\left\{-\frac{1}{2}\left[\left(\frac{F_a - A}{\sigma_a}\right)^2 + \left(\frac{F_b - B}{\sigma_b}\right)^2\right]\right\} dF_b\, dF_a . \tag{6.10}$$

The situation described by equation (6.10) is shown in Figure 2, where we take $A = 0$, $B < 0$. The ellipses about the center $(0, B)$ are contours of the probability function, and the region of integration is the region to the left of the 45° line, $F_a = F_b$.

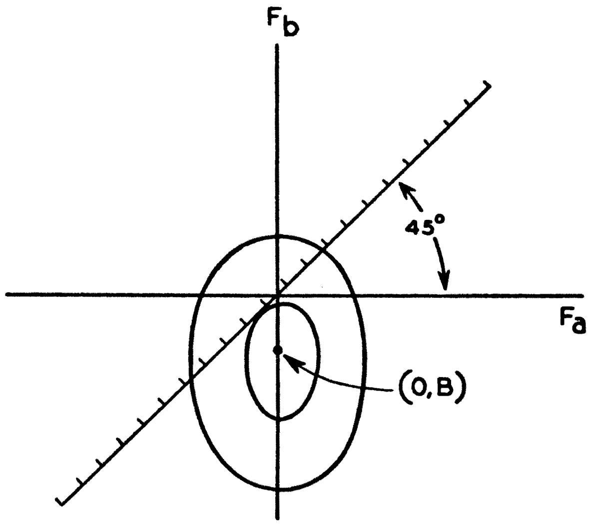

FIGURE 2

It is geometrically obvious from the figure, and can be shown analytically, that $T_X - \mathcal{E}[T(x_a)]$ will increase with an increase in σ_a or in σ_b, and with a decrease in the absolute value of B. Hence, an increase in the uncertainty of either F_a or F_b when the contract is made will increase the advantage of the employment contract over the sales contract, while a decrease in the average disadvantage of x_b as compared to x_a will have the same result.

It is also obvious that these results will hold, qualitatively, even when F_a and F_b are not independently distributed, or when the distribution is not exactly normal. In our model, then, both the conjectures set forth at the end of Section 2 prove to be correct.

One objection to the analysis needs to be raised and disposed of. We have assumed, in the employment contract, that B, when F_a and

F_b become known, will choose the larger. Why will he not choose, instead, the larger of $(a_1F_a + a_2\alpha)$ or $(a_1F_b + a_2\beta)$? If he did, the employment contract would always be preferred to the sales contract, and, indeed, it would be advantageous to the parties not to limit X at all.

The difficulty lies in the fact that, once agreement has been reached on w, there is no way for W to enforce the understanding that B will employ the magnitude of $(a_1F_1 + a_2F_2)$ rather than of F_1 as his criterion for choosing x. Moreover, it is to B's short-run advantage to maximize F_1 rather than $(a_1F_1 + a_2F_2)$ after w has been determined. Translated into everyday language, the worker has no assurance that the employer will consider anything but his own profit in deciding what he will ask the worker to do.[9]

If the worker had confidence that the employer would take account of his satisfactions, the former would presumably be willing to work for a smaller wage than if he thought these satisfactions were going to be ignored in the employer's exercise of authority and only profitability to the employer taken into account. On the other hand, unless the worker is thereby induced to work for a lower wage, the employer has no incentive to use his authority in any other way than to maximize F_1. Hence, we might expect the employer to maximize $(a_1F_1 + a_2F_2)$ only if he thought that by so doing he could persuade the worker, in subsequent renewals of the employment contract, to accept a wage sufficiently smaller to compensate him for this. Otherwise, the employer would rationally maximize F_1. We might say that the latter behavior represents "short-run" rationality, whereas the former represents "long-run" rationality when a relationship of confidence between employer and worker can be attained. The fact that the former rule leads to solutions that are preferable to those of the latter shows that it "pays" the employer to establish this relationship.

7. EXTENSION OF THE MODEL

It should hardly be necessary to state again that the model presented here, while it appears to be substantially more realistic in its treatment of the employment relationship than is the traditional theory of the firm, is still highly abstract and oversimplified, and leaves out of account numerous important aspects of the real situation. It is a model of hypothetically rational behavior in an area where institutional history and other nonrational elements are notoriously important.

In Section 6 we limited ourselves to a situation in which only two

[9] It must be remembered that our model does not take account of morale effects (e.g., that the worker may actually perform *better* if the employer makes allowance for his satisfactions). Our omission of this point does not imply that it it unimportant.

behavior alternatives were open to W—x_a and x_b. The foregoing analysis can be reinterpreted to answer the following question:

Suppose that B and W have already agreed to enter into an employment contract, with B to choose x from some subset, X_a, that does not include x_b. Is it now advantageous to the parties to enlarge W's area of acceptance to include x_b?

We interpret x_a to mean the element of X_a that maximizes $F_1(x)$ for x in X_a. If, now, we know the joint probability distribution $p[F_1(x_1), F_1(x_2), \cdots]$ for $x_1, x_2, \cdots$ in X_a, we can calculate the probability distribution of $F_a = F_1(x_a)$. It is, in fact, the distribution of the maximum of a sample where each element of the sample is drawn from a different population. Placing this interpretation on the F_a that enters into (6.8), we see that it will be advantageous to enlarge X_a to include x_b if and only if

$$T_{(X_a+X_b)} \geqslant T_{X_a}. \tag{7.1}$$

In another important respect the model can be brought into closer conformity with reality without serious difficulty. Any actual employment contract, unlike the hypothetical arrangements we have thus far discussed, specifies much more than the wage to be paid and the authority relationship. The kinds of matters over which the employer will not exercise his authority are often spelled out in considerable detail; e.g., hours of work, nature of duties (in general or specifically), and so forth. If the employment relationship endures for an extended period, all sorts of informal understandings grow up in addition to formal agreements that are made when the contract is periodically renewed. Under modern conditions when a labor union is involved, many of these contract terms are spelled out specifically and in detail in the union agreement. Our model has taken care of this fact in recognizing that authority is accepted within limits, but such limits can be introduced in another way.

In order to extend the model in this direction, let us suppose that the behavior of the worker (or a whole group of workers) is specified, not by a single element x, but by a sequence of such elements $(x, y, z, \cdots)$, where the elements in the sequence can be varied independently. Let us suppose that each of these determines a separate component in the satisfaction functions and that these components enter additively:

$$S_1 = f_{1x}(x) + f_{1y}(y) + \cdots - aw, \tag{7.2}$$

and similarly for S_2.

Then the parties may enter into a contract in which certain of the elements, say, $x, \cdots$, are specified as terms in the contract (as in the sales contract); a second set of elements, say, $y, \cdots$, is to be subject to the authority of the employer; and a third set of elements, say, $z, \cdots$, is to be left to the discretion of the worker or workers. Analogously to our previous assumptions, we may assume that if the element y is subject to the authority of B, he will fix it so as to maximize $f_{1y}(y)$ while, if z is left to the discretion of W, he will fix it so as to maximize $f_{2z}(z)$. We can now derive inequalities analogous to (6.8) that will indicate which elements should, on rational grounds, fall in each of these three categories.

Reviewing the results we have already obtained, we can see that the conditions making it advantageous (1) to stipulate the value of a particular variable in the contract are

(a) sharp conflict of interest with respect to the optimum value of the element (f_1 high when f_2 low and vice versa);

(b) little uncertainty as to the optimum values of the element (σ_{f_1} and σ_{f_2} small).

The conditions making it advantageous (2) to give B authority over an element or (3) to leave it to the discretion of W are, of course, just the opposite of those listed above. Moreover, (2) will be preferable to (3) if B's sensitivity to departures from optimality is greater than W's.

8. APPLICATION TO PLANNING UNDER UNCERTAINTY

The model proposed here deals with a particular problem of planning under uncertainty. It analyzes a situation in which it may be advantageous to postpone decision (selection of x) in order to gain from information obtained subsequently. The postponement of choice may be regarded as a kind of "liquidity preference" where the liquid resource is the employee's time instead of money.

The same general approach can be applied to the problem of choosing among more or less liquid forms for holding assets. The function $F_1(x)$ would then represent the gain derived from using assets in the pursuit of strategy x. The function $F_2(x)$ would need to be replaced by some measure of the cost of holding assets in liquid form (e.g., interest costs). Then, the advantage of postponement, given by an expression like (6.8), with $\beta = \alpha$, would have to be compared with the cost of holding assets.

Indeed, comparison of the methods of this paper with Marschak's theory of liquidity under the assumption of complete information but uncertainty (particularly pp. 182–195 of **[2]**) reveals a close similarity of approach. In both problems the central question is to determine the optimum degree of postponement of commitment. In Marschak's case this is measured by the amount of assets not invested in the first period; in our case, by the range of elements included in the set X (area of acceptance).

9. CONCLUSION

We have constructed a model that incorporates rational grounds for the choice by two individuals between an employment contract and a contract of the ordinary kind (which we have called a sales contract). By a generalization of this model we are able to account for the fact that in an employment contract certain aspects of the worker's behavior are stipulated in the contract terms, certain other aspects are placed within the authority of the employer, and still other aspects are left to the worker's choice. Since administrative theory has been interested in explaining behavior within the framework of employment relations, and economic theory in explaining behavior within the area of market relations, the model suggests one possible way of relating these two bodies of theory. The most serious limitations of the model lie in the assumptions of rational utility-maximizing behavior incorporated in it.

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