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THE EFFECTS OF RISK ON EFFICIENT LABOR CONTRACTS*

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We analyze the effects of productivity risk on the expected utility of workers under efficient labor contracts. With multiplicative uncertainty in productivity, an increase in risk increases workers' expected utility, holding expected profit constant, as has been shown by Rosen. With a technology that is concave in both labor and the productivity shock, however, the opposite is true. We also study the effects of risk on wages, employment and hours, and characterize the dependence of these effects on the curvature of the marginal productivity schedule.

1. *Introduction*

The conventional wisdom that workers require a *compensating differential* in terms of higher wages if they are to accept risky employment prospects is long-established. In an oft quoted passage, Adam Smith (1776) put it this way:

»Employment is much more constant in some trades than in others. In the greater part of manufactures, a journeyman may be pretty sure of employment almost every day in the year that he is able to work. A mason or bricklayer, on the contrary, can work neither in hard frost nor in foul weather, and his employment at all other times depends on the occasional calls of his customers. He is liable, in consequence, to be without any. What he earns, therefore, while he is employed, must not only maintain him while he is idle, but make him some compensation for those anxious and desponding moments which the thought of so precarious a situation must sometimes occasion.»

As is typical, Smith's argument is insightful and the language easily translates into modern terminology concerning risk aversion. The idea has not always been uncontroversial, however. For example, Nassau Senior (1836) argued as follows:

»We believe, after all, that nothing is so

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much disliked as steady, regular labor and that the opportunities of idleness afforded by an occupation of irregular employment are so much more than an equivalent for its anxiety as to reduce [wages in such an occupation]... below the common average.»

The purpose of this paper is to use standard labor contract theory with uncertainty in labor productivity to shed some light on these issues. Specifically, we do two things. First, we investigate the effect of an increase in risk, in the standard sense of a mean preserving spread, on the expected utility of risk averse workers holding expected profit fixed. Rosen (1985) has previously derived the following »interesting and surprising» discovery: more risk actually *increases* workers' expected utility for the special case of a technology given by $f(L, x) = x \cdot L$, where L is labor and x is the productivity shock. When we consider a general case where $f(L, x)$ is concave in its two arguments, however, the result is reversed, and more risk *decreases* expected utility. The second thing we do is ask how observable variables such as wages, employment, and hours vary with risk. Not surprisingly, the results are ambiguous, and depend on the curvature of the marginal productivity schedule (i.e., third derivatives of the production function). Conditional on this curvature, however, we are able to characterize the results rather precisely.

The paper is organized as follows. Section 2 lays out the basic model, and derives the impact of a mean preserving spread in a random productivity variable on workers' expected utility in both a divisible labor and an indivisible labor version of the implicit contract framework. Section 3 derives the effects of risk on employment and compensation. Section 4 provides a simple example, while Section 5 contains some brief concluding comments.

2. *Effects on Expected Utility*

Let x be a random productivity factor, normalized so that it has support in [0,1]. Let $\{G(x, r)\}$ be a family of cumulative distribution functions indexed by r, with the property that $r_2 > r_1$ implies $G(x, r_2)$ is *riskier* than $G(x, r_1)$, in the standard mean preserving spread sense of Rothschild and Stiglitz (1970):

$$(1) \quad \int_0^{\bar{x}} [G(x, r_2) - G(x, r_1)]\,dx \geq 0 \;\; \forall \bar{x} < 1, \qquad = 0 \text{ if } \bar{x} = 1.$$

Notice that higher values of r place more weight in the tails of the distribution, while the expected value of x is independent of r.

As in Diamond and Stiglitz (1974), we assume that $G(x, r)$ is differentiable with respect to r, divide (1) by $r_2 - r_1$ and take the limit as $r_2 - r_1 \to 0$ to yield

$$(2) \quad \theta(\bar{x}) \equiv \int_0^{\bar{x}} G_r(x, r)\,dx \geq 0 \;\; \forall \bar{x} < 1, \qquad = 0 \text{ if } \bar{x} = 1.$$

In this paper, an increase in r makes $G(x, r)$ more risky if and only if condition (2) is satisfied. That is, an increase in r implies more risk if and only if $\theta(x) \geq 0$ for all x.

Now consider a standard labor contracting model, with a continuum of workers attached to an employer for the duration of the period under analysis. The number of workers is exogenous and can be normalized to unity.[1] Also, each worker has one unit of time at his disposal to divide between leisure and labor. A *contract* is a pair of functions $[c(x), h(x)]$, where $c(x)$ is compensation and $h(x)$ is hours per worker when the productivity shock is x. Thus, the contract specifies worker compensation and employment hours as contingent functions of the realized value of the productivity shock. The state contingent »contract wage» can be defined as compensation per hour, $w(x) = c(x)/h(x)$; in general, this will differ from the marginal product of labor, which we also call the »competitive wage» and denote $W(x)$.

An efficient contract is chosen to solve the following problem (or its dual):

$$(3) \quad \max\ EU = \int U[c(x), 1 - h(x)]\,dG(x, r) \qquad \text{st } E\pi = \int \{f[h(x), x] - c(x)\}\,dG(x, r) \geq \bar{\pi}.$$

Here, $U(\cdot)$ is the workers' von Neumann-

[1] *One can also make the number of workers attached to the firm endogenous, as in Burdett and Wright (1989), for example, and the results in this section generalize to that model without much difficulty. In Section 4 we provide an example where the size of the labor force is determined endogenously.*

Morgenstern utility function while $f(\cdot)$ is the production function. We assume $U_j>0$, $U_{jj}<0$, and $U_{11}U_{22}-U_{12}^2>0$. This implies that $U(\cdot)$ is strictly concave and, therefore, workers are strictly risk averse. We assume $f_1>0$, $f_{11}<0$, and normalize x so that $f_2>0$ and $f_{12}>0$ (so that both total and marginal productivity are increasing in x). Other properties of the technology will be discussed below.

If we normalize $\bar{\pi}=0$, the Lagrangian for (3) is $\mathscr{L}=EU+\lambda E\pi$. We can ignore nonnegativity constraints here, as they will not bind under the standard curvature assumptions, $f_1 \to \infty$ as $h \to 0$, $U_1 \to \infty$ as $c \to 0$, and $U_2 \to \infty$ as $h \to 1$. The first order conditions are $E\pi=0$ and

$$(4) \quad U_1[c(x), 1-h(x)]=\lambda \ \forall x$$

$$(5) \quad U_2[c(x), 1-h(x)]=\lambda f_1[h(x), x] \ \forall x.$$

It is easy to verify that the second order conditions hold for this problem.

Equation (4) sets the marginal utility of consumption to a constant across states since λ does not depend on x, which is the standard efficient risk sharing condition. Equation (5) then equates the marginal rate of substitution to the marginal product of labor in each state, which is the standard efficient hours condition. Differentiation implies

$$(6) \quad c'(x)=-\Delta^{-1}\lambda U_{12}f_{12},$$

$$(7) \quad h'(x)=-\Delta^{-1}\lambda U_{11}f_{12},$$

where $\Delta=\lambda f_{11}U_{11}+U_{11}U_{22}-U_{12}^2>0$. In particular, $h'>0$ and hours are unambiguously increasing in the productivity shock.

We can differentiate $\mathscr{L}$ with respect to r to find the effect of greater risk on expected utility, holding $E\pi$ constant. This yields

$$\partial EU/\partial r=\int\{U[c(x), 1-h(x)]+\lambda f[h(x), x] -\lambda c(x)\}dG_r(x, r)$$

after simplifying using the first order conditions (4) and (5) (the envelope theorem). This expression may be simplified by integrating by parts to yield

$$\partial EU/\partial r=-\lambda\int f_2[h(x), x]G_r(x, r)dx,$$

again using (4) and (5) and the condition that $G_r(0, r)=G_r(1, r)=0$ for all r (which holds because G has support in [0, 1]). Integrating by parts a second time then yields

$$(8) \quad \partial EU/\partial r=\lambda\int[f_{22}(\cdot)+f_{12}(\cdot)h'(x)]\theta(x)dx,$$

where $\theta(x)=\int_0^x G_r(s, r)ds$. Recall that $\theta(x)\geq 0$ for all x, by the definition of risk (i.e., by condition 2).

This generalizes equation (20) in Rosen (1985), who considered only the special case of $f(h, x)=x \cdot h$. In his special case, our equation (8) reduces to

$$(9) \quad \partial EU/\partial r=\lambda\int\theta(x)h'(x)dx,$$

which is positive because $h'(x)>0$ by (7). This is Rosen's »interesting and surprising» discovery that greater risk increases EU holding $E\pi$ fixed (or, equivalently, increases $E\pi$ holding EU constant). In fact, his result more generally holds for any technology with $f_{22}\geq 0$, including $f(h, x)=x \cdot F(h)$ for any standard $F(\cdot)$. When $f_{22}<0$, however, the sign of the bracketed term in (8) appears to be ambiguous. We can reduce it to something manageable by inserting h'(x) from (7) into (8) and rearranging, to arrive at

$$(10) \quad \begin{aligned}\partial EU/\partial r=\lambda\int[&f_{22}(U_{11}U_{22}-U_{12}^2)\\ &+\lambda U_{11}(f_{11}f_{22}-f_{12}^2)]\Delta(x)^{-1}\theta(x)dx.\end{aligned}$$

Now, as long as $U(\cdot)$ and $f(\cdot)$ are both concave, $\partial EU/\partial r$ will be unambiguously negative — the exact opposite of Rosen's conclusion!

The finding that workers prefer jobs or contracts with more risk, counter to Adam Smith's argument, was explained by Rosen as follows: »Full insurance eliminates the adverse, direct consequences of risk aversion on expected utility. Increasing the spread affords the worker superior opportunities of allocating work to the most favorable states and limiting losses of unfavorable outcomes by consuming more leisure.» (p. 1162). A problem with this reasoning is that the contract does not eliminate *all* of the direct consequences of risk aversion for workers: although it does insure them against variability in income by equating their marginal utility U_1

across states, it does not insure them against variability in hours.[2]

Furthermore, even if the contract did eliminate hours variability, we will now demonstrate that, with a concave technology, a mean preserving spread would still reduce expected utility. To this end, we introduce a new version of the implicit contract model, where the employer insures workers against variability in hours as well as compensation, by supplying some labor himself. Let m(x) be the amount of labor he supplies in state x, and let ω denote his (constant) marginal disutility of work.[3] Then the employer's return is written $f[h(x)+m(x), x]-c(x)-\omega \cdot m(x)$, which equals profit minus his disutility of work. The contract maximizes EU subject to the constraint

$$E\pi = \int \{f[h(x)+m(x), x]-c(x) - \omega \cdot m(x)\}\, dG(x, r) \geq 0.$$

The first order conditions for this new version of the contracting problem are

$$U_1[c(x), 1-h(x)] = \lambda \ \forall x$$

$$U_2[c(x), 1-h(x)] = \lambda f_1[h(x)+m(x), x] \ \forall x$$

$$f_1[h(x)+m(x), x] = \omega \ \forall x,$$

plus the constraint at equality, $E\pi = 0$. Differentiating,

$$c'(x) = h'(x) = 0, \text{ and}$$
$$m'(x) = -f_{12}/f_{11} > 0.$$

In this model, workers' consumption and hours are constant across states and, therefore, workers bear no risk whatsoever. This does not imply that a mean preserving spread on x has no effect on EU, however.

It is easy to show by mimicking the techniques used in the previous model that

$$(11) \quad \partial EU/\partial r = \lambda \int (f_{11}f_{22}-f_{12}^2) f_{11}^{-1} \theta(x)\, dx,$$

where again $\theta(x) \geq 0$ by the definition of risk. Given $f_{11} < 0$, this expression is negative if and only if f(h, x) is concave (a stronger result than we had for the previous model, in which concavity of the production function was sufficient but not necessary for $\partial EU/\partial r < 0$). The technology $f(h, x) = x \cdot F(h)$ is not concave in (h, x), and so, as in the previous model, a multiplicative productivity shock always implies that expected utility is increasing in risk. Hence, greater spread in x can affect EU simply through its impact on output, and the sign of this effect will depend exclusively on the curvature of the production function.

To close this section, we consider a version of the model where h(x) is restricted to be either 0 or 1 for each individual worker, so that all variation in the labor input must occur via changes in the number of workers, rather than in hours per worker. The contract now sets the number of employed workers (which equals the probability that a given worker is employed) n(x), compensation of employed workers w(x), and compensation of laid off workers b(x), in each state x, to solve:

$$(12) \quad \begin{aligned} &\max EU = \int \{n(x)U[w(x), 0] + [1-n(x)]U[b(x), 1]\}\, dG(x, r) \\ &\text{st} \int \{f[n(x), x] - n(x)w(x) - [1-n(x)]b(x)\}\, dG(x, r) \geq 0. \end{aligned}$$

In fact, here we will work with the dual problem of maximizing $E\pi$ subject to $EU \geq U_0$, since this is what we will use in the next section.

Let β be the multiplier for EU and $\tau(x)$ the multiplier on the constraint $n(x) \leq 1$. Then, the first order conditions are

$$(13) \quad \beta U_1[w(x), 0] - 1 = 0 \ \forall x$$

$$(14) \quad \beta U_1[b(x), 1] - 1 = 0 \ \forall x$$

$$(15) \quad f_1[n(x), x] - w(x) + b(x) + \beta U[w(x), 0] - \beta U[b(x), 1] = \tau(x) \ \forall x$$

plus the constraints and the condition $\tau(x) = 0$ if $n(x) < 1$. It is easy to show that these imply $w' = b' = 0$, and $n' > 0$ as long as $n(x) < 1$. Fur-

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[2] *Of course, the contract could set hours to be constant; it is efficient to tolerate some risk in h, however, to take advantage of high x realizations by working more hours in those states.*

[3] *It is equivalent to interpret m(x) as hours purchased on a spot labor market at constant wage ω, from workers who are not part of the contract in question.*

thermore, the technique described above can also be used in this model to derive

(16) $\partial EU/\partial r = \lambda \int (f_{11}f_{22} - f_{12}^2) f_{11}^{-1} \theta(x) dx$,

where $\theta(x) \geq 0$ by the definition of risk.

Equation (16), which looks identical to (11), again implies that greater risk reduces EU if and only if $f(\cdot)$ is concave. There is one potentially surprising aspect to this result: Even though the contract exposes workers to nontrivial layoff risk, in the sense that n(x) varies with x, workers' attitude towards risk does not affect $\partial EU/\partial r$; that is, terms involving $U(\cdot)$ do not appear in (16). This is due to the fact that the employment rate n(x) enters the objective function linearly. In the model with indivisible labor, all that matters is En, and workers are essentially risk neutral with respect to the possibility of layoffs. Greater spread in x still affects EU, through its effect on output, but not through its impact on layoff risk.[4]

In all of these models, curvature in the production function is obviously crucial. Is joint concavity in (h, x) a reasonable assumption? Or, does the multiplicative shock, which yields quite different results, make more sense? We do not wish to take a stand on this issue here; our goal is simply to sort out the details of each case.

3. *The Effects on Observable Variables*

In this section, we consider the effects of risk on the observable variables in the contract, employment and compensation. We focus mainly on the indivisible labor model, which delivers cleaner results. Also, we work with the dual problem of maximizing $E\pi$ subject to $EU \geq U_0$, where U_0 can be normalized to 0. This allows us to interpret the results as describing differences in contracts across occupations with different degrees of riskiness when workers are free to choose any occupation they want, ex ante, which implies that all occupations must yield equal expected utility. Finally, for simplicity we assume the constraint $n(x) \leq 1$ for all x is not binding.

Deriving the effects of an increase in risk on the observables involves several steps. The first step is to differentiate (13)–(15) and solve for $\partial n(x)/\partial r$, $\partial w/\partial r$ and $\partial b/\partial r$ in terms of $\partial\beta/\partial r$:

(17) $\partial n(x)/\partial r = -(z/\beta f_{11}) \partial\beta/\partial r$

(18) $\partial w/\partial r = -(1/\beta^2 U_{11}^e) \partial\beta/\partial r$

(19) $\partial b/\partial r = -(1/\beta^2 U_{11}^u) \partial\beta/\partial r$,

where the superscript e or u on the utility function indicates that it is being evaluated at the point (w, 0) or (b, 1), and the variable z is defined by $z = \beta(U^e - U^u)$. Notice that z is positive or negative depending on whether the employed or unemployed are better off ex post.[5]

The next step in the procedure is to differentiate the constraint EU = 0:

(20)
$$\begin{aligned} &(1/\beta)\int[z\partial n/\partial r + n\partial w/\partial r \\ &+ (1-n)\partial b/\partial r] dG(x, r) \\ &+ \int[nU(w, 0) \\ &+ (1-n)U(b, 1)] dG_r(x, r) = 0. \end{aligned}$$

Now insert (17)–(19) into (20) and solve for $\partial\beta/\partial r$ (which requires integrating by parts twice). Finally, insert the solution $\partial\beta/\partial r$ back into (17)–(19) and solve for

(21) $\partial n(x)/\partial r = (\beta z^2/K_1 f_{11}) \int \theta(x) n''(x) dx$

(22) $\partial w/\partial r = (z/K_1 U_{11}^e) \int \theta(x) n''(x) dx$

(23) $\partial b/\partial r = (z/K_1 U_{11}^u) \int \theta(x) n''(x) dx$

where K_1 is a positive constant. Using these results, one can also compute the effects on average employment En, and on the expected »market wage» EW, where $W(x) = f_1[n(x), x]$,

(24) $\partial En/\partial r = K_2 \int \theta(x) n''(x) dx$

[4] *We also considered the indivisible labor model without a risk neutral employer, so that the constraint $E\pi \geq 0$ is replaced by $\pi(x) \geq 0\ \forall x$ (which is the model in Rogerson 1988). The results are messier, but essentially the same; in particular, $f(\cdot)$ concave still implies $\partial EU/\partial r < 0$.*

[5] *Either case can occur, in theory, although if leisure is always a normal good, then $z < 0$; see, e.g., Rogerson and Wright (1988).*

(25) $\partial EW/\partial r = (\beta z^2/K_1)\int\theta(x)n''(x)dx$

where K_2 is another positive constant that need not concern us here.

This rather complicated procedure actually yields some fairly straightforward results. The key observation is that everything in (21)–(25) depends on $\int\theta(x)n''(x)dx$, and since $\theta(x)$ is positive by the definition of risk, everything depends on $n''(x)$. It is easy to show that the curvature of $n(x)$ depends on the curvature of the marginal productivity schedule, $\mu(n, x) \equiv f_1(n, x)$. In particular, it is easy to show that if μ is strictly concave (convex), then $n(x)$ is strictly concave (convex), at least for $n(x) < 1$.

For example, suppose the marginal product schedule μ is concave, which means $\int\theta(x)n''(x)dx$ is negative. In this case, an increase in risk reduces En by (24), even though $n(x)$ increases in every state by (21). This ostensibly paradoxical result — En falls, even though $n(x)$ rises in every state — occurs because the expected value of any concave function decreases with a mean preserving spread. Hence, there is a direct effect of greater spread, which is to lower En given the $n(x)$ schedule, and this necessarily dominates the secondary effect on En, which occurs because the $n(x)$ schedule shifts up. At the same time, the expected market wage, EW, will fall by (25). Finally, (22) and (23) tell us the effects on compensation, w and b, depend exclusively on z; if $z > 0$ then the fall in En makes workers worse off, and compensation must rise to keep EU constant.[6]

These results all depend on the curvature of the marginal product μ and, hence, on third derivatives of the production function. Although it is certainly well-known that third derivatives are crucial in determining the effects of risk (see, e.g., Laffont (1989), Section 2.2), it is not customary to put restrictions on these objects. At least our results conditional on third derivatives are extremely sharp here.[7]

4. An Example

In this section, we consider a simple example with two sectors, one safe and one risky, where workers are free to allocate themselves between the sectors ex ante (although they are immobile ex post). The common production function across all firms is $f(L, x) = x^\alpha L^\beta$, where $L = N \cdot h$ and N denotes the number of workers at that firm while h denotes hours per worker (which are perfectly divisible here). We assume $0 < \alpha$ and $0 < \beta \leq 1$. In the safe sector, $x = 1$ with probability 1, while in the risky sector, $x = 0$ or 2, each with probability 1/2. The common utility function for workers is $U(c, 1-h) = \ln(c) + \ln(1-h)$. The level of utility workers receive, U_0, will be determined below, but firms take it as given when they choose the size of their labor force, N, and the contract, $[c(x), h(x)]$.

In the safe sector, firms choose the number of workers N and a deterministic contract (c, h) to maximize $\pi = (Nh)^\beta - Nc$ subject to $U = \ln(c) + \ln(1-h) = U_0$ or, equivalently, subject to $c = \mu/(1-h)$ where $\mu = \exp(U_0)$. The solution is $c = 2\mu$, $h = 1/2$, and the labor force

$$N = [2^{1+\beta}\mu/\beta]^\rho,$$

where $\rho = -1/(1-\beta)$. In the risky sector, firms maximize $E\pi = .5[2^\alpha N^\beta h^\beta - Nc]$ subject to $U = \ln(c) + .5\ln(1-h) = U_0$, where we have written $h(0) = 0$ and $h(2) = h$, and we have also used the fact that consumption will be state independent. The solution is $c = \mu\sqrt{3}$, $h = 2/3$, and

$$N = [\sqrt{3}\ 2^{(1-\alpha-\beta)}3^\beta\mu/\beta]^\rho.$$

Given $\rho < 0$, the demand for workers by a given firm in either sector is a decreasing function of μ, $N = N(\mu)$, and satisfies $N(0) = \infty$

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[6] *The results when the marginal product schedule μ is convex are exactly the opposite, at least assuming $n(x) < 1\ \forall x$. For the case of $f(n, x) = x \cdot F(n)$, which is neither concave nor convex, one can still show that $F'(n)$ concave implies $n(x)$ concave, and discussion in the text still holds exactly as stated.*

[7] *In the divisible hours model, things are not so simple. However, for the special case of $U = u(c + 1 - h)$ one can show that if the marginal product schedule μ is concave (convex) then $h(x)$ and $c(x)$ are concave (convex), which implies Eh and Ec fall (rise) with r. Further, if either μ is concave or the production function is $x \cdot F(h)$ and F' is concave, then one can show that $\partial Ew/\partial r > 0$, where $w(x) = c(x)/h(x)$ is the contract wage. Hence, we can at least construct reasonable examples in which the expected wage will necessarily be higher in riskier contracts.*

and $N(\infty)=0$. Aggregate demand is simply the sum across all firms in both sectors, and inherits these same properties. If we let $S(\mu)$ denote the proportion of workers in the economy who are willing to enter a contract that provides at least an expected utility of μ, then this $S(\mu)$ will be upward sloping in the (N, μ) plane and will intersect the aggregate demand curve uniquely. At this value of μ, $1-H(\mu)$ workers are voluntarily unemployed (i.e., not attached to any firm), while the rest divide themselves among the safe or risky firms in such a way as to satisfy individual firm demand.

As the above calculations show, this equilibrium has the following properties. First, risky firms have higher hours in the good state and lower hours in the bad state than safe firms, and also lower hours on average. Also, worker compensation c is higher in safe firms, but compensation per employed hour, what we call the contract wage, $w=c/h$, is higher in the risky sector. Hence, at least in this example, we can illustrate Adam Smith's intuition concerning compensating wage differentials: workers in risky firms receive higher compensation per hour. The comparison of profit, employment, and total man-hours across safe and risky firms turns out to depend on parameter values, as shown in Figure 1. Notice that $\alpha+\beta<1$, which implies $f(\cdot)$ is concave, guarantees safe sector firms have greater average profit, and also that they have a greater value of EL even though they may have greater or fewer workers under contract.

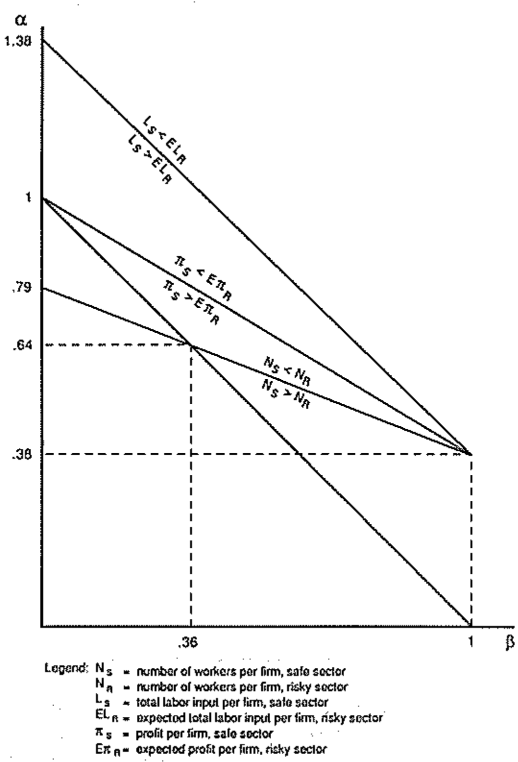

Figure 1. Employment, Man-Hours, and Profit for Safe and Risky Firms.

Finally, we consider introducing unemployment insurance (UI). Suppose the government provides a UI benefit $b=Rc(2)$ to workers in risky firms whenever $x=0$, where $c(2)$ is their compensation when $x=2$ and R is the *replacement ratio*. It is easy to show that an efficient contract will still imply $c(0)=c(2)=c$, and that the presence of UI does not change c or h. However, N now becomes

$$N=[\sqrt{3}\ 2^{(1-\alpha-\beta)}3^{\beta}\mu(2-R)/\beta]^{\rho}.$$

Thus, firm size is increasing in the replacement ratio, and the presence of UI shifts the demand curve for each risky firm. This increases the equilibrium value of μ and therefore leads to more employment in the risky sector, less employment in the safe sector, and more employment in total. Interestingly enough, an increase in UI raises total employment.

5. Conclusion

The empirical evidence on Adam Smith's view that risk should require a compensating differential in terms of higher wages has been rather mixed (see, e.g., Abowd and Ashenfelter (1981), Topel (1984), and Gaston (1991)). Some authors have interpreted this in terms of the availability of unemployment insurance, or the heterogeneity and self-selection of workers. Even without these complications, we have shown that with arbitrary functional forms, economic theory does not pin down the effects of risk on either expected utility or observable variables. Nevertheless, we have been able to characterize the dependence of these effects on functional forms in some detail. Thinking back to our introduction, even in very simple models of the labor market the effects of risk are evidently more complicated than Smith, Senior and others may have imagined; but they are not intractable.

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