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Abstract

This paper elaborates equilibrium properties of contract labor markets when cost barriers limit labor mobility in response to demand and productivity shifts. Unemployment is sustained because the marginal value of labor is not equated across all firms; however the equilibrium contract optimally allocates a worker's time between market and nonmarket uses, given transactions cost-mobility constraints. Contracts provide full unemployment insurance for risks that are diversifiable by pooling among firms. Nondiversifiable (macro) risks are only partially shifted, largely through self-insurance (contingency saving). Increasing diversifiable risk has social value, similar to the value of an option. Increasing nondiversifiable risk has negative value because it reduces lifetime consumption. The main empirical implication of contract theory is shown to be closely related to the permanent income hypothesis and establishes linkages between labor activities and consumption behavior. It is a theory of consumption rigidity rather than wage rigidity. Another empirical implication is that unemployment incidence is proportional to comparative advantage in nonmarket production. Layoffs are ordered by workers' relative productivity in nonmarket compared with market sectors. The theory is used to analyze some features of the U.S. employment system. Its empirical support is briefly reviewed.

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UNEMPLOYMENT AND INSURANCE

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I. INTRODUCTION

This paper analyzes equilibrium in labor markets characterized by stochastic environments and transactions cost barriers to labor mobility, both of which lend social value to enduring employment relationships. Instantaneous wage competition plays little economic role in allocating workers to firms in these circumstances. Instead firms compete for workers through long term attachments and implicit contractural commitments which specify a worker's employment status and consumption in each state of the world.[1] Patterns of wage payments serve a redistributive role of transferring workers' consumption claims across states, a function not at all performed by wages in a standard market. The competitive contract sustains unemployment because differences in marginal products of labor across firms persists in equilibrium. The contract provides complete consumption insurance when risks are diversifiable over the economy at large. Full unemployment compensation is efficient and level consumption is guaranteed in all states of nature, because risks can be shifted and redistributed at no social cost. Nondiversifiable macro risk must be self-insured, since these risks are not so easily shifted. Self insurance necessarily is incomplete because it must be accomplished through contingency savings, which require the equivalent of inventory holdings that reduce average per capita consumption.

The practical interest of models of this type is related to their value in explaining employment fluctuations and certain types of unemployment. Its possible relevance is strengthened by recent empirical findings that most adult workers in the U.S. economy (and elsewhere) have long-term attachments with their employers, and that a large fraction of layoffs are temporary, with workers ultimately returning to employment in their primary firms.[2] My goal is to spell out the complete implications of a simple form of the theory, to delimit its range of applicability, and to better inform empirical work on this topic. This development points to integrating consumption behavior with employment and unemployment activity as an important focus of future empirical research. I show that the theory of implicit contracts is intimately related to the permanent income theory of consumption. The theory also has some novel implications about the incidence of unemployment. It has less implications about wage rigidity than in commonly believed.

The basic framework of analysis considers an economy in which a single consumption good is produced in either of two sectors. One is home production, where a worker acts independent of all others. The other is a market sector where the worker is employed as one member among many of a competitive firm which produces and sells in the market. A firm is viewed as a collective and voluntary association, a type of club or mutual assurance society that acts in the best interests of its members.[3] Each firm is characterized by a production function and an organizational (set-up) cost which is shared among its members. The value of production in the firm is stochastic, while the value of home production is deterministic.

The model makes no distinction between work and leisure. A person works in either the market sector or at home. Home production may be given the interpretation as the value of leisure, if the reader prefers, though it is assumed that whatever is done in the nonmarket sector is perfectly substitutable with the market good. This simplification has certain expository virtues: it allows me to concentrate on alternative production possibilities of a single good rather than analyzing complex joint production-consumption allocations among goods. Furthermore, it implies that work in the home or market sector is an all-or-nothing affair. It thus allows firms' employment policies to take the form of layoffs. Indivisibilities and set-up costs in either production or labor supply are required to generate layoffs in the standard economic model and are difficult to handle. The one-good assumption, while unrealistic, therefore has some realistic implications that are more than justified on the basis of analytical tractability.

The paper is organized as follows. Section II derives the contract market equilibrium, assuming homogeneous workers and fully diversifiable risk among the firms. The latter implies that aggregate output is essentially deterministic. Risk averse workers gain from divorcing consumption from the day to day fortunes of their particular firms, and a social arrangement can be found to exploit these gains. It takes the form of an insurance or mutual fund in which firms in effect pool their stochastic outputs into an aggregate deterministic sum and withdraw equal shares. This simple point is the bare essence of the theory of implicit contracts. Insured consumption implies a form of real wage rigidity and the simultaneous existence of layoffs, which are among the basic data to be explained. Comparative statics of the basic model are worked out in section III which derives a surprising implication that the value of firm specific risk is positive. Section IV examines the incidence of unemployment and layoff policies among heterogeneous workers. The optimum layoff policy is shown to be ordered on workers' comparative advantage in the home compared to the market sector. However, contracts may be subject to the problem of adverse selection. Section V extends the model to include common, non-diversifiable or macro risk. Since these risks cannot be pooled, self insurance rather than market insurance is shown to be the optimal response. Section VI uses the model to analyze some features of official unemployment compensation schemes. The argument is summarized in the context of existing empirical work in section VII. The reader may wish to start with that section to get the general flavor of the results before getting into the details.

II. THE OPTIMALITY OF UNEMPLOYMENT INSURANCE

This section illustrates the basic ideas and results in the simplest possible way. Market equilibrium is analyzed assuming that all workers are identical in both preferences and production opportunities and that there is no macro uncertainty. Envision a competitive market with a large number of firms in which the value of production in each firm is subject to random shocks. The shock, which itself gives rise to the possibility of gains from contracts, can be thought of as an independent draw with replacement from an identically distributed urn. There are so many firms that an unlucky draw by one is sure to be counterbalanced by a lucky one by another.

In effect the entire distribution is realized among all firms together, so the average shock is zero for all practical purposes. This is the most favorable case for analyzing an insurance arrangement because all risk is completely diversifiable under these circumstances.

The structure of production, preferences and contracts is discussed in section II.A. Competitive equilibrium in the labor market is derived in section II.B. Complete insurance is shown to be the optimal and competitive market solution to the contracting problem. Some properties of the solution are discussed in section II.C, and modifications required for the introduction of a temporary labor market as well as a contract market are set forth in section II.D.

A. Construction of the Model

1. Technology. A worker employed in the nonmarket (home) sector produces k units of the consumption good. This output is not traded and is self-consumed as it is produced. All workers have identical skills.

The technology of each firm in the market sector is described by a production function $x = sf(m)$, where x is output, m is labor services employed during the period, and s is a nonnegative independent and identically distributed random variable affecting total factor productivity. $f(m)$ is strictly concave: $f'(m) > 0$ and $f''(m) < 0$. In addition, each firm pays an (amortized) set up cost of b, shared among all members. The good x is traded in the market. Establishing a collective market organization obligates its members to take a drawing out of the distribution of s in each period. Total factor productivity s is distributed as $G(s)$ for each and every firm. $G(s)$ is the fraction of firms who realize total factor productivity no larger than s, and is known to all agents. Furthermore, to keep the analysis as straightforward as possible, there is no private information. All members of the firm, and indeed all members of the economy, have costless knowledge of the value of s drawn by any particular firm, should they choose to learn it.

2. Contracts. Upon gaining membership in a firm, a worker is entitled to a wage payment of w(s) if s is drawn and the firm's employment policy requires the person to work at the firm. On the other hand, the firm may make a payment of $\bar{w}(s)$ if s is drawn and the worker is laid off and sent home to work in the nonmarket sector. The payment $\bar{w}(s)$ is temporary severance or layoff pay. It is a form of unemployment compensation. Notice that payments are conditioned on s, which is feasible because of costless state verification and public information: everybody observes s at each firm.

The firm has access to a competitive insurance market, possibly the government, which enables it to buy insurance at actuarially fair rates. Hence it need not meet contractual obligations w(s) and $\bar{w}(s)$ out of current sales. In good states wage payments are less than sales because some receipts are paid as insurance premiums. In poor states it collects an indemnity: total payout to members exceeds sales. Total receipts of the insurance company always equal total payout, and all of its obligations are fulfilled with certainty. This is feasible by virtue of no macro uncertainty and costless state verification. Alternatively and equivalently, the insurance arrangement could be rationalized as a mutual fund in which every firm owns a share of the market portfolio of other firms. In each period the entire output is claimed by the mutual, with remittances back to each firm sufficient to meet its contractual obligations.

Labor services employed by the firm are also contingent upon the state: $m(s) = \rho(s)n$, where n is the firm's labor force (membership) and $\rho(s)$ is the fraction of the membership who are employed. $1 - \rho(s)$ is the unemployment rate of the firm in state s. It is also the layoff rate in state s. In distinction to an auction market equilibrium, transport costs require workers to confront lotteries when contemplating market activity. The state of nature cannot be known in advance, and instantaneous arbitrage is too costly. Should a low state be drawn, it may be preferable for a fraction $1 - \rho$ of workers to engage in nonmarket production rather than market production. It may be prefereable for all members of the firm to engage in market production when a high state is drawn. Consequently $0 \leq \rho(s) \leq 1$.

3. Preferences. All workers are risk averse and have identical strictly concave preferences in consumption, $u(c)$, with $u'(c) > 0$ and $u''(c) < 0$. For employed persons $c(s) = w(s)$, and for unemployed persons $c(s) = k + \bar{w}(s)$. Wage payments, unemployment pay, and home production are all identified with consumption. Perfect substitution between market and nonmarket production justifies this equivalance.

B. Competitive Equilibrium.

Labor immobility rules out organized labor market exchanges as viable economic institutions. Equilibrium must be described instead as competition among firms for members; that is to say, by competition for labor market contracts. Competition for workers (members) guarantees that the equilibrium contract maximizes expected utility of a representative person in each firm, subject to the aggregate conservation laws in the overall economy that total output is constant.

Expected utility of a worker is

(2.1) $$EU = \int[\rho(s)u(w(s)) + (1-\rho(s))u(k + \bar{w}(s))]dG.$$

It is convenient to bypass the insurance market in evaluating the firm's constraint. The conservation law for the mutual fund requires that expected production of each firm must cover the organizational set up costs and contractual consumption obligations it has made to its members. Expected profit for each firm must be nil. Thus

(2.2) $$\int[sf(\rho(s)n) - n\rho(s)w(s) - n(1 - \rho(s)\bar{w}(s)]dG = b.$$

The optimal contract defines functions $w(s)$, $\bar{w}(s)$, $\rho(s)$ and a membership n that maximizes (2.1) subject to (2.2): the market solution may be found as a simple optimization problem. Let λ be the Lagrange multiplier associated with constraint (2.2). I shall not carry along explicit multipliers on nonnegativity and other constraints, since these will be clear in context. Since s is observed by everyone, all contract features (other than n) are state dependent, in principle. The optimum policy is found by differentiation, state by state, under the integral sign.

1. Optimal Wage and Unemployment Compensation. Differentiate (2.1) along with constraint (2.2) and associated multiplier λ, with respect to $w(s)$ and $\bar{w}(s)$ to obtain marginal conditions for wages and unemployment pay;

(2.3) $$\partial EU/\partial w(s) = [u'(w(s)) - \lambda n]\rho(s) = 0$$

(2.4) $$\partial EU/\partial \bar{w}(s) = [u'(k + \bar{w}(s)) - \lambda n](1 - \rho(s)) = 0.$$

Recalling that consumption c is identical with income, (2.3) and (2.4) imply $u'(c) = \lambda n$ is independent of s. Therefore, both $w(s)$ and $\bar{w}(s)$ are independent of s. This is a fundamental result. It says that consumption conditional on employment or unemployment status is independent of the (conditional) state s. It is an immediate consequence of risk aversion. Moreover, (2.3) and (2.4) imply an even stronger result: $u'(w) = u'(k + \bar{w})$. This implies $w = k + \bar{w}$ for all s. Workers demand full insurance and no macro uncertainty means that full insurance is feasible.

The key result is that consumption is independent of the state of the world and employment status. Level consumption is shared among all persons in the economy. This clearly bears a resemblence to the permanent income hypothesis. As a corollary, the worker is indifferent to home or market production. Unemployment, in the sense of home production, is voluntary in this model when unemployment insurance is complete.

2. Optimal Employment Policy. State independence of consumption and wages simplifies the objective function to

$$EU = u(k + \bar{w}) + \lambda\{\int[sf(\rho(s)n) - n\bar{w} - \rho(s)nk]dG - b\}. \tag{2.5}$$

Differentiate (2.5) with respect to $\rho(s)$:

$$\partial EU/\partial\rho(s) = n\lambda[sf'(\rho(s)n) - k]. \tag{2.6}$$

The first term in the bracketed expression is the marginal product of labor in state s. The second term is the opportunity cost of labor in home production. The firm uses the real social opportunity cost of labor to calculate its optimal layoff policy, not the actual wage or unemployment compensation. However, account must be taken of the constraint $0 \leq \rho(s) \leq 1$. For a given membership n, (2.6) implies that the internal shadow supply curve of labor services to the firm appears as in figure 1. It is infinitely elastic at the nonmarket opportunity cost k up until $\rho(s) = 1$, at which point it becomes completely inelastic because all members are fully employed, and additional workers are not available due to transactions costs. The dashed lines show two critical values of s, defined by

$$\underline{s}f'(0) = k \qquad (2.7)$$
$$\bar{s}f'(n) = k.$$

It is apparent from figure 1 that the optimum employment policy is dependent upon s and follows the form

$$\rho(s) = 0, \quad \text{for } s \leq \underline{s} \quad \Leftrightarrow \quad sf'(0) < k$$
$$(2.8) \qquad 0 < \rho(s) < 1, \quad \text{for } \underline{s} < s < \bar{s} \quad \Leftrightarrow \quad sf'(\rho(s)n) = k$$
$$\rho(s) = 1, \quad \text{for } s \geq \bar{s} \quad \Leftrightarrow \quad sf'(n) > k.$$

All available workers are employed if the shock is sufficiently large ($s \geq \bar{s}$). All members are laid off and the firm temporarily shuts down if the shock is sufficiently small ($s \leq \underline{s}$). In between some fraction of the membership is employed, and the other fraction is unemployed. The firm's unemployment rate $(1 - \rho(s))$ is decreasing in s.

3. Optimum Membership in the Firm. The result in (2.8) allows the integral in (2.5) to be broken up and written as

$$(2.9) \qquad EU = u(\bar{w} + k) + \lambda\{\int_{\underline{s}}^{\bar{s}}[sf(\rho n) - \rho nk]dG + \int_{\bar{s}}^{\infty}[sf(n) - nk]dG - n\bar{w} - b\}$$

where the dependence of ρ on s has been suppressed to economize on notation. Differentiating (2.9) with respect to n and continually exploiting marginal conditions (2.8) yields

$$(2.10) \qquad \partial EU/\partial n = \lambda\{\int_{\bar{s}}^{\infty}[sf'(n) - k]dG - \bar{w}\} = 0$$

$$(2.11) \qquad \partial^2 EU/\partial n^2 = f''(n) \int_{\bar{s}}^{\infty} sdG < 0.$$

Negativity of (2.11) implies that (2.10) defines a local maximum. Assume in all that follows that k is sufficiently small relative to the mean value of sf'(m) that it pays to supply some work to the market sector and not specialize in home production (i.e., that it pays to become a member of a firm).

Using (2.10) and the equilibrium condition $w = k + \bar{w}$, we have

$$(2.12) \qquad \bar{w} = \int_{\bar{s}}^{\infty}[sf'(n) - k]dG$$

$$(2.13) \qquad w = \int_{\bar{s}}^{\infty} sf'(n)dG + \int_{0}^{\bar{s}} kdG .$$

The equilibrium wage paid to employed members equals the expected marginal product of labor in both home and market sectors. The wage is the expected value of the maximum of home productivity and market productivity of a worker. The indemnity paid to the unemployed is the expected surplus value of a unit of market labor at full employment.

Equation (2.12) defines an equilibrium relationship between $\bar{w}$ and n. Substituting (2.12) and (2.13) into (2.2) and simplifying yields

(2.14) $$V(n) \equiv \int_{\underline{s}}^{\bar{s}} [sf(\rho(s)n) - n\rho(s)k]dG + [f(n) - nf'(n)] \int_{\bar{s}}^{\infty} sdG = b$$

where $\rho(s)$ is defined by optimality conditions in (2.8). Differentiating $V(n)$ with respect to n yields $\partial V/\partial n = -nf''(n) \int_{\bar{s}}^{\infty} sdG$, which is positive. Furthermore, $\lim_{n \to 0} V = 0$. Therefore the equality in (2.14) must hold at some positive value of n. Strict concavity of $f(m)$ requires $b > 0$ if the firm is to be of nontrivial size. Nonzero b lends an element of increasing returns to work in the market sector, analogous to u-shaped average cost curves in conventional theory. It pays to form a group to economize on fixed set up costs b and share them with other members. It is easy to show that n is increasing in b: the larger the set up costs the greater the incentive to share them among more coworkers.

C. Competitive Equilibrium Is Pareto Optimal

The assumption of perfect substitution between market and nonmarket production makes it easy to calculate the Pareto optimal distribution of employment and firm membership. Market production per firm in state s is $sf(\rho n)$ and home production per firm is $(1 - \rho)kn$. The number of firms is N/n, where N is the size of the population. Therefore, per capita income in the population is

$$I = \{\int[sf(\rho n) + (1 - \rho)nk]dG - b\}/n \ .$$

Maximizing I with respect to $\rho(s)$ yields conditions identical to (2.6) and (2.8), and maximizing it with respect to n yields a condition identical with (2.14). Therefore competition for contracts achieves Pareto optimality.

Equivalence between competition and social efficiency is in any case clear from the fact that there are no extenalities in this problem as formulated, and the firm uses the correct opportunity cost of labor in calculating $\rho(s)$.

It is important to notice, however, that the contract solution is not efficient relative to a full auction market equilibrium that would occur in the absence of transaction costs. The reason for this is that the contract equilibrium does not equate the marginal product of labor across all uses. To be sure, the marginal product of labor is equated to home productivity within firms for which $0 < \rho(s) < 1$. But firms which have drawn large values of s display marginal productivities in excess of k and also different from each other: marginal product is not necessarily equated between firms. If moving resources around the economy were costless it would pay to shift labor out of home production and away from low demand firms and move it to firms which have high demand. Costs of mobility do not make it worthwhile to arbitrage these differences. Hence the contract solution is Pareto optimal relative to positive transport costs, not to an unattainable equilibrium that would emerge were there no transport costs. This departure from the standard optimality conditions (equal marginal product everywhere) represents a perfect index of unemployment in this economy. It shows that some market imperfection or transactions cost is a necessary condition for unemployment in competitive equilibrium.

It should also be pointed out that the solution shown above differs from most of the literature. Most previous writers have arbitrarily constrained unemployment compensation to be zero. But if market work is inherently more productive than home production, which must be the typical state of affairs, it is optimal for $\bar{w} > 0$. It is also feasible, at least for the iid, diversifiable part of firms' risks. Arbitrarily setting $\bar{w} = 0$ leads to erroneous results and conclusions.

To see the precise difference between the two solutions, solve the constrained maximum problem above with the additional constraint $\bar{w} = 0$. Letting λ' be the multiplier associated with constraint (2.2) the condition for w(s) remains similar to (2.3):

$$\rho(s)[u'(w(s)) - \lambda' n] = 0. \tag{2.16}$$

Equation (2.16) shows that the wage is a constant in all states given that the person is employed. The difficulty is that this wage is not necessarily equal to k. The marginal product of $\rho(s)$ in the $\bar{w} = 0$ constrained problem is, after some simplification

$$\partial EU/\partial\rho(s) = w - \frac{u(w) - u(k)}{u'(w)} - sf'(\rho(s)n). \tag{2.17}$$

Here the term $\phi = (u(w) - u(k))/u'(w)$ is interpreted as a risk premium, the amount of consumption a person would be willing to give up to increase the probability of employment. Approximating ϕ in Taylor's series up to second order yields

$$w - \phi = k - (r/2)(k - w)^2 < k \tag{2.18}$$

where r is the coefficient of absolute risk aversion. The situation is analogous to that depicted in figure 1, except now the firm acts as if the opportunity cost of labor is $w - \phi$ up to the full employment level instead of k. But (2.18) shows that $w - \phi$ is less than the true opportunity cost of labor, k. Therefore a firm that cannot offer unemployment compensation inefficiently overemploys its labor force. All workers as a whole would be better off if market production was a bit smaller and home production was a bit larger. That is, unemployment is not large enough in the no unemployment compensation equilibrium.[4]

In the world in which we live insurance is not complete because it cannot be provided at actuarially fair premiums. The insurance company must ascertain whether an adverse event has occurred, claims must be verified and settled, premiums must be collected, and so forth. In short, the rates charged must cover the costs of providing insurance. It is an elementary proposition that risk averse agents do not buy full insurance when the load factor is positive, nor is it socially optimum for them to do so. In that (realistic) case a contract equilibrium does not provide complete insurance either. Workers bear some residual risk of unemployment. Following the logic above, unemployment is not voluntary -- it is involuntary since workers are better off (in the sense of a larger consumption standard) while employed. The shadow price of labor is somewhat smaller than k, with the difference reflecting the risk premium due to the difference in consumption between employed and unemployed states. Employment is somewhat excessive relative to the case were insurance actuarially fair. Nonetheless, coverage is pushed to the limits of its cost and the tendency toward consumption equalization remains, though it is not quite complete. Since the effects of nonactuarial insurance premiums on the solution are clear enough, I shall largely ignore them in the interest of analytical simplicity, even though they provide more realism in the analysis. Readers can supply these qualifications as desired.

Much has been made in the literature of presumed rigidity in wages implied by the optimal contract. I believe this emphasis is misplaced. The proper implication and prediction is that the optimal contract makes consumption independent of both the state of nature and employment status. This is really a theory of permanent consumption. Thus the inefficiency resulting from constraining $\bar{w}$ to zero is really due to a constraint on the worker's ability to transfer consumption claims from employed to unemployed states. This is the reason that employment is excessive in that case. Excessive employment is an imperfect substitute for insurance and if insurance is feasible and available at cost, it should be complete.

Some may argue that the optimal solution appears artificial, not the constrained one. After all, private unemployment insurance is not widely observed as a main feature of labor market contracts. An easy response is that most data and experience refer to periods when official unemployment compensation has been the rule rather than the exception. But there is a more fundamental answer. The optimal contract determines consumption in each state of the world and there is a sense in which the actual wage is indeterminate. Thus consider a temporal version of the model described above. Then GNP and total employment follow a constant, zero-growth path. The overall unemployment rate is constant too. As the problem has been written, the market for state contingent claims has been short-circuited by allowing the firm to buy insurance on the worker's behalf. It is transparent that having each worker transact in that market is conceptually equivalent. The firm would not make a payment to the unemployed. The wage paid to each employed worker would exceed the worker's consumption, with the difference going to an insurance company as the actuarial premium. The worker would collect the indemnity himself to maintain consumption while unemployed. Barring transactions costs in the insurance market such a scheme is a perfect substitute for the one stated above. The point is that it is consumption that is "downwardly rigid." It is also "upwardly rigid." Once a market for state contingent claims is considered, this kind of model says very little, if anything, about rigidity of wage payments. It of course says nothing whatsoever about nominal wage rigidity since all necessary primitives in this model are in real terms. If consumption rigidity is identified with wage rigidity, it is real wage rigidity that is predicted by a contract, not money illusion.

This discussion should clarify the intimate connection between an intertemporal version of this model (Baily, 1974) and the static version (Azariadis [1975]). Both models are logically equivalent when there is no macro uncertainty, but it is something of a misnomer to characterize the intertemporal version by savings and dissavings behavior. With no uncertainty in the economy at large, total consumption equals total output and aggregate saving is zero. Those workers in firms who have experienced a lucky draw (positive "savings") in effect subsidize those who have experienced an unlucky draw (negative "savings"). They are willing to do so because they are sure to need a subsidy at some time in the future. It is inefficient for aggregate savings to be positive because consumption is reduced below the maximum sustainable level. Thus, if one wants to describe this kind of scheme as contingency saving, the market clears when aggregate saving and the rate of interest are zero. The situation is altered when macro uncertainty is present.

D. Simultaneous Contract and Auction Markets

The model considered above has been structured on the assumption that transaction costs of seeking out alternative job prospects when laid off exceed the returns from search. For completeness, an intermediate case is sketched where transactions costs are positive but not so large as to preclude working on an alternative job when laid off, rather than in the nonmarket sector.

Suppose the round trip transport costs of seeking out another job are $\tau > 0$. I implicitly assumed above that (τ) was infinite. Think of an economy with the same technology and stochastic structure as before, except now the labor market may allow a certain dual structure. Each worker remains a primary member of a firm, but finite τ allows existence of a market for <u>temporary</u> labor. A worker laid off from primary employment may enter the temporary labor market during the period, after which he returns to the primary firm before s is drawn again. Let the market clearing wage in the temporary labor market be $\hat{w}$.

Contract details in the prmary firm remain unchanged, with wage w paid to employed primary members and unemployment insurance payments of $\bar{w}$ to laid off members. The net wage received in the temporary market is $\hat{w} - \tau$. Evidently the condition required for someone to participate in the temporary market rather than in the home sector is $\bar{w} + k \leq \bar{w} + \hat{w} - \tau$, or $\hat{w} \geq k + \tau$. If the inequality is strong there is never any unemployment (home production), so the interesting case is $\hat{w} = k + \tau$. This defines the reservation price and level of the elastic supply curve to the temporary labor market. Consumption is again identical whether the worker is employed at home, in the primary market, or in the temporary market: $w = \bar{w} + k = \bar{w} + \hat{w} - \tau$, assuming actuarial insurance rates.

Let T(s) denote temporary employees hired by the firm in state s. The constraint becomes

$$\int[sf(\rho n + T) - w\rho n - \bar{w}(1 - \rho)n - \hat{w}T]dG = b.$$

Upon substituting the inequalities for w, $\bar{w}$, and $\hat{w}$ above, this reduces to

$$\int[sf(\rho(s)n + T(s)) - kn\rho(s) - (k + \tau)T(s) - \bar{w}n]dG = b. \tag{2.19}$$

Since the worker consumes $\bar{w} + k$ with certainty, the optimum contract determines functions ρ(s), n and T(s) that maximize utility $u(\bar{w} + k)$ subject to (2.19). Differentiation reveals that

$$\partial EU/\partial\rho(s) = n\lambda[sf'(\rho(sn) + T(s)) - k]$$

$$\partial EU/\partial T(s) = \lambda[sf'(\rho(s)n + T(s)) - (k + \tau)].$$

These show that the supply curve of labor to the firm is a step function, illustrated in figure 2. The first step refers to primary employees, for which the appropriate shadow price is k. To this is appended the incremental supply of temporary employees, the second step, at reservation price $k + \tau$. Now there are three critical values of s: $\underline{s}$ and $\bar{s}$ defined above, and $\hat{s}$ defined by $\hat{s}f'(n) = k + \tau$. The optimum employment policy therefore has the following features: when $s < \underline{s}$ the firm temporarily shuts down. For $\underline{s} < s < \bar{s}$ the firm employs permanent members only, $0 < \rho(s) < 1$, and ρ(s) is determined by equality of marginal product with k. For s between $\bar{s}$ and $\hat{s}$, $\rho(s) = 1$ and all permanent members are fully employed. Temporary employment is zero. Finally, for $s > \hat{s}$ all permanent members are fully employed and the firm hires temporary help up to the point where the marginal product of labor equals $k + \tau$.

Given this characterization of employment, the integral in the constraint may be broken into these same intervals of s. Differentiation with respect to n and simplification yields the analogue of (2.12)

$$(2.20) \qquad \bar{w} = \int_{\underline{s}}^{\hat{s}} [sf'(n) - k]dG + \int_{\hat{s}}^{\infty} \tau dG.$$

Figure 2 reveals that $\hat{s}$ is increasing in τ. Therefore (2.20) approaches (2.12) as τ tends to infinity. Derived demand for temporary labor implicit in figure 2 yields a deterministic aggregate across firms, from which it is easily verified that the temporary market actually clears at wage $k + \tau$, and (2.20) holds in market equilibrium.

Comparative statics reveals that

$$\partial\bar{w}/\partial\tau < 0, \quad \partial w/\partial\tau > 0, \quad \text{and} \quad \partial n/\partial\tau > 0.$$

These results are explained by the fact that temporary mobility of labor promotes efficiency (greater national income) and that mobility is lessened by greater transport costs. The market is more efficient when $\tau < \infty$ because the marginal product of labor is equated among a subset of firms with larger values of s. Remaining inefficiency is reduced to that analogous to "gold points" among firms with intermediate drawings of s. The fact that $\bar{w}$ and w fall with τ is directly attributable to lower per capita income and consumption as τ increases. Firm size grows as τ rises because substitution with temporary labor is more expensive. Unemployment rises with τ because the probability of finding alternative temporary employment is reduced: the auction labor supply schedule is shifted upward and the level of activity in that market is reduced.

While it is strictly speaking outside the scope of the model, it is useful to relate this to the timing of shocks s. A longer horizon is appropriate if shocks are of a slower moving, longer frequency variety. Effective τ falls because transport costs are amortized over a longer period. This increases supply to the temporary market and reduces unemployment. If the shocks are of a more temporary character, τ effectively increases and unemployment rises because it is not worthwhile to move. A similar hueristic interpretation can be given in the presence of serially correlated firm disturbances (given no common component). However, the temporary market becomes more and more permanent as the persistence of the firm shock increases, so the interpretation of a firm as a voluntary "club" with permanent attachment loses its appeal and virtue. Persistent shocks are analogous to changes in relative demands and have not been modeled here.[5]

III. COMPARATIVE STATICS

Comparative static propositions are readily found from the reduced system (2.12) and (2.14). To simplify I shall assume that τ is infinite and ignore the temporary labor market. Details, but not the qualitative nature of the results are affected by this assumption. Relevant exogenous parameters are k, b, and properties of the distribution G(s). Each is considered in turn, assuming complete contractual insurance.

A. Changes in Home Productivity (k)

Differentiating (2.12) and (2.14) with respect to k and solving yields

$$\partial n/\partial k = \int_{\underline{s}}^{\bar{s}} \rho(s)dG/[f''(n)\int_{\underline{s}}^{\infty} sdG] > 0 \tag{3.1}$$

(3.2) $$\partial\bar{w}/\partial k = -\int_{\underline{s}}^{\bar{s}}\rho(s)dG - \int_{\bar{s}}^{\infty}dG < 0.$$

Furthermore, since (3.2) is nothing more than the negative of the expected employment rate, it follows that $0 > \partial\bar{w}/\partial k > -1$. Using the equality of consumption across states, $w = \bar{w} + k$,

(3.3) $$\partial w/\partial k = \int_{0}^{\underline{s}}dG + \int_{\underline{s}}^{\bar{s}}(1 - \rho(s))dG > 0$$

and it follows that $0 < \partial w/\partial k < 1$.

Firm size increases as home productivity k rises, from (3.1). The supply schedule of labor to the firm in figure 1 shifts upward and the inelastic section binds at a larger value of n. The fraction of the firm's labor force employed for any realization of s never increases and actually falls for all values of s between $\underline{s}$ and $\bar{s}$ (which themselves increase): the equilibrium unemployment rate increases. The unemployment compensation payment falls (see (3.2)): market goods are relatively more expensive, so production is smaller on average and smaller unemployment payments are supported. Nonetheless, the wage paid while working rises (see (3.3)). Because n is larger, market production is larger in the more favorable states so these payments can be sustained. Moreover, per capita consumption rises (in all states) because production possibilities in the overall economy have improved: the value of market production has remained unchanged and the value of home production has increased. Therefore expected utility rises. In sum, an increase in home productivity shifts production toward the nonmarket sector thereby increasing the equilibrium unemployment rate. Consumption and utility rise and workers are better off.

B. Organizational Costs (b)

It already has been noted (see (2.14) and discussion) that an increase in b increases firm size. Given the value of k and the distribution of s, figure 1 implies that the equilibrium unemployment rate rises. Workers must be worse off because in a sense production possibilities have become less favorable. Nonmarket production possibilities are unchanged but market production is more expensive. Per capita consumption and utility fall. The comparative statics show that

$$\partial\bar{w}/\partial b = \partial w/\partial b = f''(n)(\partial n/\partial b)\int_{\underline{s}}^{\infty} s\,dG < 0.$$

C. Mean Preserving Spread

Following Rothschild and Stiglitz [1970], parameterize the distribution function as follows:

$$dG(s;\ a) \equiv g(s;\ a) = h(s) + ay(s) \tag{3.4}$$

where $\underline{a}$ is a positive number and y(s) is a mean preserving spread, a step function that spreads weight into the tails of G(s) as $\underline{a}$ increases. If y(s) is a mean preserving spread it must have the following properties, by definition

(3.5)

$$Y(s) \equiv \int_0^s y(v)dv, \quad \text{with } \int_0^{\infty} Y(v) = 0, \text{ and}$$

$$\int_0^s Y(v)dv \geq 0 \qquad \text{for s less than max s.}$$

Substitute (3.4) into (2.12) and (2.14) and differentiate with respect to $\underline{a}$ to obtain

$$(3.6) \qquad n(\partial\bar{w}/\partial a) = \int_0^\infty [sf(\rho n) - \rho nk]y(s)ds.$$

Integration by parts reveals the sign of this expression (see Diamond and Rothschild (1978)). To prepare for the integration, define

$$(3.7) \qquad Q(s) \equiv sf(\rho(s)n) - \rho(s)nk.$$

Then

$$dQ/ds = Q'(s) = f(\rho n) + (sf'(\rho) - k)n(\partial\rho/\partial s).$$

Marginal conditions (2.8) and figure 1 show that $Q'(s) = 0$ on $(0, \underline{s}]$; $Q'(s) = f(\rho n)$ on $(\underline{s}, \bar{s})$; and $Q'(s) = f(n)$ for $s \geq \bar{s}$. Therefore, $Q'(s) \geq 0$ for all s. In addition, $Q''(s) = nf'(\rho n)(\partial\rho/\partial s)$ on $(\underline{s}, \bar{s})$ and $Q''(s)$ equals zero otherwise. Therefore $Q''(s) \geq 0$ for all s as well. Using (3.7) and (3.5), integrating (3.6) by parts twice yields

$$(3.8) \qquad n(\partial\bar{w}/\partial a) = -\int_0^\infty Q'(s)Y(s)ds = \int_0^\infty Q''(s)\left[\int_0^s Y(dv)\right]ds \geq 0.$$

Since Q'' is nonnegative and the term in brackets is positive by definition, $\bar{w}$ increases with the spread of the distribution G(s). w also increases with spread because $w = \bar{w} + k$.[6]

Increasing risk raises per capita consumption and makes people better off. The surprising conclusion that risk has positive rather than negative value is related to the theory of option pricing. The opportunity to work in the nonmarket sector with known values allows truncation of the lower tail of the market productivity distribution. Increasing risk puts more weight in the tails and allows greater selectivity toward the more favorable states of market productivity.

A similar development to the one above leads to the following expression for the effects of risk on firm size:

$$(3.9) \qquad \partial n/\partial a = \frac{\int_{0}^{\bar{s}}\{f'(\rho n)(\partial\rho/\partial s)[\int_{0}^{s}Y(v)dv] - f'(n)Y(s)\}ds}{nf''(n)\int_{\underline{s}}^{\infty}sdG} .$$

The denominator is negative, but the numerator cannot be signed since both terms in the integral are nonnegative. The effect on n depends on the particular form of y(s). Therefore increasing risk may either increase or decrease equilibrium unemployment.

These results assist in analyzing equalizing differences in unemployment risk. They indicate that the problem is more complex than appears on the surface. Consider two industries, both subject to stochastic shocks, one with larger variance in its disturbance than the other. So long as the shocks are independent and diversifiable, the optimum contract specifies complete consumption insurance in both industries. If workers are found in both of them then expected utility must be equalized and mean values of production must adjust to offset greater expected utility in the high variance sector. Relative output prices change to make this so. The risky industry in this sense is expanded beyond what it would be in the absence of transactions costs and labor market contracts.

That the optimum contract offers complete insurance implies no systematic sorting of workers by tastes to industries. A worker's consumption is independent of location in equilibrium so there is no scope for risk aversion to affect the allocation of workers to market sectors. Whether or not an equalizing difference is observed in wages depends on whether the observed wage is net or gross of the insurance premium necessary to sustain unemployment insurance payments. Equalizing differences are not observed if these payments are made by the firm on their workers' behalf. Even if workers make these payments themselves, failure to sign expression (3.9) does not allow unambiguous predictions on whether the equalizing difference with respect to observed unemployment is positive or negative.

It is important to recognize the limited scope of this result. Effectively we are dealing here with purely transitory, fully diversifiable risks. The statements above are confined to them alone. If insurance is incomplete or if shocks are sufficiently permanent to induce workers to move to other industries or firms, the picture is different. For example, it is no longer true that allocation of workers to sectors is independent of risk aversion. Rather, the least risk averse workers and those with the greatest comparative advantage in the nonmarket sector are assigned to the riskier firms. Still, this analysis indicates that equalizing differences are sensitive to the precise nature of disturbances and to precisely how risks are shifted and shared across the economy at large, a point that seldom makes its way into discussion of this subject.

IV. THE INCIDENCE OF UNEMPLOYMENT

Suppose now that there are two groups in the population, one with home productivity of k_1 and the other with home productivity $k_2 > k_1$. Assume the k-identity of workers is public information. Then one possible labor market equilibrium is complete segregation of types within firms. Firms of type 1 consist of only k_1 members and firms of type 2 contain only k_2 members. The comparative statics proves that workers in type 1 firms exhibit less unemployment and receive lower wages and larger unemployment compensation than workers in type 2 firms.

A. Integration

However, there may be gains from integrating a firm and combining worker types. For example, a type 2 firm might find it advantageous to eliminate some of its members and take on some members of type k_1. This converts the internal supply function of figure 1 to the two-step function illustrated in figure 3. The potential gain is that the k_2 members can better select their market working time toward states where market productivity is especially large: in less advantageous states they can better exploit their comparative advantage in the nonmarket sector and let the k_1's do the work instead. This possibility is related to the option virtues of increasing risk discussed above. It is also related to the economics of peak load pricing. Workers with larger values of k may serve as reserve, stand-by production capacity, to be called upon only when demand is especially large. Notice that gains from integration are present only when transactions costs make a club/contract equilibrium feasible. Integration or segregation among types is irrelevant if mobility is costless and the marginal product of labor is always equated among firms.

When is integration advantageous? The simplest way to answer the question is to assume a segregated equilibrium and ask whether someone can organize an integrated firm and make a profit by paying segregated wages. If so, then complete segregation is not viable. Labor services in such a firm are $m(s) = \rho_1(s)n_1 + \rho_2(s)n_2$, where the subscripts denote types of workers. Segregated wages are determined as above and satisfy

$w_i = \bar{w}_i + k_i$. That development implies that rent from integration is

(4.1) $$E\pi = \int[sf(\rho_1 n_1 + \rho_2 n_2) - \rho_1 n_1 k_1 - \rho_2 n_2 k_2 - \bar{w}_1 n_1 - \bar{w}_2 n_2]dG - b$$

where $\bar{w}_i$ satisfies (2.12). Differentiate (4.1) with respect to $\rho_i(s)$:

(4.2) $$\partial E\pi/\partial\rho_i = [sf'(\rho_1(s)n_1 + \rho_2(s)n_2) - k_i]n_i, \quad i = 1, 2.$$

Equation (4.2) and figure 3 suggest four critical values of s in an integrated firm. The marginal conditions for $\rho_i(s)$ are

(4.3)
$$\begin{array}{lll} s \le s_0 & \rho_1 = \rho_2 = 0, & \Leftrightarrow sf'(0) < k_1 \\ s_0 < s \le s_1 & 0 < \rho_1 \le 1 \text{ and } \rho_2 = 0, & \Leftrightarrow sf'(\rho_1 n_1) = k_1 \\ s_1 < s \le s_2 & \rho_1 = 1 \text{ and } \rho_2 = 0, & \Leftrightarrow k_1 < sf'(n_1) \le k_2 \\ s_2 < s \le s_3 & \rho_1 = 1 \text{ and } 0 < \rho_2 \le 1, & \Leftrightarrow sf'(n_1 + \rho_2 n_2) = k_2 \\ s > s_3 & \rho_1 = \rho_2 = 1, & \Leftrightarrow sf'(n_1 + n_2) > k \end{array}$$

Only when the state is more favorable than s_2 are k_2 workers brought on line and set to work in the market sector. The terms in (4.3) are defined in the obvious way by the equalities implicit in figure 3. Using those intervals and differentiating (4.1) with respect to n_i gives marginal conditions for membership of each type.

(4.4) $$\partial E\pi/\partial n_2 = \int_{s_3}^{\infty}[sf'(n_1 + n_2) - k_2]dG - \bar{w}_2 = 0$$

$$(4.5)\qquad \partial E\pi/\partial n_1 = \int_{s_1}^{s_2}[sf'(n_1) - k_1]dG + \int_{s_2}^{s_3}[sf'(n_1 + \rho_2 n_2) - k_1]dG$$

$$+ \int_{s_3}^{\infty}[sf'(n_1 + n_2) - k_1]dG - \bar{w}_1 = 0.$$

Examine first the possible size of this integrated firm. Let n_2^* be the optimum size of a segregated type 2 firm. Substituting (2.12) into (4.4)

$$(4.6)\qquad \partial E\pi/\partial n_2 = \int_{s_3}^{\infty}[sf'(n) - k_2]dG - \int_{\bar{s}_2}^{\infty}[sf'(n_2^*) - k_2]dG$$

where $n = n_1 + n_2$ is the size of the integrated firm, and $\bar{s}_2$ is the minimum full employment value of s in a segregated firm. (4.6) indicates three possibilities for n. Suppose $n < n_2^*$. Then $s_3 < \bar{s}_2$ and (4.6) is positive, so n should grow. The firm cannot have less than n_2^* members. It cannot have more than n_2^* members either. Otherwise $s_3 > \bar{s}_2$ and (4.6) is negative and the firm should shrink. Therefore $n = n_2^*$ in an integrated firm that pays segregated wages (here $s_3 = \bar{s}_2$ and (4.6) is zero, so the marginal condition is satisfied). Intuitively, the reason for this is that workers of type k_2 are "marginal:" the extensive margin for membership is determined as if the firm contained only k_2 workers. Therefore the question of integration comes down to determining whether or not it pays to replace some k_2's with an equal number of k_1's while keeping total membership constant.

It is easy to verify that $E\pi$ in (4.1) is concave in n_1 and n_2 when (4.3) holds. Therefore we only need inquire about the sign of $\partial E\pi/\partial n_1$

near $n_1 = 0$ to ascertain whether integration is profitable. Comparison of figures 1 and 3 reveals that $s_1 = \underline{s}_1$, and $s_2 = \underline{s}_2$ at $n_1 = 0$ so that

$$(4.7) \qquad \partial E\pi/\partial n_1 = \int_{\underline{s}_1}^{\underline{s}_2} [sf'(0) - k_1]dG + (k_2 - k_1)\int_{\underline{s}_2}^{\infty} dG + (\bar{w}_2 - \bar{w}_1)$$

where the derivative is evaluated at $n = n_2^*$ and $n_1 = 0$. The first term in (4.7) is the net value of market production contributed by an increment of k_1 labor. The second term is the incremental value of nonmarket production achieved by replacing a worker of type k_2 with a worker of type k_1. The third term is the added unemployment compensation expense required for a type 1 worker over a type 2 worker.

Recall the comparative statics result above $\partial\bar{w}/\partial k = -\int_{\underline{s}}^{\infty} \rho(s)dG \equiv -\beta$ where β is the expected employment rate and $\beta < 1$. Therefore, write $(\bar{w}_2 - \bar{w}_1) = -\alpha(k_2 - k_1)$ with $0 < \alpha \leq 1$. Substituting this into (4.7) shows that a sufficient condition for profitability of integrated production is $1 - G(\underline{s}_2) > \alpha$. It always pays to integrate if $G(\underline{s}_2) = 0$ (i.e., a segregated k_2 firm never shuts down). Other cases are much more complicated. Detailed analysis shows that the profitability of integration depends on the precise form of $G(s)$ in the interval $(\underline{s}_1, \underline{s}_2)$. Integration may not pay if $G(s)$ exhibits sufficient weight in that region. Intuitively, the reason is that the segregated k_2 firm engages in so much home production in that case that substituting a k_1 does not release a sufficient amount of a k_2's time to make it worthwhile.

B. Market Equilibrium

The equilibrium configuration of firms is determined by both the profitability of integration (properties of $G(s)$) and the number of workers of each type. There is a taxonomy of cases:

1. Integration not advantageous. Here integration does not increase per capita consumption. Each firm is segregated to own types. k_2 firms are larger, and their members enjoy greater per capita consumption. They pay higher wages to employed members and lower compensation to unemployed members. They also have larger unemployment rates than k_1 firms.

2. Integration, with k_2 members in excess supply. Segregated and integrated firms coexist. The former contain k_2 members only. Wages and consumption of k_2's are determined by those paid in segregated firms. k_1 workers earn rents attributable to the gains from integration. The unemployment rate of k_2's is always larger than that of k_1's. It is also larger in integrated firms than in segregated firms, but k_2 workers are indifferent because their consumption is fully assured and idential in the two types of firms. It can be shown that all firms are the same size, whether integrated or not. This size is n_2^* because k_2's are the marginal workers.

3. Integration, with k_1 members in excess supply. Segregated firms contain k_1 types only. Now k_2 workers capture all rents from integration. While k_1 workers exhibit greater unemployment rates in segregated firms than in integrated ones, their wages, unemployment compensation, and consumption are the same in either case. k_2's still exhibit a larger unemployment rate than do k_1's. It can be shown that the equilibrium size of integrated firms is less than n_2^* (since now k_1's are the marginal types). Segregated firms may be larger or smaller than integrated firms.

4. All firms integrated. This is a knife edge case in which the fraction of types in the economy exactly matches the desired fraction in integrated firms. The rents from integration are shared among both types, but the rent shares are indeterminate.

In all cases the incidence of unemployment is greatest among workers exhibiting comparative advantage in nonmarket production, illustrating the general principle that production should be allocated efficiently. Society gives up less if workers with larger home productivity bear the brunt of unemployment. Furthermore, high nonmarket productivity workers in integrated firms display a type of employment and layoff behavior that is temporally ordered, according to a "first fired, last hired" rule. Integrated firms contain subclasses of reserve employees who come on line only in the best possible states and who are sent home before other workers in bad states. The employment policy is ordered so that lower home productivity employees are only laid off after the pool of reserves has been exhausted. Notice, however, that in distinction to the usual caricature, here type 2 workers receive higher wages and consumption than others. This counter intuitive result is explained by the fact that k_2 workers are more valuable than k_1 workers in the production of total income. Their inherent market skills are the same, by assumption, and they are more skillful and valuable in household production. Hence they are more productive overall.

Another parameterization is possible; for example, distinguish among workers by market skill, but assume identical home productivity. Then labor services may be written as $m(s) = \rho(s)nz$, where z is the parameter describing efficiency of labor in market production. Reworking the results reveals that the employment policy depends on comparing $sf'(m(s))$ with k/z rather than with k. While some details vary, it is the <u>comparative advantage</u> ratio k/z that is relevant for comparative statics. The effects of a change in z are opposite in sign to those of a change in k. Given two types of labor, z_1 and z_2, with $z_1 > z_2$, the same considerations as above apply to possibilities for integration. Given k, low skilled workers have the comparative advantage in home production. They exhibit greater average unemployment than high skilled workers, and serve the "buffer stock" function in integrated firms. They are the first to be fired and the last to be rehired. They also earn less than the more highly skilled workers because they are less skilled. Yet it is comparative advantage k/z that is the key parameter, not absolute advantage.[7] For example, if k and z are positively correlated then it is not so clear which group serves the buffer function, and the employment policy is not ordered on z or k alone.

C. Adverse Selection

Equilibrium contracts require wage and employment discrimination among workers with different values of k. The analysis so far has assumed that each worker's nonmarket productivity is common knowledge. What happens when k is not publically known? Do workers have incentives to reveal their true values and self-select the proper categories? If not, contracts are potentially subject to adverse selection and may not be efficient. Assuming a self-selection equilibrium, it is necessary to ascertain whether members of one group privately gain by masquerading as members of the other. If they do not then the equilibrium described above is in fact the market equilibrium.

The analysis is easy when market equilibrium is completely segregated. Consider the incentives of k_1. Consumption is $w_1 = \bar{w}_1 + k_1$ in all states if the truth is told. Consumption is w_2 in employment states and $\bar{w}_2 + k_1$ in unemployment states if k_1 passes himself off as a k_2. Consumption is larger in the unemployment state (since $w_2 > w_1$) and less in the unemployment state (since $\bar{w}_2 + k_1 < \bar{w}_1 + k_1$) by lying than by telling the truth. Define

$$p_2 = \int_0^{\bar{s}_2} (1 - \rho_2(s))dG$$

as the unemployment probability for a k_2 in the separating equilibrium. k_1 reveals the truth if expected utility of w_1 for certain exceeds expected utility of the gamble $(w_2, w_2 + k_1; (1 - p_2), p_2)$. Since workers are risk averse we need to compute the actuarial value of the gamble to ascertain incentives for truthful revelation of k_1.

The actuarial value of the gamble compared with truth telling is

$$A = p_2(\bar{w}_2 + k_1) + (1 + p_2)w_2 - w_1$$

(4.8)
$$= p_2(\bar{w}_2 + k_1 - w_1) + (1 - p_2)(w_2 - w_1)$$

$$= \bar{w}_2 - \bar{w}_1 + (1 - p_2)(k_2 - k_1)$$

because $w_i = \bar{w}_i + k_i$ in the assumed equilibrium. We know from a result above that $\partial w/\partial k = -(1 - p) < 0$. Furthermore,

$$\partial^2 w/\partial k^2 = \int_{\underline{s}}^{\bar{s}} (\partial\rho/\partial k)dG > 0.$$

Hence the function $\bar{w}(k)$ is convex. Writing again $(\bar{w}_2 - \bar{w}_1) = -\alpha(k_2 - k_1)$ and substituting into (4.8) yields

(4.9)
$$A = (k_2 - k_1)(1 - p_2 - \alpha).$$

Convexity of $\bar{w}(k)$ implies $\alpha > (1 - p_2)$ -- see figure 4. Therefore $A < 0$ and k_1 does not gamble. A parallel argument for k_2 shows comparable incentives for truth telling. Therefore self-selection is indeed the market equilibrium and there is no cheating.

The analysis is significantly more complex when the market equilibrium involves integrated production because of the existence of rents. Rents to one group increase incentives for risk taking and lying on the part of the other group and appear to increase possibilities for adverse selection. A definitive answer remains to be given in these cases. It is clear from the analysis in section IV.A., however, that rents are increasing in $(k_2 - k_1)$ and also in the weight that G(s) places in the interval of realizations of s above $\underline{s}_2$. Hence if there is a problem of adverse selection, it is a more probable outcome the greater the difference in home productivities between groups. It is a less probable outcome the greater the weight of G(s) in the interval $(\underline{s}_1, \underline{s}_2)$. Also, it is less probable the greater the risk aversion among workers.

V. MACRO-UNCERTAINTY

The analysis above has abstracted from aggregate disturbances. Modifications required for aggregate risk that might resemble business cycles are briefly considered in this section.

The simplest way of introducing aggregate risk is through a variance-components specification of the shock s:

$$s_{jt} = \mu_t + \varepsilon_{jt} \tag{5.1}$$

where j refers to firms and t refers to time. Here μ_t is an economy-wide disturbance common to all firms in period t and ε_{jt} is a firm-specific component in period t of the type considered above. (A multiplicative specification leads to no additional conceptual issues.)

The fundamental implication of (5.1) is that market insurance can be guaranteed only up to the firm specific component ε_{jt}. Lucky realizations of μ systematically shift the average worker toward market production and away from home production. Therefore aggregate market consumption available to be redistributed among all workers varies with μ and any attempt to fully insure all uncertainty (in the cross-section sense discussed above) exposes an insurance fund to the risk of bankruptcy. Perfect market insurance is feasible only for the diversifiable ε component of s. Risk averse decision makers must use a form of self-insurance to cope with aggregate risk μ.

It is obvious that self-insurance must take the form of personal savings and dissavings over time. This point is transparent when $\varepsilon \equiv 0$. Then the law of large numbers applies only across time, and not at all across firms. The conceptual framework appropriate for that case is the familiar model of intertemporal allocation of consumption and labor supply under uncertainty. Concavity of preferences leads to the desirability of smoothing consumption relative to income. Workers allocate labor between market and nonmarket activities in proportion to realizations of μ_t. They must hold a stock of capital (e.g., an inventory of goods) in order to achieve a smooth consumption path. Stocks are built up in periods of favorable realizations of μ. Capital is consumed when realizations are unfavorable. Under general conditions regarding holding costs of contingency reserve capital it is well known that complete smoothing of consumption over time is not achieved. That is, it is hardly ever optimal to hold capital at such a large level that the probability of stock-out is zero.

The fact that macro distrubances are not diversifiable across firms but are diversifiable across time is the basis for advantageous self insurance, which must take the form of contingency saving and dissaving behavior.[8] There are real social costs involved here: the larger the variance of aggregate disturbances, the larger the contingency stock required to reduce the variance of consumption risk and the lower the expected per capita consumption. In distinction to the positive value of increasing diversifiable risk analyzed above, increasing aggregate risk definitely reduces expected utility and consumption and has negative value. Nonetheless, the main empirical implication of macro risk is very similar to that of idiosyncratic micro risk. Both imply social arrangements that reduce fluctuations in consumption relative to income. Both imply a form of the permanent income hypothesis. The fact that self-insurance is incomplete (because of inventory holding costs) suggests some residual influence of transitory income on consumption and incomplete smoothing of consumption. This requires a slightly weakened form of the permanent income hypothesis. Similarly, loading charges or other imperfections that constrain complete insurance of diversifiable micro risk also imply some effects of transitories on consumption.

VI. UNEMPLOYMENT COMPENSATION AND UNEMPLOYMENT

A. General Considerations

This section uses the model developed above to analyze certain features of the U.S. unemployment compensation system (some of these features are shared by systems in other countries.) In fact most unemployment insurance observed in the world today is provided by governments, yet the model at our disposal is one where private contracts are optimal and cannot be improved by public intervention. Since private supplements to public programs are not extensive, nor were private schemes widely observed prior to the inception of government programs, it is very unlikely that private insurance was merely displaced and offset by public insurance. Therefore some discussion of the scope and limitations of the present framework of analysis is warranted.

Moral hazard and adverse selection are potential sources of competitive market failure in the provision of insurance. They readily explain why individual specific unemployment policies are not traded, say in the manner in which life insurance policies are written. The insured event -- unemployment -- is substantially under the control and discretion of economic agents. An insurance company would have great difficulty detecting actions that firms and workers undertake to affect the probability distribution of unemployment status and could not vary premiums conformably. Workers would not face the correct social costs of their actions at the margin, leading to the problem of moral hazard. The insurance company would also have difficulty assigning individuals to appropriate risk classes, of separating inherent risks from tastes for leisure and home productivity, leading to the problem of adverse selection.

These considerations explain why unemployment insurance must be written at the level of the firm. The firm is the agent of workers in regard to unemployment and layoff decisions. This is, after all, the key insight of the theory of implicit contracts. Since the firm is the proximate decision maker in these matters, considerable decentralization and internalization of conflicting interests is achieved by making the firm pay for its decisions. The firm has the correct incentives for undertaking action if it pays the full costs at the margin of the risk it imposes on the insurance fund. This will be so if premiums are geared to actuarial experience. This is, in a sense, just a restatement of the model described above. To be sure, incomplete information always implies misclassifications and incomplete internalization in practice. But that is true of all insurance. It is insufficient reason for a complete breakdown of the market mechanism.

Therefore, I believe the rationale for the large role of the State in these schemes must be found in other causes. Chief among them is the inability of an insurance company to withstand large runs on the bank attributable to common nondiversifiable risks associated with business cycles (e.g., the variance component μ in section V). For the same reasons as were previously discussed, the company would have to hold substantial excess reserves to reduce the risk of ruin and bankruptcy to tolerable proportions. It is hard to imagine how private unemployment insurance could have withstood claims payable in the Great Depression, for example: state funds run substantial negative balances in recessions even in very recent experience. The greater the excess reserves, the smaller the insurance value and the closer the arrangement comes to contingency savings rather than to true insurance. Capital market imperfections might then imply a large role for the state, but that is beyond the scope of this article. Yet another cause lies in the fact that employment contracts are often broken in the real world. Some contracts are not permanent. Permanent demand shifts as well as technical changes make it economically worthwhile to move resources to higher valued uses. Possibilities of bankruptcy of firms, which are not trivial concerns in these circumstances, limit the liability a private insurer can expect from those it insures. And, since after a contract is permanently severed the worker becomes his own agent for seeking out new contract opportunities, decentralization and internalization virtues of insurance contracts with firms are seriously diluted.

We should stand on relatively safe ground in using this model to analyze the consequences of unemployment compensation schemes for workers who are subject to long term contracts and who have more or less permanent attachments with their firms. The analysis that follows is best applied to those workers who face threats of temporary layoff and ultimate recall. It has become increasingly apparent that a large fraction of American workers essentially have long term contractual relationships with their firms, perhaps as many as 50 percent of the experienced male adult labor force (Hall [1981]). However, this class of workers accounts for a much smaller fraction of unemployed workers, many of whom have permanently lost their jobs or who are either new entrants or re-entrants into the labor force (Hall (1980)). It is still a plausible conjecture that the two specific features analyzed below carry over to most classes of workers.

B. Unfair Insurance and Income Tax Exemptions

Unemployment insurance in the United States, while difficult to describe because of program variations across the various states that administer it, is based on relatively simple information and accounting rules designed to be self-financing and informed by actuarial practices. Premiums paid by a firm are increasing in the extent of prior claims by its employees. Systems of this sort are said to be "experience-rated." However, thorough-going actuarial balance is not achieved because of built-in implicit taxes and subsidies across risk classes. Firms exhibiting systematically large claims (e.g., the construction industry) are effectively subsidized by mandated ceilings on tax rates. Those with systematically small claims are effectively taxed by mandated minimum payments. The federal government comes into the picture because UI benefits are partially exempt from income taxation. This in itself promotes excessive demand for temporary layoffs by contractural employees. The supply of layoffs is increased in those firms receiving subsidies on their premiums because layoffs impose costs on the system not borne by these firms and also because the subsidy encourages entry into risky industries. It is worth stressing that this kind of critique is addressed at repairing program details and not at the question of unemployment insurance per se. We have already seen that full unemployment insurance is socially optimal and that unemployment is actually too small when insurance is constrained. The tax/subsidization features of the current system promote socially excessive unemployment, which is far different from saying that unemployment insurance itself promotes excessive unemployment.

These factors can be introduced into the present model as follows: let t_1 denote the rate of income taxation on earnings, t_2 the rate of income taxation on unemployment insurance payments and γ the subsidy or tax rate on the actuarial premium paid by a firm.[9] The firm still strives to maximize expected utility subject to a zero expected profit condition. Only additional parameters enter the calculations. Assuming homogeneous workers for simplicity, we have

$$EU = \int[\rho u(w(1 - t_1)) + (1 - \rho)u(\bar{w}(1 - t_2) + k)]dG$$

(6.1)

$$+ \lambda\{\int[sf(\rho n) - w\rho n - \gamma\bar{w}n(1 - \rho)]dG - b\}.$$

Home production k is not subject to tax. Marginal conditions for w and $\bar{w}$ are

(6.2) $$\partial EU/\partial w = \rho[(1 - t_1)u'(w(1 - t_1)) - \lambda n] = 0$$

(6.3) $$\partial EU/\partial\bar{w} = (1 - \rho)[(1 - t_2)u'(\bar{w}(1 - t_2) + k) - \gamma\lambda n] = 0$$

and together imply

(6.4) $$\frac{u'(w(1 - t_1))}{u'(\bar{w}(1 - t_2) + k)} = (1 - t_2)/\gamma(1 - t_1) \equiv q.$$

(6.2) and (6.3) reveal that consumption is leveled within employment or unemployment states. However, (6.4) shows that consumption is inefficient between states unless $q = 1$.

(6.5) $$w(1 - t_1) - [\bar{w}(1 - t_2) + k] \lesseqgtr 0 \quad \text{as } q \gtreqless 1.$$

$\gamma < 1$ represents the actuarial subsidy inherent in the official system while $\gamma > 1$ represents the tax. $t_2 = 0$ for many workers in the present system, so $q > 1$ is more the rule than the exception. Then, (6.5) shows that optimal consumption is larger when the worker is in the nonmarket sector than in the market sector. Workers are better off when unemployed, which flags a potential problem with the system.

It is convenient to provide a benchmark case and focus on the role of income taxation. Setting $\gamma = 1$ (actuarial insurance) we see that $q = 1$ if $t_2 = t_1$. Excessive demand for layoffs on the part of workers is neutralized if unemployment compensation benefits are taxed as ordinary income because consumption is state-independent. Nonetheless, the firm uses the incorrect social opportunity cost of labor. The constraint in (6.1) becomes

$$(6.6)\qquad \int[sf(\rho n) - \rho wn - (1 - \rho)\bar{w}n]dG - b = \int[sf(\rho n) - \rho k/(1 - t_1) - \bar{w}n]dG - b.$$

Comparing (6.6) with (2.5) reveals that the firm uses $k/(1 - t_1)$ as the shadow price for determining ρ. It should use k. Labor is valued in excess of its social opportunity cost and the firm tends to inefficiently underemploy its workforce, promoting inefficient nonmarket production at the expense of more efficient market production. This is akin to the conventional distortion of income taxation on labor leisure choices given that nonmarket production (leisure) cannot be taxed.

In much of the existing system $t_2 = 0$ and $\gamma \neq 1$. Therefore, writing $t_1 = t$, expected utility is:

$$(6.7)\qquad EU = u(\bar{w} + k) + [u(w(1 - t)) - u(\bar{w} + k)]\int\rho(s)dG.$$

The constraint remains the same as in (6.1). Differentiating (6.7) subject to the constraint with respect to ρ yields

$$(6.8)\qquad \partial EU/\partial\rho = \lambda n[\phi\gamma - (w - \bar{w}\gamma) + sf'(\rho n)]$$

where

$$\phi = [u(w(1 - t)) - u(\bar{w} + k)]/(1 - t)u'(w(1 - t))$$

$$= u(w(1 - t)) - u(\bar{w} + k)]/u'(\bar{w} + k).$$

The dependence of consumption upon employment status brings the risk premium ϕ back into the picture. $q > 1$ implies $\phi < 0$, by (6.5): the risk premium is negative because unemployment is the preferred state. The shadow price of labor in the firm (using the construction analogous to figure 1) is $w - \bar{w}\gamma - \phi\gamma$. Approximating (6.4) by first order Taylor series expansion around $w(1 - t)$ reveals that the shadow price of labor used by the firm is approximately

$$(6.9) \qquad (k + [\bar{w} - 2/r](q - 1)/q - \phi/q)/(1 - t)$$

where r is again the coefficient of absolute risk aversion evaluated at $c = w(1 - t)$. The negative risk premium works toward an excessive internal valuation of labor. The entire expression is sure to exceed k if risk aversion is sufficiently large. Consequently income taxes and UI subsidies tend to promote excessive nonmarket production and increased measured unemployment.

We saw in section IV that the incidence of unemployment falls most heavily on workers with comparative advantage in home production in an optimum unemployment insurance system and that UI payments should fall with k. The existing system appears to at least approximate this solution in its benefit formula. Benefits are proportional to a person's prior covered earnings record, up to a ceiling. Most states also impose waiting periods and all have benefit duration restrictions. All these factors work toward reducing the benefit rate for workers with larger home productivity or greater tastes for leisure because such workers are likely to have smaller covered earnings records and a greater incidence of unemployment spells as well as longer durations of spells. While this topic has been studied far less than the effects of income taxation and incomplete experience rating, we might well expect less adverse consequences of departures from optimal tailoring of benefits to individual workers, because errors in official program parameters are more likely to be "undone" in private contracts through offsetting adjustments in other payments.

There has been much empirical work on the effects of UI on measured unemployment.[10] The estimates suggest that imperfect experience rating and income tax distortions may increase unemployment rates by as much as 15 percent. It should be pointed out that programs in other Western economies have less experience rating than in the United States, so this effect is exacerbated. The political economy of why these programs take the form of such imperfect experience rating and income tax subsidies is an open question.

VII. SUMMARY AND CONCLUSIONS: IS CONTRACT THEORY RELEVANT?

The main implications of this paper may be summarized as follows:

A. The Role of Transactions Costs

Existence of transactions costs promote contract equilibria in labor markets because they lend elements of specificity to employment relationships that make enduring commitments worthwhile. It is analytically convenient to view this relationship as voluntary membership in a productive "club" which shares productivity and output risks among members and redistributes them across the larger economy. Insurance of this type can be guaranteed only up to the limits of aggregate nondiversifiable risk in the economy. It is also limited by long term shifts in relative demands because the degree of durability of membership is reduced. The model I have presented identifies transactions costs with a transport sector and restrictions on mobility. However, a long tradition of labor market research has investigated inherent specificity through various forms of firm specific human capital. Long term commitments also provide more appropriate incentives for the creation of specific capital, which has been ignored here. The main empirical claim for applicability of contract theory lies in recent empirical evidence that a large share of employment relationships are very durable and that at least half of all layoffs are temporary.

A contract equilibrium is not fully efficient relative to an "auction market" because the marginal product of labor is not equated in all possible uses. The comparison is irrelevent in any case because auctions are not viable forms of market organization in the presence of transactions costs. Competition for membership and long term contracts are the optimal forms of organization in that case. Interfirm and inter-sector differences in marginal products persist in equilibrium and arbitrage is incomplete because costs of eliminating these differences exceed the benefits of doing so. Thus a full contract labor market supports an equilibrium level of unemployment which is efficient and socially optimal under the circumstances.[11]

B. Unemployment Compensation

Unemployment insurance is complete in the pure theory of contracts. This has been a source of misperception and error in recent writing on the subject. The theory is most relevant for diversifiable risk. Risk averse workers demand full insurance to insulate consumption from firm-specific risk and state-independence of consumption is feasible through risk pooling and actuarially rated insurance arrangements. Equilibrium unemployment is not large enough when insurance is artificially restricted because workers are not allowed to transfer consumption claims across employment states. Nonmarket production is inefficiently suppressed when insurance is incomplete.

Market insurance is less feasible to the extent that aggregate shocks account for a significant fraction of total variance, or if relative demand shocks are long term and permanent. Then contract theory loses its predictive power because self-insurance through contingency reserve capital is the main mechanism for transferring consumption claims across common states, and contracts are broken if shocks persist among firms.

Departures from actuarial principles interact with income tax provisions to promote inefficiency in official unemployment insurance programs. Taxation of benefits reduces excessive demand for temporary layoffs but does not eliminate distortions caused by nontaxation of non-market production. Volumes of evidence suggest that departures from actuarial balance across firms promotes excessive employment instability in the economy and may add a percentage point or two to the natural rate. Less evidence is available on the fact that socially efficient unemployment compensation requires an inverse relationship between benefits and home productivity among persons.

Still, contractual demands for unemployment compensation are only part of the picture. The role of these payments in assisting permanent job changes, moving labor resources to their highest valued uses and smoothing consumption over business cycles has not been integrated into most empirical studies of unemployment insurance systems.[12] Furthermore, persistent and systematic departures from optimal features of these programs throughout the world suggests that some factors have been omitted from our present analysis and understanding of these programs.

C. The Value of Risk

Increasing diversifiable risk is valuable in a contractual labor market. Availability of a productive nonmarket sector allows truncation of the least favorable, and greater selectivity of market time to more favorable states, similar to the value of an option. This conclusion remains valid when home productivity is stochastic, so long as market and nonmarket shocks are not perfectly correlated. It must be tempered to the extent that market and nonmarket goods are imperfect substitutes. It is obvious that the option value of truncation and selectivity is increasing in the elasticity of substitution between market and nonmarket goods. Increasing risk has no value if labor supply is sufficiently inelastic.

On the other hand, increasing nondiversifiable risk has negative value. Increasing macro risk reduces welfare because it requires larger contingency stocks for self insurance and reduces average per capita consumption.

The empirical counterpart of these issues lies in the measurement of equalizing wage differences for employment risk. This problem is a subtle and sophisticated one, since measurement should be sensitive to the sources of risk and to personal characteristics, including home productivity. Estimates are few and far between, but show relatively small risk premia after allowing for official unemployment compensation, suggesting that market insurance may be reasonably complete.[13]

D. Wages and Comsumption

The theory of implicit contracts has few, if any implications about wage rigidity. This seems so widely misunderstood that it bears special emphasis. The theory has plenty to say about consumption rigidity. Indeed, the role of insurance in a contract equilibrium is to level consumption across states of nature. Hence the positive predictions of the theory are closely related to the permanent income hypothesis, and, when risks are fully diversifiable the two are observationally equivalent. This theory cannot lend any support whatsoever to theories of nominal wage rigidity, money illusion or related paraphenalia, since contracts are written in real terms. In those forms of the theory where consumption is identified with real wage and related payments by firms, consumption rigidity carries over to real, not nominal wage rigidity.

Consumption and the allocation of time between market and non-market uses are uniquely determined in the optimal contract, but there is a deeper sense in which wages are not uniquely determined because they play no allocative economic role in the pure theory of contracts. Insurance divorces the allocative role of prices and the distribution of consumption across states. Existence of a contract equilibrium is predicated on transactions costs sufficiently large to maintain unarbitraged productivity differences among firms. Wages therefore don't allocate labor among market activities once durable contracts have been struck. The only other possible role for wages is to allocate a worker's intensive margin of time between market and nonmarket uses. However, the existence of layoffs appears to require indivisibilities and non-convexities in either production or preferences that make marginal changes in hours of a given worker nonoptimal. Instead firms make these adjustments at the extensive margin (layoffs and rehires) on their workers' behalf.[14] This of course does not deny the role of relative changes in wages and consumption opportunities in allocating labor across sectors of the market economy in response to longer run changes in demand and production techniques, but that requires a rather different type of theory.

Returning to the consumption predictions of the model, the permanent income hypothesis needs some adjustments when load factors render insurance incomplete, when there is macro-risk, and also when market and nonmarket production are imperfect substitutes. Imperfect substitution implies <u>positive</u> correlation between leisure and consumption, with allowances for work-related consumption items and good-specific complementarities with leisure in home production functions. Macro-risk and nonactuarial premiums imply periodic departures from complete consumption smoothing because self-insurance through savings necessarily is incomplete.

Empirical investigations of consumption and permanent income are too well known to require extensive commenatary. Recent estimates show extra sensitivity of consumption to transitory income.[15] The theory here suggests systematic differences between workers who are subject to temporary layoff and those who have permanently lost their jobs, but the data are not detailed enough to make these distinctions. Nor has the relationship between transitory income and undiversifiable risk been thoroughly investigated at the individual level. Empirical studies of the consumption behavior of the unemployed show the remarkable power of the permanent income hypothesis and also corroborate excess sensitivity of consumption to transitory income for some workers. These data also do not distinguish between workers who are on temporary or permanent layoff status.

E. The Incidence of Unemployment

A final empirical implication of contract theory is that unemployment incidence is proportional to comparative advantage in non-market relative to market production. Under general conditions it pays firms to integrate employment and production among workers with differential comparative advantage. Those most efficient in household production serve as contingency reserves whose services are employed only in the most favorable states. Whether or not this leads to problems of adverse selection is not resolved at this time.

Surely the bulk of evidence is consistent with the incidence predictions of the model. The ordering of optimum employment policies by comparative advantage is consistent with widely observed layoff practices by seniority in both union and nonunion firms. It helps explain why prime age married males exhibit the lowest unemployment rates in the population by far, why single workers are more likely to be unemployed than married workers, why unemployment rates of females have been traditionally larger than those of males, and why unemployment among youth exceeds that among nonyouth. To the extent that human capital is not neutral between market and nonmarket skills it may also help account for differential incidence of unemployment by market skill, though these issues must be qualified for production substitution possibilities among these groups. It does less well in accounting for black-white differences, thought it is not necessarily inconsistent with them. However, these predictions are similar to those arising from older specific human capital models (labor as a quasi-fixed factor) and it appears difficult to differentiate between them.

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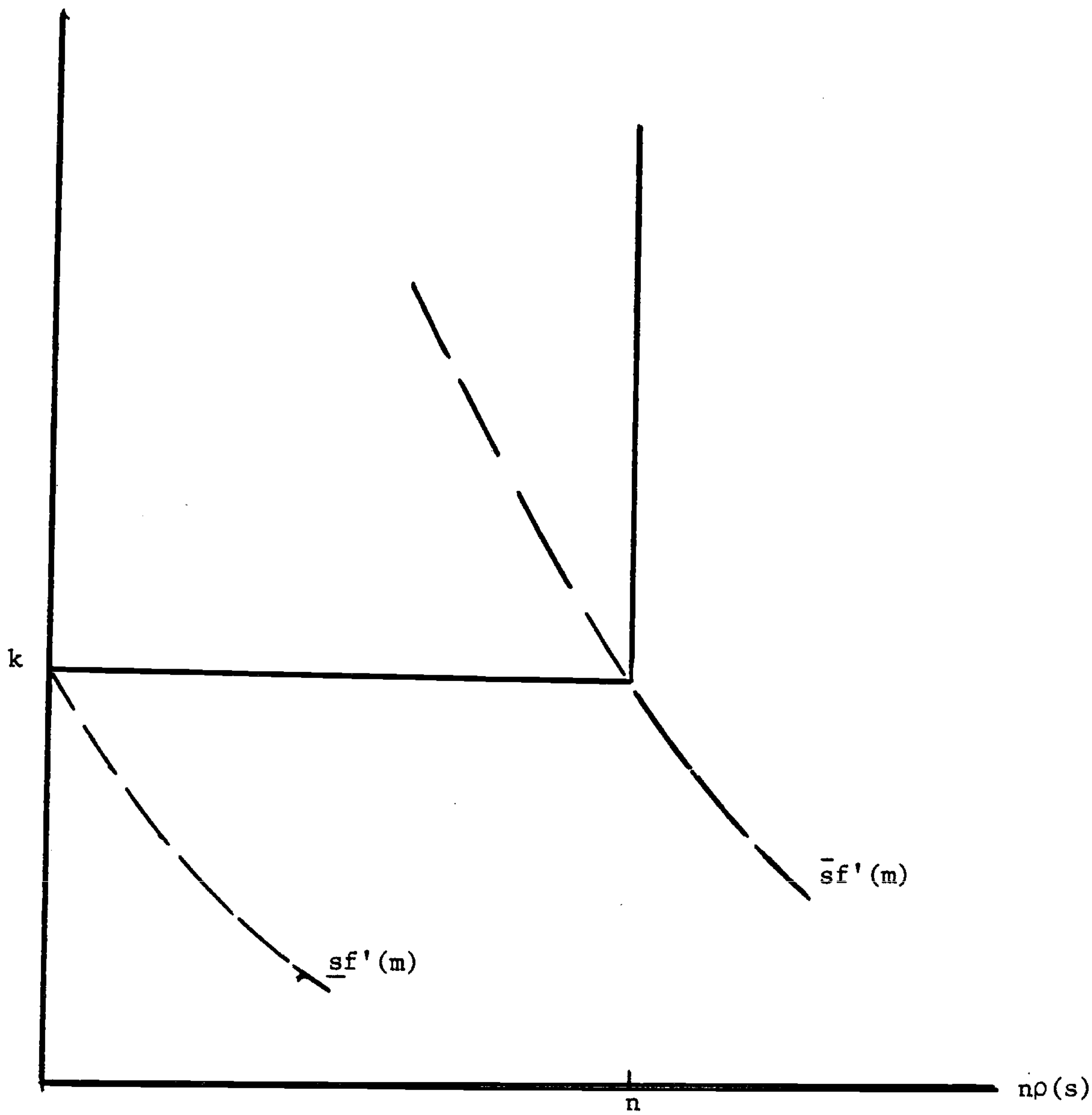

FIGURE 1

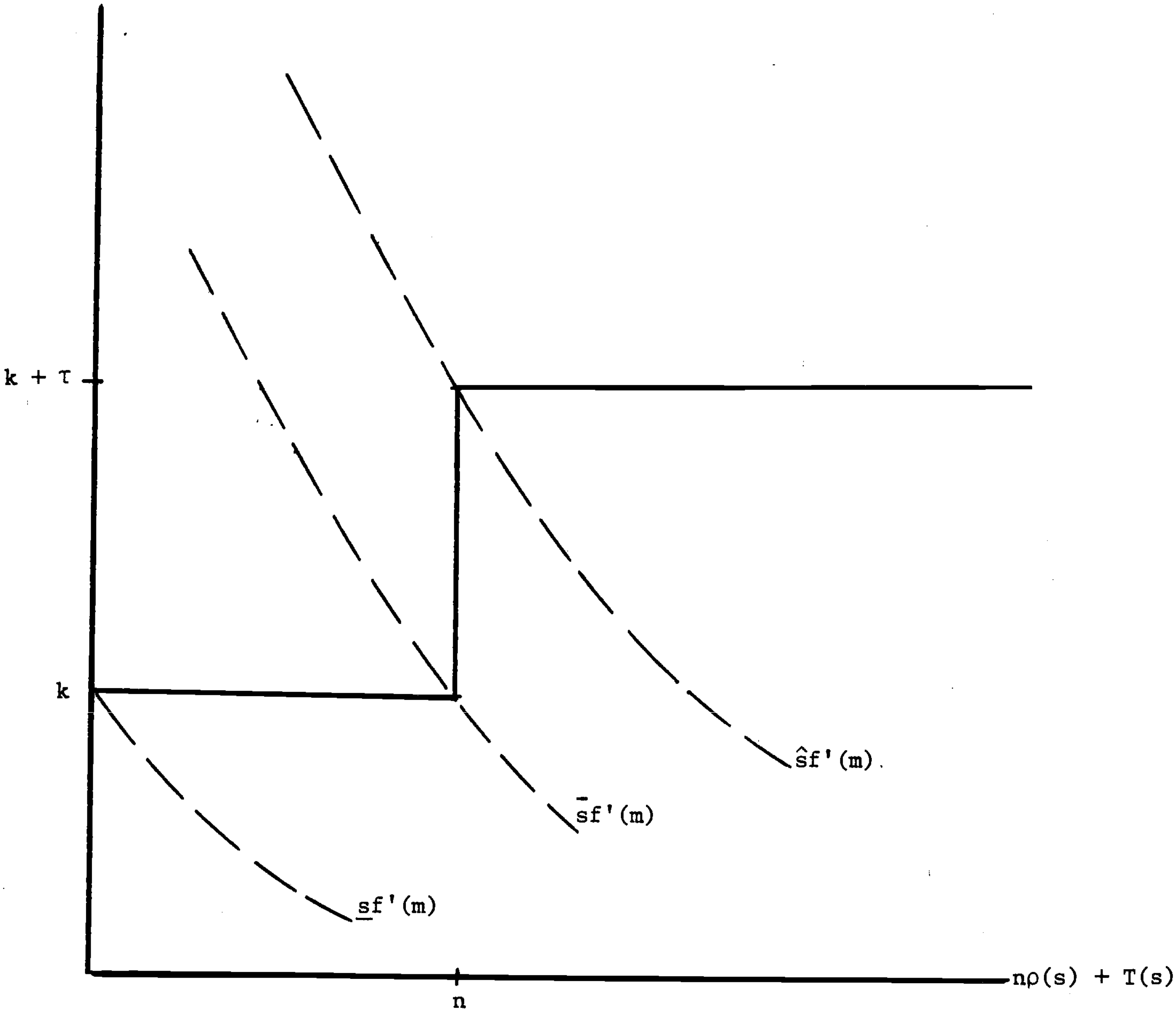

FIGURE 2

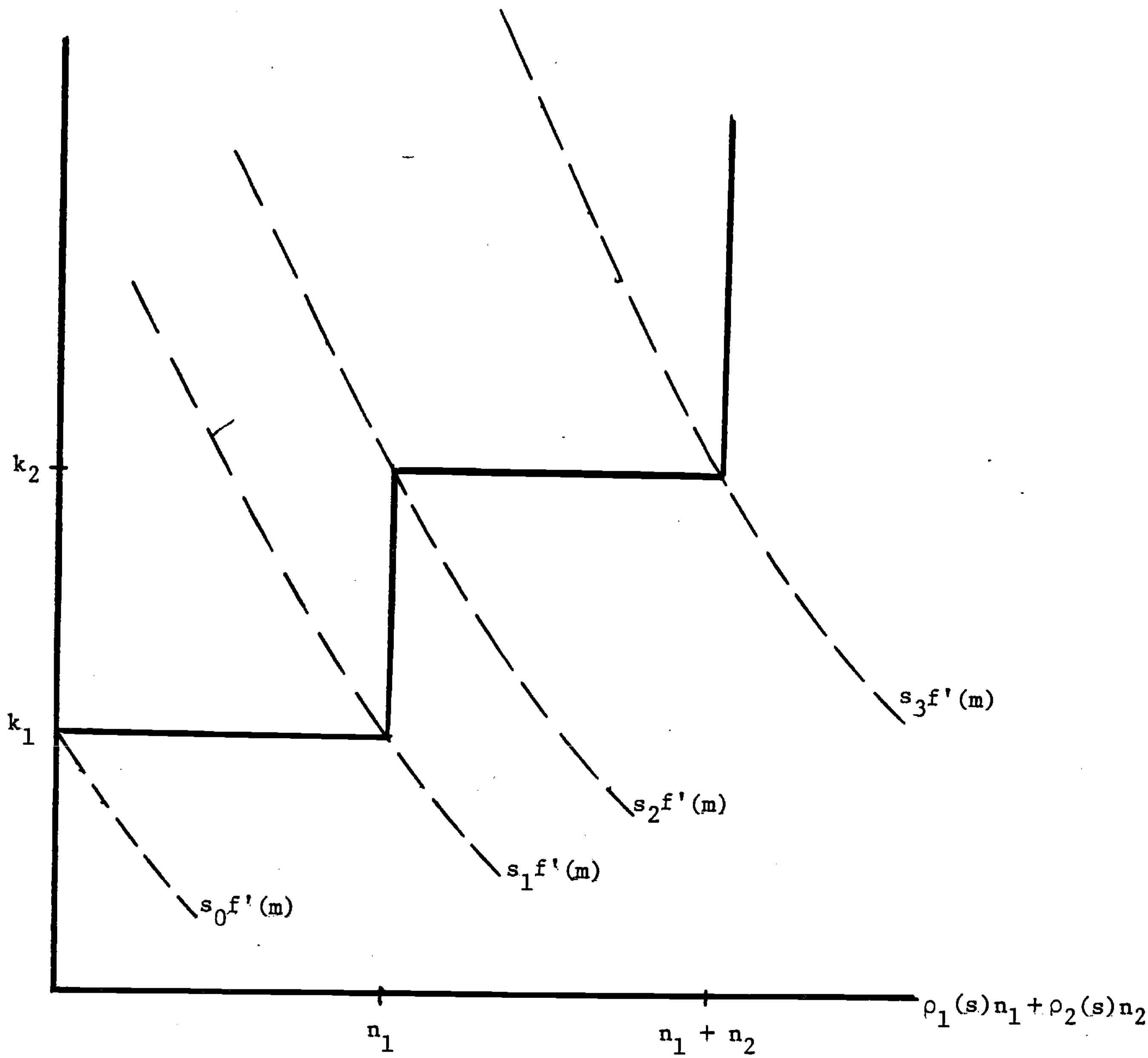

FIGURE 3

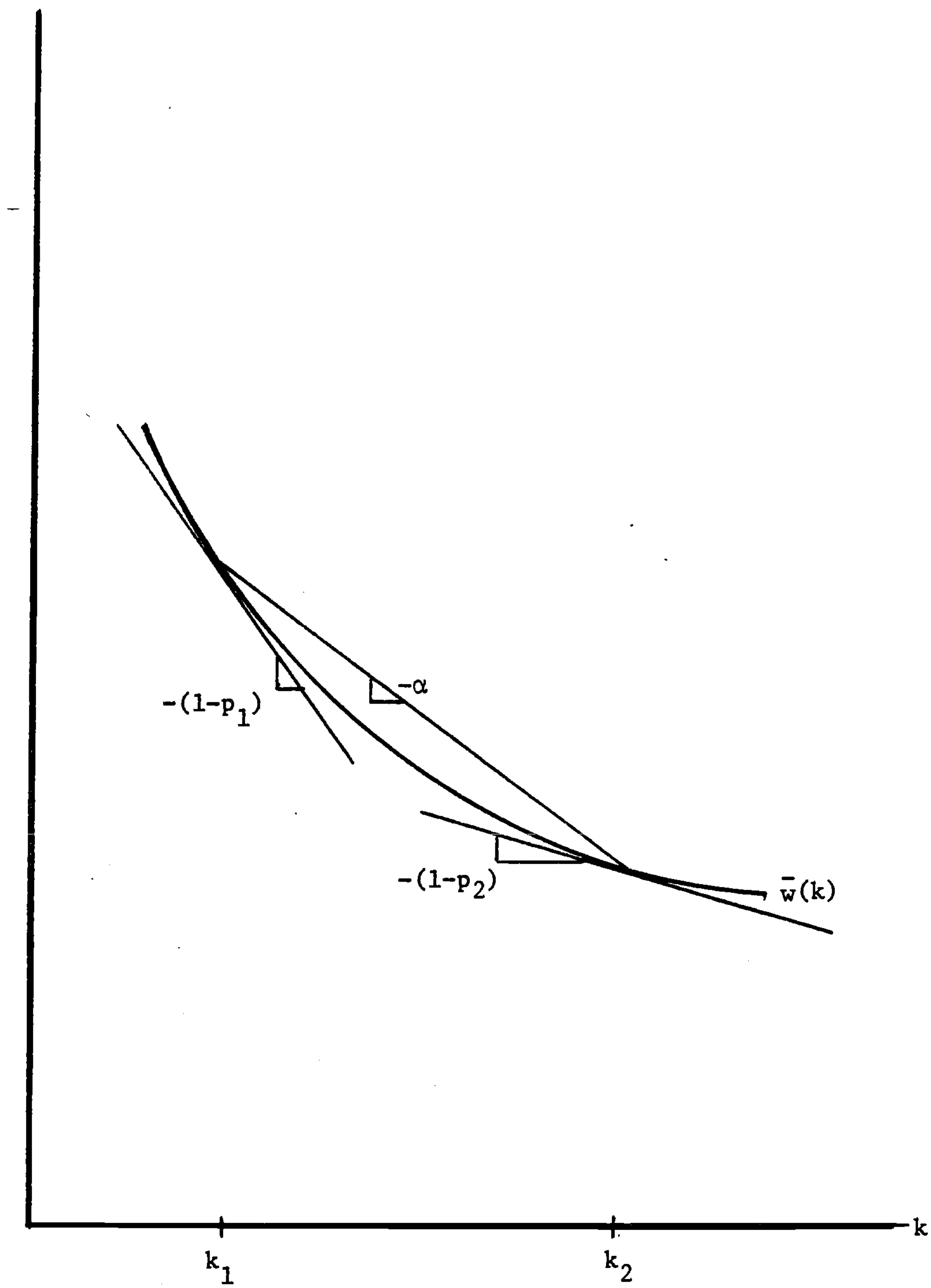

FIGURE 4

FOOTNOTES

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[1] Azariadis (1975, 1981), Baily (1974), and Gordon (1974) are the chief architects of implicit contract theory.

[2] See especially Feldstein (1976), Hall (1982), and Lilien (1980).

[3] Miyazaki and Neary (1983) use a similar construction to analyze some puzzling features of the economics of labor-managed firms. The standard approach to contracts maximizes expected profits subject to an expected utility (supply) constraint. I follow the dual approach here, which lends itself to the "club" interpretation.

[4] The point that the optimum contract provides full insurance and unemployment is voluntary has only recently been recognized. See Chari (1980), Grossman and Hart (1981), Holmstrom (1981), and Ito (1982).

[5] The pure theory of contracts is clearest when disturbances are iid, for it always pays a laid off worker to return to his primary firm if it was optimum for him to join it in the first instance: contracts are never broken. Establishing a contract equilibrium is much more complicated if disturbances are serially correlated or if relative demand shifts are more permanent, for then it is optimal for workers to move, for firms to disband, and for contracts to be broken. A

full treatment of contract equilibrium in this case remains to be achieved. Bonding and permanent severance pay arrangements are necessary for efficiency (e.g., see Hall and Lazear (1982)) but are hardly observed. H. Grossman (1978) considers some of these issues where bonds are infeasible. A more complete treatment is available in Holmstrom (1983). Lucas and Prescott (1974) deal with noncontract equilibrium when shocks are serially correlated. Bronars (1983) formulates a more workable approximate solution when industry disturbances are also covariant.

[6]A more elegant proof is as follows: define $R(s,m) = sf(m) - km$. Then the model is summarized as $\max_n\{E[\max_{m\leq n} R(s,m)] - n\bar{w}\} = b$. This equation determines $m(s)$, $\bar{w}$ and n simultaneously. $\max R(s,m)$ is a convex function of s, so its expectation increases when a mean preserving spread is applied to s, and the term in curly brackets is increased by a mean preserving spread, given n. Allowing n to vary optimally in response increases the left-hand side of the equation even more, given $\bar{w}$. Therefore, $\bar{w}$ must increase to preserve the equality. I am indebted to John Kennan for this proof.

[7]A model based on this skill parameterization is presented by Azariadis (1976), though it is not recognized that comparative advantage is the key parameter. Analysis is very sensitive to the assumption of perfect substitution among skill types. If skilled and unskilled labor are imperfectly substitutable in market production, the optimum policy is not ordered by skill, the result breaks down, and other considerations such as substitution elasticities enter.

[8]Strictly speaking, partial market insurance still may be supported by the Arrow-Borch conditions determining risk sharing among agents with different degrees of risk aversion. Fluctuations in output necessarily make this type of insurance incomplete, and it is ignored in this paper.

[9]The logic of experience rating is a bit more subtle than is generally appreciated by economists. Having a firm's tax rate vary with prior claims is like having auto premiums rise when an accident occurs. If premiums always followed experience there would be no insurance. The maximum tax therefore provides true insurance against large losses. Experience rating is like a deductable, so full experience rating is inappropriate. The difficulty with the system is that the experience rating schedule and maximum tax are the same for all firms, irrespective of their risk class. Mean activity of firms in risky industries puts the bulk of their experience beyond the limits of the schedule, and that is why they are subsidized. A more appropriate scheme would discriminate among risk classes and shift the experience rating schedule according to average experience in the firm's industry. Note also that benefits are taxable as ordinary income for high income workers in the existing system, but that is ignored here.

[10]This work builds on Feldstein (1976). The U.S. literature is surveyed by Topel and Welch (1980) and the British literature by Atkinson (1981). Topel (1983) presents the best evidence on the effects of incomplete experience rating. A useful survey of British literature on the economics of unemployment and its relation to unemployment compensation is provided by Nickell (1982).

[11] Very recent work on contracts relaxes the common information assumptions (Hart (1983)). Incentive compatibility constraints of private, asymmetric information imply second-best type inefficiencies. However, since first order empirical implications of contracts with asymmetric information are very similar to those with common information, I conjecture that it will be very difficult to distinguish between them from any data.

[12] For example, search may be inefficient without public intervention. See Mortensen (1978) and Diamond (1982). Lilien (1982) shows that intersectoral shifts within the market economy account for an increased fraction of observed unemployment in recent years.

[13] The only estimates known to me are Abowd and Ashenfelter (1981), Bronars (1983), and Hutchens (1983).

[14] The precise composition of changes in demand between hours per worker and the number of workers has not received sufficient attention (however, see Rosen (1968)). We have no complete theories on why hours don't bear more of the burden of adjustment. For an extreme example, from 1929 to 1932 hours per week of employed persons in manufacturing fell by 13 percent while employment fell by almost 40 percent and the unemployment rate practically tripled. See Baily (1981). Gordon (1982) shows that hours bear more and employment bears less of the burden of adjustment in Japan than in the United States, but these differences remain to be fully explained.

[15] See Hall and Mishkin (1982) and Hiyashi (1982). Burgess and Kingston (1981) and Hamermesh (1982) are among the few studies that have focused on consumption behavior of the unemployed.