



**OXFORD JOURNALS**  
OXFORD UNIVERSITY PRESS

---

Implicit Contracts and Fixed Price Equilibria

Author(s): Costas Azariadis and Joseph E. Stiglitz

Reviewed work(s):

Source: *The Quarterly Journal of Economics*, Vol. 98, Supplement (1983), pp. 1-22

Published by: [Oxford University Press](#)

Stable URL: <http://www.jstor.org/stable/1885373>

Accessed: 20/06/2012 14:51

---

Your use of the JSTOR archive indicates your acceptance of the Terms & Conditions of Use, available at  
<http://www.jstor.org/page/info/about/policies/terms.jsp>

JSTOR is a not-for-profit service that helps scholars, researchers, and students discover, use, and build upon a wide range of content in a trusted digital archive. We use information technology and tools to increase productivity and facilitate new forms of scholarship. For more information about JSTOR, please contact support@jstor.org.



Oxford University Press is collaborating with JSTOR to digitize, preserve and extend access to *The Quarterly Journal of Economics*.

<http://www.jstor.org>

# THE QUARTERLY JOURNAL OF ECONOMICS

---

Vol. XCVIII

1983

Supplement

---

## IMPLICIT CONTRACTS AND FIXED PRICE EQUILIBRIA\*

COSTAS AZARIADIS AND JOSEPH E. STIGLITZ

This introductory essay offers a brief guided tour of the main developments in the theory of implicit contracts, from its inception to the present. It is not intended as a survey but, rather, as an appraisal of the progress that has been made, the difficulties that remain, and as an outline of the microeconomic and macroeconomic issues that seem to invite additional work.

### I

This issue of the *Journal* brings together several recent contributions on implicit contracts and quantity-constrained equilibria. Almost ten years ago, the theory of implicit contracts signaled a fresh effort by economists to understand the twin empirical regularities of wage stickiness and involuntary unemployment, amid hopes that the microeconomic foundations of Keynesian macroeconomics, especially those of the fixed price method, would be strengthened in the process.

This introductory essay offers a brief guided tour of the main developments in the theory of implicit contracts, from its inception to the present. Our purpose, however, is somewhat different from that of ordinary tourguides: we do not intend to survey the landscape<sup>1</sup> but, rather, to appraise the progress that has been made, to identify some of the difficulties, and to outline the microeconomic and macroeconomic issues that seem to invite additional work.

\* We acknowledge with thanks financial support from the National Science Foundation.

1. The landscape is surveyed in Azariadis [1979], Hart [1982], Ito [1982], and Schwartz [1982].

We begin the tour in Section II with a description of the empirical regularities to be explained, and review in Sections III and IV the major insights of implicit contract theory—from the older, public-information literature, as well as from more recent work on asymmetric information. The newer literature makes heavy use of some concepts common to many self-selection problems; we discuss these concepts in Section V. Section VI covers macroeconomic aspects of implicit contracts—in particular, their relation to the fixed price literature. The concluding section is concerned with a survey of unresolved issues.

## II

Over a typical business cycle, average wages fluctuate less vigorously than does labor's marginal revenue product or, for that matter, the total volume of employment (see Hall [1980]). The Great Depression is a sad illustration: from 1929 to 1933 U.S. employment fell precipitously, while real wages managed to creep upward. At a less aggregative level, it is standard collective bargaining procedure to predetermine money wage rates for two or three years in advance, even though wage rigidity does not promote employment in recessions.<sup>2</sup>

The sluggishness of money wage rates, notably in periods of relatively stable inflation, and the strong contribution of layoffs to cyclical unemployment in North America have long been two of the best-documented stylized facts in economics.<sup>3</sup> Wage and price rigidity are also among the key assumptions of Keynesian macroeconomics, both in the Hicksian IS/LM framework (see Hicks [1937]) and in the very interesting concept of quantity-constrained equilibrium originally developed by Patinkin [1956], Clower [1965], Hansen [1974], Solow-Stiglitz [1968], Younès [1970], and Barro-Grossman [1971], and formalized by European economists in the 1970s.<sup>4</sup>

Keynes's own explanation of wage rigidity [1936, p. 13–15] was a sophisticated form of money illusion; workers resist cuts in money wage rates because they do not know how widespread these cuts will prove to be, each worker fearing a fall in his own wage relative to others. Relative wage arguments suggest that “fairness” in the wage

2. However, as the recent experience in the United States indicates, if too large a level of unemployment is caused by wage rigidity, both sides may agree to renegotiate the terms of the contract. Cousineau and Lacroix [1981] analyze an interesting set of data collected from Canadian collective bargaining agreements.

3. An example is the work of Feldstein [1976].

4. The main developments appear in Bénassy [1975], Drèze [1975], Younès [1975], and Malinvaud [1977].

structure is a factor to be reckoned with in labor supply decisions,<sup>5</sup> but do not develop an operational definition of “fairness.”<sup>6</sup> This is perhaps one reason why the relative wage argument did not gain ground in economics.<sup>7</sup>

Students of human capital<sup>8</sup> have provided another theory of layoffs, namely, that the accumulation of job-specific skills requires the sinking of certain expenses for hiring and training. This is an investment the employer makes in anticipation that the worker will remain attached to his job, and one he amortizes over time by paying a wage rate lower than the trained employee’s marginal contribution to the firm. If the firm should need to reduce employment in periods of slack demand, it will naturally choose to lay off first the least trained members of its labor force, those who represent the smallest undepreciated investment in training.

This story is a satisfactory explanation of the *incidence* of layoffs<sup>9</sup> not of their *existence*; it tells us why layoffs fall on the least skilled workers but leaves open the question why they occur in the first place, which is our concern here. Furthermore, the technical heterogeneity of labor that is crucial for this argument is itself an unnecessary complication in traditional macroeconomic models that are built on the simpler assumptions of homogeneous inputs and zero transaction costs.

### III

The innovation in the early literature on implicit contracts [Baily, 1974; Gordon, 1974; Azariadis, 1975] was to view the employment relation not simply as a sequential spot exchange of labor services for money, but as a more complicated long-term attachment; labor services are traded for an insurance contract that protects workers from random, publicly observed fluctuations in their marginal revenue product. The idea, shown in Figure I, is that workers can purchase insurance only from their employers, not from third parties.

Risk-averse workers deal with risk-neutral entrepreneurs whose firms consist of three departments: a production department that purchases labor services and credits each worker with his marginal

5. This is apparent in Okun’s posthumous book [1981], pp. 93–97.

6. Such a definition was later developed in welfare economics; see Varian [1974], Schmeidler and Yaari [1971].

7. See Akerlof [1980] for a recent attempt at a theory of wage rigidity based on “norms.”

8. The standard reference is Becker [1964]; our argument is due to Oi [1962].

9. For a contractual model of layoff incidence, see Azariadis [1976].

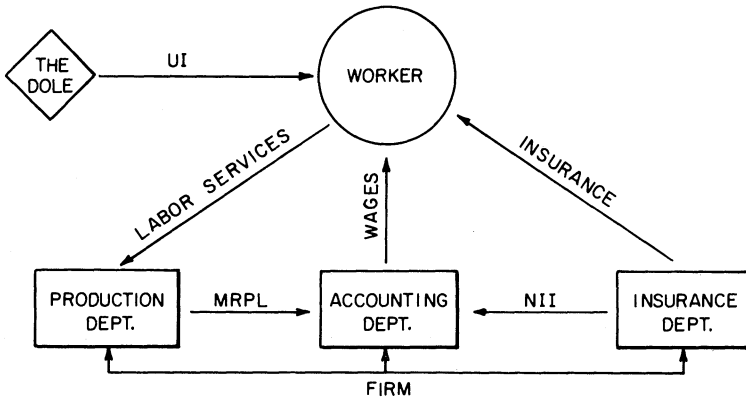


FIGURE I

revenue product ( $MRPL$ ); an insurance department that sells actuarially fair policies, and depending on the state of nature, credits the worker with a net insurance indemnity ( $NII$ ) or debits him with a net insurance premium; and an accounting department that pays each employed worker a wage  $w$  with the property that  $w = MRPL + NII$  in every state of nature.

Favorable states of nature are associated with high values of  $MRPL$ ; in these the net indemnity is negative, and wage falls short of the  $MRPL$ . Adverse states of nature correspond to low values of  $MRPL$ , to positive net insurance indemnities, and to wages in excess of  $MRPL$ . An implicit contract is then a complete description, made before the state of nature becomes known, of the labor services to be rendered unto the firm in each state of nature, and of the corresponding payments to be delivered to the worker. The contract is implementable if we assume the state of nature is directly observed by all sides.

An immediate consequence of this framework is that wages are disengaged from the marginal revenue product of labor. In fact, if we fix institutionally the amount of labor performed by employed workers, then each worker's consumption is proportional to the wage rate; an actuarially fair insurance policy should make this consumption independent of the  $MRPL$  by stabilizing the purchasing power of wages over states of nature. Ergo, the real wage rate is rigid.

In traditional macroeconomic models, of course, wage rigidity by itself is sufficient to cause unemployment: if wages do not adjust for some reason, then neither does the demand for labor. The argu-

ment does not carry over to implicit contracts because of the very separation between wages and the marginal revenue product of labor. A complete theory of unemployment must explain why layoffs are preferred to work sharing in adverse states of nature, and why laid-off workers are worse off than their employed colleagues.

This is not a simple task. Suppose, for instance, that employers are risk-neutral and that workers' preferences over consumption and leisure can be represented by a strictly quasi-concave, additively separable utility function. Then optimum contracts will result in complete work-sharing [Mortensen, 1978]; and if such work-sharing is less profitable than layoffs for technological reasons (e.g., workers produce most efficiently when they put in a full-day's effort), an optimum contract under perfect information will still equate the workers' marginal utility of consumption in states of employment and unemployment. Individuals may thus become *involuntarily employed*: they would rather be laid off than work.

The resolution of this quandary has been the objective of much recent research on the theory of implicit contracts. The papers of this symposium represent a good step forward, but as we shall see later, many questions remain unresolved. To explain unemployment, we need to complicate the analysis in some important way. Some of the complications arise from familiar problems in explicit (as opposed to implicit) insurance contracts, but a few of the problems are peculiar to implicit contracts.

One distortion that was noted early in the implicit contract literature concerns the role of the dole. In very adverse states of nature, the flow of insurance indemnities to workers can become a substantial drain on profit; one way to staunch losses is to place the burden of insurance on an outside party, the dole (see Figure I). The practice of layoffs is simply the administrative counterpart of this insurance-shifting maneuver; workers consent in advance that some of them may be separated from their jobs in order to become eligible for unemployment insurance (UI) payments from an outside public agency. Furthermore, no worker will contract his labor, unless the expected value (utility) of the total package taken over all possible states of nature exceeds the value of being on the dole in every state. This means, in turn, that employed workers receive a wage in excess of UI payments, and are therefore to be envied by their laid-off colleagues—a situation that many economists would call “involuntary unemployment.”

This particular insurance contract between a third party (the government) and the other two parties (workers, firms) is not neces-

sarily efficient. It may, however, be the only feasible way of providing third-party insurance; theoretically it is preferable that the government pay a lump sum indemnity to the firm when its profit is low, or to the worker when his income is low. The government, however, cannot always ascertain with precision the actual income or the opportunity sets of individuals; what it insures, therefore, is not an exogenous event but an endogenous variable that is more readily observable, and that, under reasonable circumstances, is correlated with the exogenous event. This creates an important *moral hazard* problem<sup>10</sup> to which we shall return in Sections IV and V.

Another source of problems for implicit contracts—which applies as well to the insurance literature but has even more force here—is the enforceability of contracts. Implicit contracts are just that—implicit—and one must ask what happens when either side deviates from the contract. Because the contracts are implicit, contracting parties may not have any legal recourse against breach. Contracts must thus either be self-enforcing or be enforced through reputations.<sup>11</sup>

To put the issue in plainer terms, let us focus on the worker: If his wage on average equals his marginal revenue product, what is to stop him from quitting in the good states, when his marginal revenue product is greater than his wage? The worker would thereby receive the benefits of the insurance offered by the firm (when the wage received exceeds the value of his marginal revenue product), and would refuse to pay the insurance premiums. What is to stop him from reneging on his “implicit” contract?

One early answer focused on the role of reputation: workers on contract might choose to reject outside offers at higher wages if, by doing so, they established a reputation for “reliability” that would enable them subsequently to attract the preferential contracts handed out to “reliable” workers.

The precise manner in which one acquires a particular reputation is rather hard to analyze. Fortunately, we do not have to, for reputation is essential to the enforceability of implicit labor contracts only within the artificial confines of single-period contracts. Bengt Holmstrom demonstrates the point admirably in his paper “Equilibrium Long-Term Labor Contracts” [this *Journal*]. Holmstrom allows workers to sign multiperiod contracts that they can abrogate at no cost after one period if they find a higher-paying job in the spot

10. A standard early reference on moral hazard is Arrow [1971]; for a more recent treatment see Arnott and Stiglitz [1982].

11. H. Grossman [1977] was among the first to point out this problem.

market. Nevertheless, equilibrium contracts will be structured so that workers *choose* not to annul them: wages in the first period, when workers cannot leave, are lower than (the expected value of)  $MRPL$ ; in the second period wages rise to equal either a state-invariant rate or the spot rate, whichever is greater.

New workers on contract thus pay the firm a “bond” that assures they will behave reliably in the future. As the bond is amortized over time, veteran employees receive higher wages than rookies do—at least as high, in fact, as spot wages. Holmstrom’s multiperiod equilibrium thus yields reliable behavior on the part of workers (his firms being reliable by definition), wage differentials by seniority class, and a weakening of strict wage rigidity to downward rigidity.

Holmstrom’s argument parallels the standard argument as to how the firm recovers the costs of specific training of workers.<sup>12</sup> If workers have limited access to the capital market, increased mobility implies that their consumption stream over time is not so smooth as it otherwise would be, and there is a welfare loss as a result. In addition, however, workers may need to leave the firm for a variety of good reasons (their health is bad, their mother-in-law moves to a nearby state, etc.).

Unfortunately, there is no easy way of distinguishing these legitimate motives for quitting from the opportunistic motives (i.e., simply renegeing on the contract). Hence, any contract that requires workers to post bonds imposes some risk on them—the risk that they forfeit the bond even if they desire to change jobs for noneconomic reasons. As a result, there will seldom be “complete” bonding. Finally, there is always another risk associated with any theory of contract enforcement through bonding: that the employer will fire the worker (or, equivalently, make work conditions so unattractive that the worker will be induced to quit and forfeit the bond).<sup>13</sup> To avoid these difficulties, either a far more complicated bonding scheme must be established, or we must rely on a theory of reputation for firms.

#### IV

Let us return to a simpler world in which firms are thoroughly trustworthy and workers never quit for family reasons. Having at least reassured ourselves that we can redesign the time path of wage payments to extract reliable behavior from workers, we go back to the single-period enforceable contract structure of Figure I to reflect on

12. A more extensive treatment appears in Arnott and Stiglitz [1981].

13. See Shapiro and Stiglitz [1982] for a detailed discussion of this problem.



the nature of layoff unemployment.<sup>14</sup> How close is the unemployment we discussed in the previous section to the involuntary unemployment that economists are so concerned about?

The fact that laid-off workers would gladly exchange places with their employed colleagues is not in itself sufficient to establish a misallocation of resources. After all, accident victims may very well envy more fortunate individuals without any implication that the insurance industry works poorly. Layoffs, by themselves, could be no more than the luck of the draw unless we can demonstrate that they constitute, in some sense, socially inefficient underemployment. This is clearly impossible within the Walras-Arrow-Debreu model.

There are, in fact, two distinct questions that we can pose. One is, do limitations on information, transactions costs, etc., when formally modeled into the optimal design of the implicit contract, lead to levels of employment that are systematically lower than would occur in a Walrasian equilibrium? The second is, taking these limitations on information, transactions costs, etc., into account, can we design (say, through tax policy) a Pareto improvement in the economy? Like most of the literature, this symposium focuses on the first question: i.e., on conditions under which market equilibrium might be characterized by layoffs, or by hours worked being less than in the corresponding Walrasian equilibrium.

One fundamental departure from the Walrasian paradigm that seems much in the spirit of implicit contracts is to alter the informational assumptions: information is no longer "public" or "symmetric," it is "private" or "asymmetric," since only one side of the market observes the relevant state of nature. Four of the papers that appear in this issue (by Azariadis, Chari, Green and Kahn, and Grossman and Hart) study the properties of implicit contracts when the value of labor's marginal revenue product is known only to the entrepreneur.<sup>15</sup>

Asymmetric information is essential for a thorough understanding of implicit contracts and, as we shall see later in this essay, for their use in macroeconomics as well. What justifies the trading of these contracts in the first place is that third parties simply are not as well informed about someone's income or employment status as is his employer; the employer, in turn, may be less informed about an

14. Developments here were greatly influenced by the paper of Akerlof and Miyazaki [1980].

15. Calvo and Phelps [1977] were the first to pose this question; for related work see Hall and Lilien [1979].

employee's nonlabor income and job opportunities than is the worker himself.

Let us face these complications one at a time. First, how does the market write and evaluate state-contingent contracts when the state itself is observed by employers alone? Suppose that  $S$  is the set of all possible states, and consider the possibility that wages and employment are predetermined functions of the state *announced* by the employer. For the sake of concreteness, we begin with the contract  $\delta^*$ , which the parties find optimal under symmetric information; the employer observes the true state  $s$ , announces some state  $\theta$ , and the wage-employment combination is whatever  $\delta^*$  specifies for  $\theta$ . Will the employer tell the truth by announcing  $s = \theta$ ? If so, we say that  $\delta^*$  is *implementable*; if not, we must pick another contract.

We recall from the previous section that the contract  $\delta^*$  does not generally equate wages with *MRPL*, which implies that, if the firm told the truth, it would not maximize profit in state  $s$ . To do so for sufficiently adverse states, the firm will sometimes (that is, for some, but not all, possible combinations of worker and entrepreneur preferences) announce a state worse than what actually occurs.

If an optimum public-information contract is unimplementable under asymmetric information, we know from economic theory<sup>16</sup> that it can be appropriately modified to motivate entrepreneurs to tell the truth in each state of nature. This is accomplished by making truth the value-maximizing strategy for firms in each state of nature.

All four symposium papers on asymmetric information exploit this straightforward idea but differ in operational details. The papers by Azariadis, and Grossman and Hart begin with optimum symmetric-information contracts that are not implementable when information is asymmetric because entrepreneurs will announce a state *lower* than actual; to cure this lack of incentive-compatibility, employment in all states but the highest is reduced below its optimum symmetric-information value. By appropriately restricting the level of employment and restructuring wages, truthful announcements come to be in the entrepreneur's own best interest.

In the papers by Chari, and Green and Kahn, however, entrepreneurs' state announcements are biased *upward* under that optimum full-information contract. To change the incentive structure, asymmetric-information contracts increase employment in all states of nature, except the lowest, beyond its full-information level.

16. The fundamental ideas on allocation mechanisms with the revelation property are developed in Myerson [1979] and Harris and Townsend [1981].

In an economy without informational or other distortions, entrepreneurs and workers can write contracts that support a Pareto optimal allocation of both risk and effort. The contribution of the four papers we are discussing is to show exactly how this first-best allocation is disturbed when information about what state of nature has occurred is private. Neither risk nor effort is then distributed optimally: not all individuals have identical marginal rates of substitution between consumption in any given pair of states; and the marginal disutility of work does not equal the marginal utility of consumption in every state.

As a result, all four papers agree that there will be departures from the first-best volume of employment in almost all states. There is less uniformity on what *specific form* this inefficiency takes: for two of these papers [Azariadis; Grossman and Hart] it appears as excessively *low* employment in adverse states; for two others [Chari; Green and Kahn], it appears as excessively *high* employment in favorable states. As we show in Section V, the differences arise because these investigations do not share a common preference structure.

Before we make up our mind whether private information leads to involuntary unemployment or overemployment, it is prudent to remember that we are discussing a rather one-sided class of information impactedness models. Workers, too, possess specialized knowledge, about their own preferences and outside employment opportunities, that far surpasses their employer's.

Suppose, for instance,<sup>17</sup> that the utility function of the typical worker is additively separable in consumption and leisure, and assume the marginal rate of substitution, that is, the number of consumption units per unit of leisure along an indifference curve, is a random variable  $s$ . With risk-neutral employers, an optimum public-information contract is to free the wage bill, and the worker's consumption, from all variability; and to choose an employment schedule that decreases in  $s$ .

Once more we have a contract that is not implementable under private information for it compels self-seeking workers always to announce the highest credible value of  $s$ . An optimum private-information contract may reward truth-telling (or punish lying) in two ways: it makes the wage bill a decreasing function of  $s$ , and it lowers employment below public-information levels in all states but the highest. The outcome is involuntary underemployment again.

17. The rest of this section is based on unpublished work by Russell Cooper [1981].

To sum up: it seems a safe claim that private information by itself is sufficient to explain departures of employment from its fully Pareto optimal volume. First principles of economics, however, do not guarantee that “involuntary” (that is, inefficient) underemployment or unemployment is a necessary consequence of *every* informational asymmetry. The direction of the inefficiency depends on several factors, one of them being the nature of this asymmetry.

## V

In this section we attempt to explain with elementary diagrammatical techniques why implicit contracts with asymmetric information are characterized by unemployment in some instances and overemployment in others. We formulate the simplest possible model. There are two equiprobable states of nature, denoted by subscripts 1 and 2. In state  $\theta_i$ , the gross revenue of the firm per worker is  $F(h_i, \theta_i)$ , where  $h_i$  is the number of hours worked by the worker. The contract specifies the income paid the worker and the hours worked in each state  $\{w_i, h_i\}$ . The firm knows the state of nature, but the workers does not. The contract terms must be designed to maximize the expected profits of the firm, subject to the firm being able to recruit workers (i.e., the worker’s expected utility being at a sufficiently high level); and it must explicitly take into account the informational asymmetry.

This problem is formally similar to a wide class of “screening” problems involving the use of self-selection mechanisms, and we can therefore borrow a number of standard results from that theory. That literature distinguishes between two classes of equilibria. In one of them, behavior is invariant to the state that occurs (in our context,  $w$  and  $h$  do not depend on  $\theta$ ). This is referred to as a pooling equilibrium; pooling equilibria are of particular interest in macroeconomic situations, as they imply a lack of adjustment in important economic variables (employment) to changes in the environment (productivity of labor). In the other class of equilibria, behavior varies with the state. There are two obvious reasons that there should be an adjustment in wages and hours in response to changes in  $\theta$ : first, changes in the productivity of work call for changes in the number of hours worked (i.e., changes in total employment); second, if firms are risk-averse, the optimal contract (with perfect or with asymmetric information) would entail some risk sharing, which means labor income would vary.

As in most self-selection problems, the employee cannot rely on the honesty of the employer to announce the true  $\theta$ , and set  $h$  and  $w$  accordingly. If contract wage payments do not vary much over states but hours of work do, the employer may announce a good state when the bad one occurs in order to extract more hours from laborers; if, on the other hand, wage payments vary substantially more than do hours of work, the employer may announce the adverse state when the favorable one occurs in order to lower costs. The design of the optimal contract takes these possibilities into account.

Let  $\pi(\theta_i, \theta_j) = F(h_j, \theta_i) - w_j$  be the entrepreneur's profit in state  $i$  if he announces state  $j$  ( $i, j = 1, 2$ ). As we know, the first-best contract  $\delta^* = \{w^*(\theta), h^*(\theta)\}$  maximizes under perfect information the firms' expected profit:

$$(1) \quad \bar{\pi} = (1/2)[\pi(\theta_1, \theta_1) + \pi(\theta_2, \theta_2)]$$

subject to nonnegativity, and to an expected-utility constraint,

$$(2) \quad (1/2)[u(w_1, h_1) + u(w_2, h_2)] \geq \bar{u},$$

which enables the firm to recruit laborers. Here  $u(\cdot)$  is a von Neumann-Morgenstern index for individual workers, and  $\bar{u}$  is the reservation value of their expected utility.

With asymmetric information, the optimum contract maximizes equation (1) subject to inequality (2), and to two additional self-selection (or truth-telling) constraints, i.e.,

$$(3) \quad \pi(\theta_1, \theta_1) \geq \pi(\theta_1, \theta_2); \quad \pi(\theta_2, \theta_2) \geq \pi(\theta_2, \theta_1).$$

To see exactly what self-selection constraints do, we depict in Figure II the first-best contract  $\delta^*$ , assuming that, ceteris paribus, the marginal revenue product of labor is higher in state 2 than in state 1. In that diagram we plot for each state  $i = 1, 2$ , the (concave) isoprofit line and the (convex) indifference curve that goes through the optimal pair  $(h_i^*, w_i^*)$ . Because  $\delta^*$  is first-best, each pair  $(h_i^*, w_i^*)$  corresponds to a tangency point between the relevant isoprofit line and indifference curve. From Figure II, it is clear that in state 1 profits are higher if the firm announces that the state is 1 than if it announces that it is 2; the isoprofit line for state 1 through  $(h_1^*, w_1^*)$  yields higher profit than the isoprofit line for state 1 through  $(h_2^*, w_2^*)$ . The same is true of state 2. Thus, even though there is asymmetric information, the contract  $\delta^*$  is implementable, for firms will correctly reveal the true state.

Two more interesting situations are shown in Figures III and IV. Figure III, again, contains the first-best contract. We note, however,

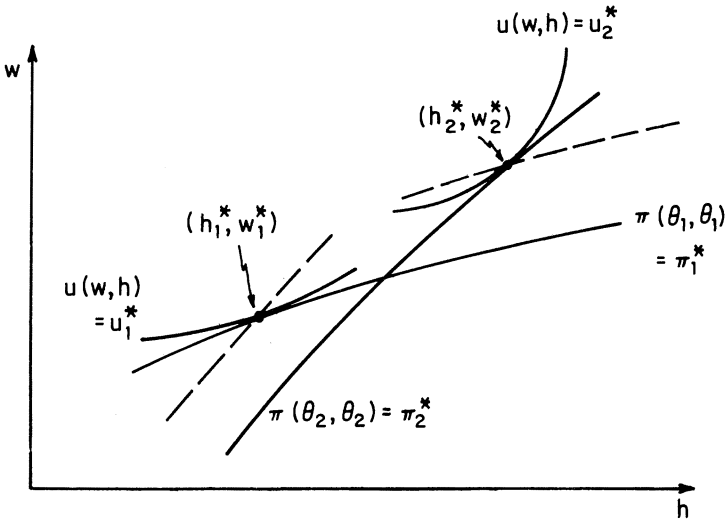


FIGURE II  
First-Best Equilibrium Implementable

that profits in state 2 are higher if the firm announces state 1 (so that payments to workers are lowered to  $w_1^*$ ) than if it tells the truth.

The first-best contract  $\delta^*$  is no longer implementable: by an-

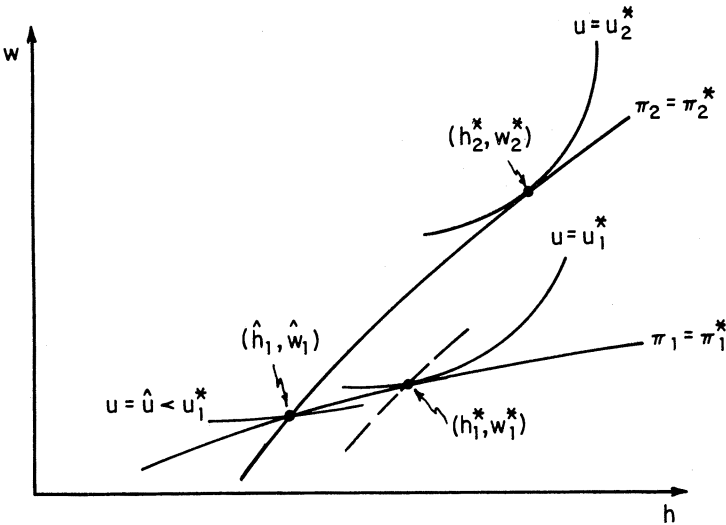


FIGURE III  
First-Best Equilibrium Not Implementable  
Second-best equilibrium characterized by inefficient underemployment in adverse state.

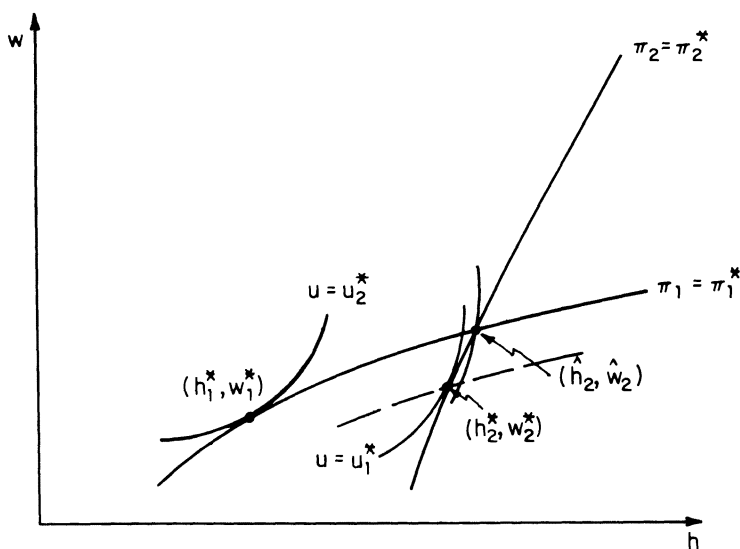


FIGURE IV  
 First-Best Equilibrium Not Implementable  
 Second-best equilibrium characterized by inefficient overemployment in favorable state.

nouncing falsely that the bad state has occurred, the first extracts fewer hours than otherwise from its workers; but the reduction in hours is not sufficient to outweigh the gain obtained from lower wages. To induce truthtelling, a stronger punishment is required. If  $(h_1^*, w_1^*)$  is lowered to  $(\hat{h}_1, \hat{w}_1)$ , as depicted, the firm will no longer have any incentive to lie. But truthtelling has been obtained at a cost: while under the first-best contract (i.e., in a Walrasian equilibrium) the worker's marginal rate of substitution is equal to his marginal revenue product (i.e., to the slope of the relevant isoprofit line), at  $(\hat{h}_1, \hat{w}_1)$  the two are not equal; the marginal revenue product exceeds the marginal rate of substitution. It is in this sense that asymmetric information results in unemployment or, more accurately, in underemployment.

In Figure IV we depict an equilibrium in which, under the first-best contract, there is relatively little variability in the wage bill. The firm then always has the incentive to announce the good state, forcing workers into longer hours. The first-best contract is again not implementable. To induce truthtelling, we must make the firm pay the workers much more than otherwise if it announces the good state; this is easily accomplished by raising  $(w_2^*, h_2^*)$  to, say,  $(\hat{w}_2, \hat{h}_2)$ . But again,

truthtelling comes at a cost: the marginal revenue product of labor is now less than the marginal rate of substitution. The equilibrium contract suffers from *overemployment*.

Since underemployment and overemployment are both possible, the reader may ask under what circumstances the former or the latter are a property of equilibrium contracts with asymmetric information. Suppose first that entrepreneurs are risk-neutral and workers have additively separable preferences, which implies that leisure is a normal good. Then the equilibrium contract cannot consist of the pairs  $(\hat{w}_1, \hat{h}_1)$  and  $(w_2^*, h_2^*)$  depicted in Figure III; if it did, we could modify it by raising the wage bill in the bad state by a small number  $\Delta w$ , lowering the wage bill in the good state by the same amount, and leaving hours of work unchanged.

The new contract we would obtain this way would obviously continue to satisfy the self-selection constraints, would not affect expected profit if the two states are equiprobable, and be, at the same time, preferred by workers, since it stabilizes their earnings.

Overemployment will therefore be the equilibrium outcome given the configuration of preferences assumed in the previous paragraph. But the argument there breaks down, and underemployment emerges, if entrepreneurs are at the margin more risk-averse than workers. We recall also from Section IV that underemployment may well be the result of private information on the worker's side.

## VI

What have we learned, or are we likely to learn, about macroeconomics from implicit contracts? We shall discuss three aspects of this question here: aggregate unemployment, money wage rigidity, and the connection of implicit contracts to the literature on quantity-constrained equilibria.

For all the advances described in previous sections, we do not yet have at hand an entirely satisfactory aggregative story of unemployment or of money wage rigidity. The asymmetric-information models of Section IV suffer from some limitations that should be mentioned, perhaps as incentive for further work. First, and least important, they depict inefficient underemployment as worksharing, not as layoffs. Second, they do not supply a general equilibrium picture of underemployment, which would require an explanation why underemployed (or unemployed) individuals are not hired by other firms.<sup>18</sup>

18. Hosios [1981] has formulated a simple general equilibrium model analyzing layoffs and new hires simultaneously.



Third, and most important, the unemployment found in the contributions to this symposium is a response to private, firm-specific risks, while observed unemployment in market economies is thought by most economists to be a reaction to social risks, especially to business cycles set in motion by aggregate demand disturbances. Unless one intends to make the far-fetched claim that the general public is unaware of changes in government consumption, money supply, or consumer confidence, does it not appear that information-based unemployment simply describes the behavior of an isolated firm?

We do not think so. In order to have an inefficient volume of equilibrium employment, it is sufficient that *some but not all* information be private. In fact, it is not difficult to imagine general equilibrium extensions of the work we are discussing that would include both public and private information [Farmer, 1981; and Grossman, Hart, and Maskin, 1982]. Such extensions will be particularly useful if they manage to establish a firm link between inefficient underemployment and extreme values of some publicly observed aggregate disturbance.

Whatever progress we have made toward understanding fluctuations in employment has not dispelled the dense fog that still shrouds the issue of wage rigidity. All we have to go on is the well-known result of Baily [1974, pp. 44–46] that the wage rate is state-invariant under public information when labor supply is inelastic. This stickiness, however, is a property of the *real* rather than the nominal wage rate, and it is the latter that is assumed to be rigid in Keynesian macroeconomics.

To understand wage rigidity, in our view, one must begin with a careful definition of it. Rigidity does not necessarily imply complete time-invariance, nor does it require money wages to change less frequently than other prices; it is simply an information-processing failure. The standard procedure in collective bargains, for instance, is to predetermine money wages several years in advance; more often than not those wages are invariant to any information that may accumulate over the duration of the contract. Only in exceptional circumstances are money wages in the United States allowed to reflect *any* contemporaneous developments in the cost of living (indexation) or in the profitability of the employer (bankruptcy).

The mystery of wage rigidity is then the failure of contracts to set money wages as *functions* of publicly available information that is obviously relevant to the welfare of all parties. Why does the wage-setting process choose to ignore this information? One answer

is transactions costs [Wachter and Williamson, 1978]:<sup>19</sup> contracts are cheaper to evaluate and implement when they are defined by a few simple numbers rather than by functions. True enough, but the cost of recomputing wages every month drops sharply with every new generation of computers; and even before the age of computers, it would be perilous, we think, to attribute to transactions costs whatever unemployment is due to wage inflexibility in adverse stages of aggregate demand.

We find more promise in an argument that relies on the risk-bearing properties of alternative contracting schemes. Economies with private information, or with an incomplete array of securities markets, rarely admit equilibria supporting a fully Pareto optimal allocation of resources.<sup>20</sup> It is therefore possible, but not certain, that a superior allocation will result from the introduction of new securities. We regard implicit contracts as securities and inquire whether to invent them would be in everyone's—or anyone's—interest.<sup>21</sup>

The outcome of this inquiry must depend on the market structure that existed *before* the invention of contracts as well as on the type of contracts we are willing to contemplate. Kihlstrom and Laffont study the question in their paper "Implicit Labor Contracts and Free Entry" [this *Journal*].<sup>22</sup> The authors compare three alternative labor market structures: a pure spot market that operates in the usual Walrasian manner, equating supply and demand in each state of nature; a pure forward exchange of labor services for a sure (that is, fixed) wage that is determined in advance; and a combination of these two markets that permits sequential trades, with forward contracts concluded before the state is revealed, and spot exchange afterward. As Kihlstrom and Laffont demonstrate, if entrepreneurs and workers are alike, the third market structure dominates each of the first two.<sup>23</sup>

19. Gray [1976] provides a theory of indexation based on transactions costs.

20. The work of Diamond [1967] and Stiglitz [1982] on the stock market, and of Hart [1975] on temporary equilibrium are relevant here.

21. We are not addressing the conceptually distinct problems of *how* such securities come to be invented.

22. A related paper by Peters [forthcoming] examines whether it is desirable to introduce implicit contracts in an economy consisting of a spot and of a stock market that does not contain enough securities to span all states of nature. Azariadis and Cooper [1981] study how fixed-price contracts allocate endowment risks in a monetary economy.

23. In an interesting aside, the same paper verifies a widespread assumption in the literature that typecasts entrepreneurs as risk-neutral and workers as risk-averse. The authors show that, if the technology satisfies stochastic constant-returns-to-scale and individuals have a choice of becoming either entrepreneurs or workers, then risk-neutral persons will not become workers in equilibrium.

To the evidence of progress on unemployment, we may add on the score card of implicit contracts a reasonable chance of similar advances on money wage rigidity, properly discounted, of course, for most of these advances are still to come. We have less to report on quantity constraints and rigid prices in commodity markets.

This is not entirely a surprise for there are some decent non-contract stories to tell about quantity constraints. One of them is told in the paper, "Toward a Reconstruction of Keynesian Economics: Expectations and Constrained Equilibria," by Neary and Stiglitz [this *Journal*]: current quantity constraints are caused by the expectation, justified or not, of future quantity constraints. For instance, producers may increase current sales if they anticipate that they may be rationed in the future, thus contributing to a state of excess supply in the present.<sup>24</sup>

A different explanation is offered by Böhm, Maskin, Polemarchakis, and Postlewaite in "Monopolistic Quantity Rationing" [this *Journal*]. Here the question is whether it is in the interest of a monopolist, or any seller with some market power, to use quantity rationing as an allocative device, in addition to setting price. Linear prices with quantity constraints are, of course, a special case of a nonlinear price schedule that may be used to extract the consumer surplus of any one buyer, or to exploit differences among buyers.

The price nonlinearities one obtains from quantity constraints are rather primitive, not permitting price discrimination of the first kind; rationing is therefore of no use when buyers are identical. In an example with three goods and three types of buyers, however, the authors demonstrate that rationing may well be desirable for monopolists because it is akin to price discrimination of the second kind. We might also add parenthetically that rationing will seem less offensive than direct price discrimination to those who draw a sharp distinction between cash prices and shadow prices.

## VII

We conclude with capsule reviews of those issues that, on the basis of Sections III through VI, seem ripe for future work or badly in need of it. One of them is the means by which contracts are enforced

24. Hahn's concept of "conjectural equilibrium" should be mentioned here because it, too, relies on constraint expectations. Rationing in Hahn's work [1978], however, is not due to price rigidity; it comes about because individuals, say producers, perceive that they can exceed their ration if they accept a lower unit price. We do not yet know whether such perceptions are consistent with price observations in equilibrium.

on firms. One intuitive answer is obvious here: firms do not wish to jeopardize the investments in hiring, training, and information gathering that attend long-lived job attachments. But intuition alone will not suffice for a thorough understanding, of, say, earnings profiles, unless it is buttressed by systematic formal work on the relation between specific human capital and long-term contracts.<sup>25</sup> The problem of employer reputation is also relevant here; we shall return to it below.

The stock market is long overdue for some attention in implicit contract theorizing, which is built on an excessively strong assumption of market incompleteness,<sup>26</sup> namely that contracts are the only means of redistributing risk. Formal models often begin with entrepreneurs of infinite risk-tolerance; much as this simplifies our analyses, we do recognize that third parties share in the ultimate bearing of risks on human capital. As Baily stressed in 1974, entrepreneurs are in part intermediaries between workers and the securities markets, especially the stock market, where risks are finally diversified.

Asymmetric information is another area that holds considerable promise as a source of applications to labor economics and macroeconomics. There are a very large number of substantive issues as well as of possible permutations of informational asymmetries, so we mention just four. First, information that is private to workers may be essential in understanding why inefficient underemployment often takes the form of layoffs rather than worksharing, and what role the public sector has in the provision of unemployment insurance.<sup>27</sup> Second, bilateral asymmetric information (i.e., information that is in part private to workers, and in part private to firms) is critical for determining whether the inefficient volume of employment supported by contracts in equilibrium is too large, too small, or a combination that depends on the prevailing state of nature. Third, a potential mechanism for enforcing contracts on employers is through reputations. When the employment relation is long-lived and the discount rate is low enough, reputation by itself may be sufficient to overcome the problem of moral hazard: self-selection constraints become superfluous because the worker need ascertain that the employer tells the truth only "on average" (see Radner [1981] and Newbery and Stiglitz [1982]). And fourth, private information needs to be combined

25. Harris and Holmstrom [1982] have made an interesting start in that direction.

26. One exception we are aware of is Peters [1982].

27. Arnott, Hosios, and Stiglitz [1982], and Geanakoplos and Ito [1981] study the limits this type of asymmetry places on the structure of severance pay and on the profitability of worksharing.

with public information<sup>28</sup> if we are ever to make equilibrium sense of the Keynesian proposition that unemployment is related to changes in publicly observable signals like policy variables.

Macroeconomic applications, moreover, require the imbedding of contracts in some aggregative model of general equilibrium that contains at least one paper asset.<sup>29</sup> Because implicit contracts are really portfolios of claims contingent, at most, on states of public information, the properties of these macroeconomic models will depend heavily on how much market incompleteness is built into them. The existence or prevalence of contracts with rigid money wages, the nature and extent of unemployment, the efficacy of various stabilization policies, all will hinge on what securities individuals may use to diversify the risks that confront them. There are no hard and fast rules to help one choose which markets should be open and which ones closed. In the tradition of temporary equilibrium theory (see Hart [1975], and Grandmont's survey article [1977]), we may fix market structure arbitrarily (say, by imposing large costs on certain transactions), and study the consequences; or we may follow the more demanding dictates of the asymmetric information literature and allow trade in claims contingent on any publicly observable event. We cannot predict the outcome here, but we suspect that sorting out the "right" models will require considerable patience and a great deal of experimentation.

UNIVERSITY OF PENNSYLVANIA  
PRINCETON UNIVERSITY

## REFERENCES

- Akerlof, G., "Labor Contracts as Partial Gift Exchange," mimeo, University of California, Berkeley, 1980.
- , and H. Miyazaki, "The Implicit Contract Theory of Unemployment Meets the Wage Bill Argument," *Review of Economic Studies*, XLVII (1980), 321–38.
- Arnott, R., and J. Stiglitz, "Equilibrium in Competitive Insurance Markets: The Welfare Economics of Moral Hazard," mimeo, Queens University, 1982.
- , and —, "Labor Turnover, Wage Structures and Moral Hazard," mimeo, Princeton University, 1981.
- , A. Hosios, and J. Stiglitz, "Implicit Contracts, Labor Mobility and Unemployment," mimeo, Princeton University, 1982.
- Arrow, K., *Essays in the Theory of Risk-Bearing* (Chicago: Markham, 1971).
- Azariadis, C., "Implicit Contracts and Underemployment Equilibria," *Journal of Political Economy*, LXXXIII (1975), 1183–202.
- , "On the Incidence of Unemployment," *Review of Economic Studies*, XLIII (1976), 115–25.

28. Hart [1982] has already done this at the partial equilibrium level.

29. Farmer [1981] makes an interesting attempt along these lines.

- , "Implicit Contracts and Related Topics: A Survey," in Z. Hornstein *et al.*, eds., *The Economics of the Labour market* (London: HMSO, 1979).
- , "Employment with Asymmetric Information," this *Journal, Supplement*, XCVIII (1983), 157–72.
- , and R. Cooper, "On Predetermined Prices," mimeo, University of Pennsylvania, 1981.
- Baily, M. N., "Wages and Employment under Uncertain Demand," *Review of Economic Studies*, XLI (1974), 37–50.
- Barro, R., and H. Grossman, "A General Disequilibrium Model of Income and Employment," *American Economic Review*, XVI (1971), 82–93.
- Becker, G., *Human Capital* (New York: NBER, 1964).
- Bénassy, J.-P., "Neo-Keynesian Disequilibrium Theory in a Monetary Economy," *Review of Economic Studies*, XLII (1975), 503–23.
- Böhm, V., E. Maskin, H. Polemarchakis, and A. Postlewaite, "Monopolistic Quantity Rationing," this *Journal, Supplement*, XCVIII (1983), 189–97.
- Calvo, G., and E. Phelps, Appendix to "Indexation Issues," in K. Brunner and A. Meltzer, eds., *Stabilization of the Domestic and International Economy* (Amsterdam: North-Holland, 1977).
- Chari, V. V., "Involuntary Unemployment and Implicit Contracts," this *Journal, Supplement*, XCVIII (1983), 107–22.
- Clower, R., "The Keynesian Counter-revolution: A Theoretical Appraisal," in F. Hahn and F. Brechling, eds., *The Theory of Interest Rates* (London: Macmillan, 1965).
- Cooper, R. "Risk-Sharing and Productive Efficiency in Labor Contracts under Bilateral Asymmetric Information," mimeo, University of Pennsylvania, 1981.
- Diamond, P., "The Role of the Stock Market in a General Equilibrium Model with Technological Uncertainty," *American Economic Review*, LVII (1967), 759–76.
- Drèze, J., "Existence of an Equilibrium under Price Rigidity and Quantity Rationing," *International Economic Review*, XVI (1975), 301–20.
- Farmer, R., "A New Theory of Aggregate Supply," mimeo, University of Toronto, 1981.
- Feldstein, M., "Temporary Layoffs in the Theory of Unemployment," *Journal of Political Economy*, LXXXIV (1976), 937–58.
- Geanakoplos, J., and T. Ito, "On Implicit Contracts and Involuntary Unemployment," mimeo, University of Minnesota, 1981.
- Gordon, D. F., "A Neoclassical Theory of Keynesian Unemployment," *Economic Inquiry*, XII (1974), 431–59.
- Grandmont, J.-M., "Temporary General Equilibrium Theory," *Econometrica*, XLV (1977), 535–72.
- Gray, J., "Wage Indexation: A Macroeconomic Approach," *Journal of Monetary Economics*, II (1976), 221–35.
- Green, J., and C. Kahn, "Wage-Employment Contracts," this *Journal, Supplement*, XCVIII (1983), 173–87.
- Grossman, H., "Risk-Shifting and Reliability in Labor Markets," *Scandinavian Journal of Economics*, LXXIX (1977), 187–209.
- Grossman, S., and O. Hart, "Implicit Contracts, Moral Hazard, and Unemployment," *American Economic Review* (Papers and Proceedings), LXXI (1981), 301–07.
- , and —, "Implicit Contracts under Symmetric Information," this *Journal, Supplement*, XCVIII (1983), 123–56.
- , —, and E. Maskin, "Unemployment with Observable Aggregate Shocks," mimeo, 1982.
- Hahn, F., "On Non-Walrasian Equilibria," *Review of Economic Studies*, XLV (1978), 1–17.
- Hall, R., "Employment Fluctuations and Wage Rigidity," *Brookings Papers on Economic Activity* (1980), 91–124.
- , and D. Lilien, "Efficient Wage Bargains under Uncertain Supply and Demand," *American Economic Review*, LXIX (1979), 868–79.
- Hansen, B., *A Study in the Theory of Inflation* (London: Allen and Unwin, 1974).
- Harris, M., and B. Holmstrom, "A Theory of Wage Dynamics," *Review of Economic Studies*, XLIX (1982), 315–33.
- , and R. Townsend, "Resource Allocation under Asymmetric Information," *Econometrica*, XLIX (1981), 33–64.
- Hart, O., "On the Optimality of Equilibrium When the Market Structure Is Incomplete," *Journal of Economic Theory*, XI (1975), 416–43.

- , "Optimal Labour Contracts under Asymmetric Information: An Introduction," mimeo, London School of Economics, 1982.
- Hicks, J., "Mr. Keynes and the Classics," *Econometrica*, V (1937), 147–59.
- Holmstrom B., "Equilibrium Long-Term Labor Contracts," this *Journal, Supplement*, XCVIII (1983), 23–54.
- Hosios, A., "Externalities, Efficiency, and the Implicit Contract Theory of Employment," mimeo, Princeton University, 1981.
- Ito, T., "Implicit Contract Theory: A Critical Survey," mimeo, University of Minnesota, 1982.
- Keynes, J. M., *The General Theory of Employment, Interest and Money* (London: Macmillan, 1936).
- Kihlstrom, R., and J.-J. Laffont, "Implicit Labor Contracts and Free Entry," this *Journal, Supplement*, XCVIII (1983), 55–105.
- Malinvaud, E., *The Theory of Unemployment Reconsidered* (Oxford: Blackwell, 1977).
- Mortensen, D., "On the theory of Layoffs," mimeo, Northwestern University, 1978.
- Myerson, R., "Incentive Compatibility and the Bargaining Problem," *Econometrica*, XLVII (1979), 61–74.
- Neary, J. P., and J. Stiglitz, "Toward a Reconstruction of Keynesian Economics: Expectations and Constrained Equilibria," this *Journal, Supplement*, XCVIII (1983), 199–28.
- Newbery, D., and J. Stiglitz, "Wage Rigidity, Implicit Contracts and Economic Efficiency: Are Market Wages Too Flexible?," mimeo, Princeton University, 1982.
- Oi, W., "Labor as a Quasi-Fixed Factor of Production," *Journal of Political Economy*, LXX (1962), 538–55.
- Okun, A., *Prices and Quantities* (Washington, D.C.: The Brookings Institution, 1981).
- Patinkin, D., *Money, Interest, and Prices* (New York: Harper and Row, 1956).
- Peters, M., "Labour Contracts in a Stock-Market Economy," *Journal of Economic Theory*, forthcoming.
- Radner, R., "Monitoring Cooperative Agreements in a Repeated Principal-Agent Relationship," *Econometrica*, XLIX (1981), 1127–48.
- Schmeidler, D., and M. Yaari, "Fair Allocations," mimeo, 1971.
- Schwartz, A., "The Implicit Contract Model and Labor Markets: A Critique," mimeo, Northwestern University, 1982.
- Shapiro, C., and J. Stiglitz, "Equilibrium Unemployment as a Worker Discipline Device," mimeo, Princeton University, 1982.
- Solow, R., and J. Stiglitz, "Output, Employment and Wages in the Short Run," this *Journal*, LXXXII (1968), 537–60.
- Stiglitz, J., "The Inefficiency of the Stock Market Equilibrium," *Review of Economic Studies*, IXL (1982), 241–62.
- Varian, H., "Equity, Envy, and Efficiency," *Journal of Economic Theory*, IX (1974), 63–91.
- Wachter, M., and O. Williamson, "Obligational Markets and the Mechanics of Inflation," *Bell Journal*, IX (1978), 549–71.
- Younès, Y., "Sur les notions d'équilibre et de déséquilibre utilisées dans les modèles décrivant l'évolution d'une économie capitaliste," mimeo, CEPREMAP, 1970.
- , "On the Role of Money in the Process of Exchange and the Existence of a Non-Walrasian Equilibrium," *Review of Economic Studies*, XLII (1975), 489–501.