Insiders, Outsiders, and Nominal Wage Contracts

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While the consequences of nominal wage contracts have been rather thoroughly analyzed, there is no generally accepted theory of why such contracts prevail. In this paper I argue that the distinction between insiders and outsiders is important for understanding nominal wage contracts. Since most employment fluctuations take the form of fluctuations in hiring, insiders are normally not affected by them. Since prices are primarily determined by costs, demand shocks have small effects on real wages. Thus insiders have little incentive to change to more complicated contracts. With rigid nominal wages, nominal demand shocks have large effects on the employment opportunities of outsiders, but outsiders have little influence on labor contracts.

I. Introduction

While the consequences of nominal wage contracts have been rather thoroughly analyzed, starting with Fischer (1977*a*) and Taylor (1980), there is no generally accepted theory of why such contracts prevail. Why would agents write nominal contracts that contribute to large and inefficient fluctuations in activity? In fact, since nominal contracts

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are hard to reconcile with rational behavior, they are often ignored in modern macroeconomic analysis.

It is not the length of labor contracts—typically 1–3 years—that is surprising: a wage bargain is a costly affair that cannot be repeated every month or quarter. What is surprising is that labor contracts take such a simple form. While optimal labor contracts would, in general, make wages and employment contingent on all relevant information, most actual contracts set a fixed nominal wage and do not specify the level of employment.[1]

Of course, it is too difficult to take account of all possible contingencies in the contract, but it should be relatively easy to tie wage payments to the general price level, import prices, or aggregate output. In general, any such indexation should improve the contract, so that both parties could be made better off. Why are simple forms of indexation used so seldom?

The basic idea of this paper can be illustrated by the following hypothetical conversation between a representative employed worker and a representative economist:

ECONOMIST: Why don't you write employment into the contract?

WORKER: Why should we? The risk that someone will be fired is small. If there is a slump, the firm will just reduce hiring.

ECONOMIST: OK, but why don't you index wages to prices? That way you would know what your real wage would be!

WORKER: We could, but since we know pretty well what other unions get, we have a good idea what prices will be. It is not worth the trouble to index the contract.[2]

ECONOMIST: But suppose that there is another jump in oil prices; then your real wage will be reduced substantially!

WORKER: If oil prices go up, they will hurt real profits as well as real wages. Then it is reasonable that we take part of the reduction in real income.

In this paper, the standard labor contract model of Baily (1974) and Azariadis (1975) is modified in two ways. First, since most employment variations take the form of variations in hiring and most

[1] Oswald and Turnbull (1985) provide evidence that labor contracts in Britain do not specify the level of employment and that they are typically not indexed to anything at all. Indexation to consumer prices appears to be more common in the United States, but the majority of U.S. workers have contracts without cost-of-living provisions (Card 1986). Bils (1989*b*) finds evidence that contractual rigidities have significant real effects. (In order to document stylized facts here and below, I shall draw on evidence for Britain and the United States, but the observations appear to be relevant for many countries.)

[2] On this point, McCallum (1986) agrees with the representative worker.

workers have a high degree of job security,[3] a theory that aims at explaining broad macroeconomic aggregates should focus on variations in hiring rather than layoffs. Here, this is done as simply as possible. In the macroeconomic model presented below, all employment variations take the form of variations in hiring, and employed workers have full job security. The contracting parties are the firm and its currently employed workers (insiders). Unemployed workers (outsiders) have no influence on the contract.[4]

Second, I assume that the wage for new hires (entrants) cannot be set independently of the wage for insiders. A specific reason for this is given below: if the differential between insider and entrant wages is too large, the firm gets a strong incentive to replace insiders. Such a contract is therefore undesirable for a union representing the insiders. There may also be other factors that limit wage dispersion within the firm.

These modifications of the standard labor contract model have important consequences. In the original Baily-Azariadis model, the wage had no allocative role, and the wage rigidity that was derived had no consequences for employment. With the assumptions made above, the wage does have an allocative role, and wage rigidity does raise the volatility of employment.

The main result is that under plausible conditions, the optimal contract leaves employment to be determined by the firm, and a small cost for writing a state-contingent contract is sufficient to support an equilibrium with fixed nominal wages, where fluctuations in nominal demand cause large variations in output and employment.[5]

[3] Hall and Lilien (1986) conclude that the contribution of temporary layoffs to total unemployment is quite small in the United States, and temporary layoffs are less common in Britain. Pissarides (1986) reports the ratio of confirmed monthly redundancies to employment to be below 0.25 percent in Britain during 1977–84, and Freeman and Medoff (1984) report the fraction of U.S. workers permanently laid off per month to be 0.3 percent in 1958–71 and 0.8 percent in the recession of 1981. Pissarides (1986) notes that, except for the period 1979–81, almost all the variation in the stock of unemployment in Britain can be attributed to changes in the rate at which people leave unemployment. Main (1982) found that over three-fifths of the full-time job holders in the United Kingdom had jobs that would last for 10 years or more, and according to Hall (1982), 60 percent of U.S. workers were holding jobs that would last 5 years or more.

[4] For a review of the implicit contract literature, see Rosen (1985). The distinction between insiders and outsiders has been emphasized by several authors recently (e.g., Shaked and Sutton 1984; Solow 1985; Blanchard and Summers 1986; Gregory 1986; Carruth and Oswald 1987; Gottfries and Horn 1987; Lindbeck and Snower 1989). Oswald (1987), in a closely related paper, argues that unions represent the interests of senior workers, who do not risk layoff. Therefore, optimal contracts are on the labor demand curve. Whereas Oswald's analysis is partial, the present paper examines optimal contracts in a macroeconomic model with aggregate shocks.

[5] The relation to the menu cost literature will be discussed in the concluding section. An alternative explanation of nominal contracts is given by Smith (1989), who argues that nominal contracts may be a self-selection device.

The basic model is presented in Section II. The macroeconomic analysis and the main results are presented in Section III. Section IV looks at the provisions made in the contract for states in which insiders are threatened by layoff. Section V contains a summary and discussion.

II. The Model

The economy is populated by large numbers of workers and entrepreneurs. Each entrepreneur owns a firm. At the beginning of a period, an entrepreneur and his currently employed workers write a (possibly state-contingent) labor contract. Then demand and supply shocks are realized; entrepreneurs hire workers (following the terms set in the contract), produce, and set prices; and goods markets open.

A firm produces goods with labor as the only input under constant returns to scale. Productivity is denoted θ. The production and price of firm i are denoted q_i and p_i. The demand curve for the firm is

$$q_i = \left(\frac{p_i}{p}\right)^{\epsilon} \frac{m}{p}, \quad \epsilon < -1, \tag{1}$$

where m is the money supply and p is the aggregate price level.[6] The economy is subject to stochastic aggregate shocks to money and productivity; the joint density function is $f(m, \theta)$.

Workers are divided into two groups: insiders and outsiders. Insiders are workers already employed by a firm at the start of the period. They are organized in a union and bargain collectively with the firm. After the realization of the shocks, outsiders may be hired or insiders may be laid off. Outsiders who are hired will be called entrants. Wages may differ between insiders and entrants. If insiders are laid off, they receive (private) unemployment compensation.

Let the wage of insiders be w_i, the entrant wage ω_i, and unemployment compensation z_i. Let the utility of a representative insider be $U(w_i/p, 0)$ if he is employed and $U(z_i/p, 1)$ if he loses his job (the second argument is leisure). The terms U' and U'' will be used to denote first- and second-order derivatives with respect to real income. The utility function is increasing and concave in real income ($U' > 0$, $U'' < 0$). In principle, a contract may specify the insider wage, the entrant wage, unemployment compensation, and production (and thus employment) as functions of the shocks. Denote these functions by $W(m, \theta)$, $\Omega(m, \theta)$, $Z(m, \theta)$, and $Q(m, \theta)$.

The employer and the insiders have a joint interest in holding

[6] Since the focus of this paper is on the supply side, the demand side is modeled as simply as possible: velocity is assumed to be constant. A serious treatment of money would require a multiperiod model with an explicit transactions technology.

down wages for entrants so as to maximize the surplus to be shared between them.[7] However, a low entrant wage may be dangerous for insiders since it gives the employer an incentive to replace insiders. While the union will protect insiders from being replaced by outsiders, there will typically be ways in which an employer can make such replacements. The employer may make working conditions for employees so bad that they "voluntarily" quit. Some minor violation of work rules may be used as a cause of dismissal. One production unit may be closed down while another expands, so that insiders are effectively replaced by outsiders. Such actions are costly to the firm, however.

Let us formally assume that the union is unable to observe whether individual workers misbehave. Assume further that, for efficiency reasons, the contract leaves the firm free to replace insiders who misbehave. Let there be a cost, c, to the firm of replacing an insider. In order *not* to give the firm an incentive to fire insiders, who do their job properly, the contract must satisfy the following incentive compatibility constraint:

$$\Omega(m, \theta) \geq W(m, \theta) - c. \qquad (2)$$

Since insiders and firms have a joint interest in holding down entrant wages, this constraint must be binding. This is straightforward to prove formally, but to simplify the presentation, I shall impose equality in (2). Also, c will be set to zero, so that the outsider wage is equal to the insider wage ($\omega_i = w_i$). This is done to simplify notation and does not affect the qualitative conclusions. What is important for the analysis below is that there is *some* constraint that limits wage dispersion within the firm.

Let the number of insiders at the start of the period be n. The real profit of the firm is

$$\Pi\left(\frac{w_i}{p}, \frac{z_i}{p}, q_i, \frac{m}{p}, \theta\right) = \left(\frac{pq_i}{m}\right)^{1/\epsilon} q_i - \frac{w_i}{p}\frac{q_i}{\theta} - \frac{z_i}{p}\min\left(0, n - \frac{q_i}{\theta}\right). \qquad (3)$$

Entrepreneurs are risk averse, and the utility of the entrepreneur is $V(\Pi)$, where V is a concave function. Since all firms are subject to the same shocks, entrepreneurs cannot insure against risks by diversifying their portfolios.

In order to analyze the contract problem of an individual firm and

[7] Frank (1985) analyzes a model in which insiders extract all the surplus, allowing outsiders to be hired at reservation wages. If, on the other hand, insiders risk being laid off in the future, they may want to raise the entrant wage in order to prevent an increase in the number of insiders (Drazen and Gottfries 1990). This effect does not appear in the analysis below since insiders have job security.

union, let us suppose that the aggregate price level depends on the state according to some function $P(m, \theta)$. Since we are not concerned with what determines the *levels* of wages and employment, the exact bargaining situation will not be specified. Let us assume only that the resulting contract is Pareto optimal from the point of view of the contracting parties (subject to the constraint [2]) and that it leads to less than full employment of outsiders. For the contract to be optimal, the functions $W(m, \theta)$, $Z(m, \theta)$, and $Q(m, \theta)$ must solve the following maximization problem for some number V^0:

$$\max \int\int \min\left[\frac{Q(m, \theta)}{\theta n}, 1\right]\left[U\left(\frac{W(m, \theta)}{P(m, \theta)}, 0\right) - U\left(\frac{Z(m, \theta)}{P(m, \theta)}, 1\right)\right] + U\left(\frac{Z(m, \theta)}{P(m, \theta)}, 1\right) f(m, \theta)\, dm d\theta \tag{4}$$

subject to

$$\int\int V\left(\Pi\left(\frac{W(m, \theta)}{P(m, \theta)}, \frac{Z(m, \theta)}{P(m, \theta)}, Q(m, \theta), \frac{m}{P(m, \theta)}, \theta\right)\right) f(m, \theta)\, dm d\theta \geq V^0.$$

III. Macroeconomic Wage Rigidity

Depending on the shock, either all insiders remain employed or some of them are laid off. While the literature has focused on situations in which contracted workers are laid off, firms are normally hiring workers to replace those who retire or quit for other reasons.[8] To focus on such situations, let us look at an economy in which $f(m, \theta)$ has compact support and the solution is such that the firm is always hiring workers; that is, $Q(m, \theta)/\theta > n$ for all realizations of m and θ.

The unemployment benefit, z, is irrelevant in this case. Let the multiplier for the constraint in (4) be λ. The first-order conditions can be written[9]

$$U' + \lambda V' \frac{\partial \Pi}{\partial (w_i/p)} = 0 \tag{5a}$$

[8] The distinction between layoffs and quits is meaningful when there are some constraints on the contract between the firm and the *individual* worker, as is the case when the union sets the wage. Bowers, Deaton, and Turk (1982) estimate quit rates on the order of 20 percent. They find that "for the vast majority of cases even the minimum estimated quit rate is considerably in excess of the decline in desired employment" (p. 47).

[9] To interpret the first-order conditions, think of the integrals as probability weighted sums of utilities in different states (see Rosen 1985). The optimal contract sets the wage in each state so as to maximize the Lagrangean. The shadow price λ is independent of the state.

and

$$\lambda V' \frac{\partial \Pi}{\partial q_i} = 0. \tag{5b}$$

Condition (5b) implies that the decision with respect to total employment can be left to the firm. Since insiders' jobs are not at risk, they do not care about the level of employment, and there is no need to specify total employment in the contract.[10] Thus the price is set to maximize profit:

$$p_i = a\frac{w_i}{\theta}, \tag{6}$$

where $a \equiv \epsilon/(1 + \epsilon) > 0$. The quantity becomes

$$q_i = a^{\epsilon}\left(\frac{w_i}{\theta p}\right)^{\epsilon}\frac{m}{p}, \tag{7}$$

and the profit is

$$\Pi = -\frac{a^{\epsilon}}{1+\epsilon}\left(\frac{w_i}{\theta p}\right)^{1+\epsilon}\frac{m}{p}. \tag{8}$$

Substituting into condition (5a), we get

$$\begin{aligned} & U' - \lambda V' \frac{q_i}{\theta} \\ &= U'\left(\frac{W(m,\theta)}{P(m,\theta)}, 0\right) \\ &\quad - \lambda V'\left(-\frac{a^{\epsilon}}{1+\epsilon}\left[\frac{W(m,\theta)}{\theta P(m,\theta)}\right]^{1+\epsilon}\frac{m}{P(m,\theta)}\right)a^{\epsilon}\left[\frac{W(m,\theta)}{\theta P(m,\theta)}\right]^{\epsilon}\frac{m}{\theta P(m,\theta)} \\ &= 0. \end{aligned} \tag{9}$$

If all firms have the same contract, equation (6) implies $P(m, \theta) = aW(m, \theta)/\theta$. Substituting this into (9), we see that the equilibrium contract will, in general, be state contingent and fully indexed to the monetary shock.[11]

[10] This point was made by Oswald (1987). For this to hold (exactly) in a multiperiod model, entrants must not threaten the jobs of (current) insiders *in the future*. While this is clearly not exactly true, the evidence quoted above suggests that most insiders do have a high degree of job security.

[11] Gray (1976) and Fischer (1977*b*) analyzed wage indexation, constraining contracts to be indexed only to the price level. They found less than full indexation if there are shocks to both productivity and money. If there are only monetary shocks, the equilibrium contract is fully indexed. Here, the contract is allowed to be contingent on both shocks, so the equilibrium contract is fully indexed also when there are productivity shocks.

But could there be situations in which nonindexation is also an equilibrium? To analyze this question, suppose that all unions have contracts with a fixed nominal wage, w^*. Then the optimal contract for an individual union is determined by

$$\begin{aligned}&\Lambda(W(m, \theta), m, \theta)\\ &\equiv U'\left(\frac{\theta W(m, \theta)}{aw^*}, 0\right)\\ &\quad - \lambda V'\left(-\frac{1}{1+\epsilon}\left[\frac{W(m, \theta)}{w^*}\right]^{1+\epsilon}\frac{\theta m}{a^2 w^*}\right)\left[\frac{W(m, \theta)}{w^*}\right]^{\epsilon}\frac{m}{aw^*}\\ &= 0.\end{aligned} \tag{10}$$

The slope of $W(m, \theta)$ is found by differentiation. Let us first consider indexation to demand shocks:

$$\frac{\partial W}{\partial m} = -\left(\frac{\partial \Lambda}{\partial w_i}\right)^{-1}\frac{\lambda}{aw^*}\left(\frac{W}{w^*}\right)^{\epsilon}\left[V''\frac{1}{1+\epsilon}\left(\frac{W}{w^*}\right)^{1+\epsilon}\frac{\theta m}{a^2 w^*} - V'\right]. \tag{11}$$

The second-order condition requires $\partial\Lambda/\partial w_i$ to be negative. The slope of the wage function is ambiguous. Since prices do not vary with demand, workers prefer a constant nominal wage to one that varies with demand. The firm's profit increases with demand, however. If the entrepreneur is highly risk averse ($V'' \ll 0$), the wage should increase with m, so that the worker absorbs some of the risk. But if the entrepreneur is not very risk averse, the optimal degree of indexation may be small. In fact, if the entrepreneur is risk neutral, the optimal wage is *falling* in m.[12] The reason is that *all* workers will be paid w_i, not only the current insiders. The higher the demand, the more workers are employed and the more costly a one-dollar wage increase is for the firm. The firm prefers to pay high wages when there are few workers employed.

Thus it is not clear whether the optimal wage should increase or decrease with the money supply, and for some function V, the optimal wage is independent of the money supply. In this particular model, this happens when $V(\Pi) = \ln \Pi$. Thus, for some preferences, there is no (private) gain from indexation: nonindexation is optimal provided that all others have nonindexed contracts.

Let us now turn to productivity shocks:

$$\frac{\partial W}{\partial \theta} = -\left(\frac{\partial \Lambda}{\partial w_i}\right)^{-1}\frac{1}{aw^*}\left[U''W + \lambda V''\frac{1}{1+\epsilon}\left(\frac{W}{w^*}\right)^{1+2\epsilon}\frac{m^2}{a^2 w^*}\right]. \tag{12}$$

[12] A similar result is found by Oswald (1987) with respect to real shocks in a partial model.

Again, the slope is ambiguous. Since prices fall with productivity, the real wage increases with productivity for a given nominal wage. Profit also increases with productivity. Thus if the nominal wage is fixed, the firm and the worker share the risk associated with productivity shocks. Depending on the preferences, the optimal contract may imply that more or less risk should be borne by the worker. For some utility functions, the risk sharing that occurs under a nominal contract coincides with optimal indexation.[13] In this specific model, this occurs if both agents have the same constant relative risk aversion.

The results above imply that if both V and U are log functions, the gains from both types of indexation are zero.[14] Of course, it is unlikely that preferences are such that the gain from indexation is exactly zero. But the gain from indexation may be small. Hence, a small cost of indexation (or a small deviation from rationality) may be sufficient to support an equilibrium with nominal wage contracts.[15]

The result above would be of limited interest if the utility gain from indexation were small only for a narrow range of parameter values. I have therefore calculated the (private) gain from indexation for a range of parameter values. The calculation is presented in the Appendix. The gain from indexation is measured as the gain to a fictional arbitrator who maximizes $E(U + \varphi V)$. It is measured as the certain addition to the wage that would give the same increase in $E(U + \varphi V)$ as the introduction of indexation. A quadratic approximation is used in the calculations. The two shocks are assumed to be uncorrelated with a standard deviation of 5 percent.

Table 1 shows the gain from indexation when the price elasticity, ϵ, is minus seven. The gain from indexation to demand increases with the risk aversion of the firm and decreases with the risk aversion of the worker, though the latter effect seems less important. The gain is small. If the risk aversion of the firm is below six, the gain is less than 0.1 percent of the wage. The lower part of the table shows the gain from indexation to productivity. This gain may be substantial if the risk aversion of the worker is large whereas the firm has little risk aversion. Otherwise, the gain from indexation is quite small.

Table 2 shows the gain from indexation when the price elasticity is minus three. Now the gain increases more rapidly with the risk

[13] This analysis is concerned with aggregate shocks, which are readily observable. The argument made here does not apply to local productivity shocks. Problems of measurement and asymmetric information are probably an important obstacle to indexation to local (e.g., firm-specific) productivity shocks.

[14] This is most easily seen from the fact that both m and θ disappear from condition (10) when U and V are logarithmic.

[15] Akerlof and Yellen (1985) and Mankiw (1985) made a similar argument with respect to costs for changing prices; see Sec. V.

TABLE 1

Gain from Indexation When the Price Elasticity Is −7
(Percentage of the Wage)

Relative Risk Aversion of the Worker	Relative Risk Aversion of the Firm: 1	2	4	6	8
	Indexation to Demand (m)				
1	...	.02	.06	.10	.15
2	0	.02	.06	.10	.14
4	0	.01	.05	.10	.14
6	0	.01	.05	.09	.13
8	0	.01	.05	.08	.13
	Indexation to Productivity (θ)				
1	...	.02	.06	.10	.15
2	.13	0	.03	.07	.11
4	.38	.06	0	.02	.04
6	.63	.18	.02	0	.01
8	.88	.35	.08	.01	0

Note.—The table shows the increase in the wage that would give the same utility gain as the introduction of indexation. The calculation is made in the Appendix. The standard error of both shocks is 5 percent. When both agents have relative risk aversion equal to unity or less, the concavity condition is not fulfilled.

TABLE 2

Gain from Indexation When the Price Elasticity Is −3
(Percentage of the Wage)

Relative Risk Aversion of the Worker	Relative Risk Aversion of the Firm: 1	2	4	6	8
	Indexation to Demand (m)				
1	...	.06	.19	.31	.44
2	0	.04	.16	.28	.41
4	0	.03	.13	.24	.36
6	0	.02	.10	.21	.32
8	0	.01	.09	.18	.29
	Indexation to Productivity (θ)				
1	...	.06	.18	.31	.44
2	.13	0	.07	.18	.30
4	.38	.10	0	.04	.12
6	.63	.29	.05	0	.03
8	.88	.50	.15	.03	0

Note.—See note to table 1.

aversion of the firm, and the risk aversion of the worker is more important for the results. Otherwise the picture is similar.

It is hard to say what parameter values are reasonable. Owners of firms are probably less risk averse than workers. On the other hand, we have neglected fixed costs and thus underestimated the relative variability of profits. What we can say is that there is a substantial region of parameter values for which the gain from indexation is small. For those values of the parameters, a small cost of indexation can support an equilibrium with nominal wage contracts.

Before I close this section, note that this analysis concerns the gain from indexation if all other unions have nonindexed contracts. If all other unions have indexed contracts, the loss to one individual union from nonindexation is large. Indexation and nonindexation are social customs that, once established, tend to persist.[16]

IV. The Nature of the Contract for Low Levels of Demand

In the previous section I assumed that desired employment adjustments could be made without the layoff of insiders. Since this is the normal situation, this may be an appropriate approximation for a macroeconomic analysis, but *some* insiders are certainly threatened by layoff some of the time. What provisions are made for such states in an optimal contract?

This question will be analyzed in a partial model in which the price level, p, is set to unity. In general, there are three regions for the solution to the problem stated in (4), characterized by three different sets of conditions. When the state is favorable, $Q/\theta > n$, and as in the previous section,

$$U'(W, 0) - \lambda V'(\Pi)\frac{Q}{\theta} = 0 \tag{13a}$$

and

$$\frac{1 + \epsilon}{\epsilon}\left(\frac{Q}{m}\right)^{1/\epsilon}\theta = w. \tag{13b}$$

When demand is low, so that $Q/\theta < n$, the following conditions, which are familiar from implicit contract theory, hold:

$$\frac{Q}{\theta n}U'(W, 0) - \lambda V'(\Pi)\frac{Q}{\theta} = 0, \tag{14a}$$

[16] Since all firms are symmetric, we cannot have an equilibrium in which only some contracts are indexed. Ball (1988) studies a model in which the cost of indexation varies between agents.

$$\left(1 - \frac{Q}{\theta n}\right) U'(Z, 1) - \lambda V'(\Pi)\left(n - \frac{Q}{\theta}\right) = 0, \tag{14b}$$

$$\frac{1}{\theta n}[U(W, 0) - U(Z, 1)] + \lambda V'(\Pi)\left[\frac{1 + \epsilon}{\epsilon}\left(\frac{Q}{m}\right)^{1/\epsilon} - \frac{W - Z}{\theta}\right] = 0. \tag{14c}$$

In the intermediate case,

$$U' - \lambda V'n = 0 \tag{15a}$$

and

$$\frac{Q}{\theta} = n. \tag{15b}$$

In order to interpret these conditions as simply as possible, let the utility function be that used by Azariadis (1975): $U(w, 0) = U(w)$ and $U(z, 1) = U(z + b)$, where b is the monetary value of leisure plus outside unemployment benefit. Then (14a) and (14b) imply $Z = W - b$, and thus, from (14c),

$$\frac{1 + \epsilon}{\epsilon}\left(\frac{Q}{m}\right)^{1/\epsilon} \theta = b. \tag{16}$$

The left-hand side of (13b) and (16) is the marginal revenue product. Thus if the marginal revenue product of the last insider (at $q = n\theta$) is higher than the wage, the firm hires workers until (13b) holds. If the marginal revenue product of the last insider is below the wage but above b, all insiders are employed but no workers are hired. Only if the marginal revenue product of the last insider falls below b will insiders be laid off. Since firms are normally hiring workers, this should be a relatively unlikely event, at least if the outside unemployment benefit is substantially lower than the wage.

Thus for most states the contract leaves the firm to choose total employment, subject to the provision that insiders are not fired. This is broadly consistent with the observations of Oswald and Turnbull (1985): union contracts give the employer the unilateral right to fix the total number of jobs, but at the same time, "British firms try hard to avoid making compulsory redundancies, and they rely extensively on natural wastage and on payments for voluntary redundancy" (p. 82).

Conditions (14a) and (15a) imply that, unless the firm is risk neutral, the wage should be state dependent for states in which there is no hiring. The wage should increase with demand so that both the firm and the worker share the risk. This is not what we observe. One reason may be that such states are relatively infrequent, so that it is not worthwhile to specify a special wage scale for such states. Furthermore, casual evidence suggests that situations in which firms must drastically reduce employment are often the result of sector- or firm-specific shocks (e.g., the emergence of new competition or management problems in the firm) rather than normal business fluctuations. It is probably difficult to take such contingencies into account in a contract. Furthermore, there is always the possibility of recontracting if insiders' jobs are really at risk. In fact, both parties should realize that the contract will be renegotiated if a very bad state occurs.[17]

V. Summary and Discussion

A model economy was analyzed in which a large number of monopolistic firms produce under constant returns to scale. The economy is subject to shocks to aggregate demand (money supply) and productivity. At the beginning of a period, the firm and its currently employed workers (the insiders) write a contract that may be state contingent. The quit rate is sufficiently large that desired employment adjustments can be made without the layoff of insiders. Since insiders are not affected by employment variations, employment decisions can be left to the firm.

Suppose that all firms have contracts with fixed nominal wages. Then the price level varies with productivity, but not with demand. Will an individual firm (and its insiders) have an incentive to make the wage contingent on demand? Since insiders have job security and since the price level is independent of demand, they prefer a fixed nominal wage to one that is indexed to demand. Profits vary with demand, but unless the firm is very risk averse, the gain from a state-contingent contract is small.

Numerical examples show that for a range of parameter values the gain from indexation is less than 0.1 percent of the wage. A small cost for writing a state-contingent contract is therefore sufficient to make indexation inefficient from the point of view of the contracting parties. With fixed nominal wages, insiders have job security and a stable real wage. Firms bear real income risk, but they are ready to do so if their risk aversion is limited. Unemployed workers are seriously

[17] Discussing the "givebacks" in the early 1980s, Freeman and Medoff (1984, p. 56) note that "the key factor in a union's decision to make concessions is the extent to which the existing wage packages threaten employment of a sizable proportion of the membership. A change in demand for labor that reduces hires or leads to the layoff of relatively junior employees is unlikely to produce concessions." See also Mitchell (1982).

affected by demand variations, but they have no influence on labor contracts.

Now consider productivity shocks. If nominal wages are constant, a positive productivity shock reduces prices, so that real wages and real profits increase. Thus workers and firms share the risk associated with aggregate productivity shocks. If both workers and firms are risk averse, this may be close to the optimal allocation of risk, and the gain from indexation may again be small.

The assumption of constant returns to scale plays a critical role for these results. With constant returns and constant elasticity, demand shocks do not affect prices. The assumption of constant returns is questionable in an analysis of business cycle fluctuations, but its *implication* is consistent with empirical observations. Most studies of price determination find that demand variations have small effects on prices.[18] Thus demand shocks are unlikely to produce much price uncertainty under nominal wage contracts.

Another critical assumption is that there is a limit on wage dispersion between insiders and entrants. This assumption was motivated by incentive problems in a unionized labor market. The results will apply also to a nonunionized labor market, however, provided that there is *some* constraint that limits the spread between insider and entrant wages. For example, social custom may make it hard to pay very different wages to two workers who do the same job.[19]

Let us finally compare this model with two alternative models in which nominal shocks have real effects: Lucas's (1975) model of the business cycle and models with menu costs. In Lucas's model, aggregate demand shocks have real effects because agents confuse variations in the price level with relative price changes. One weakness of this model is that if agents are constantly confused by price movements, they should have a strong incentive to obtain better information, and aggregate price indices and money supply figures are relatively easy to obtain. The main weakness of the model, however, is its inconsistency with actual observations of prices. Prices appear to respond more slowly to nominal shocks than output does. For example, Barro (1981, p. 74) notes that "there is evidence that money shocks—but not price level surprises—are involved with expansions of economic activity."

[18] For references to the empirical literature, see Gottfries (1991). Theoretical explanations of this observation have been analyzed by Woglom (1982), Andersen (1985), Nishimura (1986), Rotemberg and Saloner (1986), Bils (1989*a*), Ball and Romer (1990), and Gottfries (1991).

[19] The assumption that all workers are paid the same wage is crucial for many results in the literature on labor unions, e.g., the persistence (hysteresis) result of Blanchard and Summers (1986) and Gottfries and Horn (1987).

The present model does not share these difficulties. Whether or not insiders observe demand shocks (ex post) does not matter, and insiders have no incentive to find out about demand shocks since they are not affected by them (except in very bad states). A monetary shock has a direct effect on production, which is not systematically related to its effect on price.

The recent literature on "menu costs" asks the question, Can small costs for changing prices be sufficient to support an equilibrium with price rigidity?[20] Akerlof and Yellen (1985) and Mankiw (1985) observed that the private cost of price rigidity is second-order. This means that we can write $dW = A(dp)^2$, where dW is the private loss from a deviation from the optimal price, dp, and A is a constant that depends on the parameters of the model. Thus, *in the limit*, as dp goes to zero, dW/dp goes to zero. But this says nothing about what dW will be when dp has a relevant magnitude since this depends on the constant A.

Blanchard and Kiyotaki (1987) studied a model with a monopolistic price and wage setting. They showed that the private cost of nonadjustment of prices and wages may be small even for changes in demand on the order of 10 percent. The cost depends critically on the parameters, however. Ball and Romer (1989) show that for plausible values of the labor supply elasticity, the private cost of wage rigidity is nonnegligible.

These results illustrate a general point made by Blanchard (1986) and Ball and Romer (1990): if relative prices (markups and demanded real wages) are rigid, a small nominal friction may be sufficient to support an equilibrium with nominal price rigidity. Hence, we should look for reasons why demand shocks have small effects on real wages, although they have large effects on employment. This is exactly what was done in the present paper. The argument, simply stated, was that insiders want real wage stability, and they are normally not affected by employment variations. Thus the private cost of wage rigidity is small, although demand shocks create large variations of output and employment.

Appendix

Calculation of the Private Gain from Indexation

In this Appendix, the certainty equivalent of indexation is calculated: the increase in the wage that would give the same gain in utility as the introduction of indexation.[21]

[20] Mankiw (1985) also raised the normative question, What is the relation between the private and the social cost of price rigidity? See also Ball and Romer (1989).

[21] Alternatively, one could calculate the cost of indexation that would make private agents indifferent between indexed and nonindexed contracts. The two measures are very similar. I have chosen the measure that was simplest to calculate.

The adoption of indexation leads to a shift in the utility possibility frontier for the contracting parties. How this gain is shared between the parties depends on their relative bargaining power. For the present purposes, all we need is a measure of the shift in the utility possibility frontier. A simple way to get this is to imagine a fictional arbitrator, who chooses the contract so as to maximize

$$Eu(\theta, w) + \varphi Ev(w, \theta, m), \tag{A1}$$

where

$$u(w, \theta) \equiv U\left(\frac{\theta w}{aw^*}, 0\right),$$

$$v(w, \theta, m) \equiv V\left(-\frac{1}{1+\epsilon}\left(\frac{w}{w^*}\right)^{1+\epsilon}\frac{\theta m}{a^2 w^*}\right),$$

and φ is an exogenously given weight. (The subscript i is dropped.)

Let w^0 be the optimal fixed wage contract and let the means of m and θ be unity. To calculate the gain from indexation, we shall use quadratic approximations to u and v at the point $(w, m, \theta) = (w^0, 1, 1)$. Let $(\hat{w}, \hat{m}, \hat{\theta})$ denote the deviation from this point. Using subscripts to denote partial derivatives, we write the quadratic approximations

$$u(w, \theta) \approx u(w^0, 1) + u_w\hat{w} + u_\theta\hat{\theta} + \frac{u_{ww}}{2}\hat{w}^2 + \frac{u_{\theta\theta}}{2}\hat{\theta}^2 + u_{w\theta}\hat{w}\hat{\theta},$$

$$\begin{aligned} v(w, \theta, m) \approx {} & v(w^0, 1, 1) + v_w\hat{w} + v_\theta\hat{\theta} + v_m\hat{m} \\ & + \frac{v_{ww}}{2}\hat{w}^2 + \frac{v_{\theta\theta}}{2}\hat{\theta}^2 + \frac{v_{mm}}{2}\hat{m}^2 + v_{w\theta}\hat{w}\hat{\theta} + v_{wm}\hat{w}\hat{m} + v_{\theta m}\hat{\theta}\hat{m}. \end{aligned} \tag{A2}$$

With these approximations, the first-order condition for the fixed wage contract is $u_w + u_{ww}\hat{w} + \varphi(v_w + v_{ww}\hat{w}) = 0$, implying $-u_w/v_w = \varphi$ since $\hat{w}$ is zero for this contract by definition. Let us now turn to the indexed contract, which sets $\hat{w} = H(\hat{m}, \hat{\theta})$. Denote the gain from indexation—the increase in $E(u + \varphi v)$—by G:

$$\begin{aligned} G = E\Bigg[& \left(u_{ww} - \frac{u_w v_{ww}}{v_w}\right)\frac{H(\hat{m}, \hat{\theta})^2}{2} \\ & + \left(u_{w\theta} - \frac{u_w v_{w\theta}}{v_w}\right)H(\hat{m}, \hat{\theta})\hat{\theta} - \frac{u_w v_{wm}}{v_w}H(\hat{m}, \hat{\theta})\hat{m}\Bigg], \end{aligned} \tag{A3}$$

where we have used the fact that $\varphi = -u_w/v_w$. From the first-order condition, we get the optimal contract

$$H(\hat{m}, \hat{\theta}) = \beta_\theta\hat{\theta} + \beta_m\hat{m}, \tag{A4}$$

where

$$\beta_\theta = -\left(u_{ww} - \frac{u_w v_{ww}}{v_w}\right)^{-1}\left(u_{w\theta} - \frac{u_w v_{w\theta}}{v_w}\right)$$

and

$$\beta_m = \left(u_{ww} - \frac{u_w v_{ww}}{v_w}\right)^{-1}\frac{u_w v_{wm}}{v_w}.$$

Assume that θ and m are uncorrelated. Substitute (A4) back into (A3) to get

$$G = -\frac{1}{2}\left(u_{ww} - \frac{u_w v_{ww}}{v_w}\right)^{-1}\left[\left(u_{w\theta} - \frac{u_w v_{m\theta}}{v_w}\right)^2 \sigma_{\theta\theta} + \left(\frac{u_w v_{wm}}{v_w}\right)^2 \sigma_{mm}\right]. \quad \text{(A5)}$$

Now let

$$u(w, \theta) = \frac{(\theta w)^{1+\alpha}}{1 + \alpha}$$

and

$$v(w, \theta, m) = \frac{(w^{1+\epsilon}\theta m)^{1+\gamma}}{1 + \gamma},$$

where $\alpha < 0$ and $\gamma < 0$ measure the relative risk aversion of workers and firms. (For given w^*, θw is the real wage, and $w^{1+\epsilon}\theta m$ is real profit, except for uninteresting constants.) The optimal contract is then

$$H(\hat{\theta}, \hat{m}) = -\frac{(\alpha - \gamma)\hat{\theta} + (1 + \gamma)\hat{m}}{\alpha - \epsilon - \gamma - \epsilon\gamma} w^0.$$

The second-order condition requires the denominator to be negative. Dividing G by $w^0 u_w$, we get the percentage *certain* increase in the wage that would lead to the same increase in utility:

$$\frac{G}{w^0 u_w} \approx -\frac{1}{2}\frac{(\alpha - \gamma)^2\sigma_{\theta\theta} + (1 + \gamma)^2\sigma_{mm}}{\alpha - \epsilon - \gamma - \epsilon\gamma}.$$

This number is reported in tables 1 and 2 for various parameter values.

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